

**THE BASIS OF COASTAL FISHERY MANAGEMENT FOR SMALL
FISHING COMMUNITIES: THE CASE OF THE SHRIMP
(PENAEUS KERATHURUS) FISHERY IN WESTERN GREECE**
**OSNOVE ORGANIZACIJE PRIOBALNOG RIBARSTVA U MALIM RIBARSKIM
ZAJEDNICAMA: PRIMJER IZLOVA RAKA (PENAEUS KERATHURUS)
U ZAPADNOJ GRČKOJ**

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Izlaganje sa stručnog skupa

Summary

The fishery for Penaeus kerthurus in western Greece illustrates key features of the balance that must be struck to manage marine resources in small coastal communities, whether in Greece or in Croatia.

Keywords: coastal fisheries, Peaneus kerathurus

Sažetak

Opisano je stanje upravljanja priobalnim ribarstvom malih ribarskih zajednica. Određeni su prioriteti budućih primijenjenih istraživanja izlovljavanja raka Penaeus kerathurus na području zapadne Grčke i njegove posljedice na lokalno gospodarstvo.

Ključne riječi: priobalni ribolov, Peaneus kerathurus

Introduction

Uvod

Numerous reports over the past ten years have documented the worldwide increase in the urbanization of marine coastal areas. In 1994, about 21% of the world's population lived within 30 km of the coast, and 37% lived within 100 km.

The FAO (1998) projects that, within the next 20 to 30 years, the number of shoreline inhabitants will double, thereby intensifying the economic development in these areas and heightening the demand for coastal resources. It is, thus, very natural that coastal zone management has become a priority in the agendas of coastal states. This is especially true of those bordering the Mediterranean.

Previous approaches to coastal zone management have not addressed coastal problems in their full complexity; that is, they have not been *holistic*. *Holistic coastal management* refers to an approach in which *'careful planning and management of the activities of all sectors is performed simultaneously'*. This results in greater overall benefits for the integrated coastal community than derives from any approach that focuses only on the development of any one sector.

The two competing sectors that usually require the most attention are, broadly, the economic and the environmental. On the one hand, the coastal zone offers very attractive economic opportunities for production (fishing, agriculture, and aquaculture), transportation (shipping, ports, and harbors), and tourism development. These activities are all part of the growing urbanization cited earlier.

On the other hand, these economic activities clearly have an impact on environments in which they are conducted. If not properly managed, these impacts may, in the limit, destroy those natural resources that made the coastal zone an attractive site for economic development in the first

Alexis J. Conides and C. Papaconstantinou National Centre for Marine Research, Agios Kosmas, Hellinikon, 16604 Athens, Greece, e-mail: akoni@tee.gr, conides@ncmr.gr

place.

In practice, of course, owing to the complicated web of interactions that characterizes inhabited coastal communities, it is extremely difficult to strike a balance between economic and environmental interests. Developing the concepts and management techniques required to implement a rational management plan for any coastal community requires a continuous program of applied scientific research that focuses on quantifying the characteristics of each sector, and the interaction of all sectors. The objective is to arm organizations charged with coastal zone development with the tools needed for rational management and policy formulation.

The present contribution deals with one important part of this larger problem, a traditional coastal activity of long standing that involves very clear economic and environmental issues: marine fisheries.

Coastal fisheries

Priobalni ribolov

Fishing is an extremely old activity: Evidence of freshwater and marine fishing during prehistoric times has been uncovered in a variety of locations around the world. It still is very common that provincial communities in cultures as diverse as Ireland, Greece, Croatia, Kenya, Brazil, and the Philippines rely almost exclusively upon fisheries—along with agriculture and livestock production, in some cases—to provide both food and labor security for the local inhabitants.

Fisheries interact with other economically

important coastal zone activities—such as aquaculture, agriculture, and tourism—in ways that may be beneficial, antagonistic (*i.e.*, detrimental), or agonistic (*i.e.*, competitive) to one or the other.

