# SAC GFCM
# Sub-Committee on Stock Assessment

| Date* | 1 | November | 2010 | Code* | ANE1710Doc |
|---|---|---|---|---|---|

**Authors***

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**Species Scientific name***

1 *Engraulis encrasicolus - ANE*
Source: GFCM Priority Species

2
Source: -

3
Source: -

**Geographical area***

Northern and central Adriatic Sea (southern limit: Gargano Promontory).

**Geographical Sub-Area (GSA)***

17 - Northern Adriatic

Combination of GSAs
1
2
3

# SAC GFCM - Sub-Committee on Stock Assessment (SCSA)

**Assessment form** — **Sheet #0** — **Basic data on the assessment**

**Code: ANE1710Doc**

| Date* | 1 | Nov | 2010 | Authors* | Document prepared by the AdriaMed (MIPAAF-FAO project) working group for small pelagics: Santojanni A. (1), Leonori I. (1), Carpi P. (1), De Felice A. (1), |
|---|---|---|---|---|---|

| Species Scientific name* | Engraulis encrasicolus - ANE | Species common name* | Anchovy |
|---|---|---|---|

## Data Source

| GSA* | 17 - Northern Adriatic | Period of time* | 1975-2009 |
|---|---|---|---|

## Description of the analysis

| Type of data* | Catch at age and echo-survey abundance index for tuning. | Data source* | Database (containing data from different sources) shared by the three research institutes of Ancona, Ljubljana, Split. |
|---|---|---|---|
| Method of assessment* | Virtual Population Analysis (VPA) with Laurec-Shepherd tuning. | Software used* | Lowestoft MAFF-VPA by Darby and Flatman (1994). |

## Sheets filled out

| B | P1 | P2a | P2b | G | A1 | A2 | A3 | Y | Other | D | Z | C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | --- | --- | --- | --- | 1 | 1 | 3 | --- | 1 | 1 | 1 | --- |

## Comments, bibliography, etc.


Darby C.D., Flatman S. 1994. Virtual Population Analysis: version 3.1 (Windows/Dos) user guide. Information Technology Series, MAFF Directorate of Fisheries Research, Lowestoft, 1: 85 pp.

Gislason H., N. Daan, J.C. Rice, J.G. Pope. 2008. Does natural mortality depend on individual size? ICES CM 2008/F:16.

Jacobson L.D., De Oliveira J.A.A., Barange M., Cisneros-Mata M.A., Félix-Uraga R., Hunter J.R., Kim J.Y., Matsuura Y., Ñiquen M., Porteiro C., Rothschild B., Sanchez R.P., Serra R., Uriarte A., Wada T. 2001. Surplus production, variability, and climate change in the great sardine and anchovy fisheries. Canadian Journal of Fisheries and Aquatic Science, 58(9): 1891-1903.

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

Santojanni A, Cingolani N., Arneri A., Donato F., Colella S., Giannetti G., Belardinelli A., Panfili M. 2008. Biological sampling of commercial catches in the GSA 17, Italian Data Collection Regulation, year 2007 (in Italian). 70 pp.

**Comments, bibliography, etc.**

Additional bibliography:

Cardinale M., Abella A., Bartolino V., Colloca F., Bellido J.M., Di Natale A., Bigot J.L., Fiorentino F., Garcia Rodriguez M., Giannoulaki M., Petrakis G., Gil de Sola L., Pilling G., Martin P., Quintanilla L.F., Murenu M., Osio G.C., Santojanni A., Sartor P., Spedicato M.T., Ticina V., Rätz H.J., Cheilari A. 2008. Report of the SGMED-08-04 Working group on the Mediterranean, Part IV. Editors: Cardinale M., Rätz H.J., Cheilari A. EUR - Scientific and Technical Research Series. 728 pp.

Leonori I., Azzali M., De Felice A., Parmiggiani F., Marini M., Grilli F., Gramolini R. 2009. Small pelagic fish biomass in relation to environmental parameters in the Adriatic Sea. Proceedings of the Joint AIOL - SITE Meeting, Ancona, 17-20 September 2007. http://www.ecologia.it/congressi/XVII/articles/ 213-217.

Morello E.B., Arneri E. 2009. Anchovy and sardine in the Adriatic Sea - An Ecological Review. Oceanography and Marine Biology: An Annual Review, 47: 209-256.

Rampa R., Arneri E., Belardinelli A., Caputo E., Cingolani N., Colella S., Donato F., Giannetti G., Santojanni A. 2005. Length at first maturity of the Adriatic anchovy (Engraulis encrasicolus L.). Document presented at the General Fisheries Commission for the Mediterranean (GFCM), Scientific Advisory Committee (SAC), Sub Committee on Stock Assessment (SCSA), Rome, 26-30 September 2005.

Santojanni A. 2009. Comments on “Is anchovy (Engraulis encrasicolus, L.) overfished in the Adriatic Sea?” by Klanjscek and Legovic [Ecol. Model. 201 (2007): 312-316]. Ecological Modelling, 220: 430-433.

Santojanni A., Arneri E., Barry C., Belardinelli A., Cingolani N., Giannetti G., Kirkwood G. 2003. Trends of anchovy (Engraulis encrasicolus, L.) biomass in the northern and central Adriatic Sea. Scientia Marina, 67(3): 327-340.

