Anchovy Spawning Stock Biomass of the Gulf of Cadiz in 2020 by the DEPM

By

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General sampling information

|	
Eggs	**Anchovy DEPM survey BOCADEVA 0720**
Survey area	(36º13'-36º50'N −6º07'-−8º55'W)
R/V	R/V Ramón Margalef
Date	9th to 17th July 2020
Transects (Sampling grid)	21 (8x3)
Pairovet stations (150 μm)	162
Sampling maximum depth (m)	100
Hydrographic sensor	CTD SBE 911
Flowmeter	Yes
CUFES stations	152
CUFES (335 μm)	3 n miles (sample unit)
Environmental data	Temperature and Salinity
Adults	**Acoustic survey ECOCADIZ 2020-07**
Survey area	(36º11'-36º47'N −6º12'-−8º54'W)
R/V	R/V Miguel Oliver
Date	31th July to 13th August 2020
Gears	Pelagic trawl (63.5/51 Tuneado gear)
Biological sampling:	On fresh material, on board the R/V
Sample size	At least 60 individuals randomly picked; up to 120 (adding batches of 10 randomly picked anchovies) if a minimum of 30 mature females were not found for spawning fraction estimation. A minimum of 150 hydrated females for batch fecundity estimation.
Fixation	4% Phosphate-buffered Formaldehyde
Preservation	4% Phosphate-buffered Formaldehyde

METHODOLOGY: EGG SAMPLING
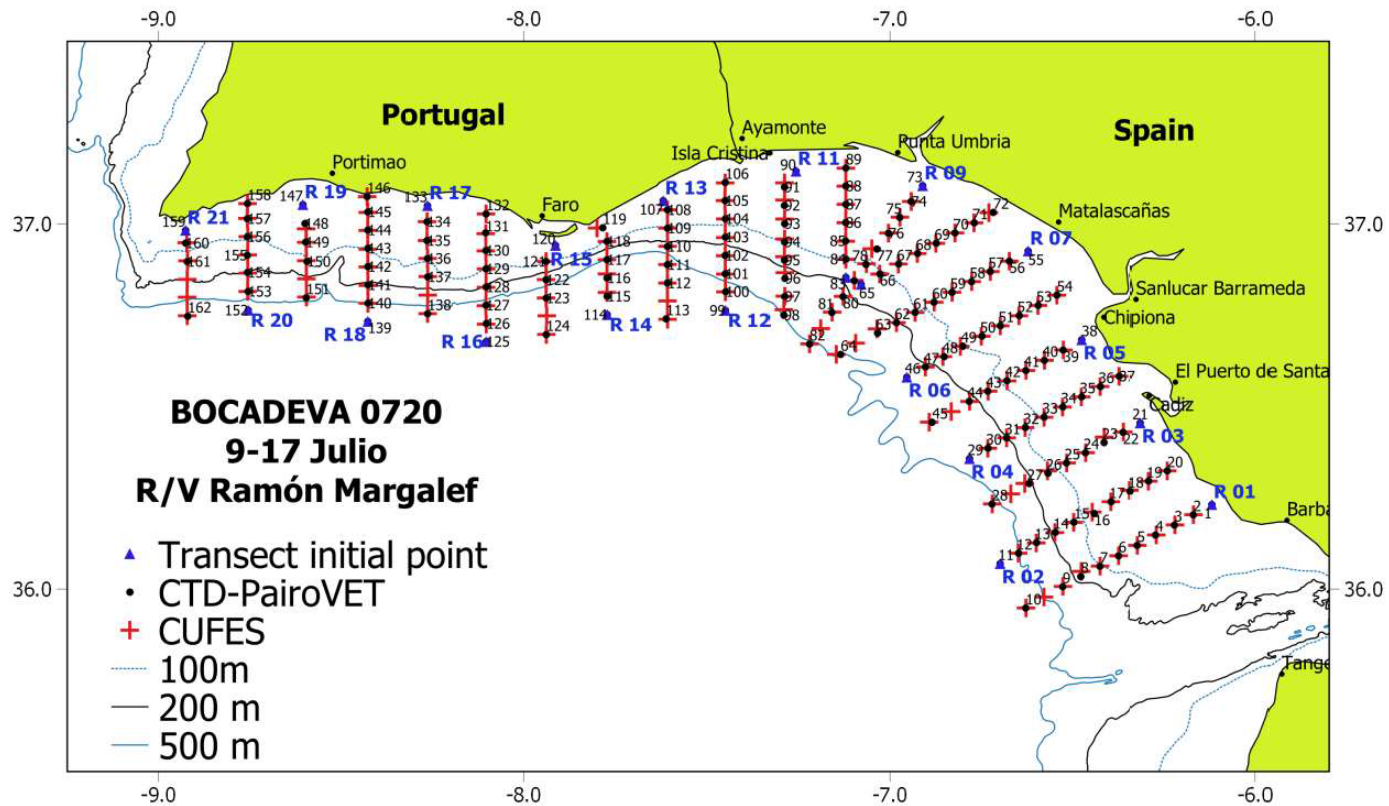
PairoVET:
- ✓ 150 μm mesh size net
- ✓ Fixed stations every 3 nm
- ✓ Vertical hauls (maximum 100m depth)
- ✓ Underwater positioning systems HiPAP 500 Kongsber