The benefits of a well-managed fishery to an area's economic development are obvious and rather easily identified: Worldwide, a number of small coastal communities depends almost entirely upon capturing and marketing local fish and shellfish stocks for their livelihoods. Additionally, fishing can have a beneficial effect on tourism by insuring a supply of fresh seafood that can enhance a regions tourism value.

Competition may arise, however, when the activities of another industry use resources critical to the health of a fish stock. A classic example is an industry that destroys wetlands habitat—perhaps by the discharge of untreated agricultural or industrial waste—that functions as a nursery for a commercially exploited marine species, such as shrimp or many fish.

Agonistic interactions also may arise from a pure economic perspective. For example, local fisheries products may compete with those derived from local aquaculture.

It must also be added that a fishing industry has the potential to adversely affect the productivity of the fish stocks that it targets, as well as those of species that are captured only incidentally (*i.e.*, the so-called by-catch).

Of the myriad interactions possible, several that present recurring problems for coastal fisheries managers, but that are not so well recognized by the general public, may be cited:

- Fisheries are considered 'open access' activities; *i.e.*, professional fishermen have to compete with sport-fishers and tourists

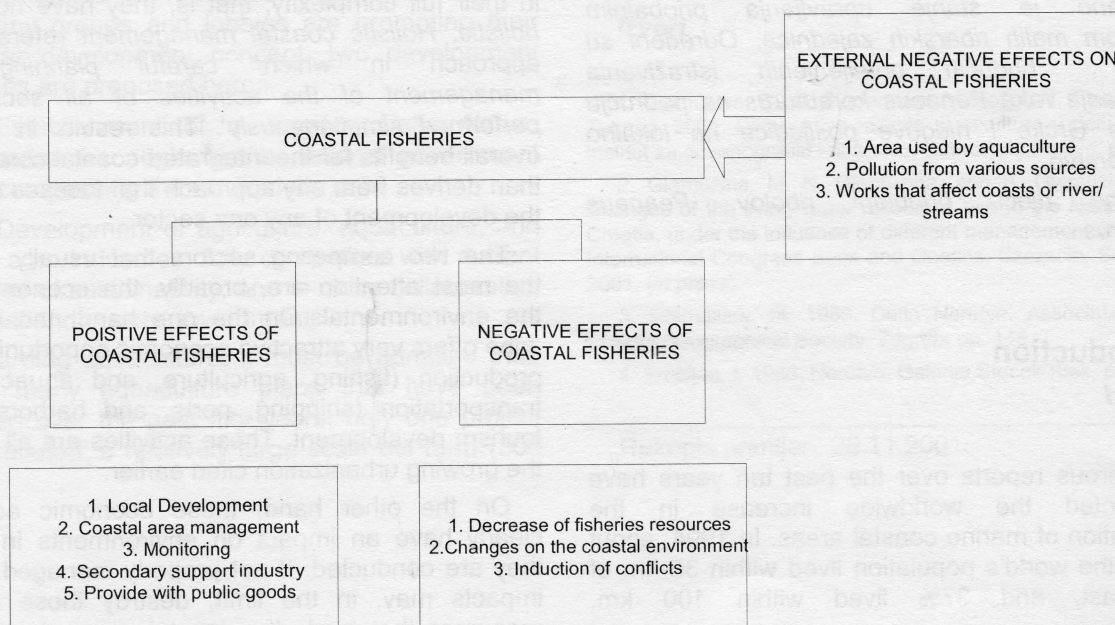


Figure 1. Impacts of fisheries and other sources in coastal area
Slika 1. Utjecaj ribarstva i ostalih djelatnosti u obalnom području

- The economic returns from fishing are controlled by market prices and consumer preferences, as well as components of fishing costs that are not controlled by fishermen.
- Flaws in management of coastal fisheries have created the conditions for *economic over-exploitation* (owing to the increased costs of fishing, low economic yields of the resources, and high competition with other users) and also *biological over-exploitation*, which occurs when fishing effort reduces stocks below optimum levels

An example of the web of interactions that ties fisheries and other coastal zone activities is illustrated in Fig. 1. Balancing these interactions is the central challenge of successful holistic coastal zone management.