Santojanni A., Arneri E., Bernardini V., Cingolani N., Di Marco M., Russo A. 2006. Effects of environmental variables on recruitment of anchovy in the Adriatic Sea. Climate Research, 31(2-3): 181-193.

Sinovcic G., Zorica B. 2006. Reproductive cycle and minimal length at sexual maturity of Engraulis encrasicolus (L.) in the Zrmanja River estuary (Adriatic Sea, Croatia). Estuarine, Coastal and Shelf Science, 69: 439-448.

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|---|---|
| **Assessment form** | **Sheet B**<br>**Biology of the species** |

**Code: ANE1710Doc**

**Biology**

| Somatic magnitude measured (LH, LC, etc)* | Total length. | Units* | cm |
|---|---|---|---|

| Sex | Fem | Mal | Both | Unsexed | | |
|---|---|---|---|---|---|---|
| Maximum size observed | | | | | Reproduction season | Spring-summer. |
| Size at first maturity | | | 8 | | Reproduction areas | |
| Recruitment size | | | 9 | | Nursery areas | |

**Parameters used (state units and information sources)**

| | | | Sex | | | |
|---|---|---|---|---|---|---|
| | | Units | female | male | both | unsexed |
| Growth model | L∞ | | | | 16.147 | |
| | K | | | | 0.4 | |
| | t0 | | | | -2.041 | |
| | Data source | Santojanni et al (2008) - Italian DCR. | | | | |
| Length weight relationship | a | | | | | |
| | b | | | | | |
| | M | | | | | |

| sex ratio (mal/fem) | |
|---|---|

**Comments**

Natural mortality rates, M, at age (in years) were estimated by the Gislason's method (Gislason et al., 2008), which is based on the empirical equation:
ln M = a + b ln L + c ln Linf + d ln k
where a, b, c, d were estimated by means of the statistical analysis performed by Gislason et al. (2008):
a = 0.659, b -1.691, c = 1.444, d = 0.898.

The growth parameters reported above, Linf = 16.147 and k = 0.400, obtained by Santojanni et al. (2008) for the Italian DCR, were used, although Linf = 16,147 is lower than expected for this stock.
The following values of M at age were estimated:

| Age | M |
|---|---|
| 0 | 1.02 |
| 1 | 0.82 |
| 2 | 0.67 |
| 3 | 0.57 |
| 4+ | 0.54 |

where 4+ is the plus-group, which includes individuals of the age classes 5 and 6.

Tthese estimates of M at age were used in the present assessment.

**Comments**

In previous assessments M = 0.6 and M = 0.8 were used for all the age classes, according to literature and Hoenig's equation. The first value was preferred according to the precautionary approach.

1) Literature:

Anchovy: M = 0.54 and M = 0.81 were reported for the Catalan Sea by Pertierra and Lleonart (1996).

Pertierra J.P., Lleonart J. 1996. NW Mediterranean anchovy fisheries. Scientia Marina, 60 (Suppl. 2): 257-267.

2) Hoenig's equation:

Ln Z = 1.44 - 0.982 Ln tmax

"based largely on data from unexploited stocks", thus with Z being very close to M (Hoenig, 1983; Hewitt and Hoenig, 2005).

Individuals older than 4 are found in the catches of this stock.

| tmax (year) | predicted Z |
|---|---|
| 1 | 4.22 |
| 2 | 2.14 |
| 3 | 1.43 |
| 4 | 1.08 |
| 5 | 0.87 |
| 6 | 0.73 |
| 7 | 0.62 |
| 8 | 0.55 |
| 9 | 0.49 |
| 10 | 0.44 |
| 11 | 0.40 |
| 12 | 0.37 |

Hoenig J.M. 1983. Empirical use of longevity data to estimate mortality rates. Fishery Bulletin, 82: 898-903.

Hewitt D.A., Hoenig J.M. 2005. Comparison of two approaches for estimating natural mortality based on longevity. Fishery Bulletin, 103: 433-437.

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**Assessment form**

**Sheet P1**
**General information about the fishery**

**Code: ANE1710Doc**

| | | | |
|---|---|---|---|
| Data source* | Database (containing data from different sources) shared by the three research institutes of Ancona, Ljubljana, Split. | Year (s)* | 1976-2009 |
| Data aggregation (by year, average figures between years, etc.)* | Catch data are relative to the total fleet (Italy, Croatia, Slovenia). Split-year was used assuming the first of June as the birth date of anchovy, e.g. split-year 1976 was formed by Jun-Dec of 1975 and Jan-May 1976. | | |