- ✓ CTD Sea Bird 911
- ✓ SST and SSS at 5 m (termosalinometer)

CUFES
- ✓ 335 μm mesh size net
- ✓ Depth sampling up to 5 m from the surface
- ✓ 600 l/min flow approximately
- ✓ Plankton samples preserved in buffered formaldehyde at 4%

METHODOLOGY: ADULTS SAMPLING
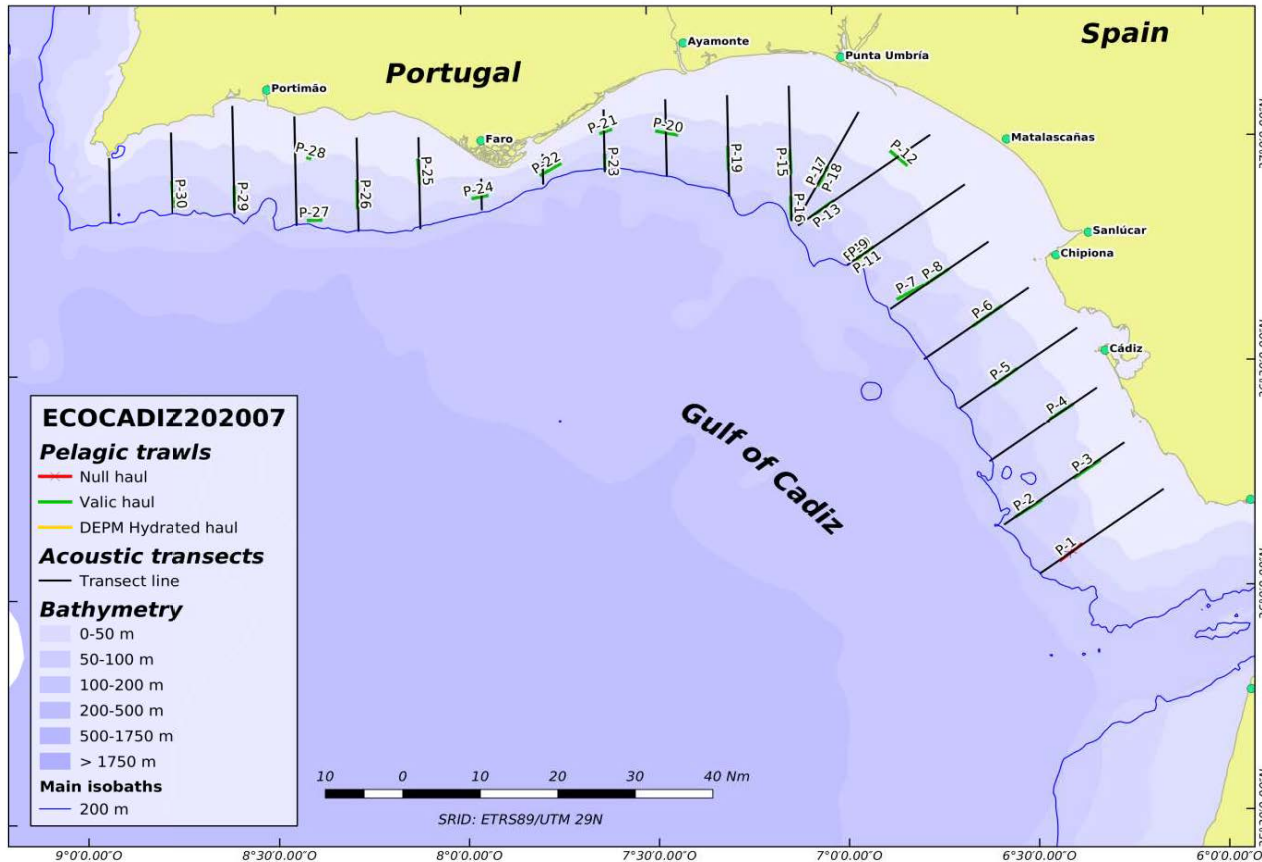
hauls: 30
valid hauls: 29
- 25 for echo-traces identification;
- 4 for collecting hydrated females.

