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MARICULTURE ON CROATIAN ISLANDS

G. Šarušić

Summary

The first attempts of intensive mariculture in Croatia commenced at the very beginning of 1980's. The mid–eighties brought an expansion of mariculture production, which has been continuously increasing. A few different marine organisms are intensively cultured — both fish and shellfish. Among them commercially most important and highly valued species are sea bass *Dicentrarchus labrax* and sea bream *Sparus aurata*. Mussel *Mytilus galloprovincialis* and oyster *Ostrea edulis* are the most important shellfish. Fish species such as dentex *Dentex dentex*, red sea bream *Pagrus major* and sheepshead bream *Puntazzo puntazzo* are reared too, but in a rather small quantities. Only recently the rearing, on–growing— of bluefin tuna *Thunnus thynnus* started in Croatia. The juveniles (70%) are reared in a Croatian hatcheries, and 30% has to be imported mainly from Italy and France, due to a higher demand for this kind of culture among the small growers.

Croatian part of Adriatic sea possesses a number of geomorfologicaly suitable sites and meteorological conditions which determined the choice — type — of intensive culture. All fish species are reared in a floating cages. The choice of cages i. e. semi off–shore or floating frames, size, rearing volume and design depend on the investors personal preference. The annual turnouf of a market size bass was about 600t and 300t bream in 1996., by 10 island farms which is 70% of total production in Croatia. Including other cultured fish species last year production was up to 1000t, and it's being estimated to be about 1300t in the following year. The shellfish production on the islands is usually individual attempt of farmers, producing minor quantities mostly in polyculture. This production has bigger potential but it's limited owing to the EU quality control regulations which do not allow the export, and by domestic market which has drastically decreased due to the collapse of tourism during the recent war.

Almost 80% of consumption fish is exported to Italy and bluefin tuna to Japan exclusively. It's expected that demand for mariculture products, fish and

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shellfish, will increase on domestic market. These expectations are based on a possibility of new local investments and a market perspectives on account of tourism revival which seems to be the most important for the small island producers. The reasons for having implemented farms on islands are unexploited good environmental conditions, less risk from the coastal and industrial pollution, less users conflicts and less comptetition for locations and concessions. Island mariculture is a part of political or socio–demografic orientation of the government, but regarding producers this option is voluntary.

Key words: mariculture, Croatian islands, fish and shellfish production, hatchery, cage fish farms, marketing

INTRODUCTION

The first attempts of intensive mariculture in Croatia were at the very beginning of 1980's. Sea bass *Dicentrarchus labrax* was the first cultured species reared from the imported fingerlings (Filić, 1978; Filić and Pojed, 1981; Vodopija and Miljak, 1981). The expansion in mariculture activities commenced during the mind–eighties. Production of fingerlings in domestic hatcheries, first sea bass and soon after the other species, initiated the industrial way of marine aquaculture in Croatia. Fish species such as red sea bream *Pagrus major*, sheepshead bream *Puntazzo puntazzo* and dentex *Dentex dentex* are produced and reared, but in a rather small quantity. Only recently the rearing — fattening od bluefin tuna *Thunnus thynnus* started in Croatia. However, commercially the most important and dominant species are sea bass and sea bream *Sparus aurata* Mussel *Mytilus galloprovincialis* and oyster *Ostrea edulis* are the most important reared shellfish. There are more than 1100 islands, islets, cliffs and reefs in the Adriatic sea. Less than one hundred islands are inhabited. Only 17 bigger islands are populated by 1000 up to 17.000 inhabitants. The remaining part of the islands is underpopulated, namely only among 100 to 300 inhabitants are domiciled permanently. Entirely about 127.000 inhabitants live on the islands that makes 2.6% of total population in Croatia (Magaš D., pers. comm.).

The Adriatic sea as well as Mediterranean sea is considered to be an oligotrophic sea. The Adriatic sea belongs to the moderate warm sea. Sea temperatures are modest, and during the winter the range is between 10–13 °C, while summer range is between 22 and 26 °C. Winds are rarely tempestous, prevailing during winter months. In general, meteorological and climatological conditions are not severe. Hydrological characteristics such as transparency, colour, streams, waves, salinity, oxygen etc., are convenient and in favour of intensive fish rearing. Sea depth in the island coastal zone varies between 3 and 30 m (Peres and Brida Gamulin, 1973.).

FRY PRODUCTION

Sea bass and bream as well as other cultured species (excluding bluefin tuna) are reared in a hatchery. Technology applied respects maximum control under conditions of intensive breeding activities. There are 4 hatcheries in Croatia, one on island and three of them are placed on the mainland. Annual production is about 5 mil. fingerlings, and this quantity has been almost standard over the past decade. At this point of production capacity in Croatia, this amount of fingerlings makes about 70% of requirements. Large enterprises have encircled culturing process, including reproduction up to marketable fish, and their production essentially satisfies breeding capacity.