## Fleet and catches (please state units)

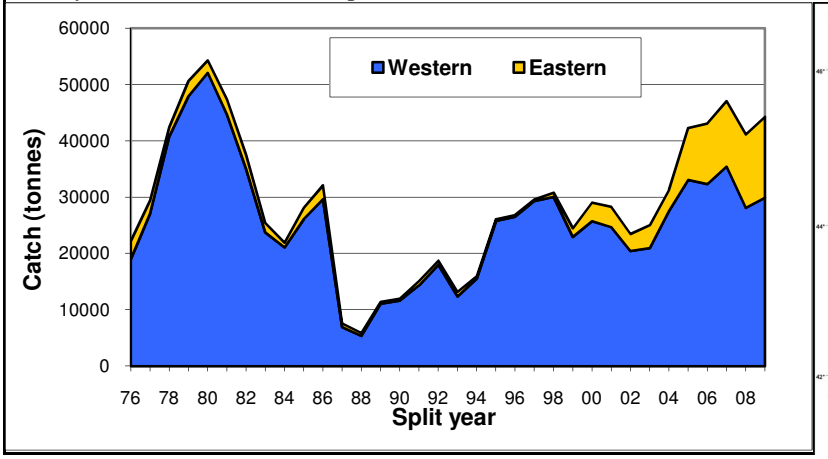
| | Country | GSA | Fleet Segment | Fishing Gear Class | Group of Target Species | Species |
|---|---|---|---|---|---|---|
| Operational Unit 1* | | | | | | |
| Operational Unit 2 | | | | | | |
| Operational Unit 3 | | | | | | |
| Operational Unit 4 | | | | | | |
| Operational Unit 5 | | | | | | |

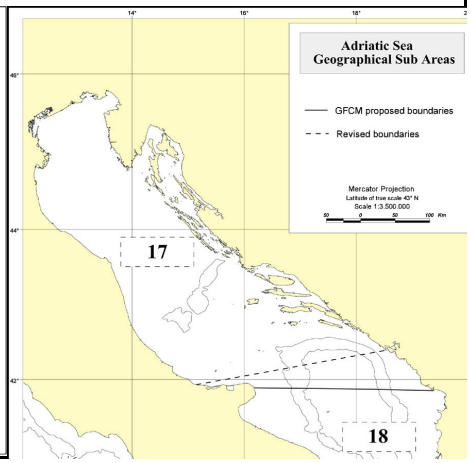
| Operational Units* | Fleet (n° of boats)* | Kilos or Tons | Catch (species assessed) | Other species caught | Discards (species assessed) | Discards (other species caught) | Effort units |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| Total | | | | | | | |

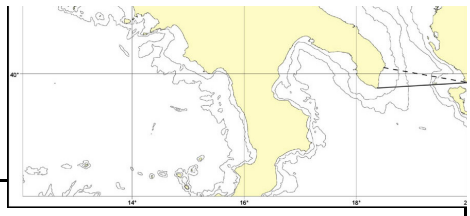
| | |
|---|---|
| Legal minimum size | |

## Comments

Fishery: mid-water trawlers and purse seiners.





**Comments**

| SAC GFCM - Sub-Committee on Stock Assessment (SCSA) | |
|---|---|
| **Assessment form** | **Sheet A1**<br>**Indirect methods: VPA, LCA** |

**Code: ANE1710Doc**



| Sex* | M+F |
|---|---|

| Analysis # * | VPA |
|---|---|

**Time series**

| Data | Size | Age |
|---|---|---|
| (mark with X) | | x |

| Model | Cohorts | Pseudocohorts |
|---|---|---|
| (mark with X) | x | |

| | | | |
|---|---|---|---|
| Equation used | | Tunig method | Laurec-Shepherd tuning. |
| # of gears | | Software | Darby C.D., Flatman S. 1994. |
| $F_{terminal}$ | | | |

**Population results (please state units)**

| | Sizes | Ages | | Amount | Biomass |
|---|---|---|---|---|---|
| Minimum | | | Recruitment | | |
| Average | | | Average population | | |
| Maximum | | | Virgin population | | |
| Critical | | | Turnover | | |
| | | | | | |
| | | | | | |

**Average mortality**

| | | Gear | | | | | |
|---|---|---|---|---|---|---|---|
| | Total | | | | | | |
| $F_1$ | | | | | | | |
| $F_2$ | | | | | | | |
| Z | | | | | | | |

(F1 and F2 represent different possible calculations. Please state them)

**Comments**

Catch at age data (see also the sheet A2):
- amounts: for both western and eastern sides of Adriatic are available since 1975;
- biological data needed to distribute numbers of caught individuals into age classes: for the western side of Adriatic are available since 1975 while for the eastern one since 2001.

Proportion of sexually mature individuals. This proportion was taken as equal to 0.50 for the age class 0 and 0.75 for 1 and 1.00 for 2-4+.

Tuning data:
- Laurec-Shepherd VPA was tuned on abundance (number of fish) at age derived from echo-surveys carried out in both western and eastern sides of Adriatic. All the GSA 17 was thus covered by the surveys;
- western echo-survey abundances were distributed into age classes by means of length frequencies coming from the western echo-survey and age-length keys coming from the Italian commercial fleet;
- eastern echo-survey abundances were distributed into age classes by means of length frequencies and age-length keys coming from the Croatian commercial fleet;
- the data series is from calendar year 2004 onwards, with surveys being carried out in September; since split year was used for anchovy, for example, split year 2009 (formed by June-December of

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**Assessment form** — **Sheet A2** — **Indirect methods: data**

**Code: ANE1710Doc**

| Sex* | M+F | Gear* | Mid-water trawlers and purse seiners. | Analysis # * | VPA |
|---|---|---|---|---|---|

| Data source | |
|---|---|

## Data

Total catch at age (numbers in thousands) used as input data for VPA calculations.