Trawling time: from 06:58 to 21:19 hrs GMT (4 hauls at night targeting hydrated females).

Adult Samples:

Total of sampled Anchovies (sex & length & weight): 1691.
686 ovaries were collected (180 hydrated females for batch fecundity estimation).
Gonads preserved in 4% Phosphate-buffered formaldehyde.

Eggs data

PairoVET
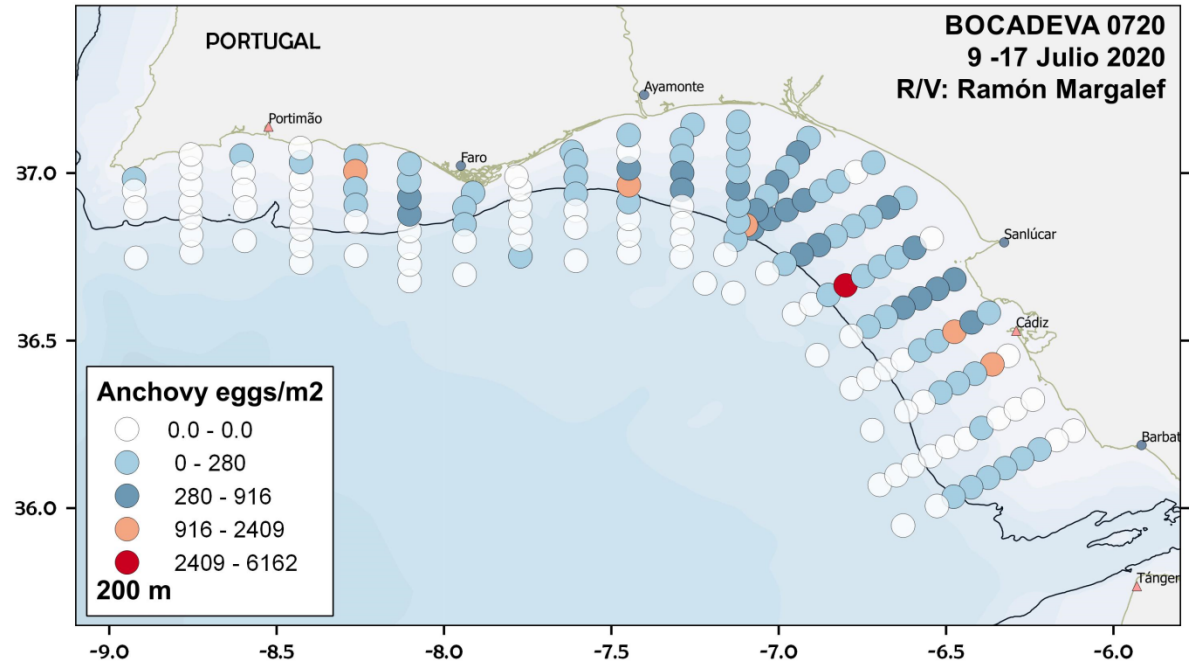
Total surveyed area: 16223 km^2
Positive area: 10058 km^2 (62%)

Total stations: 162
Positive stations: 86 (53%)
Total Anchovy eggs: 2916
Max. number: 530
Total density: 33873.9 eggs/m^2
Max. density: 6161.6 eggs/m^2

A total of 152 stations by <u>CUFES</u> were carried out, 69% positive. A total of 36476 eggs of anchovy were caught, the third highest value in the historical series (2005-2020).

Eggs data. Historical series

By Pairovet	2005	2008	2011	2014	2017	2020
N radials	21	21	21	21	21	21
N stations	119	127	125	151	151	162
N positive stations	46 (39%)	84 (66%)	71 (57%)	70 (46%)	52 (34%)	86 (53%)
N total eggs	583	1373	2387	3097	949	2916
N maximum eggs	204	104	191	195	215	530
Total density (egg/m^2)	11539	14266	24722	33019	10273	33874
Maximum density	4020	1229	2195	2024	2453	6162

The highest estimates of <u>maximum egg density</u> by station and <u>total egg density</u> as sampled by PairoVET were recorded during the 2020 survey.

