

## Unusual occurrence of anchovy (*Engraulis encrasicolus*, Linnaeus 1758) eggs in December 2006 in Boka Kotorska Bay (Adriatic Sea)

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*Five anchovy (*Engraulis encrasicolus*, Linnaeus 1758) eggs were caught during an ichthyoplankton survey in Boka Kotorska Bay (south Adriatic Sea) with a PairOVET (modified CalVet) plankton net on December 5<sup>th</sup>, 2006. Eggs were found at two sampling stations (42°28'30.24" N, 18°44'41.81" E and 42°29'30.23" N, 18°40'41.84" E). It is the third record of anchovy eggs in the winter months in the Adriatic Sea.*

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**Key words:** *Engraulis encrasicolus*, spawning, south Adriatic Sea

### INTRODUCTION

Anchovy (*Engraulis encrasicolus*, Linnaeus 1758) is the only representative of the family Engraulidae in the Mediterranean and the Adriatic Sea. It is distributed in the Atlantic, from the western coast of Africa up to Bergen, as well as in the North Sea, the Baltic, the Mediterranean, and the Black Sea (WHITEHEAD *et al.*, 1986). It is widely distributed in the Adriatic Sea, inhabiting all its parts down to a depth of 210 m (MUŽINIĆ, 1973).

Anchovy is one of the commercially most important Adriatic fish. Anchovy eggs are pe-

lagic and frequent in plankton from April to September, with a peak in June-July, and sometimes from March to November (FAGE, 1920, VARANGOLO, 1964, 1965; VUČETIĆ, 1964; ZAVODNIK, 1970; MERKER & VUJOŠEVIĆ, 1972; REGNER, 1972, 1985; PICCINETTI *et al.*, 1980, REGNER, 1996; PALOMERA, 1992).

Spawning occurs most intensively in the most productive areas of the Adriatic Sea, namely in the eutrophic waters of the western part of the shallow northern Adriatic and along the Italian coast to the peninsula of Gargano. Anchovy spawns in the Adriatic in temperature and salinity ranges of 11.6-27.6°C and 9.1-39.6 ppt, re-

spectively (REGNER, 1996).

The first description of anchovy eggs was given by RAFFAELE (1888). The eggs have an elongated ellipsoid form, with the major axis of 1.15-1.25 mm, and the minor of 0.50-0.55 mm. The chorion is thin, without pores or canals, the perivitelline space is narrow and the structure of the yolk is segmented and similar to that of clupeid eggs. There are no oil globules.

## MATERIAL AND METHODS

Seasonal qualitative and quantitative ichthyoplankton surveys were carried out at 18 stations in Boka Kotorska Bay during the 2006-2009 period. The plankton samples were taken with a PairOVET (modified CalVet) plankton net. The diameters of net cylinders were 25 cm each, and the total mouth area was 0.098 m<sup>2</sup>, while the mesh size was 0.160 mm. The net was towed vertically at a speed of 0.5 m sec<sup>-1</sup>. Eggs were staged and aged using the methodology given in REGNER (1985). Data on temperature and salinity from the surface to the bottom were collected by a CTD probe at each station.

## RESULTS AND DISCUSSION

Eggs were found on December 5<sup>th</sup>, 2006 at two sampling stations in Boka Kotorska Bay (42°28'30.24" N, 18°44'41.81" E within the Bay of Kotor, and 42°29'30.23"N, 18°40'41.84" E within the Bay of Risan, at 09:20 and 10:42 hours, respectively) (Fig. 1).

At the sampling station within the Bay of Kotor, we have found 4 eggs (40.76 eggs/m<sup>2</sup>). Two of them were at the III stage of embryonic de-

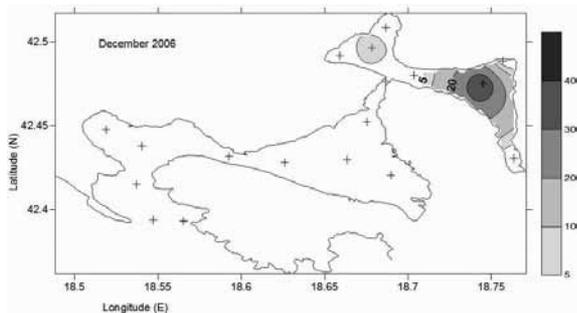


Fig. 1. Distribution of anchovy eggs in Boka Kotorska Bay in December 2006 (N/m<sup>2</sup>)



Fig. 2. Anchovy eggs found on December 7<sup>th</sup>, 2006



Fig. 3. Anchovy egg with destroyed chorion

velopment, and the third egg was at the end of the VI stage. The chorion of the fourth egg was destroyed, probably by the plankton net during sampling (Fig. 2 and 3). The major axes of eggs were 1.19, 1.19 and 1.33 mm, respectively.

At the sampling station within the Bay of Risan, we have found only one egg (10.2 eggs/m<sup>2</sup>) which was at the end of the III stage of embryonic development and 1.19 mm long.

The average temperature of the water column (the sampling was performed at a maximum depth of 33 m) was 16.9°C and the average salinity was 37.25 ppt. Sea surface temperature (SST) was 17.5°C.