Since number of fish farms has remarkable increased in past few years and breeding potentiality consecutively, among small growers, in the first place, the lack of juveniles from domestic hatcheries affects mainly the smaller producers, who are forced to import fry. Bass and bream fry are imported mainly from Italy and France. However, sea bass remains the dominant cultivated fish species and makes almost 70% of all intensively reared fish. During spring and summer months the juveniles are delivered to the ongrowning facilities weighing approximately 1–3 g. For this purpose using the transportation tanks and by way of boats or ferry–boats the juveniles are transferred to the farm facilities.

MARINE FISH FARMS IN CROATIA

In the year 1996. there were entirely 25 fish farms in Croatia. Ten of them are placed along the mainland coastline. On 13 islands there are 15 farms operating. One of them is ongrowing bluefin tuna, the others are bass and bream producers. The majority of farms are small enterprises, private investments, running family business, with annual production capacity of about 100 tonnes. But there are three large farms with the production capacity of over 300t per year. In spite of production capacity, last years productivity was between 20 and 80 t for small enterprises, and 150–400 of bigger ones.

Characteristics of the coast and islands determined the type of rearing. All the fish species in Croatia are intensively cultured in a floating cage. Geographical conditions give the opportunity of rearing site dispersivity. The coast and the islands possess numerous sheltered bays or locations well protected from severe winds and waves. The breeding sites are close to the island village or close to the island itself. Such locations are most preferred rearing sites. The priority in site selection by the small scale producers, is attached to the home vicinity since most of them are island residential. Breeding plants include land based facilities: food and net storage and equipment essential for farming activities. The lack of infrastructure such as

electric power, water supply or traffic connection doesn't seem to be an essential requirement in site selection.

Deciding upon the rearing sites, the request is focused on hydrografic, chemical and microbiological parameters and they are included in monitoring concerning applications for fish farm license. Maritime traffic isolation adequate distance from the existing or planned touristic capacities and destinations, is respected by the farmers as well by the authorities responsible for the concessions. Mistakes in rearing site selection may endanger fish production, in ecological point of view also, and distroy the image of mariculture. According to the present trends in rearing site selection, in–shore locations and cages constructed as square frames in form, made of galvanized tubes or polyethilene and placed on polystyrene buoys with the polyamid nets suspended down into the water column are in the most common use. Number of cages are linked into multiple units. The units are anchored in a shore vicinity on a sea depth of minimum 12m. Lighter mooring system is applied which alows certain minor dislocation of the cage unit if necessary. They are easily accessible from the shore by a light boat on a daily basis to assure the routine maintenance regarding the procedure in operating the farm.

For the initial breeding period, the cages of smaller volume capacity of dimensions 5x5 or raceway type 5x10m are used. For the ongrowing period the most standard cage size is 10x10m, with a holding capacity of 5–8 tonnes. In–shore type of cages are used in a both, mainland and island farms. Verified and established technology, availability at the domestic market are undoubted reasons for application of in–shore cages. Actually 90% of farmers are using this type of cages. Off–shore cages are used by a small number of producers so far. This type of cages are imported, more sofisticated technological approach which makes them insufficiently present in mariculture production in Croatia. The variety of dimensions could be used, from 6m up to 50m in diameter. Most often the cage dimensions of 12 or 16m are used, with holding capacity from 25 to 35t respectively. The cultivating period in floating cages is about 22 months for sea bass, and 15 months for sea bream, for the market size fish of approximately 350gr.

The breeding of bluefin tuna which recently started in Croatia, begins during the summer months and depends on a catch and size of captured individuals. They are kept in a off–shore cages of a holding capacity of about 100t, and fattened for about 8–9 months, which is actually the breeding period.

The annual turnout of a market size bass in the year 1996, was about 600t and 300t bream, from island farms. Including other cultured fish species: red sea bream, sheepshead bream, bluefin tuna, the last year production was up to 1000 t. This production is achieved by 10 island farms (Fig. 1). The fish production from the island farms made 60% of total production in Croatia (Fig. 2).

