

**MARICULTURE DEVELOPMENTS AND USE CONFLICTS
IN THE COASTAL ZONE OF REPUBLIC SLOVENIA
RAZVOJ MARIKULTURE I KONFLIKTI U OBALNOM PODRUČJU
REPUBLIKE SLOVENIJE**

UDK 574.5'2636(262)(497.12)
Conference paper
Izlaganje sa stručnog skupa

Summary

This paper describes basic characteristics of the marine environment and use conflicts in the coastal zone of R Slovenia. Despite its limited size the coastal area has rather an important role for the country's economy providing access to the Mediterranean Sea and possibilities for development of different maritime and shore-based activities. Gross domestic product per inhabitant in the coastal region exceeds the Slovenian average, however, the economic importance of fishing and mariculture is small: its share of total value added in Slovenia was less than 0.2 % in 2000. Due to limited space either onshore or in coastal waters aquaculture in Slovenia has to compete with other users, especially tourism and maritime transportation. While being sensitive to environmental problems aquaculture itself may have a negative impact on the marine environment due to pollution with inorganic and organic nutrients, with potentially toxic chemicals and through spread of disease.

Keywords: mariculture, coastal zone management, Gulf of Trieste, Slovenia

Sažetak

U ovom se članku opisuju osobitosti morskog okoliša i konflikti u obalnom području Republike Slovenije.

Unatoč ograničenoj površini, ovo obalno područje ima važnu ulogu u gospodarstvu, omogućujući Sloveniji pristup Sredozemnom moru i razvoj različitih pomorskih i priobalnih aktivnosti. Bruto

nacionalni dohodak po stanovniku u obalnom području premašuje slovenski prosjek. Međutim, gospodarska važnost ribarstva i marikulture je mala: udio u ukupnom dohodku Slovenije bio je manji od 0.2 % u 2000. godini.

Zahvaljujući ograničenom priobalnom i vanjskom morskom prostoru, Slovenija se mora natjecati s ostalim zemljama, posebice u turizmu i pomorskom transportu. Imajući na umu osjetljivost na probleme okoliša, sama akvakultura može imati negativan utjecaj zbog onečišćenja organskim i anorganskim nutrijentima, potencijalno toksičnim kemikalijama kao i zbog širenja bolesti.

Ključne riječi: marikultura, obalni menadžment, Tršćanski zaljev, Slovenija

Background

Pozadina

The Gulf of Trieste, of which the south-eastern part belongs to Slovenia, is located at the northernmost extension of the Adriatic Sea (Fig. 1).

This shallow (max depths < 30 m) semi-enclosed marine basin (surface about 600 km², volume 9.5 km³) is strongly influenced by freshwater discharges mainly from its north-western coast. Mean river water input to the gulf has been estimated to vary between 2.4 to 3.4 x 10⁹ tons per year giving an average volume specific discharge (freshwater entering the gulf vs. volume of the gulf) nearly 3 times higher than the northern Adriatic as a whole. Gulf's waters are also characterized by large temperature variations (6-26 °C).

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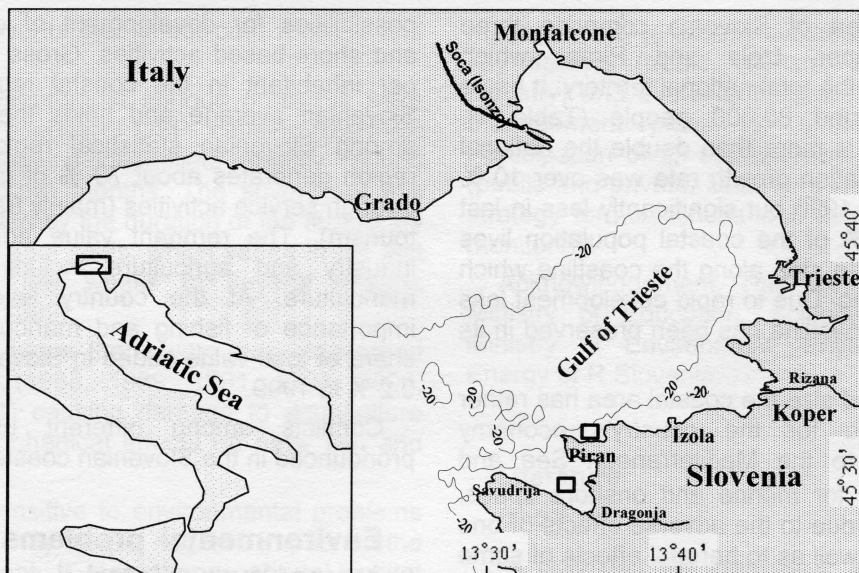


Figure 1. Sketch of the Gulf of Trieste, its bathymetry and locations of two areas dedicated to mariculture.