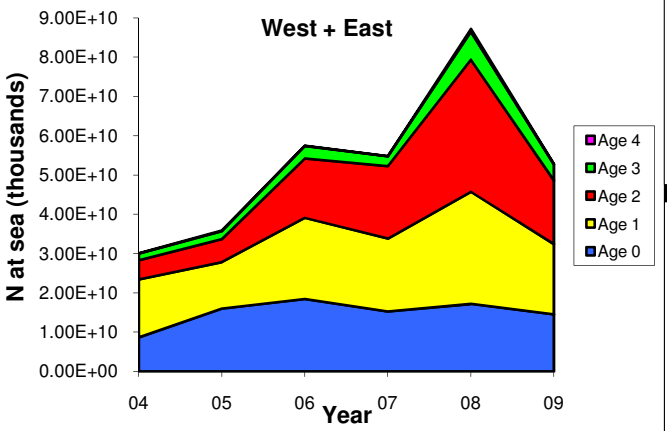
| Split year | Age 0 | Age 1 | Age 2 | Age 3 | Age 4+ |
|---|---|---|---|---|---|
| 76 | 296691 | 686091 | 480224 | 221629 | 83577 |
| 77 | 362899 | 768650 | 587692 | 339326 | 190485 |
| 78 | 629137 | 1303524 | 843825 | 418961 | 201054 |
| 79 | 962994 | 1868703 | 1025407 | 376911 | 117188 |
| 80 | 594600 | 1524697 | 1153558 | 595074 | 270313 |
| 81 | 460310 | 1294987 | 1092606 | 600133 | 299005 |
| 82 | 581166 | 1045453 | 736400 | 392667 | 186551 |
| 83 | 538138 | 719903 | 413727 | 211638 | 91843 |
| 84 | 585801 | 626031 | 285235 | 137334 | 50293 |
| 85 | 903238 | 803134 | 277163 | 120871 | 28520 |
| 86 | 507957 | 638687 | 401614 | 266062 | 108615 |
| 87 | 123399 | 114640 | 77416 | 70299 | 42427 |
| 88 | 316468 | 117550 | 47454 | 26896 | 9133 |
| 89 | 525159 | 279251 | 109436 | 40112 | 7356 |
| 90 | 404575 | 268710 | 140347 | 70441 | 16149 |
| 91 | 386111 | 371134 | 174825 | 88455 | 36519 |
| 92 | 489542 | 310754 | 183858 | 150916 | 110267 |
| 93 | 147249 | 308002 | 151684 | 114463 | 106191 |
| 94 | 341049 | 478188 | 177472 | 108763 | 65023 |
| 95 | 422169 | 892358 | 316490 | 154855 | 78699 |
| 96 | 217939 | 834866 | 377253 | 197706 | 111294 |
| 97 | 500532 | 751743 | 305104 | 245281 | 158812 |
| 98 | 472876 | 747334 | 360525 | 271427 | 169079 |
| 99 | 422169 | 622278 | 302634 | 226727 | 98775 |
| 00 | 813325 | 906112 | 416398 | 115379 | 9098 |
| 01 | 754071 | 1050164 | 340092 | 65643 | 3235 |
| 02 | 440144 | 862964 | 387591 | 69170 | 6216 |
| 03 | 361837 | 1184318 | 460288 | 72766 | 4342 |
| 04 | 937742 | 1566232 | 414941 | 82271 | 7881 |
| 05 | 1270095 | 1534611 | 754955 | 90644 | 9803 |
| 06 | 840354 | 1442839 | 784111 | 181755 | 84980 |
| 07 | 348001 | 918557 | 1708298 | 303673 | 28836 |
| 08 | 402565 | 1060100 | 1324708 | 290665 | 40427 |
| 09 | 414062 | 1478567 | 1317734 | 268714 | 31303 |

| Sex* | M+F | Gear* | Mid-water trawlers and purse seiners. | Analysis #* | VPA |
|---|---|---|---|---|---|

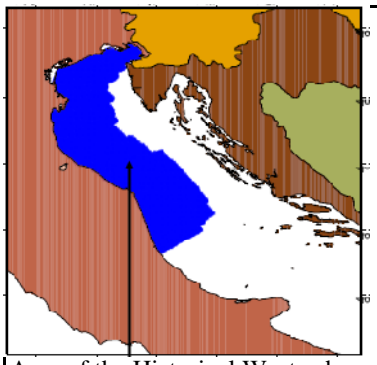
## Population in figures

Abundance at age (numbers in thousands) from West and East echo-surveys used for the VPA tuning.

| Year | Age 0 | Age 1 | Age 2 | Age 3 | Age 4 |
|---|---|---|---|---|---|
| 04 | 8657525385 | 14740568939 | 4895221186 | 1730187052 | 72506473 |
| 05 | 16018107232 | 11841569580 | 5835061599 | 1996270696 | 182549902 |
| 06 | 18421760999 | 20697262215 | 15129330377 | 3181839978 | 34086812 |
| 07 | 15289684630 | 18553206017 | 18465035063 | 2466807408 | 28452752 |
| 08 | 17195308432 | 28562290518 | 33627015190 | 7091835712 | 732305938 |
| 09 | 14576034459 | 17876863081 | 16179065678 | 4092937907 | 127416218 |