Mussels and oysters are grown on vertical structure suspended from floating long lines on the sea surface. Naturally produced spat is collected for

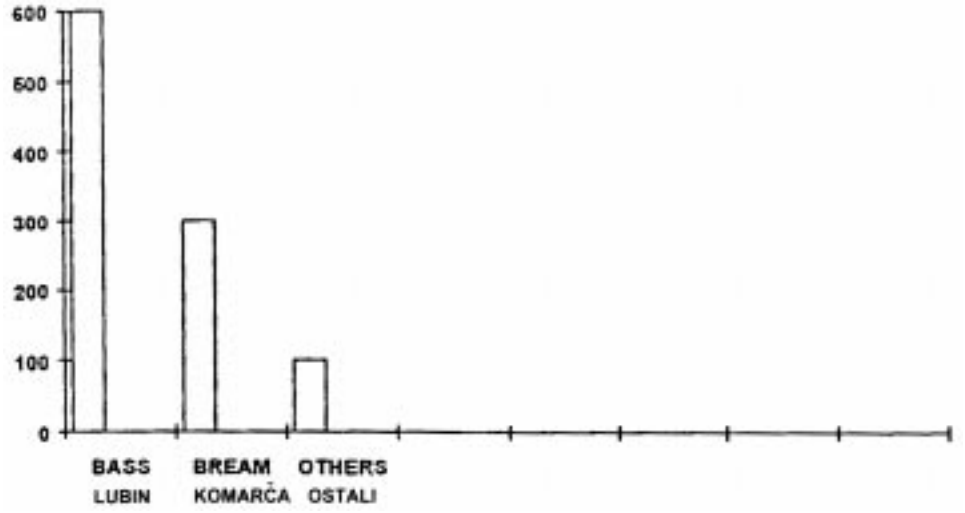

Figure 1 Annual turnout of market size fish achieved by 10 island farms in 1996 (tonnes)

Slika 1. Godišnja prodaja konzumne ribe s 10 otočnih farmi u godini 1996. (tona)

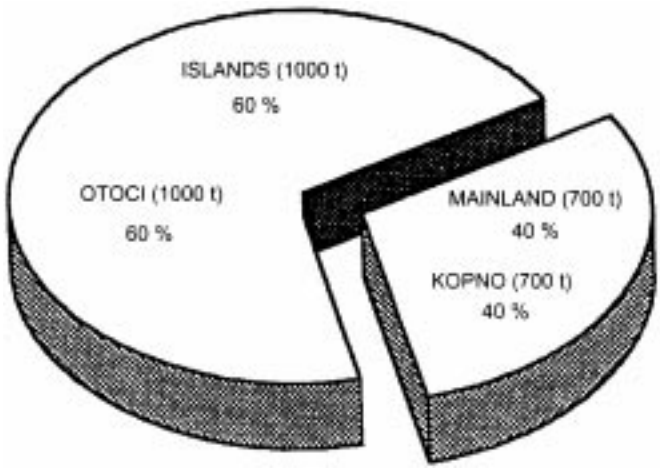

Figure 2 Proportion of total marine fish production (1700 t) between island and mainland farms in Croatia in 1996

Slika 2. Udio od ukupne proizvodnje morskih riba (1700 t) na otocima i kopnu u Hrvatskoj godine 1996.

the production. The shellfish farms are based mostly on the mainland coastline. At the present there are 100 producers of mussels and oysters. The annual production is 900 t of mussels and 100 t of oysters — equal to 700.000 pieces. The entire production can be attributed to the mainland farms. Namely, there are only 10 shellfish farmers on the islands. It is usually an individual attempt of fish farmers producing minor quantities of mussels in polyculture. The main obstacle for shellfish island farming is oligotroficasy of the Adriatic as well as conditions of a higher salinity then required (Katavić, 1996).

MARKETING

Almost 80% of consumption fish are exported to Italy and bluefin tuna to Japan exclusively. The mariculture industry in Croatia is facing with 15% of import taxes that is charged on the fish entering European market. Croatian suppliers are forced to reduce prices by the same amount to remain competitive (Katavić, 1996). Home market seems to be more profitable but it is of a limited capacity. It's expected that demand for mariculture products— fish and shellfish will increase on domestic market. These expectations are based on a market perspective on account of tourism revival that seems to be the most important for the small island growers in particulary.

Outside the domestic market export to Europe is immediate target for most of biggerr producers. The shellfish production has a bigger potential but it is limited owing to the EU quality control regulations which do not allow the export even though requested monitoring carried out shows no danger of plankton organisms. Limitations on domestic market due to the collapse of tourism during the recent war drastically affected shellfish production.

REASONS FOR HAVING IMPLEMENTED FARMS ON ISLANDS

The potentials of the islands were not evaluated, which is the reason of demografic and economic decline. Most of the islands are practically perspectivless being abandoned, underpopulated, undeveloped and isolated for a long period of time. Only small industrial capacities are planned in the future, along the mainland coastline and the islands. Unpolluted and unexploited environmental condition, abundance of adequate sites in the domicile vicinity of the farmers, if small scale producers are concerened, fewer users conflicts and less competition for locations and concessions are obviously the most important advantages for island mariculture.

