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# QUALITY ASPECTS OF OYSTERS REARED IN VARANO LAGOON (SOUTH ITALY) IN RELATION TO MARKETABILITY

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Blue growth is generally accepted long-term strategy to support sustainable growth in the marine and marine sector. Shellfish culture, based on ecological and market assessment, is considered a driving force for socio-economic change and ecological complex coastal systems as lagoons throughout the Mediterranean area. Oyster aquaculture is of great importance worldwide, with production increasing at an average of 7.8% per annum over the last 30 years, stimulated by market (FAO, 2004). In order to diversify the fish production, the pacific oyster *Crassostrea gigas* was cultured at commercial farms in the Varano lagoon (SE Italy). The aims of this study were to evaluate the quality and market aspects of oysters through three condition indices (CI, CI<sup>CG</sup>, CI<sup>E</sup>) and Polydora index (PI) reared in two different sites (Site FO and Site LA) of the Varano lagoon, characterized by different hydrodynamic conditions. The observation period on rearing sites of *C. gigas* was performed from March 2015 to September 2015. Specific sites were located in the North-East area of Varano Lagoon where concessions for shellfish culture (mussels and clams) of the Consortium of Fishermen Ischitella are concentrated. Site LA is located in a more central area characterized by highest hydrodynamic condition, because wind exposed, and by higher depth (>4 m); Site FO is located within a channel sheltered, close to a sandbanks system, and subject to weak hydrodynamics influenced by tidal ranges and at lower depths (2m).

## Biological measures

After four months of rearing, samples of 30 oysters were opened and soft tissue and shell were weighted for evaluation the economic and ecophysiological quality of the oysters. For this purpose four condition indices, level of infestation by the worm and total lipid content was performed. Then inner shell valves were examined to estimate their degree of blistering by burrowing worms according to Fleury et al., 1999. A synthetic "Polydorid Index" (PI) was calculated. For determination of condition indices 6 oysters from each sample time were considered. To determine the dry mass of meat (DMW) and valves (DSW), soft tissue and shell were freeze-dried and weighed.



## Quality indices

Condition index (CI) by Davenport & Chen (1987) e Waite & Mann (1975)

$$CI = \frac{DM_{meat}(g)}{DM_{shell}(g)}$$

The Crosby and Gale's index of (CICG) accounts for the presence of internal fluid and shell cavity volume, where a high value represents large oyster meat nei risultati:

$$CI^{CG} = \frac{DM_{meat}(g)}{1000 / \text{cavity volume}(g)}$$

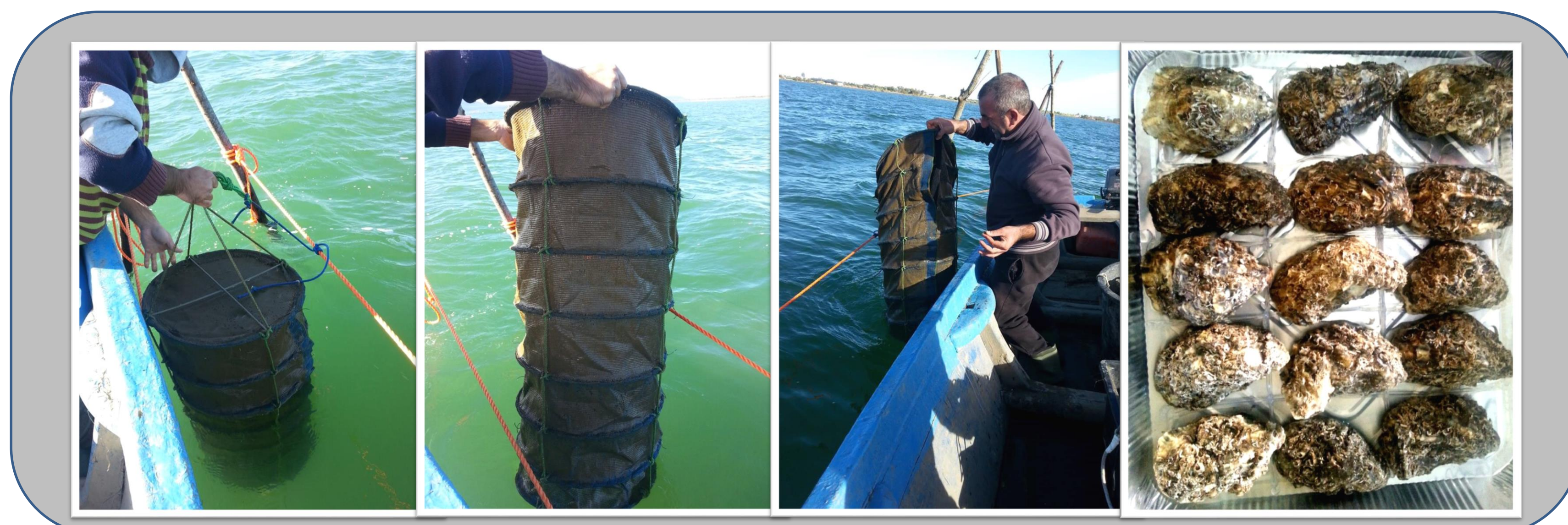
$$\text{Cavity volume} = \text{whole weight}(g) - \text{shell weight}(g)$$