The development time of eggs, from fertilization to hatching, was 2.47 days at the station within the Bay of Kotor, and 2.55 days at the station within the Bay of Risan.

Estimated average age of the eggs at stage III

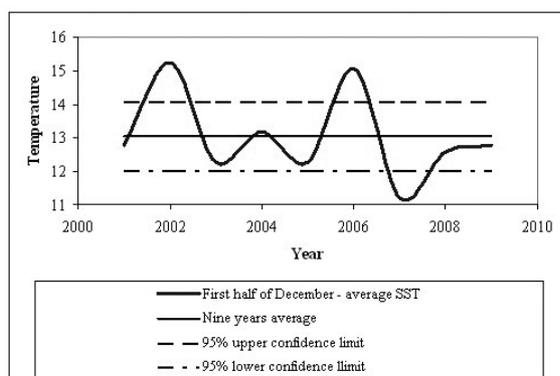


Fig. 4. Average sea surface temperature (°C) in December (2001-2009)

was 0.51 day, while the age at stage VI was 1.42 days.

To date, there were only two records of anchovy egg occurrence during the winter in the Adriatic Sea. One anchovy egg was found on February 26<sup>th</sup> 1967 in the Gulf of Venice, when the sea temperature was 9.5°C on the surface and 9.8°C near the bottom (ZAVODNIK, 1970). According to ZAVODNIK, (1970), CAR and HADŽI (1914) have found one anchovy egg in Kvarner Bay also in February.

In contrast to the Adriatic Sea and the other northern parts of the Mediterranean Sea, in the southern Mediterranean (Gulf of Tunis), during cruises performed in August and October 2002 and in February and April 2003, it was found that anchovy spawned in February, with a low intensity of 7 eggs/10 m<sup>2</sup>, within the temperature range of 10.5°C to 14.7°C where the average was 13.4°C (ZARRAD *et al.*, 2006). Nevertheless, the most intensive spawning during this research was recorded in spring and summer (*ibid.*).

During the three-year long ichthyoplankton survey in Boka Kotorska Bay, we have found that the anchovy spawned from April to October (however, we found only several eggs in October in the entire investigated area).

Extended spawning periods are likely to be affected by higher temperatures (REGNER, 1972). In December 2006 Boka Kotorska Bay was characterized by air temperatures above the average for the winter period which consequently caused higher temperatures of the sea. Average SST for the first half of December, calculated from data

recorded at the meteorological station in Kotor, show that during the period from 2001 to 2009 the first half of December in the year 2006, along with 2002, was the warmest one (Fig. 4).

Consequently, high temperatures are probably one of the causes of the occurrence of anchovy eggs in December 2006 in Boka Kotorska Bay.

As far as the records of anchovy eggs in February in the Adriatic Sea (ZAVODNIK, 1970) are concerned, they may indicate earlier onset of the spawning season than usual. However, the author did not state the developmental stage of the eggs found and, moreover, whether they were even fertilized. Therefore we quote Zavodnik's opinion: "We are of the opinion that the appearing of anchovy eggs in North Adriatic at such low temperatures is exceptional and the result of pre-time spawning activities of isolated specimens. However, an error in the laboratory treatment of the material could be also involved".

## CONCLUSIONS

In our case we are dealing with the delayed end of the spawning season. The obtained results show that the difference between the estimated ages of eggs at stages III and IV was 0.91 days, or 22 hours. Back calculation shows that eggs at stage III were spawned at about 20:00 hours on December 4<sup>th</sup>, while the egg at stage VI was spawned at 20:30 hours on December 3<sup>rd</sup>. This undoubtedly indicates that anchovy spawned for at least two days in this area, which could not be a mere incidence.

We have to emphasize that the occurrence of anchovy eggs even in November is also rare. For example, the analysis of plankton samples collected from 1962 to 1976 on a monthly basis showed that anchovy eggs were found only in November 1969 (REGNER, 1979, appendices IV-VII). Therefore this occurrence of anchovy eggs, although in the first decade of December, may be considered as unusual.

Small sizes of eggs suggest that small individuals, probably just matured, spawned in this shallowest and most tucked-into-the-mainland area of Boka Kotorska Bay.

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Received: 12 December 2010

Accepted: 19 December 2011

## Neobična pojava jaja inćuna (*Engraulis encrasicolus*, Linnaeus 1758) u prosincu 2006. godine u Bokokotorskom zaljevu (Jadransko more)

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### SAŽETAK

Pet jaja brgljuna (*Engraulis encrasicolus*, Linnaeus 1758) su uhvaćena tijekom istraživanja ihtioplanktona u Bokokotorskom zaljevu (južni Jadran) s PairOVET (izmijenjeni CalVet) i planktonskom mrežom 5. prosinca 2006. godine. Jaja su pronađena na dva mjesta uzorkovanja (42 ° 28'30 .24 "N, 18 ° 44'41 0,81" E i 42 ° 29'30 0,23 "N, 18 ° 40'41 0,84" E). Ovo je treći nalaz jaja brgljuna u zimskim mjesecima u Jadranu.

**Ključne riječi:** *Engraulis encrasicolus*, mriješćenje, južni Jadran

