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Risk management

PROGNOSES OF SEA-FISH SPECIES CATCHES IN GREECE AT BIOLOGICAL AND BIODIVERSITY RISK

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Abstract. Multidimensional time series database on fishery in Greece stores data of Greek fishery sector on biological, economical and technical aspects. Time series on total quantity as well as on each area of fish catches per specie are processed in order to estimate fish species at biological and biodiversity risk. Trend modelling of time series on catch quantity of fishes at risk is applied. In case of existing trend the prognosis (forecasting) of the catch quantity is based on the attained best trend model. Otherwise short analysis and prognoses are realised using the Weighted Moving Average Method. The achieved information is important for fish resources exploitation and protection.

Keywords: Greek fish resources, multidimensional database, fish catches, risk analysis, prognoses.

AIMS AND BACKGROUND

Water resources constitute an integral part of Hellenic territory as they occupy a significant part of it and contribute to the local economy[1]. Fishery constitutes a major economic type of the exploitation of ecosystems that faces favourable challenges[2] contributes to fishermen profits and reasonable distribution of earnings in the coastal regions, along with the creation and/or increase of employment, as well as in the maintenance of population and the investment of social surplus locally[3]. The knowledge on the biodiversity and coastal habitats is important both for their harvest and for monitoring the data on marine environment[4].

According to the International Union for Conservation of Nature (IUCN) Red List of endangered species, 1414 species of fish, or 5% of the world known species, are at risk for extinction. While habitat loss and pollution are significant factors in the decline of these species, the greatest threat by far is over-fishing[5]. The same source claims that 43 species of marine fish were assessed as being at risk of extinction in the Mediterranean Sea, largely as a result of over-fishing, damage to habitat and pollution[6].

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An endangered species is a species of organisms facing a very high risk of extinction. The phrase refers to those designated Endangered in the IUCN Red List for wild species, where it is the second most severe conservation status for wild populations, following Critically Endangered. Critically Endangered is the highest risk category assigned by the IUCN Red List. Critically Endangered species are those that are facing an extremely high risk of extinction in the wild.

Over-fishing has affected the population structure and densities of the demersal fish communities, at least at depths up to 200 m, where most of the fishing activity is focused[7]. Some scientists believe that conventional fishing practices put some fish at risk, even though their stocks appear healthy[8].

EU Commissioner Damanaki welcomes agreement on reform of Common Fisheries Policy. The overarching aim of the reformed fisheries policy is to end over-fishing and make fishing sustainable environmentally, economically and socially. The reform seeks to establish conditions for a better future for fish and fisheries, as well as the marine environment that supports them. The policy aims to bring fish stocks back to sustainable levels by taking an science-based approach to the setting of fishing opportunities. It further aims to support sustainable sectoral growth, create job opportunities in coastal areas and ultimately provide EU citizens with a healthy and sustainable supply of fish[9].

An approach for finding fish species at risk is the analysis of statistical data for a relatively long period of time. These data refer to economical activities in fishery sector and are usually stored in large size datasets. The combination of known statistical methods and data mining rules[10] provides the ability of finding important patterns analysis of the Fishery Time Series (FTS) database of Greece[11].

Researches and managers need modern information technologies in order to observe and analyse processes related to fishery in Greece. Large databases such as FAOSTAT and FishBase do not provide detailed information for countries. National Statistical Service of Greece (NSSG) provides detailed statistical data on fishery in Greece but not specific data processing[12].

Basic aim of this paper consists of integrating information and statistical methods for making prognoses of catch quantity of fishes at risk in Greece.

EXPERIMENTAL

The flowchart in Fig. 1 presents the basic conception of data processing. The elements of the flowchart are as follows:

● Multidimensional FTS database stores time series on fishery in Greece in four dimensions: quantity of fish catch, value of fish catch, employment and time. Quantity of fish catch is an indicator for determining fish species at risk. Figure 2 presents the relationships between entities concerning quantity of fish catch and time. Time series on quantity of fish catch by 18 areas and 71 fish species are extracted from FTS database and processed in order to achieve the purpose of this study.