## Population in biomass



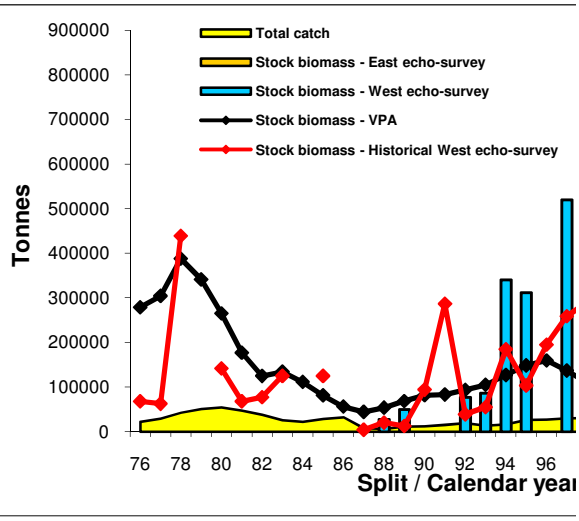
Average total catch

| | | |
|---|---|---|
| 1976-09 | 28938 | tonnes |
| 2007-09 | 44162 | tonnes |

Average stock biomass

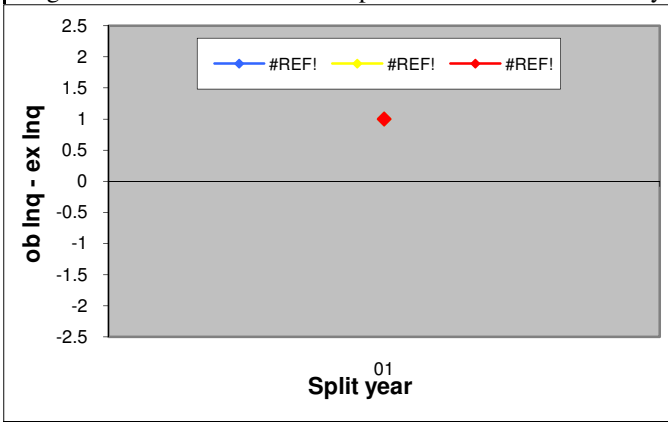
| | | |
|---|---|---|
| 1976-09 | 175432 | tonnes |
| 2007-09 | 388020 | tonnes |

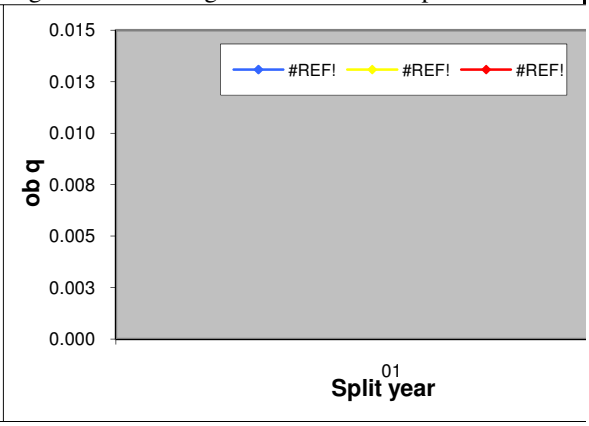
Area of the Historical West echo-survey.




## Fishing mortality rates

Diagnostics to check if the assumption of constant catchability at age over the tuning time selected is respected.

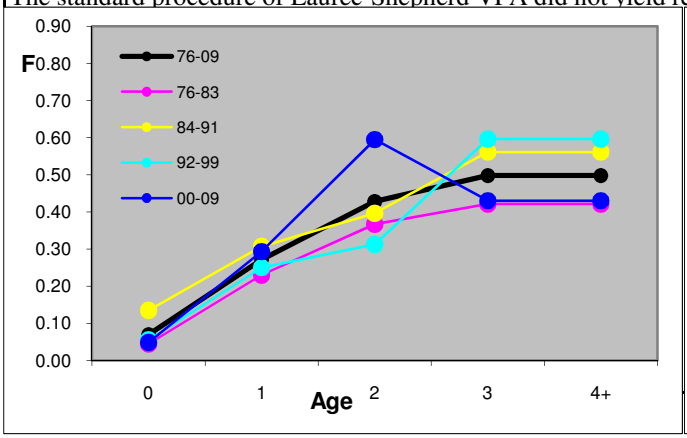


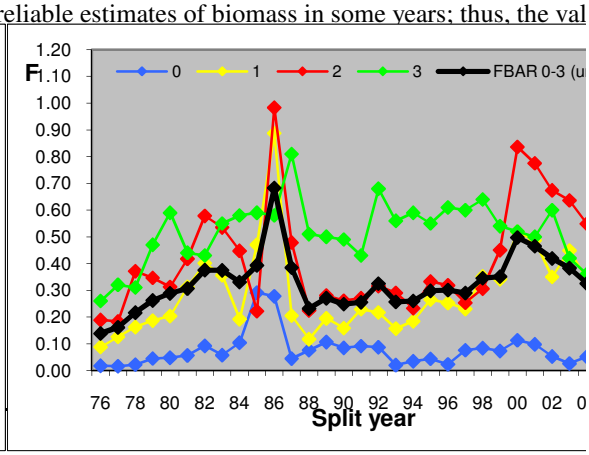



| Sex* | M+F | Gear* | Mid-water trawlers and purse seiners. | Analysis #* | VPA |
|---|---|---|---|---|---|