	2005	2008	2011	2014	2017	2020
Total density (egg/m2)	11539	14266	24722	33019	10273	33874
Max. number	204	104	191	195	215	530
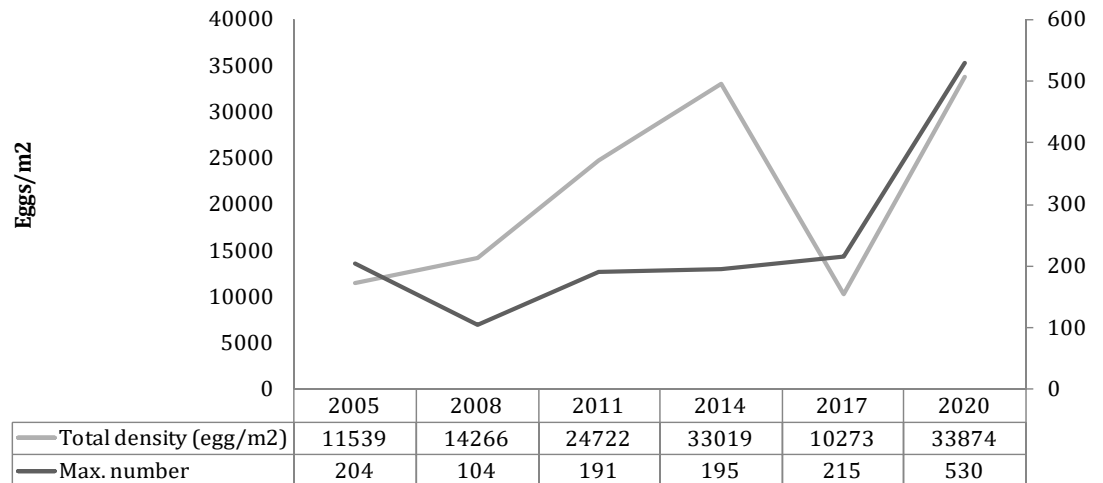
98% of Anchovy eggs were classified into 11 stages according to the degree of embryonic development (according to the key proposed by Moser and Ahlstrom, 1985). The most abundant stage was stage II (38.5%).

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	Dis
N	7	1124	65	188	175	346	403	133	204	204	8	59
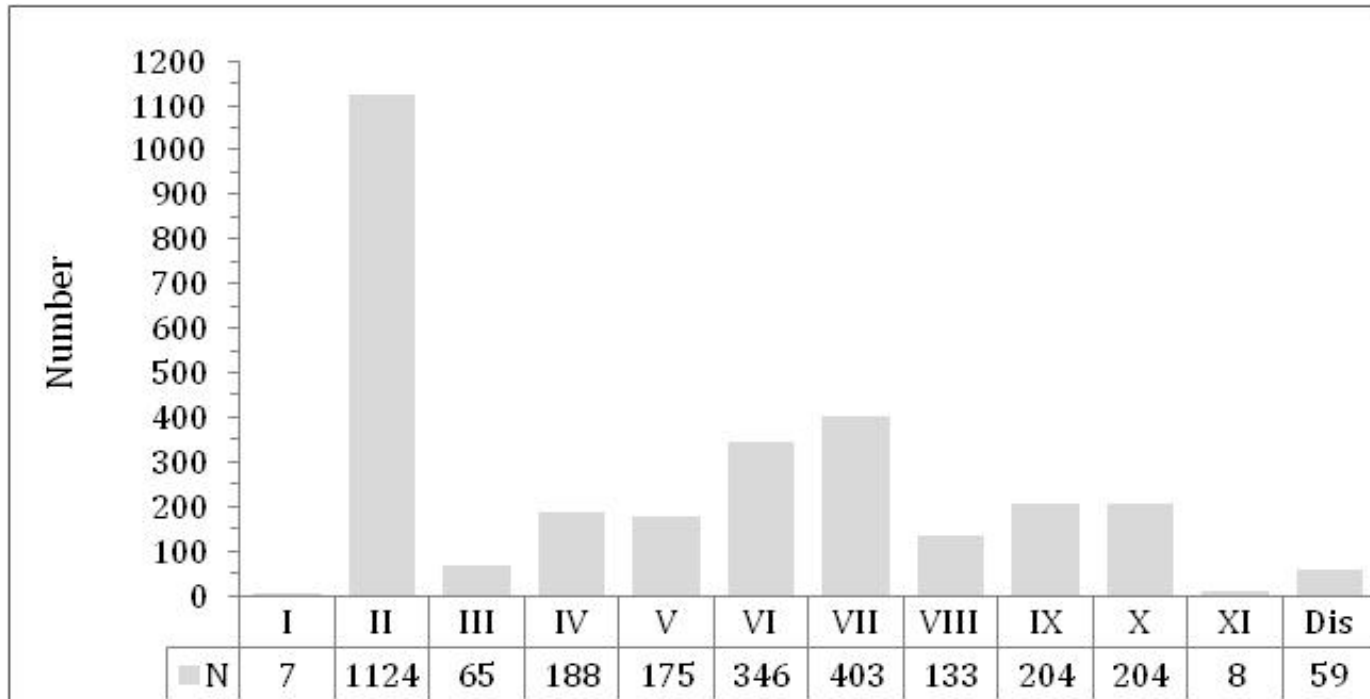
Stage I eggs were mainly caught at 23:25 GMT, coincident to the peak spawning for the species in the area (22:00 GMT ± 2h) and the egg development model (Bernal et al., 2012).

