

## Evolution of Shellfish Breeding in Varano Lagoon

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**Özet:** *Varano Dalyanında Kabuklu Yetiştiriciliğinin Gelişimi.* Güney İtalya'nın Puglia bölgesinde yer alan Varano Dalyanı 6500 ha. yüzey alanı ve ortalama 5m derinliği ile kabuklu yetiştiriciliği bakımından bölge ekonomisine önemli katkılar sağlamaktadır. Çevre yerleşim birimlerinde yaşayan halkın geçim kaynağını oluşturan dalyanda yaklaşık 40 yıldır geleneksel yöntemlerle midye yetiştiriciliği yapılmaktadır. Bu yetiştiricilik, "Bahçe" adı verilen dalyan içindeki özel bölgelerde, ağ torbalar içinde bulunan propilen borulara yerleştirilen midyelerin, sırtıklar arasına gerilmiş iplerden sarkıtılması şeklinde yapılmaktadır. Dalyanlarda yapılan midye üretiminin başlıca sorunları ilkbahar dönemlerinde hızlı çoğalan fouling organizmalar, kirlenme riski olan bölgelerdeki midyelerde zehirlenme ve insan sağlığına zararlı maddeler taşımasıdır. Bunu önlemek amacıyla midye üreticileri açık deniz yetiştiriciliğine geçmektedirler. Açık denizde yetiştirilen midyeler et kalitesi ve lezzet yönünden daha üstün olsalar da üretim maliyeti yönünden ancak kooperatifleşebilmiş işletmelerin yapabileceği bir üretim yöntemidir. Dalyanlarda yapılan üretimin çevre halkının ekonomik düzeyine getirdiği yararlar ve sağladığı iş imkanları gözardı edilemez. İtalya' da midye yetiştiriciliği kendi kendine yeter duruma ulaşmıştır bundan sonra yapılması gereken daha kaliteli ürünleri daha uygun fiyatlarla tüketiciye sunabilmektir.

**Anahtar kelimeler:** Midye üretimi, Midye ağ torbaları, İpte yetiştiricilik, Dalyan, Kirlilik

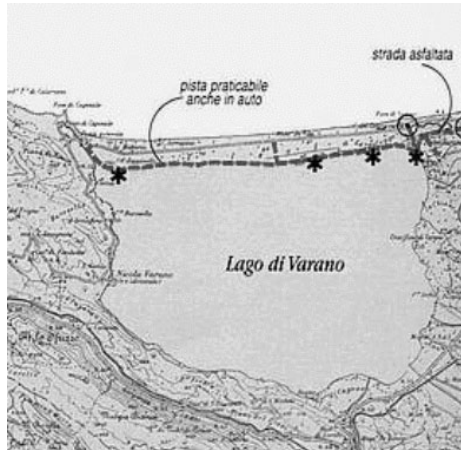
**Abstract:** The mussel culture in Varano Lagoon that has 6500 ha surface area and average 5m. depth, has economical importance for the near villages. The mussel culture has been made for 40 years by traditional methods. This method consists of mussel production in "Garden". The mussels used to be put in propylene pipes and these pipes placed into net bags. These net bags attached to the long-lines inside the gardens. The major problems of mussel culture in lagoons are fouling organisms in spring, heavy metal accumulation in polluted lagoons and transfer of such pollution to human by food chain. Mussel breeders are moving their hatcheries to open sea in order to prevent such problems. Although the better flavour and meat quality of the produced mussel, the production in open sea have higher expenses. The collaborated breeders would be able to make production in open sea. The mussel production in lagoons improves economic level of villages and offers occupation for the inhabitants. The mollusc culture has reached the level of self-sufficiency in Italy. The future studies have to be made to improve quality of the product to supply it with better prizes, quality and certification to the market.

**Key words:** Shellfish culture, Mussel net bags, Long-line culture, Lagoon, Pollution

### Introduction

Around 850 km considerable extensions of the Apulian coasts and the environmental characteristic of some biotopes, offer suitable

environmental sites for bivalve breeding. Varano Lagoon is an example with its 6500 hectares surface area and average 5m. depth (De Angelis, 1953) (Fig 1).