The *Penaeus kerathurus* fishery in Western Greece

Izlovljavanje raka Penaeus kerathurus u zapadnoj Grčkoj

1. Regional economic activities

Regionalne gospodarske aktivnosti

1.1. Fisheries

Ribarstvo

Along with livestock production, fishing is a traditional activity of long standing in the communities located along the Amvrakikos Gulf in Western Greece (Figure 2). This area has been strongly affected by poverty: The Prefectures of Ioannina, Preveza, and Arta—all of which border the Gulf on the North—have been included in the latest EU list of the poorest regions in Europe. This immediately suggests that the local fisheries have a very low potential for advancing beyond the current level of technology, as the local community cannot support the cost of modernizing their fleet.

Understanding the economic and environmental interactions associated with fisheries in this area begins with a description of the present state of the local environment, especially regarding the structure of the marine food web. It first must be pointed out that the environment has suffered a severe degree of degradation during the last 20 years. In particular, strong pressure has been exerted on the resident shrimp population, owing largely to:

- Loss of traditional spawning grounds
- An increase in average seawater temperature of 4 - 6°C since the early 1980s.
- Eutrophication, and the accompanying

deterioration of the sediment (high H₂S concentration). The ecosystem in Amvrakikos Gulf has shifted: Once characterized by high diversity and a well-organized food web, today, owing to eutrophication, benthic trophic levels are not well-developed, while dense schools of small pelagic fish (sardines and anchovies) are concentrated in the area. This has attracted predators, especially dolphins, turtles, and seals. In particular, the turtle population found in the Gulf is the most abundant of any site in Greece. Dolphins, turtles, and seals destroy fishing nets, thereby having a strong negative economic impact on the local fishermen.

- The onset of anoxic conditions—likely the result of the aforementioned eutrophication—of the bottom 40 meters of the deepest part of the Gulf. This prevents shrimp from completing their winter migration, an essential part of their natural cycle.
- The large and un-estimated portion of juvenile shrimp caught in the lagoon during the annual migration to offshore feeding grounds jeopardizes the natural replenishment of commercial stocks.

Each the above issues has had an impact on the local shrimp fishing industry. Of note,

- shrimp production now is very low
- there is no other commercial species of comparable economic value.
- the only legally permitted fishing gear in the Gulf is the passive trammel or simple nets and long lines. This limits introduction of technology that better could manage available stocks.
- the cost of entering the fishery is very high in relation to production per fisherman.
- recurring maintenance costs—for example, replacing nets once per year (in some cases 2-3 times per year) owing to dolphin and turtle attacks—has been increased.
- there is no compensation from the government or the EU for losses.
- the lack of effective management of the lagoon fisheries significantly affects the juvenile year classes, on which replacement of commercial stocks depends critically.

The average fishing effort in the target areas is 225 fishing days per year for each fisherman. In all cases, there does not exist a recording system for fishing information either by the fishermen's cooperative or by government administrators.

1.2. Aquaculture

Akvakultura

The Amvrakikos Gulf hosts a diverse group of aquaculture enterprises. It currently is the home of twelve cage-culture farms, two hatcheries, one long-line mussel farm, one government hatchery, and five eel farms—one of which is the biggest in Europe (HELPA S.A.). Most of these activities are located along the north shore of the Gulf, while only one

hatchery, three cage farms, and one mussel farm are found in the south.

Annual production has been estimated at 600 t of eels, 5.000 t of marine fish, and 5-10 t of mussels. Owing to its relatively remote location, further aquaculture development currently is limited by the lack of skilled labor. This also limits development of essential

1.3. Agriculture

Poljoprivreda

The region's agriculture is distributed rather evenly around the Gulf. Agriculture along the northern shore, however, is characterized by a dense system of plots divided by artificial freshwater channels. This forms an extensive irrigation-drainage system that utilizes freshwater diverted from the rivers Louros and Arachthos, their tributaries, and other small creeks. Control of freshwater flow and use of agricultural chemicals have created adverse conditions for shrimp stocks, especially because these coastal wetlands are the nurseries in which young shrimp develop before migrating offshore.