Egg parameters

P_0 (eggs/m²/day) = 523.4 (0.38)

z (day⁻¹) = -1.1124 (0.44)

P_{total} (eggs/day) = 5.264431e+12 (0.38)

Adult parameters

W = 16.630 g (0.13)
F = 8212 eggs (0.14)
R = 0.543 (0.009)
S: in progress

Due to the COVID19 pandemic and the consequent confinement and remote work, the histological processing of the gonad samples needed for the reading of POFs and estimation of S has not been possible to finish it yet. So, the mean value of spawning fraction (S) of the historical series has been used provisionally to estimate the SSB for 2020 (S = 0.241).
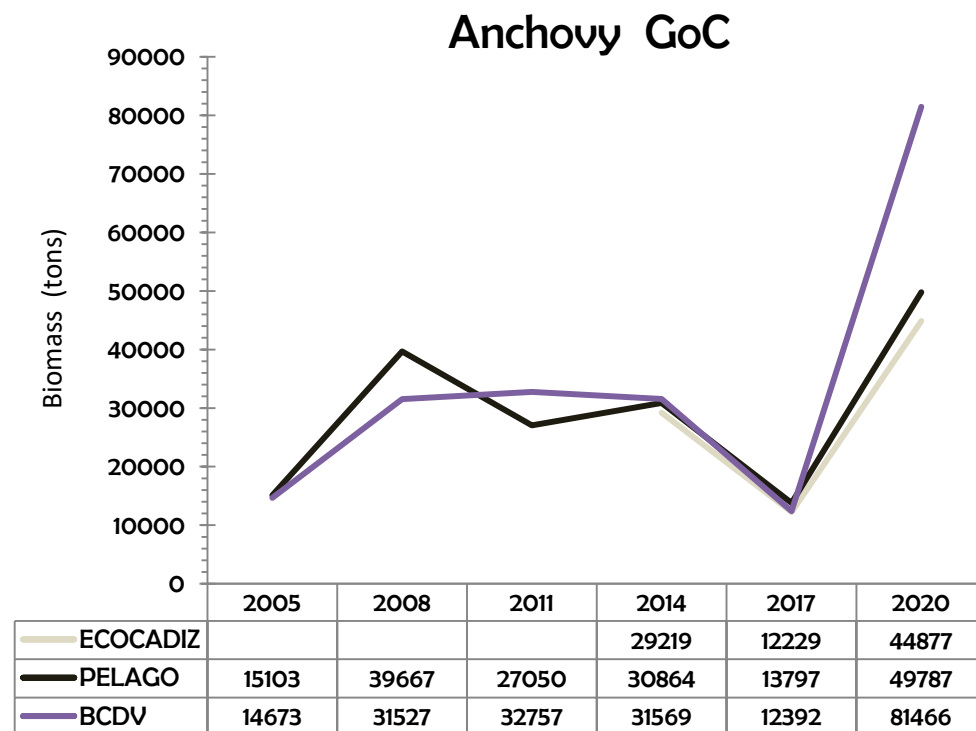
Preliminary Gulf of Cádiz Anchovy SSB 2020

SSB = 81466 t (0.43)