## Population in figures

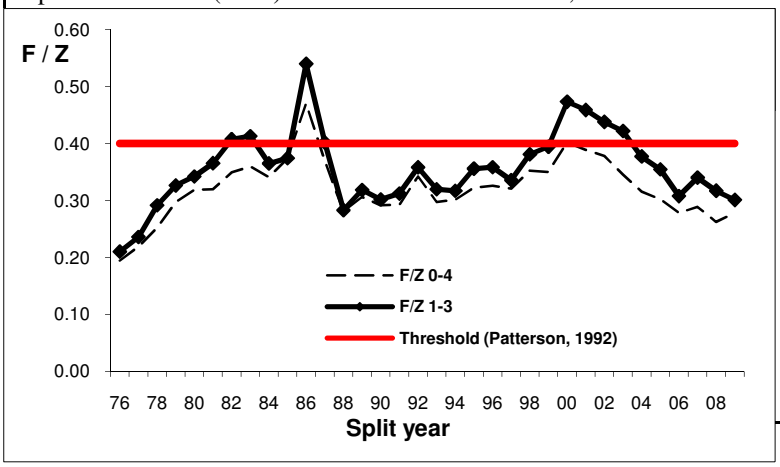
Left: fishing mortality rate as a function of age (average for different periods). Right: fishing mortality rate as a fuction c
The standard procedure of Laurec-Shepherd VPA did not yield reliable estimates of biomass in some years; thus, the val




## Population in biomass

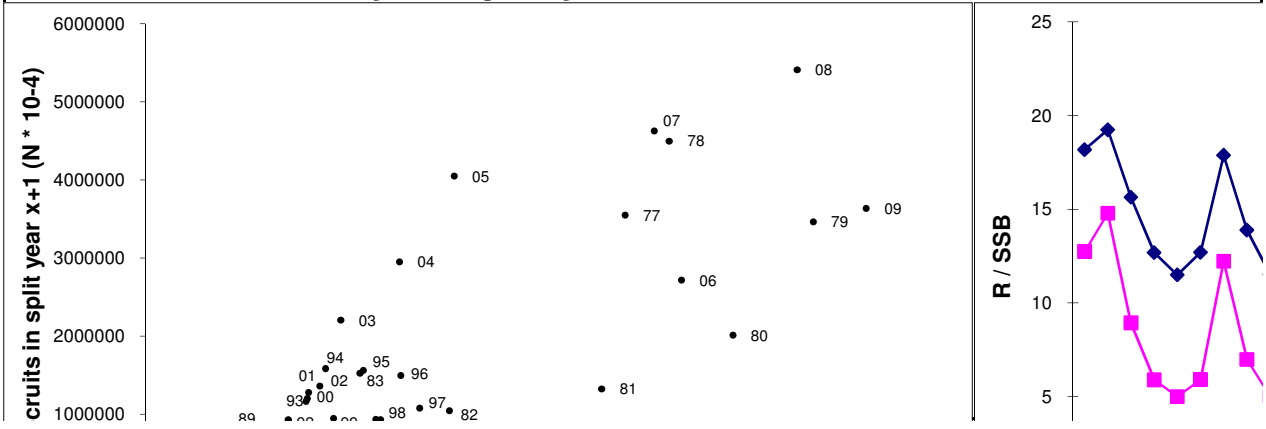
Exploitation rate F/(F+M) = F/Z as a function of time; the threshold 0.4 suggested by Patterson (1992) for the manageme




| Average F/Z 1-3 | |
|---|---|
| 1976-09 | 0.36 |
| 2007-09 | 0.32 |

## Fishing mortality rates

Recruitment (R, individuals with age 0) and spawning stock biomass (SSB).

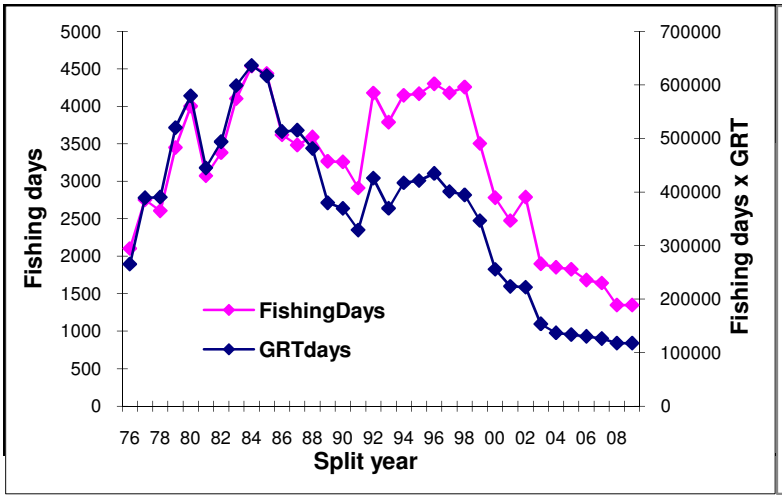


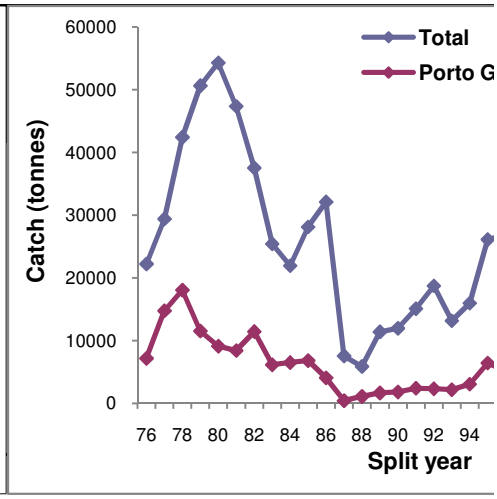
| Sex* | M+F | Gear* | Mid-water trawlers and purse seiners. | Analysis #* | VPA |
|---|---|---|---|---|---|