Slika 1. Tršćanski zaljev - batimetrija i smještaj područja za marikulturu

Table 1. Surface and population of the three coastal municipalities. Data from Statistical Office of R Slovenia - Statistical Yearbook 2000.

*Tablica 1. Površina i broj stanovnika triju priobalnih općina
Podaci iz Statističkog ureda Republike Slovenije- Statistički godišnjak 2000.*

	Area (km ²)	Population (permanent)	Population served by municipal sewer system (%)	Seasonal population increase during 3 summer months (%)
Koper	311.2	48 251	57	5.4
Izola	28.6	14 590	80	16.6
Piran	44.4	17 440	86	81.4

Table 2. Number of moorings in yachting harbours Data from Statistical Office of R Slovenia - Statistical Yearbook 1999

Tablica 2. Broj vezivanja u nautičkim lučicama Podaci iz Statističkog ureda Republike Slovenije - Statistički godišnjak 1999.

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
No.mo	898	898	969	1061	1065	1338	1238	1618	1618	1619

Table 3. Total marine fish catch (in tonnes), % cultured (seabass and seabream), mussel production (vast majority cultured) in the period 1991-1999.

Data from Statistical Office of R Slovenia - Statistical Yearbook, 2000

Tablica 3. Ukupni ulov morske ribe (u tonama), % uzgojene ribe (lubini i orade), proizvodnja dagnji (velika većina uzgojena) u razdoblju od 1999-2000.

Podaci iz Statističkog ureda Republike Slovenije- Statistički godišnjak 2000.

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Fish (total)	5,012	3,768	2,052	2,110	1,911	2,203	2,192	1,959	1,820
% cultured	< 0.1	0.3	0.9	3.6	2.6	3.4	4.1	5.2	5.6
Muss. (tot)	65.3	140.1	42.7	27.5	12.7	50.3	36.6	44	37.1

The coastal area of Slovenia comprise three municipalities (Koper, Izola and Piran) which represent < 2 % of the total national territory. It has a population of around 80,000 people (Table 1). Population density is more than double the national average; the population growth rate was over 10 % in the period 1980-1990 but significantly less in last decade. Over 80 % of the coastal population lives within a 1,5 km wide strip along the coastline which is 46 kilometres long. Due to rapid development less than 20 % of the coastline has been preserved in its natural state.

Despite its limited size the coastal area has rather an important role for the country's economy providing access to the Mediterranean Sea and strong competition for marine and onshore space, conflicts also exist due to the adverse effects of one use on another as well as to harmful effects of some uses on the ecosystem. The principal coastal and marine activities/uses in Slovenia include: navigation and communication (shipping, port development, recreational motor boating), tourism and recreation (hotels, tourism infrastructure, swimming, diving, recreational fishing, sailing, rowing and surfing), coastal infrastructure development (roads, water supply, reclamation and/or alteration of coastal waters/lagoons). Waste disposal and pollution (sewage and industrial waste waters, dumping of dredged material, nonpoint sources of pollution such as runoff, river sedimentation), fishing and aquaculture, and protection of marine and coastal environment (protected areas) are of major concern.

Development of aquaculture in Slovenia and the present situation

Razvoj akvakulture u Sloveniji i sadašnja situacija

Aquaculture was introduced in Slovenia in the early 70-ties with rafts for culturing mussels (*Mytilus galloprovincialis*) in the bays of Piran and Strunjan. Annual production peaked to over 300 tonnes in the late 80-ties, with the majority exported to neighbouring Italy. Afterwards production of mussels decreased due to saturation of the market and some environmental problems, and in the last decade varied between less than 13 tonnes in 1995 and about 140 tonnes in 1992 (Table 3).

Since the early 90-ties production of two fish (seabass, *Dicentrarchus labrax*, and seabream, *Sparus auratus*) has been established in fish cages at two farms in the Bay of Piran. Initial production was rather low but stabilised at around 120 tonnes per year after 1995. While in the early 90-ties quantity of cultured fish represented less than 0.1 % of total fish production in Slovenia, its contribution to the total increased steadily afterwards (Table 3). However, one of the reasons for this increase was a marked reduction of the catch of wild fish. Most recently experiments for culturing flat fish are being carried out.

possibilities for development of different maritime and shore-based activities. Gross domestic product per inhabitant in the coastal region exceeds the Slovenian average and holds the second position among Slovenian statistical regions. The coastal region generates about 70 % of gross value added through service activities (mainly trade, transport and tourism). The remnant value added comes from industry and agriculture including fisheries and mariculture. At the country level the economic importance of fishing and mariculture is small: its share of total value added in Slovenia was less than 0.2 % in 1999.