The Imai and Sasakai index was defined also Economical Condition index CIE

$$CI^E = \text{shell thickness}(mm) \times (0.5(\text{shell length}(mm) + \text{shell width}(mm)))^{-1}$$

Polydorid Index (PI)

$$PI = p(0)*0 + p(1)*0.25 + p(2)*0.5 + p(3)*0.75 + p(4)*1$$



## RESULTS

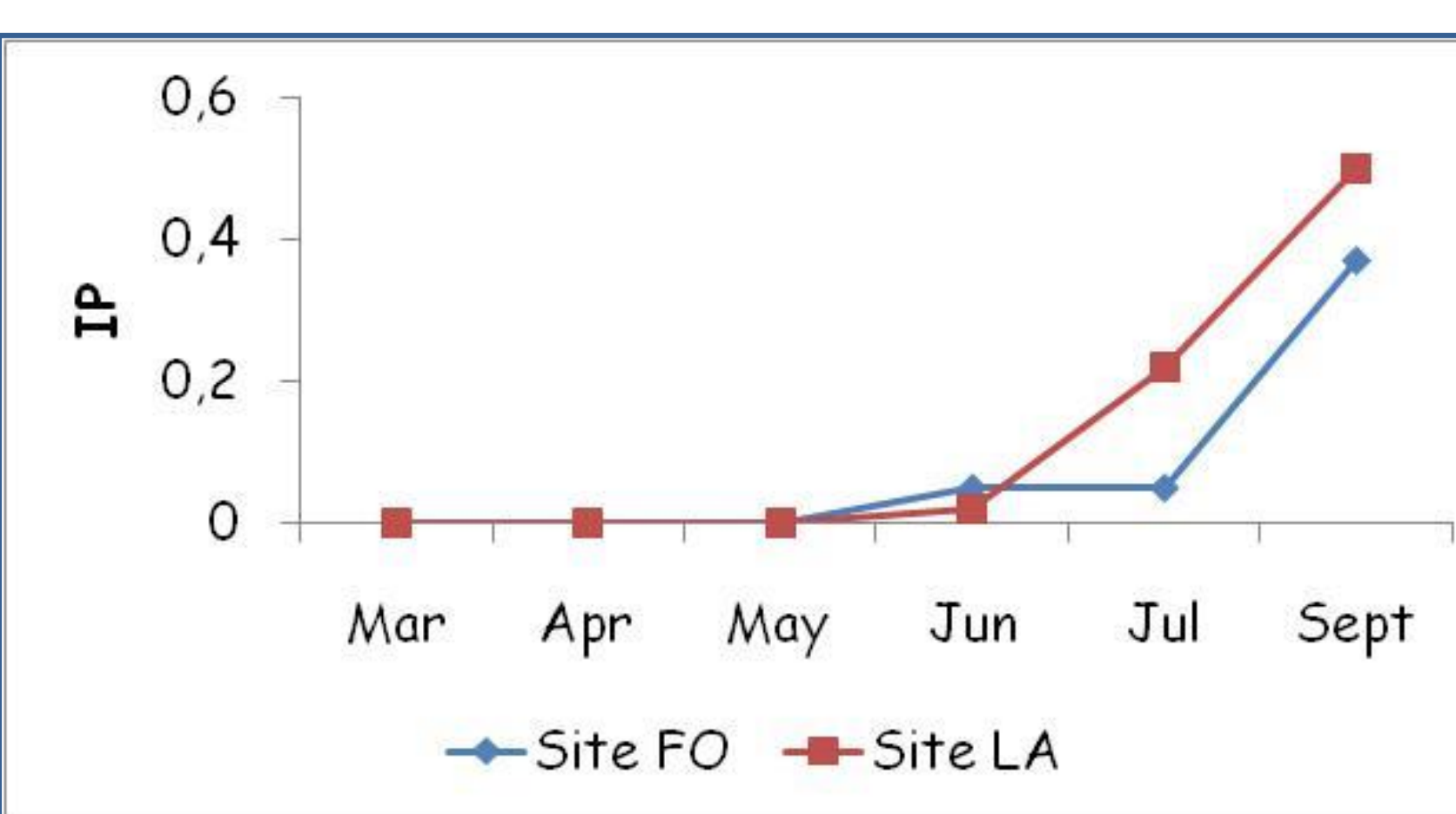
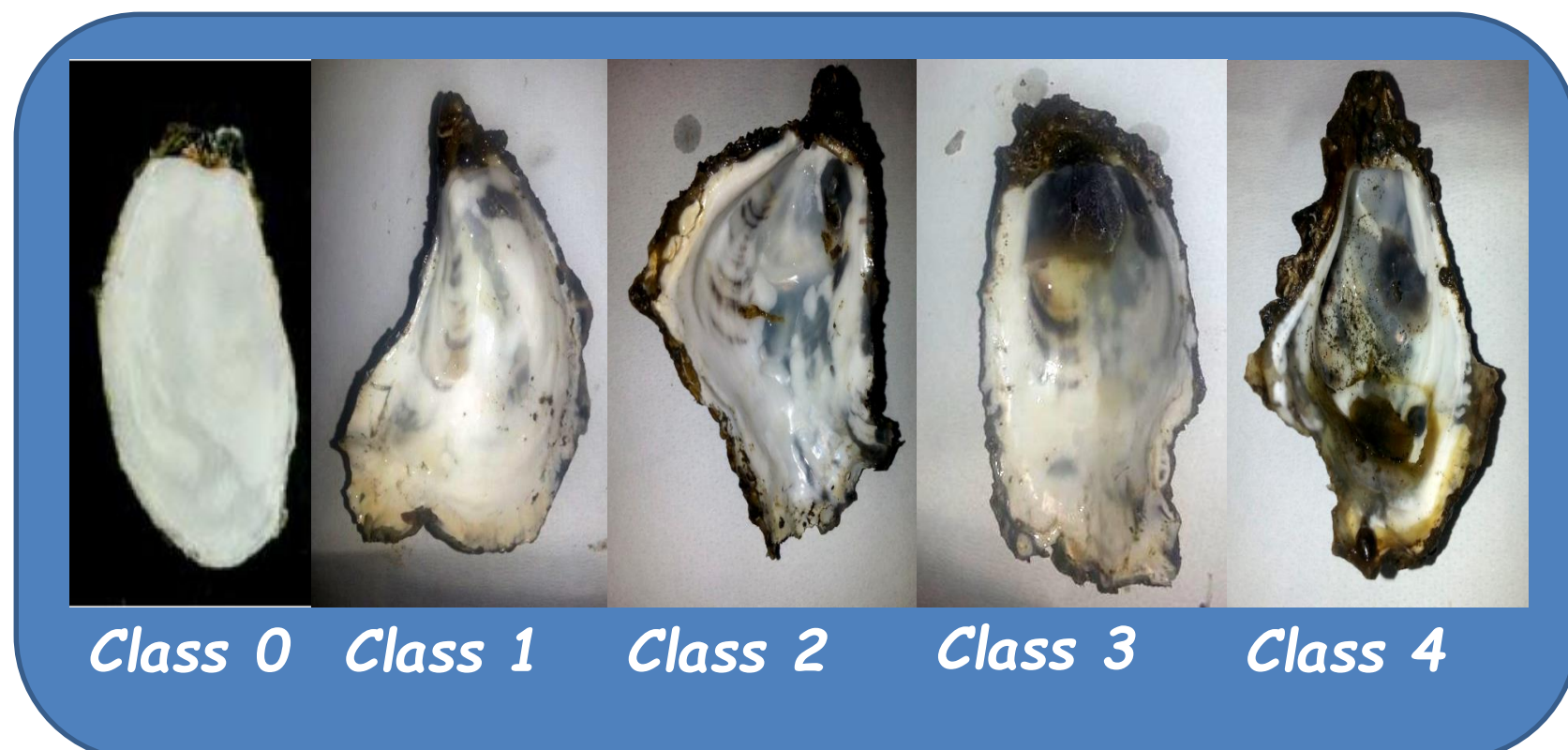
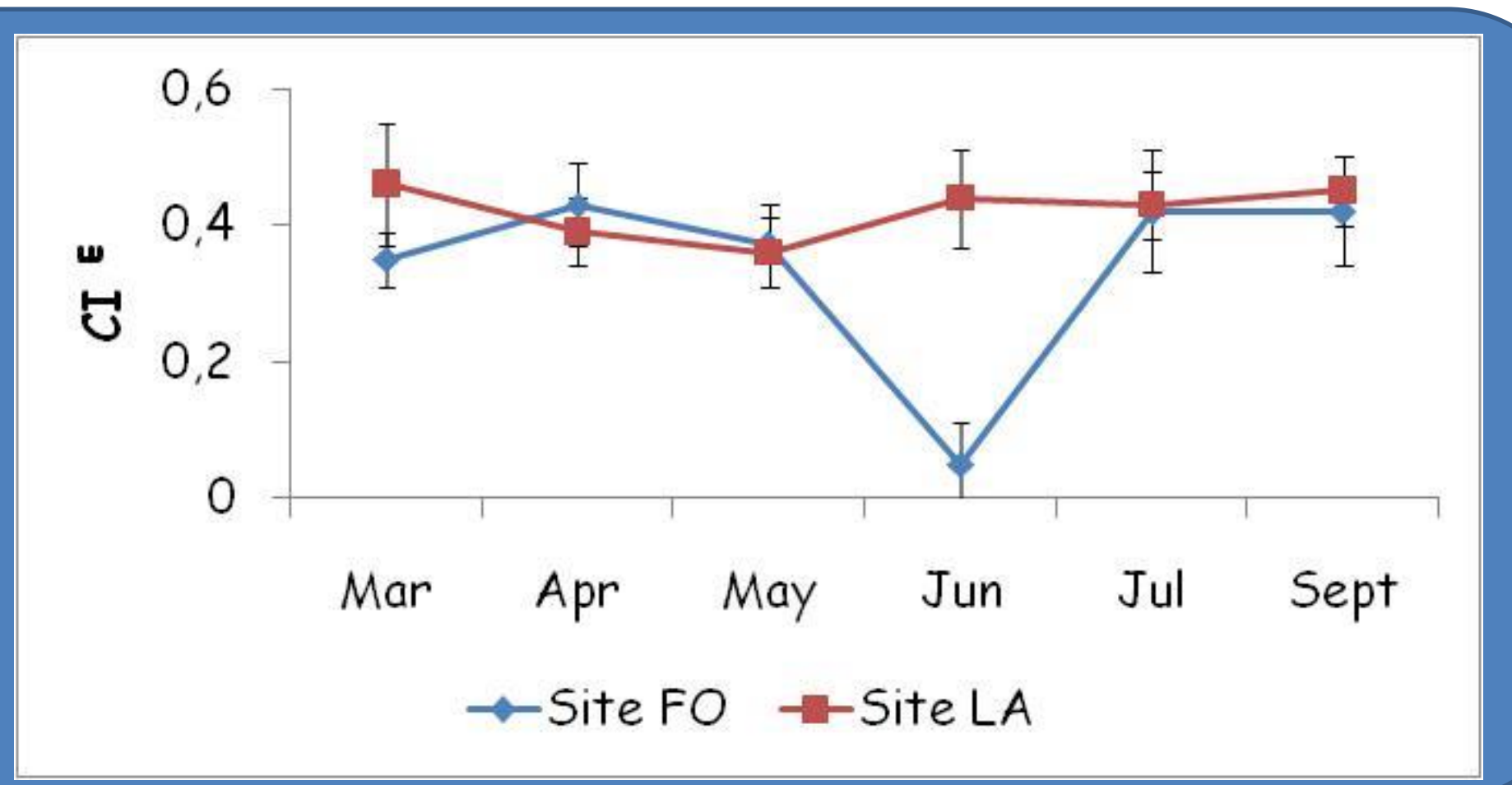
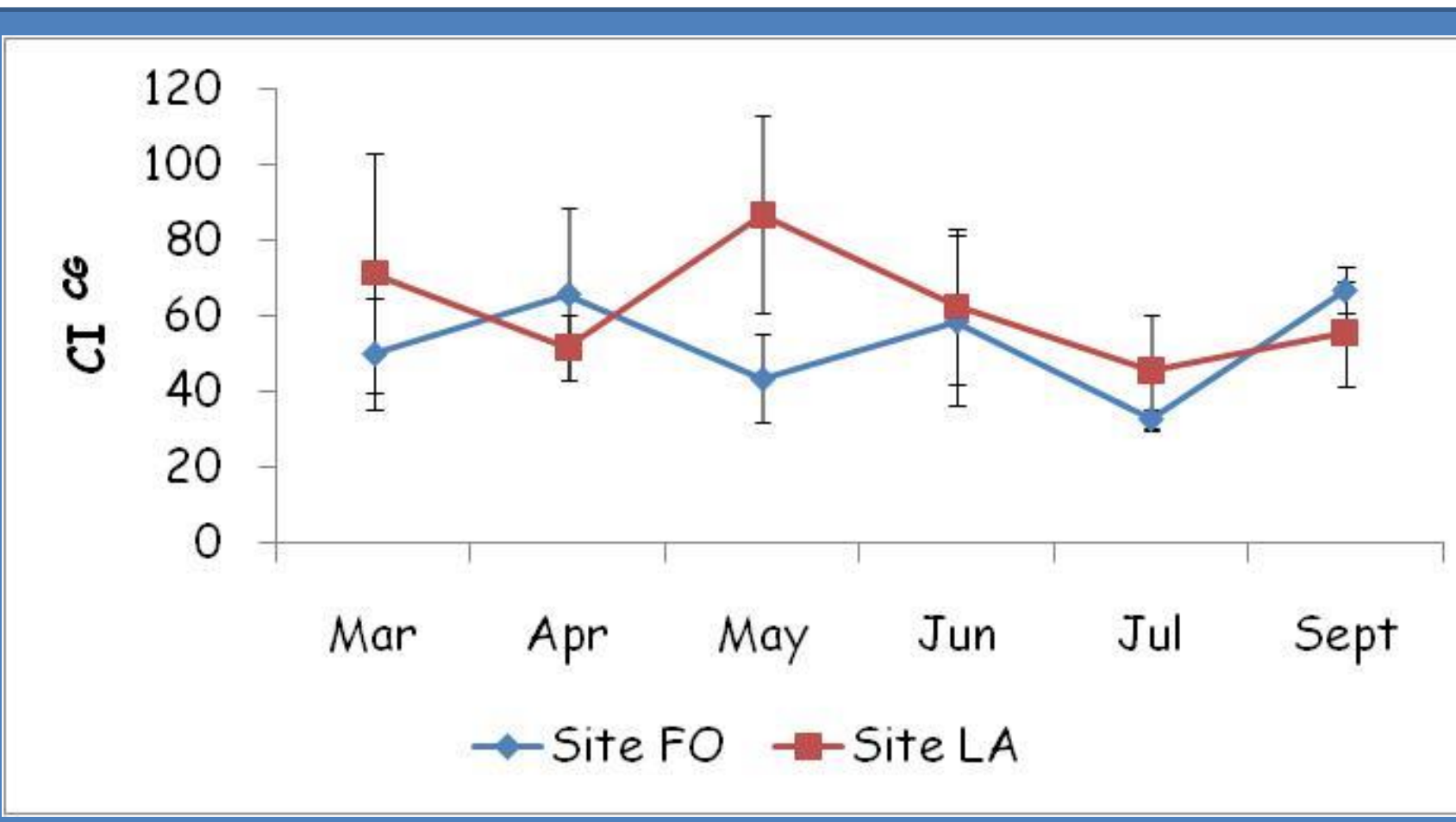
