# CONDITION AND FECUNDITY OF RED MULLET OVER MUDDY AND "CORALLIGENE" SUBSTRATA

S. Somarakis [1, 2] *, Ch. Stamataki [2], A. Machias [2], N. Papadopoulou [2], C. Smith [2], I. Karakassis [2]

[1] University of Patras, Department of Biology, Patra, Greece - * somarak@upatras.gr
[2] Institute of Marine Biology of Crete, Iraklio, Crete, Greece

**Abstract**

We compared somatic, gonadal and hepatic condition as well as batch fecundity of red mullet (*Mullus barbatus*) between two sites differing in substratum type. The first site had muddy substratum, whereas the second site was covered by dense patches of calcareous algae and associated biogenic structures ("coralligene"). The results suggested that red mullet was in superior condition over coralligene, where fish had significantly ($P<0.05$) higher hepatic or somatic mass. Batch fecundity did not differ ($P>0.05$) between sites.

*Keywords: Mullus barbatus, condition, fecundity, coralligene*

## Introduction

The red mullet, *Mullus barbatus*, is one of the most important species for the Mediterranean fisheries. It is abundant throughout the continental shelf, over both muddy and coarser substrata, although it shows maximum abundance and frequency of occurrence over muddy bottoms (1).

In the present contribution we present preliminary results of the comparison of somatic condition, organ condition and fecundity of red mullet between muddy and coralline algae substrata. The latter comprise important fishing sites for local small-scale fisheries (2).

## Materials and methods

Three replicate hauls were taken at each of two sites of similar depth (70-90 m) in the South Evoikos Gulf (Aegean Sea) using an otter trawl with a cod-end bag liner of 28 mm stretched mesh-size. The first site had muddy substratum (90% silt and clay) whereas the other one was considerably coarser (89% sand and gravel) and dominated by dense patches of biogenic structures related to colony-forming calcareous algae of the class Rhodophycae ("coralligene" [3], "tragana" in Greek). The substratum types were determined by grain size analysis and side scan sonar tows over the trawl path.

A sample of red mullets was randomly selected from each haul and fixed in 10% buffered formalin solution. In the laboratory, the fish were measured (total length [TL], 1mm; total weight [TW], 0.01g; eviscerated weight [EW], 0.01g), sexed and their gonads and liver dissected and weighted (gonad weight [GW], 0.0001g, hepatic weight [LW], 0.0001g). Samples from the gonads were subsequently dehydrated and embedded in paraffin. Sections (4-6 µm) were cut and stained with hematoxylin and eosin. The hydrated oocyte method was used for batch fecundity measurements (4).

For each site, we modeled GW, LW and batch fecundity (FEC) on EW as well as EW on TL and FEC on GW using the allometric equation: $Y=aX^b\exp(\varepsilon)$. In all cases, this simple model was more efficient in terms of residuals and explanation of the variation than other models. Analysis of covariance (ANCOVA) was used to test for between-site differences in the log-log relationships between variables. Slopes were tested first using a model that included an interaction term. If the interaction term was not significant (i.e. slopes were not significantly different between sites), then the y-intercepts were tested.

## Results and conclusion

Histological analysis of the gonads revealed that 99 and 100% of the analysed females and males were in the hydrated and spermatogenic stage, respectively. Non-hydrated females were not used in the subsequent analyses.

The calculated parameters of the allometric relationships for each site and sex are given in Table 1. The ANCOVA results indicated that, for both sexes, the LW-on-GW relationship had higher intercept in the coralligene site (females: $P<0.05$, males: $P<0.0001$). The EW-on-TL relationship for females had also higher intercept in the coralligene site ($P<0.001$). No significant ($P>0.05$) differences between sites were found for the fecundity relationships (FEC-on-EW and FEC-on-GW).

These preliminary results suggest that red mullet was in superior condition in the coralligene site, where the fish had, on average, higher hepatic or somatic mass. This superior condition did not seem to affect batch fecundity of mature females. The biological and functional complexity of submarine coralligene (2) is likely to provide superior feeding conditions for red mullets and other fishes. Unpublished results from a diet analysis study seem to corroborate this hypothesis; higher stomach contents weight was observed in the diet of *M. barbatus* over coralligene sites with the main prey taxa being decapods and small crustaceans which are thought to be of higher nutritional value and energy content [5].

**Table 1. Parameters of the allometric functions ($Y=aX^b$) between gonad weight (GW) and eviscerated weight (EW), liver weight (LW) and eviscerated weight, eviscerated weight and total length (TL), batch fecundity (FEC) and eviscerated weight, and batch fecundity and gonad weight. n: sample size, $r^2$: coefficient of determination, a,b: parameters of the allometric model.**

| Relationship | Sex | Substratum | a | b | $r^2$ | n |
|---|---|---|---|---|---|---|
| GW-EW | Females | Mud | 0.103 | 0.993 | 0.850 | 55 |
| | | Coralligene | 0.048 | 1.176 | 0.854 | 48 |
| LW-EW | | Mud | 0.049 | 0.791 | 0.733 | 55 |
| | | Coralligene | 0.026 | 0.991 | 0.746 | 48 |
| EW-TL | | Mud | $4\,10^{-6}$ | 3.196 | 0.976 | 55 |
| | | Coralligene | $3\,10^{-6}$ | 3.216 | 0.968 | 48 |
| FEC-EW | | Mud | 136.42 | 1.002 | 0.749 | 55 |
| | | Coralligene | 57.40 | 1.203 | 0.771 | 48 |
| FEC-GW | | Mud | 1398.4 | 0.991 | 0.855 | 55 |
| | | Coralligene | 1305.1 | 1.011 | 0.882 | 48 |
| GW-EW | Males | Mud | 0.025 | 0.943 | 0.543 | 81 |
| | | Coralligene | 0.053 | 0.718 | 0.206 | 59 |
| LW-EW | | Mud | 0.037 | 0.61 | 0.506 | 81 |
| | | Coralligene | 0.026 | 0.0772 | 0.559 | 59 |
| EW-TL | | Mud | $2\,10^{-6}$ | 3.373 | 0.960 | 81 |
| | | Coralligene | $5\,10^{-6}$ | 3.126 | 0.922 | 59 |

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