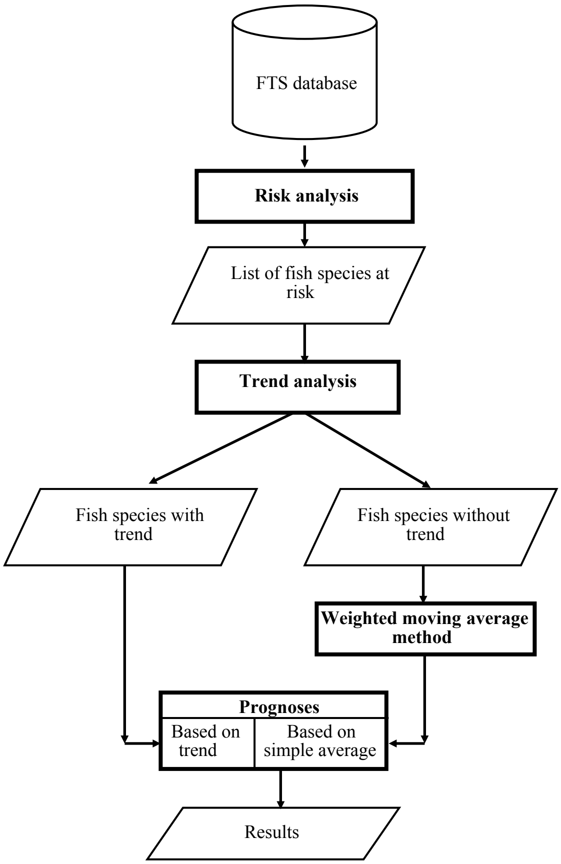

Fig. 1. Flowchart of processing time series on quantity of catches of fish species at risk in Greece

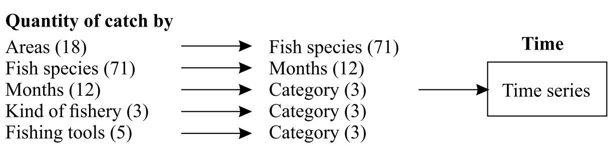

Fig. 2. Entity-relationships of FTS database

● Data mining algorithm is used to estimate fish species at risk[13]. This algorithm applies trend modelling and categorising rules for processing total data on fish species catches as well as data on fish species catches by areas. This algorithm gives the opportunity to find the fish species at biological and biodiversity risk.

● Prognoses of fish catch quantity:

– Based on trend when there is an adequate trend model. Strong level of confidence is applied ($F = 0.01$) because the trend model will be used for forecasting purposes. The results from trend modelling are used for prognoses assuming that the studied event will follow the same rules during the historical and the forecasted period. The attained projections are a simple consequence of the trend line extrapolation.

– Based on weighted moving average method in case adequate trend model is missing. This method is applied on consequent subsets of each time series of length 5. The weights are defined this way: 0.10, 0.15, 0.20, 0.25 and 0.30.

RESULTS AND DISCUSSION

Eleven fish species at risk are determined after applying of data mining algorithm on subsets on quantity of fish catches of FTS database – Croaker, Garfish, Oyster, Stone bass, Grouper, Guitarfish, Black sea bream, Eel, Crab, Bay scallop, Brill. Figure 3 presents the quantity of catch for two fish species at risk. Black sea bream is in risk from year 2005 while Eel is in risk during the whole studied period of time.

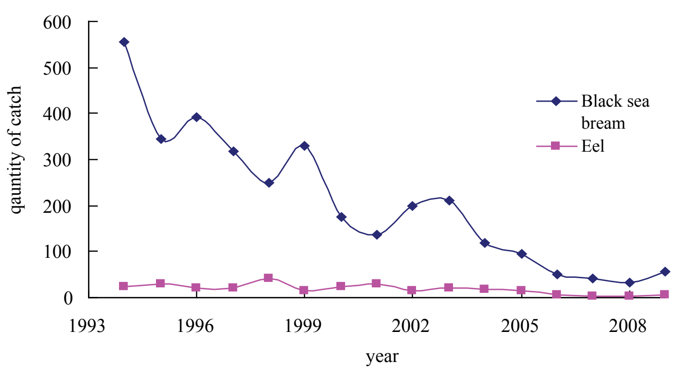

Fig. 3. Fish species at risk

The trend modelling procedure is used to process time series on quantity of catch for fishes at risk. Table 1 presents the fish species and the best trend model that can be used for prognosis.