1.4. Livestock

Stoka

Livestock production is the second most important economic sector in the area, the principal products of which are pigs (35%), sheep (20%), goats (8%), poultry (17%), and cows (20%). No particular environmental policy currently is applied for the treatment of discharge resulting from livestock cultivation.

1.5. Tourism

Turizam

Development of tourism has been made possible because all of the coastal towns are situated along the main highway connecting Athens to Ioannina; and also because the port of Igoumenitsa provides regular summer ferry service to Italy and—until the early 1990s—a connection to Dubrovnik, Croatia. These sea routes are especially important: They connect the mainland to the tourist islands of Kerkyra-Corfou (to the North) and Lefkada (to the South), as well as to the Greek-Albanian and Greek-FYROM border checkpoints.

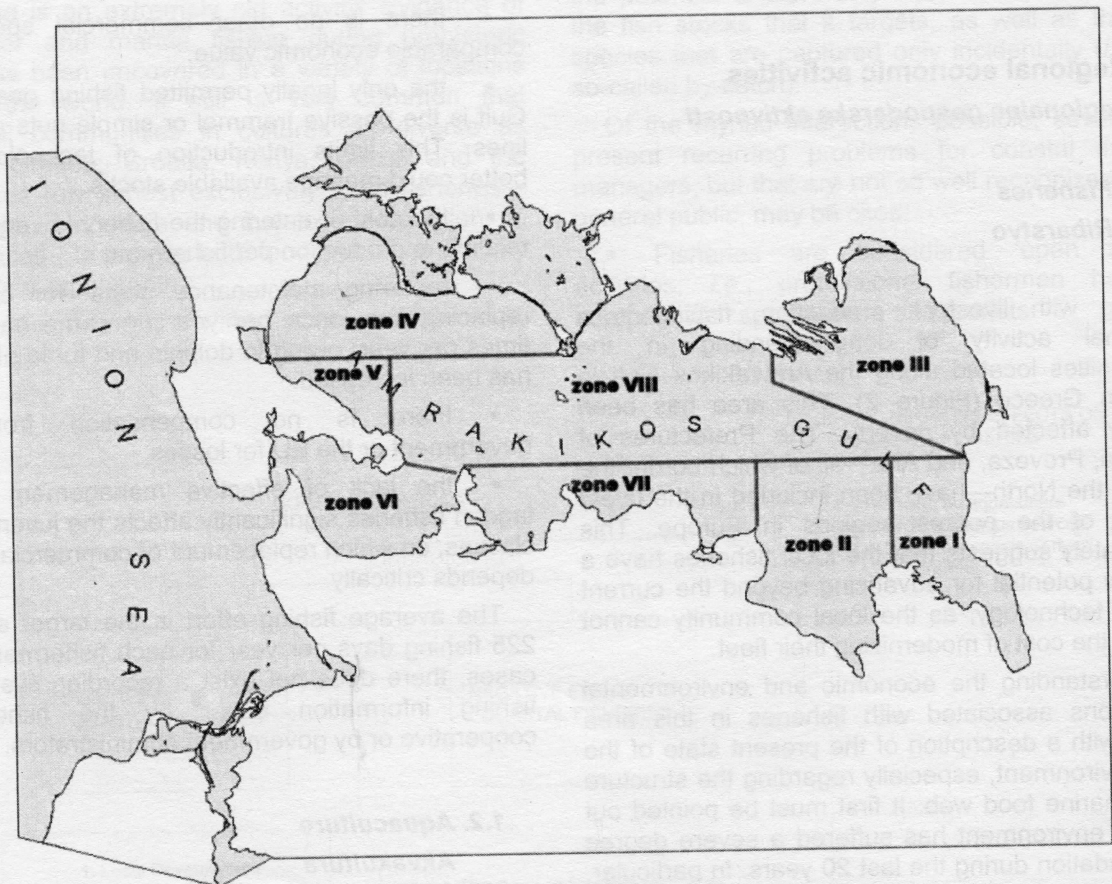


Figure 2. GIS map of Amvrakikos Gulf (West Greece), with fishing sub-divisions (E.U. DG-XIV 037/98 Research project)

Slika 2. GIS karta zaljeva Amvrakikos (zapadna Grčka) s podjelom ribolovnih područja (E.U. DG-XIV 037/98 Research project)

Pollution in the area, however, as well as the lack of competitive tourist attractions, encourage most of foreign tourism to visit the Ionian islands. For this reason, local development of tourism and related services has diminished in recent years.