**Fig 1.** Lagoon of Varano, South of Italy.

In whole Italian peninsula, there is a considerable diffusion of shellfish breeding (Naples, Gaeta, Venice, Trieste, Taranto, Scardovari bay, Caleri, Grado and Marano Lagoons, Muggia, Grignano and Sistiana bays etc.) also it is possible to consider that, at least 50% of the shellfish is being produced in the Venetian Lagoon. In Puglia, shellfish breeding is being practised in the Varano Lagoon for forty years as a tradition. It is the second massive production area after Taranto. However, commercial shellfish sector is facing a crisis due to a series of problems in last years. One of most remarkable problem is caused by an excessive offer of the product into all national territory for some years. Second is due to the scarce diversification of the product. The processing of mussels would be beneficial in order to avoid decreased marketing prices. Also, this situation can offer some extra occupation opportunity for the workers of food manufacturing sector. The total loss of production would be possible due to the typical dystrophic character of the lagoon waters. Such condition forces breeders to sell mature mussels with

lower prices. Fishermen of the Varano have being reacted to this special situation by moving the hatcheries into the sea since 1995, in order to avoid the dangers caused by dystrophic and adverse environmental conditions those compromise entirely their income (Breber and Sirocco 1998). Since many years, the mussels price has stabilized around 0.5165 € \ Kg, while the price of the raw materials, like nets, fuel and manpower suffer from the considerable increases. Until 1995, mussel breeding in Varano lagoon has being made by traditional methods, adopted by Taranto fishermen. This consists of the constitution of so-called "gardens".

#### **Materials and Methods**

The structure of mussel breeding system consists couples of crossed chestnut poles. Series of poles were usually fixed on the backdrop of lagoon, which were connected by ropes with each other. Mussel net bags are being attached to these rope lines for production. Mussel breeding operation begins with the collecting of seed or mussels, which are around 1-1,5 cm. of length, approximately. The suitable period for this operation is usually month September. In the previous years, seeds were naturally being collected from other lagoons according to the traditional methods. Unfortunately, this method causes some unfavourable biological phenomenon. Thus, the seed are usually supplied from the local breeders, who are collecting seeds from the natural reefs of the sea by landing nets that have scraper knives mounted in front of them. These nets are collecting mussels by scraping the walls of reefs. Once the mussels are collected, they are being transferred to the "gardens" located in lagoons.

Subsequently, the operation of

“stocking mussels into net” has being processed. Seeds are being placed inside of a propylene pipes that are wrapped by a net. Normally, the length of net is 1.60m and its diameter varies according to the diameter of propylene pipe. As a rule, this size has to be selected in order to easily allow mussels growth (Table 1).

After the mussels had placed into net bags, they used to be attached to the longitudinal lines and suspended into the water. These nets have to be renewed when the mussels grow. The net bag has to be cut with a knife and the propylene pipe filled with mussels has to be placed into another net bag of a larger size for the replacement. When the mussels find enough space for growth, the growth rate will increase. This operation is also essential for smaller mussels to reach uniform size as others.

**Table 1.** Diameter net bag suitable for the diameter of propylene pipe in mussel culture.

Diameter of net bag (mm)	Diameter of propylene pipe (mm)
18	30-40
18	40-50
21	60-100
23	100-120
26	120
28	120
32	150

Usually, the propylene pipe with a diameter of 50 mm is needed for the initial stage of breeding. In the second stage the propylene pipe with 100-110 m diameter has needed.

At the beginning of spring season, fouling organisms usually cover the mesh of net bags due to the increasing water temperature. In such situations, the net bags have to be aerated well under the sunshine in order to destroy fouling organisms. This periodic operation is fundamental for the growth of mussels.

Such organisms would prevent the normal filter feeding mechanism of the mussels and so as its growth.

In spring season the egg deposition phase also starts for the mussels (this called as “feta” among Varano breeders). In this phase the mussel net bags should not handled. The egg deposition process usually weakens the mussel’s immune mechanism. So mussels would not stand healthy during net bag cleaning or replacement in such periods.

In lagoon hatcheries, breeders require approximately 15-20 horsepower boats for the management. The mussels would reach ten times of their initial length in eight months. Also, this size would accept as commercial size. This growth rate varies with the availability of planktonic organisms. The success of production would increase by the increase of phytoplanktons in lagoons (Alpbaz, 1993). Therefore, in preventive breeding conditions like lagoon hatcheries, the breeders have to supply seeds at amount of 1/10 of scheduled marketable production into the hatchery site for a continuous production.

