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BIOLOGICAL REQUIREMENTS FOR INCREASING AQUACULTURE PRODUCTION IN THE SOUTHERN ADRIATIC SEA

BIOLOŠKE PRETPOSTAVKE ZA POVEĆANJE AKVAKULTURNE PROIZVODNJE U PODRUČJU JUŽNOG JADRANA

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Abstract

In the south Adriatic sea region mariculture, is currently limited to traditional cultivation of oysters and mussels, as well as some cage-culture of seabass and sea bream, in the Bay of Mali Ston. The spatial zoning commission of the Dubrovnik-Neretva County, in fact, has identified about thirty suitable rearing sites, with an estimated combined capacity of over 10.000 MT/yr of fish. One strategy for revitalizing Croatian and Dubrovnik-Neretva County mariculture is introduction of new species for cultivation sach as : greater amberjack (Seriola dumerili), dusky grouper (Epinephelus marginatus), golden grouper (Epinephelus costae), red scorpionfisch (Scorpaena scrofa), salema (Sarpa salpa), pink dentex (Dentex gibbosus), maegre (Argyrosomus regius). One important way in which the long-term profitability of the south Adriatic region mariculture sector can be insured is through an aggressive program to evaluate rationally, and to commercialize rapidly, new species for cultivation.

Keywords: aquaculture, Southern Adriatic

Sažetak

Marikultura se na južnom Jadranu zasniva na uzgoju kamenica i dagnji kao i na kaveznom uzgoju brancina i orade u Malostonskom zaljevu. Povjerenstvo za izradu Prostornog plana Dubrovačko - neretvanske županije odredilo je tridesetak mjesta pogodnih za marikulturu s kapacitetom većim od 10000 MT/god ribe. Jedna od smjernica razvitka marikulture kako u Hrvatskoj tako i u Dubrovačko - neretvanskoj županiji je uvođenje novih uzgojnih vrsta kao što su: gof (Seriola dumerili), kirnja golema (Epinephelus marginatus), kirnja zlatica (Epinephelus costae), škrpina (Scorpaena scrofa), sopa (Sarpa salpa), zubatac krunaš (Dentex gibbosus), hama (Argyrosomus regius). Dugoročni napredak marikulture na južnom Jadranu može se postići novim programima kroz koje će se razumno procijenjivati uvođenje u uzgoj i komercijalizacija novih vrsta.

Ključne riječi: akvakultura, južni Jadran

Background

Preduvjeti

Dubrovnik-Neretva County, one of the smaller counties in the Republic of Croatia, features a highly indented coastline and includes within its jurisdiction a number of islands, both inhabited and uninhabited. It should not be surprising that this geographical setting has spawned a particularly intimate relationship with the sea, one that is reflected clearly in the County's history, commerce, and the lifestyle of its people.

The County's economy is based on its natural resources, above all the Adriatic Sea and the region's very pleasant Mediterranean climate. Tourism, by far, makes the most important contribution to the economy; but commercial maritime activities also play an important role. Other sectors, including mariculture, production of sea salt, fishing, and cultivation of traditional Mediterranean crops—principally olives, citrus fruit, and wine grapes—are especially important locally. Further,

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certain processing industries are found in and around the larger cities, mainly Dubrovnik and Ploče.

Tourism is widespread throughout the County and has grown significantly over the past five years. Mariculture, on the other hand, currently is limited to traditional cultivation of oysters and mussels, as well as some cage-culture of seabass and sea bream, in communities that border the Bay of Mali Ston.

Despite a long history of fisheries and shellfish culture in this part of the Eastern Adriatic, neither yet has come close to realizing its full economic potential. While global aquaculture production continues to experience impressive growth worldwide—going from 3 million tons in 1973 to 28 million tons in 1996—Croatian production yet is negligible.

In the case of the Mediterranean, aquaculture has flourished over the last decade—especially in Greece, which produces over 50,000 tons of seabass and sea bream annually. In Croatia, a pioneer in Mediterranean mariculture in the late 1970s and early 1980s, production since has stagnated. Annual production of four registered fish farms in the Southern Adriatic is only about 300 MT, less than one-tenth of estimated national production in 2000.

This poor output is not owed to a lack of suitable conditions for aquaculture: Seawater temperatures are relatively stable, with the winter average not below 13°C; the configuration of the coastline and sea bottom favor development; and there is a ready market for fresh seafood in both domestic and regional markets.

The spatial zoning commission of the Dubrovnik-Neretva County, in fact, has identified about thirty suitable rearing sites (Fig. 1), with an estimated combined capacity of over 10.000 MT/yr of fish. These locations qualify as inshore and semi-offshore sites. The potential for developing true offshore—or open-ocean—mariculture, which seems at first blush to be very good, awaits serious evaluation.