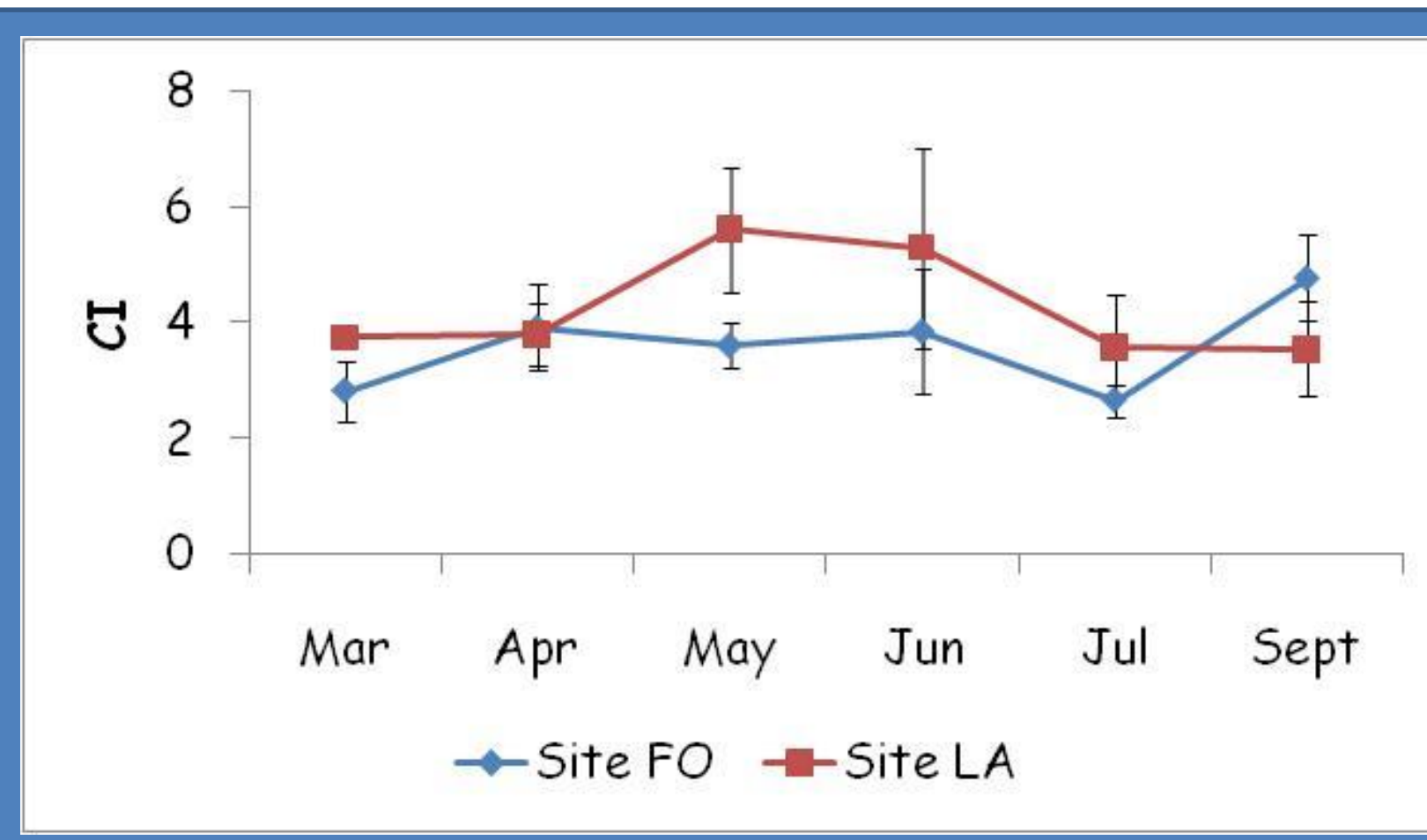
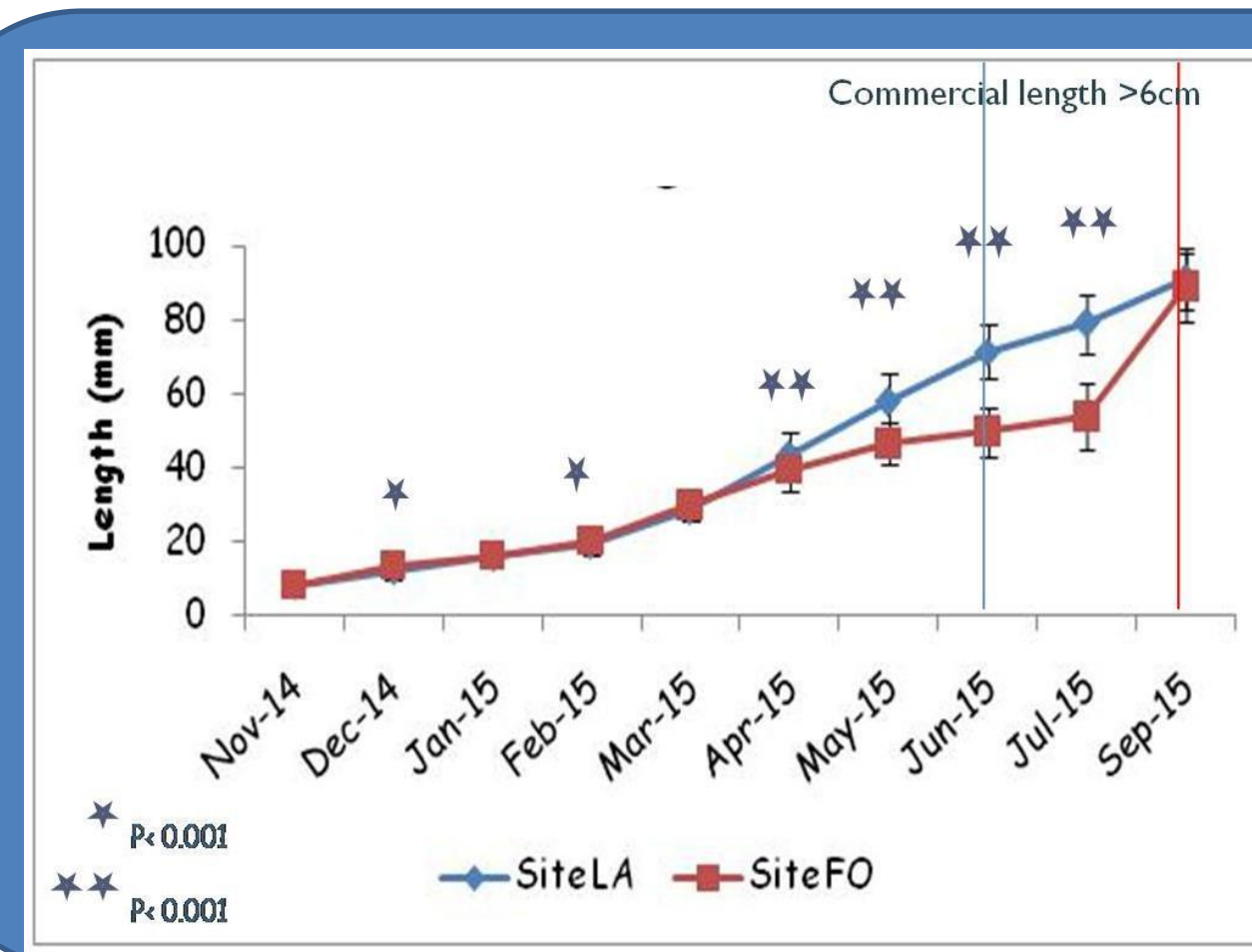
The results of this study showed over the period observation (March - September 2015) the highest value of CI in September (4.79 ± 0.75) and May (5.62 ± 1.09) for Site FO and Site LA respectively; instead the lowest values were registered in July (2.67 ± 0.28) and in September (3.55 ± 0.82) for Site FO and Site LA respectively.