## Population in figures

Calculations of F on the odest age for each year x, i.e. Fx in the following proportion:
Fx : Ex = F 76-80 : E 76-80
where the average F for the time interval 1976-1980 was derived from a run of the standard procedure of Laurec-Shepherd VPA,
while E is the total fleet fishing effort in fishing days (not standardized); this series was obtained by means of a proportion between Porto Garibaldi fishing effort and catch of anchovy relative to the same harbour and the total fleet.
The fleet (mid-water trawlers) of Porto Garibaldi (Italy) accounts for high fractions of anchovy catch.
Since 2000 onwards, these total fleet raw fishing days were increased by 30% to take into account probable improvements in the technology on boards of fishing vessels.
See the pictures below.

## Population in biomass



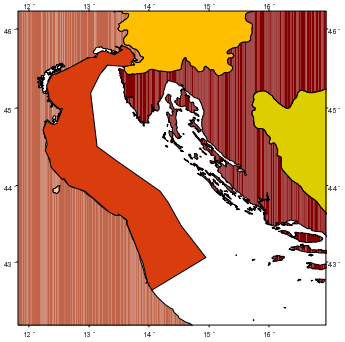

## Fishing mortality rates

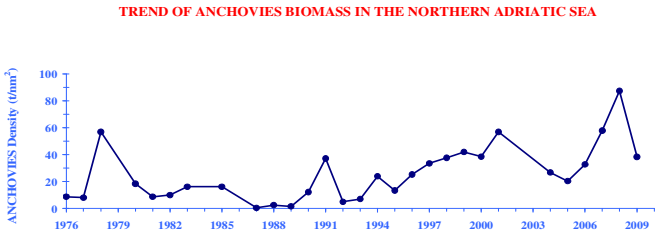
## Other assessment methods

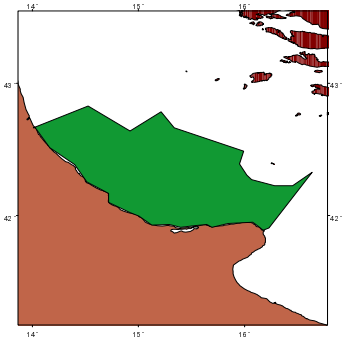
Additional information on western echo-survey.

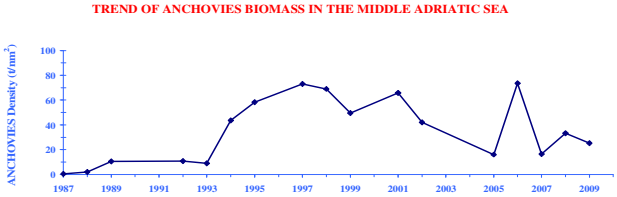
The trend of anchovy biomass density in the North Adriatic Sea (see figure below) in the period 1976-2009 derived from acoustic surveys is represented in the graph below. The average biomass density value was estimated in 25.7 t/nm2. After a peak in 1978 anchovy biomass began to decrease until the collapse of the years 1986-90; the recovery started in 1991 and proceeded until now with two peaks (2001, 2008) and one relative minimum value (2005). Biomass density in 2009 resulted 38.4 t/nm2, 50% higher respect to the average of the studied period.

The trend of anchovy biomass density in the Middle Adriatic Sea (see figure below) in the period 1987-2009 derived from acoustic surveys is represented in the graph below. The average biomass desnsity value was estimated in 35.2 t/nm2. Anchovy biomass presents very low levels in the years 1987-93; the change happens in 1994 with a significant increase in biomass. In more recent years the stock maintains good levels of biomass even if it presents fluctuations particularly evident in 2005-07 with a relative minimum value followed by a peak and then a minimum again. In 2009 anchovy biomass density level is a bit lower (25.2 t/nm2) respect to the average value of the hystorical series.







| SAC GFCM - Sub-Committee on Stock Assessment (SCSA) | |
|---|---|
| **Assessment form** | **Sheet D Diagnosis** |

**Code: ANE1710Doc**

## Indicators and reference points

| Criterion | Current value | Units | Reference Point | Trend | Comments |
|---|---|---|---|---|---|
| B | | | | | |
| SSB | | | | | |
| F | | | | | |
| Y | | | | | |
| CPUE | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**Stock Status*** Use one (or both) of the following two systems for the stock assessment status description

| Unidimensional | | |
|---|---|---|
| | ☐ | ? - (or blank) **Not known or uncertain**. Not much information is available to make a judgment; |
| | ☐ | U - **Underexploited, undeveloped or new fishery**. Believed to have a significant potential for expansion in total production; |
| | ☑ | M - **Moderately exploited**, exploited with a low level of fishing effort. Believed to have some limited potential for expansion in total production; |
| | ☐ | F - **Fully exploited**. The fishery is operating at or close to an optimal yield level, with no expected room for further expansion; |
| | ☐ | O - **Overexploited**. The fishery is being exploited at above a level which is believed to be sustainable in the long term, with no potential room for further expansion and a higher risk of stock depletion/collapse; |
| | ☐ | D - **Depleted**. Catches are well below historical levels, irrespective of the amount of fishing effort exerted; |
| | ☐ | R - **Recovering**. Catches are again increasing after having been depleted or a collapse from a previous; |