Potential for introducing new species into aquaculture

Potencijali za uvođenje novih vrsta u akvakulturu

One strategy for revitalizing Croatian mariculture is introduction of new species for cultivation. As part of long-term research focused on this objective, our group continues to carry out investigations on the abundance and distribution of fingerlings of local species with commercial potential. This has led to establishment of broodstocks of a number of candidate species, a necessary first-step in further research on their suitability for commercial exploitation.

The following tables, based on the results of our research and on information culled from the literature, present the main characteristics of several such species. Table I summarizes data for species currently under research in our laboratory; Table II contains data for other species that also seem to offer commercial potential.

The impact of aquaculture

Utjecaj akvakulture

Responsible development of aquaculture in Croatia must take into account its impact on other sectors. Several particularly noteworthy considerations are described briefly next.

Tourism

Aquaculture can strengthen the country's economic position in both national and foreign markets. It also is particularly well suited to support tourism. As tourism becomes an increasingly important part in the national economy, domestic aquaculture firms will have a growing market—albeit a strongly seasonal one—for their product.

Sociology

Aquaculture has the capability to create significant employment opportunities in the core production sector, as well as in upstream and downstream support businesses, such as seafood processing and distribution.

Population

Many rural communities along the coast and on the islands currently have no firm economic base. Aquaculture might be implemented in a way that contributes to the revitalization of such areas, thereby helping to reverse the trend of emigration from the countryside to the larger cities of mainland Croatia.

Conservation

Rearing installations and their support facilities must be implemented in ways that conserve the natural resources of the surrounding area. When assigning concessions, regulating authorities must pay strict attention to limiting all forms of pollution, whether originating from shore-based tourist and industrial activities, or from water-borne sources, such as aquaculture itself.

Conclusions

Zaključak

The Eastern Adriatic Sea and its coastline—especially that of Dubrovnik-Neretva County—offer attractive opportunities for development of a variety of profitable economic activities. Two of these are

tourism and aquaculture. Tourism is well developed and growing rapidly; aquaculture currently is poorly developed, but is poised for rapid growth.

The potential for conflict between these sectors arises when they compete for use of adjacent coastal resources. For the good of the County, as well as for the good of the nation, such conflicts must be resolved in a manner that insures that both industries advance in a complementary fashion, each supporting the other. Only in this way can the valuable natural resources that are at the foundation of their development be conserved for future generations.

One important way in which the long-term profitability of the Croatian mariculture sector can be insured is through an aggressive program to evaluate rationally, and to commercialize rapidly, new species for cultivation.

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Table 1.

Tablica 1.

Species	Distribution	Quantity caught	Size	Time of sexual maturity	Spawning time	Captivity growth rates
gof, orhan greater amberjack *Seriola dumerili*	pelagic species, south, middle and part of the northern Adriatic	Adriatic 20 t Mediterranean up to 300t	up to 190 cm and 80 kg, average 30-50 cm	third year, 100% in the fifth year	end of spring and beginning of summer (above 18C)	reaches 1 kg at the end of the first year
kirnja golema dusky grouper *Epinephelus marginatus*	sedentary, south, central and part of the northern Adriatic	Adriatic up to 30 t Mediterranean up to 1300t	up to 150 cm and 100 kg, average 20-80 cm	over 40 cm length,	second half of summer	
kirnja zlatica golden grouper *Epinephelus costae*	sedentary, south and central Adriatic	negligible	up to 140 cm average 50-80 cm	over 33 cm length	second half of summer	
škrpina red scorpionfisch *Scorpaena scrofa*	sedentary, south, central and northern Adriatic	eastern Adriatic up to 150 t	up to 66 cm (ca 5kg) average 20-30 cm		end spring and beginning summer	
sopa salema *Sarpa salpa*	coastal; south, central and northern Adriatic	Adriatic up to 200 t Mediterranean up to 2000-3000t	up to 51 cm (ca 3 kg9) average 12-30 cm	with 20 cm lengths	beginning fall	
zubatac krunaš pink dentex *Dentex gibbosus*	coastal; south, central and rarely northern Adriatic	negligible	up to 120 cm (ca 24 kg) generally 35-60 cm		spring	
hama, grb maegre *Argyrosomus regius*	coastal, generally rare, frequently caught only at the mouth of Bojana River	Mediterranean up to 1000 t	up to 2 m (ca 70 kg), generally 30-100 cm		spring and beginning of summer	

Table 2.

Tablica 1.