Table 1. Fish species and the best trend model

Best trend model	Fish species at risk
Linear	croaker
Second degree	garfish, oyster
Exponential	stone bass, grouper, guitarfish, Black sea bream, eel, crab, bay scallop
No adequate trend model	brill

Figure 4 shows the results of prognosis of catch quantity for Garfish applying three different trend models. Linear trend model is not proper for forecasting purposes of this species at risk because declining trend will lead to 'negative' prognosis. Second degree trend model is very optimistic. The exponential trend model gives the most balanced prognosis (Fig. 4). In some cases the acceptance of forecasting values is based on human intuition and experiences in the field.

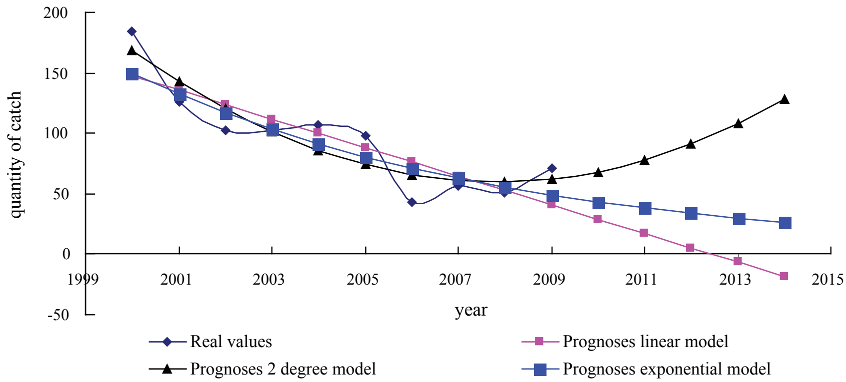

Fig. 4. Prognosis of quantity of catch for Garfish based on trend models

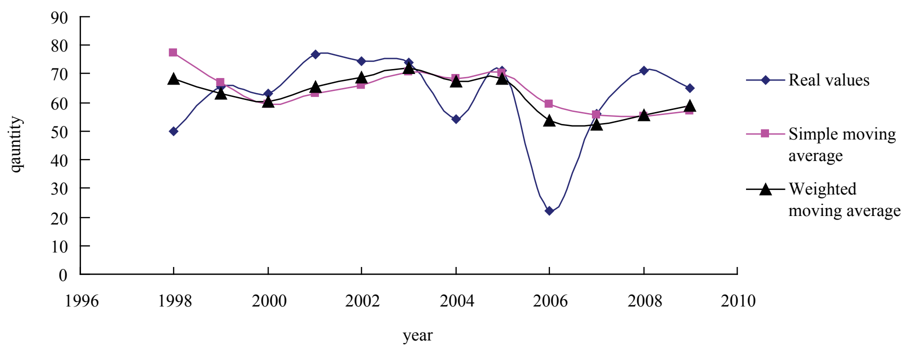

Fig. 5. Smoothed values of catch quantity of Brill

Smoothed values on catch quantity for Brill are achieved through weighted and simple moving average methods (Fig. 5). Based on the received trend line the prognosis consists of sustainable quantity of catch with slight increasing for the latest short period of time. Weighted moving average method is better than simple average method for forecasting purposes if it is accepted that lasted values of the sub-period are more closed to next.

CONCLUSIONS

The objective of the present work on forecasting is to create and apply two methods as the forecasts are prepared on the basis of the time series data, which may incorporate effects of other factors. Hence the experts in the field of fishery, familiar with the studied event, may need more than one forecast in order to take these factors into account. They can decide which of the proposed forecasts is more probable involving their personal experience and sense of understanding of the studied event.

This study and the achieved information is important, first from methodological significance since application of information (DB+DM algorithm) and statistical approaches help out for making prognoses and second, from ecological meaning to taking measures for effective exploitation and protection of fish resources.

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