When the breeding operated in the open sea environment, the cost of management becomes more expensive than the lagoon environment. Requirement for large-scale boats in order to transfer materials to production site would increase the expenses. Due to the more energetic character of sea coastal than lagoon surface, the usage of powerboats with various horsepower is essential. In fact, the entrepreneurs had understood the importance of co-operation in such category of profession. The renewed system of breeding has borrowed from the North Adriatic breeders. The example for this system is utilized by shellfish breeders in Trieste Bay (Bussani, 1983). The scheme of breeding in open sea foresees the system of floating cans, separated by ropes on

which mussel nets were attached. The system can be subject to the swells and therefore it has needed to fix concrete anchors on the seabed. Nevertheless, this system seems to be more expensive for the breeders but on the other side a better and more organic product can be produced. In fact, the mussels derived from the lagoon of Varano have fewer savouries than the ones from the sea (Pelosi and Franchi, 1999).

### Results

The series of analyses related to the chemical composition and the microbiology of mussel's meat have revealed that those raised in the adjacent

locations of Varano coasts are qualitatively better than the ones derived from the lagoon. The mussels would store transferable toxic substances to the human body in virtue of the food chain (Volterra L. And Bonadonna L.,1986)

Undoubtedly, the most important criteria to determine the level of contamination in mussels are the polluting substances in meat and particularly heavy metals (Bisio and Chestnut, 1990), aromatic polycyclic hydrocarbons and pesticides. Some series of analyses on samples of mussels from Varano Lagoon had revealed that lead, mercury and cadmium concentrations are below the levels that found in other mussel production areas of Italy (Table 2).

**Table 2.** Concentrations of heavy metals in meats of *Mytilus galloprovincialis* in mussel culture locations of Italy.

Location	Lead	Cadmium	Mercury	Reference
Laguna S. Gilla	(**)38	3	0.87	Arru et al.(1979)
Portovenere	(*)0.8 - 0.7	0.090-0.120	0.079-0.150	Ademollo et al.1980
Trieste	(*)1.1-1.837	0.150-0.553	0.040-0.150	Crisetig et al.1984
Venezia	(*)0.83-1.526	0.255-0.525	0.030-0.076	Crisetig et al.1984
Scardovari	(*)0.477-0.776	0.280-0.312	0.017-0.034	Crisetig et al.1984
Vieste	(*)1.240	0.246	0.028	Crisetig et al.1984
S.Giulia	1.32-2.03	0.459-0.555	-	Crisetig et al.1984
Laguna Varano	0.497	0.023	0.009	Ins.Zoo.Prof. 1992
Olbia	< 0.05	0.17	<0.05	Ioseffini M.1992
Laguna di Marano	n.d.	0.10	<0.05	Ioseffini M.1992
Alberoni	1.31	0.10	<0.05	Ioseffini M.1992
Gabicce	0.505-1.325	0.158-0.266	0.116-0.02	Crisetig et al.1984

\* ppm in fresh tissue; \*\* ppm in dry tissue

It is possible to assume that moving mussel hatcheries to the open sea would increase the quality of mussel meats. Thus, the lagoon waters are mostly subject to an antropic contamination of toxic hydrocarbons (Pelosi and Franchi, 2000). However, during Dinoflagellate alga's flowering periods the filter feeding mussels in lagoon waters would contain harmful toxins for the human beings (Caroppo, 1999). Less fouling

accumulation on mussels' net segment is another advantage for the breeders that allocated their hatcheries in open seas.

### Discussion and Conclusion

One of the ecological advantages for mussel breeding in the Varano Lagoon is reduction of individual per unit volume of production area. It has been known that the excessive concentration in breeding

results as the reduced growth rate and thin meat structure due to the shortage of algae for nutrition.

The mollusc culture has always been an economic demand in the Lagoon of Varano (Breber, 1982). The first attempts for mussel culture had been affected from the studies of Institute for Biological Exploitations of the Lagoon –C.N.R. located in Lesina (Blundo et al.,1972)

These attempts were not satisfied the breeders in reduction even if they got good results in technical and economic point of view. The first attempts included the introduction of *Modiolus barbatus* (hairy mussel), *Clamys opercularis* and *Venus verrucosa* into the Lagoon of Varano. The *Modiolus barbatus* doesn't have practically made any growth record; the animals have not died but they have maintained the conditions of metabolic homeostasis. The *Clamys opercularis*, have made good growth indexes in production period but followed by total mortality of adults. Also, in North Adriatic the attempts for introduction of this species have made good records except some failures owed to difficult manipulation of this species. *Venus verrucosa* had suffered from the meteorological adversities in the time of study that were affecting the dispersion of seeds into the lagoon area.

Nowadays, the production of mussels has reached self-sufficiency in Italy. The mussel production had increased to 65.000 tonnes in Italy (Fishstat, 2000). The future studies have to be made to improve quality of the product to supply it with better prizes, quality and certification to the market (Pelosi et al.,2000)

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