Species	Distribution	Quantity caught	Size	Biology and time of sexual maturity	Spawning time	Captivity growth rates
zubatac common dentex *Dentex dentex*	coastal, eastern Atlantic, Mediterranean, entire Adriatic	Adriatic up to 50-70 t Mediterranean up to 4.000-6.000t	up to 1 m, ca (16) kg, average 20-50 cm	some examples are hermaphrodites	from end spring to beginning summer (April-June)	
pic, šiljac sharpsnout sea bream *Diplodus puntazzo*	coastal, eastern Adriatic, Mediterranean, entire Adriatic, not especially abundant	eastern Adriatic ca 15 t	up to 47 cm average 20-25 cm		beginning of summer	
šarag white sea bream *Diplodus sargus*	coastal, eastern Atlantic, Mediterranean, entire Adriatic, not abundant	eastern Adriatic ca 15 t	up to 45 cm (up to 2,5 kg) average 20-25 cm	protandric hermaphrodism; sexually mature in the second year of life (ca 17 cm)	spring	
fratar common two-banded sea bream *Diplodus vulgaris*	coastal, eastern Atlantic, Mediterranean, entire Adriatic, abundant	eastern Adriatic ca 15 t	up to 45 cm (ca 1,3 kg) average 12-20 cm	potential hermaphrodite; sexually mature in the second year of life (cca 19 cm)	during fall	
ovčica striped sea bream *Lithognathus mormyrus*	coastal, eastern Atlantic, Mediterranean, throughout the Adriatic	eastern Adriatic ca 5 t	up to 45 cm (ca 2 kg) generally 20-30 cm	proterandric hermaphrodite; matures first as a male in the second year of life (cca 14 cm)	spring and summer	
ušata, saddled bream, *Oblada melanura*	coastal, eastern Atlantic, Mediterranean, throughout the Adriatic	Adriatic ca 200t, Mediterranean cca 2000 t	up to 30 cm (close to 0,6 kg) generally 15-20 cm	generally a separate sex, but some are protoginic hermaphrodites	during June and July	
arbun, common pandora, *Pagellus erythrinus*	coastal, eastern Atlantic, Mediterranean, throughout the Adriatic	Adriatic ca 50t, Mediterranean up to 1,500t	up to 60 cm (up to 3 kg), generally 10-30 cm	protoginic hermaphrodite; sexually mature in first or second year of life	end of spring and beginning of summer	
batoglavac, axillary sea bream, *Pagellus acarne*	coastal, eastern Atlantic, Mediterranean, throughout the Adriatic	along the eastern Adriatic shore, only a few tons, in the Mediterranean ca 150 t	up to 35 cm (ca 0,5 kg), generally 10-25 cm	proterandric hermaphrodite; sexually mature as male in second year of life (at 13-18 cm), sex change at 2-7 years (at 17-19 cm)	second half of summer	
kantar, black sea bream, *Spondyliosoma cantharus*	coastal, eastern Atlantic, Mediterranean, posvuda u Jadranu	in the Adriatic ca 50 t and only along the eastern coast, in the Mediterranean ca 700 t	up to 50 cm (ca 2,5 kg), generally 20-30 cm	protogynic ?? hermaphrodite	from February to May	
strijela modrulja pompano *Trachinotus ovatus*	pelagic species, eastern Atlantic, Mediterranean, south Adriatic	Adriatic, a few tons	up to 70 cm, average 20-35 cm		spring and summer	
cipol putnik, thicklip grey mullet, *Chelon labrosus*	epipelagic, coastal, eastern Atlantic, Mediterranean, throughout the Adriatic	along the eastern Adriatic shore, ca 25 t	up to 60 cm (2,5 kg), generally 30-40 cm	separate sexes; sexually mature between 27 cm (males) and 35 cm lengths (females)	in winter months	
cipol balavac, thinlip gey mullet, *Liza ramada*	pelagic, coastal, eastern Atlantic, Mediterranean, along the entire Adriatic coast	along the eastern Adriatic coast ca 50 t	up to 50–60 cm	separate sexes; males at 25-27 cm, females 25-30 cm	during fall and winter	
cipol zlatac, golden grey mullet, *Liza aurata*	pelagic, coastal, eastern Atlantic, Mediterranean, distributed throughout the entire Adriatic coast	along the eastern Adriatic coast ca 50 t	up to 50 cm (ca 1 kg)	Separate sexes: males sexually mature 3-4 (20-24 cm), and females 4-5 years (26-31 cm)	from July to November	
cipol dugaš, leaping mullet, *Liza saliens*	pelagic, coastal, eastern Atlantic, Mediterranean, along the entire Adriatic coast	along the eastern Adriatic coast ca 20 t	up to 40 cm (3,5 kg)	separate sexes; males sexually mature at 2, and females at 3 years (28 cm)	during summer and fall	
list, šfoja, common sole *Solea vulgaris*	bottom, sedentary, eastern Atlantic, Mediterranean, throughout the Adriatic, especially in the northern part	Adriatic ca 1.000t, Mediterranean up to 10.000t	up to 50 cm (ca 1 kg)	cca 25 cm (second year of life)	late fall and beginning of winter	