2. Sectoral modeling and analysis

Modeliranje i analiza po područjima

2.1. Products

Proizvodi

Products originating from local fisheries (including the northern lagoon fisheries) include: shrimp (*Penaeus kerathurus*); European sea bass; gilthead sea bream; other sparids (3 species); eels; mullets (4 species); red mullets (2 species); cuttlefish; sardines and anchovies.

The most abundant of these products are the sardines and anchovies, present throughout the year. Other important commercial species are seasonal. For example, shrimp are fished from October-January; cuttlefish and red mullet both are captured from February-July.

2.2. Market and prices

Tržište i cijene

The current local prices, per kg, of the various fishery products are tabulated below.

All products are sold whole and fresh, on ice, and are obtained either directly from the fishermen after they return to port (app. 20%) or from fish retailers. The latter are comprised of professional fishermen or a member of their family (50%); and of fishmongers (30%).

One market, located in Preveza, is operated by the government. It is, however, far away from most fishing villages; thus, most catch reaches consumers directly through retailers or the fishermen.

About 80% of the catch is consumed locally, while the rest is transported to markets in Athens, or exported. (A small amount of eels, for example, is exported to Italy.)

Product	Price (GRD/kg)
Shrimps (<i>Penaeus kerathurus</i>)	5000-7000
European sea bass	3000
Gilthead sea bream	5000
Other Sparids (3 species)	4750
Eels	2500
Mullets (4 species)	2000
Red mullets (2 species)	4000
Cuttlefish	1500
Sardines, anchovies	700

2.3. Fleet

Ribarska flota

According to the official national register of fishing vessels, there are 754 licensed professional fishing vessels operating in the area of the Gulf. The total number of professional fishermen enlisted in the seven local cooperatives is approximately 604, and the number of professional fishing vessels operating at any time is 435.

Owing to their proximity to the fishing ports and fishing grounds, most vessels operate in zones IV through VIII. The mean age of the fleet is 24 years for Amfilohia harbor, 28 years for Menidi harbor, and 22 years for Preveza harbor. In other Greek fishing areas, such as Thermaikos Gulf, the mean age of the professional fleet is around 15 years—good landings and higher production allows for better maintenance of the vessels working those areas. Regardless of the age of the vessels, lower levels of maintenance results in the generally poorer condition of the Amvrakikos Gulf fleet.

2.4. Fishing grounds

Ribolovna područja

Eight fishing grounds preferred by fishermen—owing to the seasonal abundance of the target species, mainly shrimp—have been identified (Fig. 3). The more preferred of these are zones V through VIII.

2.5. Fishing Costs

Troškovi ribolova

Selected costs and expenses of fishing, as elucidated during a recent on-site survey in the area, are tabulated below.

ANNUAL COSTS (in GRD) (1EURO=340.75 GRD)	
Boat maintenance	100.000
Boat painting	150.000
Other costs (replacements, minor maintenance etc.)	80.000
	330.000
DAILY EXPENSES (in GRD)	
Fuel	3.000
Wages (for one worker)	10.000
	13.000
ANNUAL EXTRAS (in GRD)	
Engine overhaul	150.000

According to these data, the daily cost of fishing may be estimated as about 16.000 GRD, or about 47 Euro. (To arrive at this figure, the sum of Annual Costs and Annual Extras was divided by 225 working days, and to this result was added Daily Expenses.)