DEPM 2020 (Preliminary estimates) & HISTORICAL SERIES

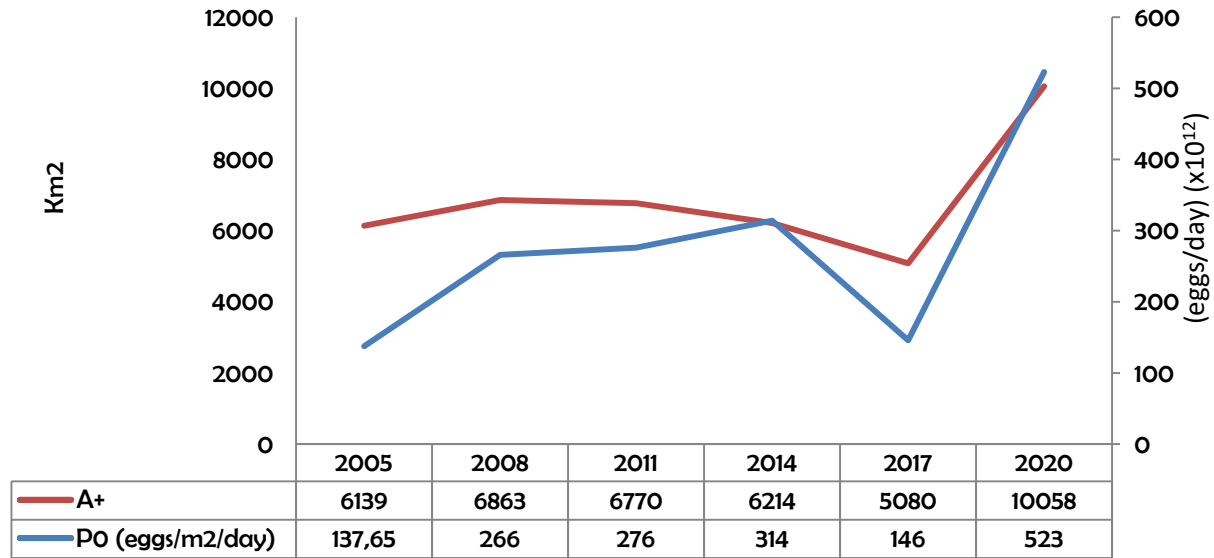| Year	2005	2008	2011	2014	2017	2020
Eggs						
P_0 (eggs/m²/day)	138	266	276	314	146	523
Z (day⁻¹)	-0.04	-1.43	-0.29	-0.33	-0,16	-1.11
P_{total} (eggs/day) (x10¹²)	1.13	2.11	1.87	1.95	0.74	5.26
Surveyed area (km²)	11982	13029	13107	14595	15556	16223
Positive area (km²)	6139	6863	6770	6214	5080	10058
Adults						
Female Weight (g)	25.2 / 16.7	23.7	15.2	18.2	16.2	16.6
Batch Fecundity	13820 / 11160	13778	7486	7502	7507	8212
Sex Ratio	0.53 / 0.54	0.53	0.53	0.54	0.53	0.54
Spawning Fraction	0.26 / 0.21	0.218	0.276	0.276	0.243	0.241 [1]
SSB						
Spawning Biomass (t)	14673	31527	32757	31569	12422	81466

(1) Historical series mean value

BIOMASS (tons) – HISTORICAL SERIES

Year	ECOCADIZ (Acoustic)	PELAGO (Acoustic)	BOCADEVA (DEPM)
2004	18177		
2005	-	15103	14673
2006	36521	24082	
2007	28882	39965	
2008	-	39667	31527
2009	21580	26834	
2010	12339 *	8583	
2011	-	27050	32757
2012	-		
2013	8487	16655	
2014	29219	30864	31569
2015	21305	33100	
2016	34184	65345	
2017	12229	13797	12392
2018	34908	23473	
2019	57700	29876	
2020	44877	49787	81466
2021		14065	

(*) Spanish waters only

Anchovy GoC

	2005	2008	2011	2014	2017	2020
ECOCADIZ				29219	12229	44877
PELAGO	15103	39667	27050	30864	13797	49787
BCDV	14673	31527	32757	31569	12392	81466

BOCADEVA series

	2005	2008	2011	2014	2017	2020
A+	6139	6863	6770	6214	5080	10058
P0 (eggs/m2/day)	137,65	266	276	314	146	523

Ptot

	2005	2008	2011	2014	2017	2020
Ptotal (eggs/day) (x1012)	1,13	2,11	1,87	1,95	0,74	5,26