**Bidimensional**

**Exploitation rate**

| | |
|---|---|
| ☐ | No or low fishing |
| ☑ | Moderate fishing |
| ☐ | High fishing mortality |
| ☐ | Uncertain / Not assessed |

**Stock abundance**

| | |
|---|---|
| ☐ | Virgin or high abundance |
| ☑ | Intermediate abundance |
| ☐ | Low abundance |

| | |
|---|---|
| ☐ | Depleted |
| ☐ | Uncertain / Not assessed |

**Comments**

**Code: ANE1710Doc**

## Management advice and recommendations*

The recent exploitation rate F/Z is under the Patterson's threshold 0.4 (Patterson, 1992). Thus, anchovy stock can be considered as moderately exploited.

However, strong changes and fluctuations over time are commonly observed in the abundance of small pelagics (Jacobson et al., 2001). In the past, the biomass of anchovy stock dropped at very low level in 1987 with consequent crisis of Italian fishery. After this collapse, recovery took place, but fluctuations still occured, in particular in recent years. Moreover, an increase was observed in the total catch of most recent years.

Adriatic small pelagic fishery is multispecies and effort on anchovy cannot be separated from effort on sardine, so that most of the management decisions have to be taken considering both species: the low increase in the recruitment observed for sardine doesn't justify at all an increase in the exploitation of these stocks.

In conclusion, the stock can be considered as moderately exploited, but it is recommended not to increase the fishing effort in the near future.

**Advice for scientific research***

Present improvements.

In comparison with the previous assessment presented in the SCSA meeting held in Malaga in 2009, the following improvements in the methodology were introduced.

1) Echo-survey data used for VPA tuning, just like in the previous assessment, were relative to both western and eastern sides of Adriatic; however, in the present assessment, it was possible to split eastern echo-survey abundance into age classes using length frequencies and age-length keys (although coming from the commercial fleet) coming from the eastern side. Thus, it was possible to avoid the assumption that western echo-survey abundance index can be used for all the GSA 17.

2) Finally, the calculation of length frequencies for the western echo-surveys was improved since it was possible to include some distributions for the middle Adriatic (i.e. area between Giulianova and Vieste).

For the future.

The ongoing exercise with Integrated Catch Analysis (ICA) should be improved in order to set up another powerful tool for the small pelagic stock assessment in the Adriatic.

Further more the Adriatic coutries are developing a common protocol to apply in the next future the Daily Egg Production Method (DEPM) to improve the assessment techniques for small pelagics.

# Abstract for SCSA reporting

**Authors**

Document prepared by the AdriaMed (MIPAAF-FAO project) working group for small pelagics:
Santojanni A. (1), Leonori I. (1), Carpi P. (1), De

**Year** 2010

**Species Scientific name**

Engraulis encrasicolus - ANE

Source: GFCM Priority Species

Source: -

Source: -

**Geographical Sub-Area**

17 - Northern Adriatic

**Fisheries (brief description of the fishery)***

Fishery: mid-water trawlers and purse seiners.
Average total catch in the time interval 1976-2009 is 29000 tonnes.
Average total catch in the time interval 2007-2009 is 44000 tonnes.

**Source of management advice***

**(brief description of material -data- and methods used for the assessment)**

VPA based on Laurec-Shepherd tuning was carried out, by means of the software developed by Darby and Flatman (1994).

The total catch at age from 1976 to 2009 (split year) used were relative to both western and eastern sides of Adriatic.

Tuning was performed using abundance at age data from echo-surveys carried out in both western and eastern sides of Adriatic, from 2004 to 2008 (due to the split year, information from surveys carried out in 2009 did not enter in the tuning data set).

Natural mortality at age was estimated by means of Gislason's method:

| Age | M |
|---|---|
| 0 | 1.02 |
| 1 | 0.82 |
| 2 | 0.67 |
| 3 | 0.57 |
| 4+ | 0.54 |

The threshold exploitation rate F/Z = 0.4, suggested by Patterson (1992) for the management of small pelagics, was used as biological reference point.

**Stock Status***

M - Moderately exploited, exploited with a low level of fishing effort. Believed to have some limited potential for expansion in total production;

**Exploitation rate**

Moderate fishing mortality

**Stock abundance**

Intermediate abundance

**Comments**

**Management advice and recommendations***

The recent exploitation rate F/Z is under the Patterson's threshold 0.4 (Patterson, 1992). Thus, anchovy stock can be considered as moderately exploited.

However, strong changes and fluctuations over time are commonly observed in the abundance of small pelagics (Jacobson et al., 2001). In the past, the biomass of anchovy stock dropped at very low level in 1987 with consequent crisis of Italian fishery. After this collapse, recovery took place, but fluctuations still occured, in particular in recent years. Moreover, an increase was observed in the total catch of most recent years.

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