The highest values of CI<sup>CG</sup> (reflecting the fullness of an oyster cup) were observed in September (67.07 ± 13.72) and May (86.84 ± 26.03) for Site FO and Site LA respectively, whereas the lower values were found in July both sites (22.47 ± 6.05 for Site FO and 45.47 ± 15.13 for Site LA).

The highest values of CI<sup>E</sup> (indicating economic quality of oysters) were recorded in June (0.43 ± 0.06) and in September (0.45 ± 0.05) for Site FO and Site LA respectively, instead the lower values were registered in May in both sites (0.37 ± 0.061 Site FO and 0.36 ± 0.05 Site LA).

Polydorid Index (PI) indicates mudworm presence for each site all over the observation period. The highest values of PI was recorded in September in both sites (0.37 in the Site FO and 0.50 in Site LA).

	Site LA			Site FO			2-way ANOVA	
	mean ± DS	min	max	mean ± DS	min	max	sites	months
T °C	18.30±7.01	9.00 (Jan)	30.10(Jul)	18.30±6.90	9.80 (Jan)	29.50 (Jul)	n.s.	**
S psu	20.60±2.10	19.00 (Apr)	25.00(Sep)	24.20±5.98	15.00 (Apr)	31.00(Sep)	*	n.s
O %	92.26±13.31	73.39 (Sept)	111.63 (Apr)	87.79±13.31	67.87 (Sept)	112.24 (Jun)	n.s.	n.s.
TSM mg/l	18.98±5.70	7.20 (Jan)	30.10 (Jul)	31.24±31.10	15.50 (Jan)	127.20 (Nov)	n.s.	n.s.
ISM mg/l	15.10±4.90	6.00 (Jan)	2.29 (Jul)	24.70±0.27	1.10 (Jan)	10.84 (Nov)	n.s.	n.s.
OSM mg/l	3.90±1.90	3.00 (Nov)	7.70(Jul)	6.50±7.80	1.10 (May)	38.8 (Jan)	n.s.	n.s.
Chl-a mg·m <sup>-3</sup>	4.31±6.52	0.13 (Sep)	24.93 (Jul)	2.61±2.06	0.24 (May)	8.85 (Sep)	n.s.	n.s.
NOx μM	18.42±11.92	0.31(Jul)	39.26 (Dec)	17.20±10.89	0.42 (Jul)	32.26 (Dec)	n.s	***
NH <sub>4</sub> μM	1.65±1.88	0.14(Jul)	6.80 (Sep)	2.91±1.90	0.37(Mar)	6.92 (May)	**	*



## DISCUSSION

The growth times of oyster in Varano lagoon at site LA were estimated after 7 months, when a commercial size (> 6cm) is reached and the best economic index is occurred. By contrast, the best condition indices were found in May, with a low Polidora index. At site FO, affected by a wider variation in salinity, market size of oysters is reached in September, with lower condition indices and higher percentage of Polidora index than those observed at site LA.

During the observation period from March to September, the mud blister worm presence (*Polydora ciliata*) was recorded in June/July, representing a real problem for the oysters' market value and posing a serious financial loss for the company.

The condition indices have shown that a longer rearing period does not correspond to an increase of product quality. The fullness and the economic quality of higher oysters were observed only after seven months, at site LA, when the *Polydora ciliata* starts affecting negatively the oysters farming.

Our results emphasize the potential economic benefits associated with the sustainable development of aquaculture in the lagoon and its relative diversification. In the Varano lagoon there are sites not subjected to rapid changes in environmental parameters, suitable for the development of breeding oyster. Based on our findings, it is possible to anticipate the sowing period of a few months (September) in order to have larger oysters with high quality and to avoid the most critical periods for the infestation Polydora.

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