Most important disadvantages regarding island mariculture such as traffic isolation and lack or poor infrastructure doesn't seem to be constrain, from the point of farmers view. Uncompetition by touristic and industrial intentions

of the country are factors in favour for mariculture productivity expansion in the near future. Moreover, perspective off–shore rearing techniques and exposed locations, evidently open access to rearing site diversity as well as to production capacities.

Revival of the islands is a part of political and socio–demografic orientation of the government. But regarding the producers this option is voluntary. A number of licencess granted for marine aquaculture. Aquaculture has a minimum environmental impact, especially if well sited and managed. New governmental incentives towards islands is expected to contribute to mariculture industry in particularly. Namely incentives for sea bass and bream will be 2 DM/kg for fish produced on the island farms, and 1.5 DM/kg for a farms located along coastline. The lack of bank loan lines, or unrealistically expensive existing ones in many ways obstructs investments. Small scale farms suffer lack of capital, adapted and insufficient equimpment, lack of work force (which affects island farms in particularly) and trained personnel. Obviously, the lack of capital on a long term basis could result in inadequate and insufficient equipment and application of new technologies essential for expansion and productivity of entire mariculture industry. Certain foreing interest for mariculture in Croatia is shown by Italians, French, and Japanese investors. Some activities regarding shareholding and joint–venture have been already actualized.

Sažetak

MARIKULTURA NA HRVATSKIM OTOCIMA

G. Šarušić*

Prvi intenzivniji pokušaji proizvodnje marikulture u Hrvatskoj počeli su početkom 1980–ih godina. Sredinom osamdesetih dolazi do širenja i razvijanja marikulture, sa stalnom tendencijom rasta. Intezivno se uzgaja nekoliko vrsta riba i školjaka. Od riba komercijalno su najvažnije i vrlo cijenjene lubin *Dicentrarchus labrax* i orada (podlanica) *Sparus aurata*, a od školjaka su najvažnije dagnja *Mytilus galloprovincialis* i kamenica *Ostrea edulis*. Također se, iako u malim količinama, uzgajaju zubatac *Dentex dentex*, japanski pagar *Pagrus major* i pic *Puntazzo puntazzo*. Nedavno se započelo s uzgojem tune *Thunnus thynnus*. Riblji mlađ uzgojen u hrvatskim mrjestilištima pokriva 70% domaćih potreba, dok se zbog veće potražnje mlađa poglavito malih uzgajivača, 30% uvozi uglavnom iz Italije i Francuske. Na hrvatskoj strani Jadranskog mora postoje brojni predjeli čije su geomorfološke i meteorološke značajke odredile način ove vrste intenzivnog uzgoja. Sve se riblje vrste uzgajaju u plutajućim kavezima. Izbor kaveza, odnosno tzv. polupučinski kavezi ili kavezi pogodniji za zaštićenije uvale, veličina, uzgojni volumen i konstrukcija ovise o ulagačevu osobnom izboru. Godišnja proizvodnja 1996. ostvarena u 10 uzga-

jališta smještenih na otocima iznosila je oko 600 t konzumnog lubina i 300 t podlanice, što čini 70% ukupne proizvodnje u Hrvatskoj. Uključujući i druge uzgojne vrste, prošlogodinja je proizvodnja iznosila do 1 000 t, a predviđa se da bi mogla iznositi oko 1 300 t u sljedećoj godini. Proizvodnja školjaka na otocima obično je osobni pokušaj uzgajivača, koji proizvode manje količine, i to uglavnom u polikulturi. Ovakva proizvodnja ima veće mogućnosti, ali je dijelom ograničena zakonima o kvaliteti kontrole EZ–a, po kojima izvoz školjaka nije dopušten, a dijelom i situacijom na domaćem tržištu koje je znatno smanjeno zbog kolapsa turizma u vrijeme nedavnog rata. Gotovo 80% konzumne ribe izvozi se u Italiju, a tuna se isključivo izvozi u Japan. Očekuje se da će zahtjevi za morskim proizvodima, ribama i školjkama, porasti na domaćem tržištu. Ova se očekivanja temelje na mogućnostima novih ulaganja, kao i na tržišnim perspektivama ponovno oživjelog turizma koji je, čini se, od osobite važnosti upravo za male otočne uzgajivače. Neiskorišteni dobri uzgojni uvjeti, mali rizik od obalnih i industrijskih onečišćivača, manje vlasničkih nesporazuma, manja konkurencija za lokacije i koncesije razlozi su otvaranja farmi na otocima. Razvoj marikulture na otocima dio je i političke ili socio–demografske orijentacije vlade, ali iskorištavanja ovih mogućnosti ovise o odabiru proizvođača.

Ključne riječi: marikultura, hrvatski otoci, proizvodnja ribe i školjaka, mrjestilište, uzgajalište, marketing

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