Especially during recent years—a period which has seen significant decreases in production—it has become increasingly difficult for local fishermen to meet these costs. In particular, they are extremely concerned about destruction of nets by dolphins, as they generally do not have funds or attractive financing options to purchase a new set of nets every year.

The daily estimated income, nevertheless, still is positive, in the range of 1,000 and 4,000 GRD, depending strongly upon the species sought and the landed catch.

2.6. Estimated income from shrimp fishing

Očekivani prihodi od ulova rakova

Based upon on-site surveys, a fisherman's daily landed production averages between 0 - 3 kg of shrimp for 100 days of effort per year; and between 0 - 5 kg of fish for 100 - 125 days of annual effort.

Total annual income from shrimp thus is in the range of 1.800.000 – 2.000.000 GRD; and, for fish, from 1.500.000 – 1.700.000 GRD.

For a fisherman without a retail shop, this amounts to an annual income of not more than 3.700.000 GRD (~11.000 Euro). In addition, a worker's wage is approximately 10.000 GRD/day or 2.250.000 GRD/year. (~6.600 Euro).

2.7. Effects of fishing on yields

Učinci ribolova

The estimated fishing mortality levels for optimum yield is $F_{\text{optimum}} = 1.36 \text{ year}^{-1}$, while the current mean fishing mortality in Amvrakikos Gulf was found to be slightly lower, $F_{\text{current}} = 1.11 \text{ year}^{-1}$. The implication is that the current fishing level is about 82% of the maximum allowable effort; that is, it is below the level that would indicate conditions of 'growth over-fishing'.

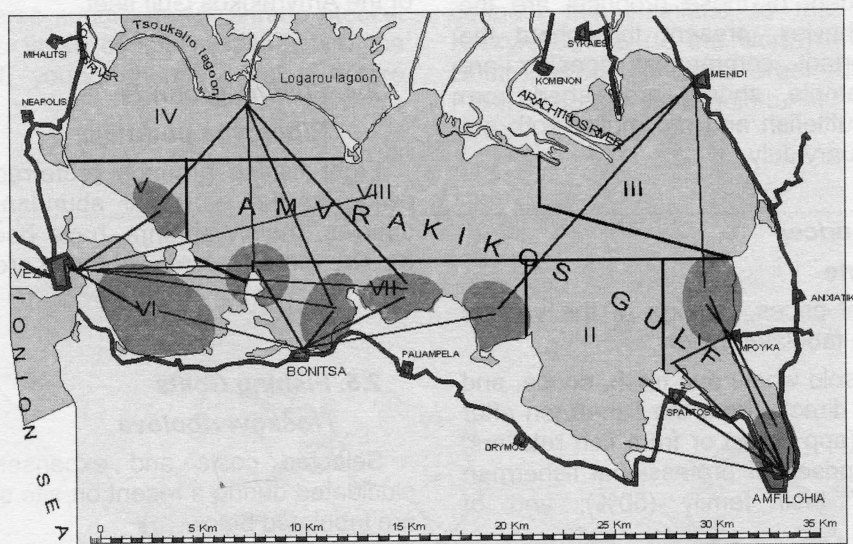


Figure 3. Fishing grounds and fishing routes in Amvrakikos Gulf

Slika 3. Ribolovna područja i putevi u zaljevu Amvrakikos

Conclusions

Zaključci

The following topics have been identified as priorities for further applied research on the *Penaeus kerathurus* fishery in the Amvrakikos Gulf:

- *Detailed study of the environment* – the state of pollution, existence of endangered species
- *Fisheries assessment study* – assessment of the status of the resources
- *Detailed study of the economic sector* – to reveal the importance of the various sectors (including fisheries) for the local economy, and to describe the market, especially prices and their elasticities, the demand and supply of products, and fishing cost
- *Infrastructure* – fleet, distribution of fleet, age

of fleet, processing sector, fishing routes, and distances

- *Monitoring system of environment and fisheries* – time-series of variables and the use of modern equipment (remote sensing etc.)
- *Legislation and environmental protection schemes* – the balance between the natural and human environments has to be maintained.

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