Conflicts among different users are rather pronounced in the Slovenian coastal zone: there is

Environmental problems: general and aquaculture related

Problemi okoliša: općeniti i vezani uz akvakulturu

Like the whole northern Adriatic the Gulf of Trieste is an area under significant anthropogenic pressure that presents different environmental problems. Eutrophication-related localised phenomena and the sanitary quality of beaches appear to be the main environmental problems in the narrow coastal belt of the northern Adriatic (Pagnotta et al. 2000). However, dramatic and widespread events that result from anthropogenic forcing in combination with natural characteristics may affect the whole northern Adriatic basin. These events include: large scale eutrophication with high phytoplankton abundance and biomass, hypoxic and anoxic bottom waters, the mucilage phenomenon, harmful algal blooms (HABs), population explosions and invasions of non indigenous species (Malej et al. 2000). In their overview of environmental characteristics and problems relevant to development plans on Slovenian coast Malačič et al. (1999) stressed the impact of point sources of pollution such as direct discharge of primary treated municipal waste waters from the towns of Koper and Izola into the estuary of the Rižana river, and about 300 m offshore, respectively. In Piran, municipal wastewaters are discharged after treatment about 3 km offshore. The quantity of discharged wastewaters of all three towns was estimated to be about 28,000 m³/day. Chemical pollution seems to be limited although some substances have not been monitored (example: organotin). Port of Koper with its annual cargo of over 10 million tons of different (some hazardous) compounds is another possible source of pollution.

Aquaculture is very vulnerable to poor water quality and pollution. Pollution pressure is the highest in the Bay of Koper, and not very important in the Bays of Strunjan and Piran, where aquaculture is located. Nevertheless, two environmental problems may cause serious damage to aquaculture activities, especially mussel production: recurrent HAB events, especially those caused by toxic species, and large

scale mucilage events that affect both mollusc and fish production.

Up to the present most serious problems were caused by the presence of DSP- causing (diarrheic shellfish poisoning) dinoflagellate mainly during summer and autumn months. The severity of this problem is indicated by the duration of the temporary suspension of mussel sales, which varied in the last decade from a few weeks to several months (Mozetič & Božič 1999).

In the last 15 years there were five widespread mucilage events (1988, 1989, 1991, 1997, 2000, Malej et al. 2001) causing damage to aquaculture mainly due to mechanical effects on nets, fish and shellfish.

While being sensitive to environmental problems aquaculture itself may have a negative impact on the marine environment. It may change natural habitat through pollution with inorganic and organic nutrients, with potentially toxic chemicals and through spread of disease. Fish farming in shallow coastal waters especially may have detrimental effects on benthic communities below cages. Studies carried out in Piran bay (Forte 2001, Kovač et al. 2001) indicated that cage farming of seabass and seabream caused significant reduction of meiofauna abundance and community structure, while macrofauna was completely absent below fish cages. To address these problems EU project (BIOFAQs) has been proposed with the main objective to demonstrate the effectiveness of reducing the environmental impact of organic inputs from intensive mariculture using biofilter deployments. Partners from the UK, Israel, Greece and Slovenia are examining the validity of biofilter use in association with mariculture within the economic and environmental framework in different environments.

Conclusion

Zaključak

Due to limited space either onshore or in coastal waters aquaculture in Slovenia has to compete with other users, especially tourism and maritime transportation. Experiences have shown that sectoral planning is inadequate and a more comprehensive approach to coastal management has to be used. Integrated coastal management addressing wider issues of sustainable and optimal resource use in the coastal zone, minimisation of conflicts and environmental impact as well as conservation of natural resources seems to be able to overcome the limitations and difficulties associated with sectoral approaches (Cicin-Sain & Knecht 1998). Recognising principles of integrated coastal management and sustainable development Slovenia has put the following goals in medium-term national program for coastal area: to establish institutional/organizational framework for integrated

management, to assure sustainable development of key sectors (traffic, tourism, agriculture, energy, industry) and sustainable spatial planning including management plans for special conflict areas. Participation of all stakeholders should be ensured (public and private, State and local etc.) early in the strategy formulation as well as implementation and monitoring.

Acknowledgement. This work was supported by Ministry of Education, Science and Sports and Ministry of Environment, Physical Planning and Energy of R Slovenia.

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Rukopis primljen: 26.11.2001.