FISHERY DATA AND CLIMATE CHANGE: EVIDENCE OF A RELATIONSHIP FROM THE VENICE LAGOON?

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Abstract
By analysing regime shifts detected within landings time series from the Venice lagoon, a significant decrease of catches from the mid 80s was highlighted. In order to explore possible causes, the correlation with climatic parameters has been analysed. Results show a significant negative correlation between temperature anomalies and landings, but no correlations with the NAO time series have been found.
Keywords: Fisheries, Temperature, Time Series, Lagoons, Adriatic Sea

Introduction
Trends in annual mean temperature anomalies for the globe show relatively stable temperatures from the 1800 through about 1910, a rapid and steady warming through the early 1940s, followed by another period of relatively stable temperatures through the mid-1970s. A rapid rise similar to that in the earlier part of the century has been observed since [1]. The Lagoon of Venice, like most lagoons, is a sensitive and fragile ecosystem, liable to major and sudden variations and, consequently, very dynamic [2]. Furthemore the lagoon is subjected to different kinds of external pressures and has evolved under strong anthropogenic presence. This emphasizes the challenge of a dynamic management taking into account the ecosystem historical trend. In the context of the environmental management and analysis of possible effects of climate change, growing interest is devoted to time series analysis, since they allow to describe temporal trends and individuate possible points of shift. In this context, landing data could play a crucial role, since it is generally assumed a correspondence between relative abundance of a species in landings and in the ecosystem [3] and often they represent the only available historical data source about temporal variations of the system.

Material and methods
The time series (1945-2008) here presented were obtained from the Chioggia fish market. In order to minimize possible sources of bias, such as variation in the fishing effort and/or fishing grounds, changes in fishing gears and/or target species [4], we decided to use the total catch of commercial categories caught within the lagoon environment by fyke nets (eel, grass goby, shrimp, green crabs, brown shrimp, mullet, sand gobies, flounder, cuttlefish, sand smelt). To detect regime shifts within the time series, the STAR method, which analyses discontinuity or change points expressed by shifts in the variance and especially in the mean [5], has been applied.

Results and discussion
Of the six different phases (regimes) identified, most of them are in agreement with results reported by other authors [6]: 45-64 increasing of the fishing capacity due to the engine-powered boat introduction; 65-75 increase of the carring capacity due to nutrient enrichment (eutrophication); 76-83 decrease in landings due acute eutrophication and beginning of dystrophic crises; 95-08 decrease in landings due to mechanical clam harvesting (Fig.1).

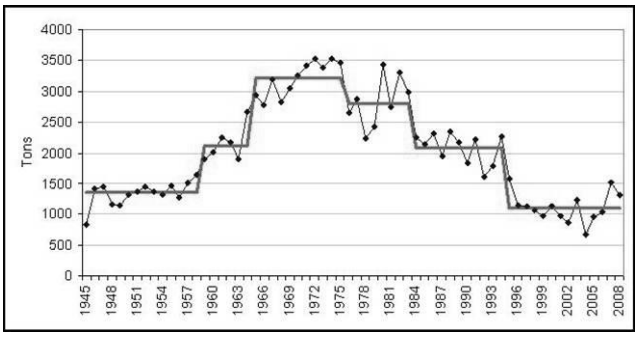

Fig. 1. Regime shifts recorded within the time series of total catches from the Venice lagoon.

We focused mainly on the negative trend recorded between the period 1984-94. To explore possible causes of this phase, we attempted to correlate the landings trend with climatic parameters (temperature and North Atlantic Oscillation-NAO). Results highlight a significant negative correlation between temperature and landings anomalies (cross-correlation analysis), but no correlations with the NAO time series were detected. From 1962-1982 the temperature anomalies are mainly negative, while since 1983 a transitional phase characterized by positive values has been started, specially from 1988. This trend lasted until 2008, showing a general warming that seems to have affected the landings. Climate change, via its oceanographic influence, can play an important role in Adriatic ecosystems due to the incoming Mediterranean warmer water leading to changes of nektonic communities [7]. The obtained results are probably not sufficiently robust to explain the entire time series, being impossible, at the moment, to disentangle the single contribution of all other drivers (such as environmental factors or anthropogenic pressures). It is quite interesting, however, to underpin the inversion (from positive to negative for landings and from negative to positive for temperature) recorded in 1983-1984 (Fig. 2).

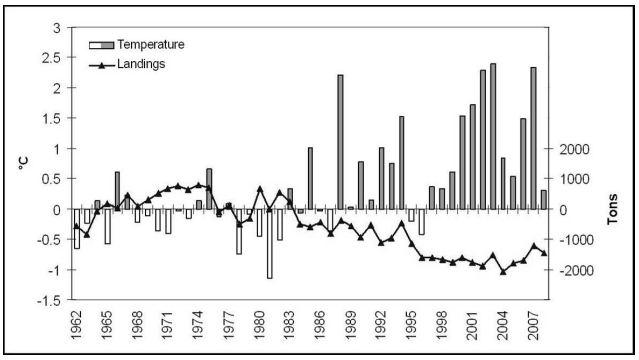

Fig. 2. Time series (1962-2008) of landings (line) and temperature anomalies (box).

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