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Fishing capacity of the southeastern Black Sea anchovy fishery

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ABSTRACT

Georgian, Turkish and Ukrainian vessels have exploited the southeastern Black Sea anchovy fish stock in the Economic Exclusive Zone (EEZ) of Georgia since 1999. This exploitation has resulted in a significant decrease of the anchovy fish stock. The availability of reliable and accurate measures of the capacity and overcapacity of the fleet provides policymakers with useful tools to avoid rent dissipation of fishermen and/or the overexploitation of anchovy stocks. This paper is aimed at measuring the fishing capacity and the structural excess of fishing capacity over sustainable levels (overcapacity) of this fleet in the period 2005–2009. Two data envelopment analysis linear mathematical programs were run to attain the desired measures. This paper concludes that fishing capacity was 142.37 mT in the 2008–2009 season and that it increased since the implementation of a new management framework in 2006. This paper also concludes that there was a considerable overcapacity of the fleet in 2009, given that the measured fishing capacity exceeded almost 2 times the Total Allowable Catch set by policymakers, and the technical efficiency of the fleet was very low. These results suggest the necessity of international cooperative rights-based fisheries management to guarantee bio-economic sustainability.

1. Introduction

Overexploitation of fishery resources, that is, the exploitation of commercial fish stock over safe biological limits, is a large concern in world fisheries. Approximately 32% of the stock groups of the world monitored by the Food and Agricultural Organization of the United Nations (FAO) are overexploited, depleted or recovering from depletion (FAO, 2010).

Overexploitation is mostly caused by overfishing as a consequence of economic incentives for fishermen to maximize their capture instead of investing in the conservation of their exploited fish stocks in open-access or regulated open-access fisheries. The incentives of fishermen produce the capitalization of fishing fleets. This capitalization leads to levels of fishing capacity that are generally significantly higher than sustainable not only from a biological point of view but also from an economical point of view. These high levels of fishing capacity result in overcapacity and, hence, in the dissipation of the potential rent that fishermen gain in different periods and the overexploitation of fish stocks, depending on the regulatory framework (Gordon, 1954; Homans and Willen, 1997).

In the Mediterranean Sea and the Black Sea, the main commercial fish stocks are not an exception to this overexploitation problem. Hake, red mullet and small pelagic fish stocks are fully exploited or overexploited in these two seas (FAO, 2010). In addition, the main commercial fish stock of the Black Sea, the anchovy, has been recently classified as overexploited (FAO, 2012; STECF, 2011).

Six countries exploit the goods and services provided by the Black Sea Economic Exclusive Zone (EEZ), which has an area of 423,500 km^2: Turkey, Bulgaria, Romania, Ukraine, the Russian Federation and Georgia (Fig. 1). The Black Sea is a nearly enclosed sea only connected to the Mediterranean Sea through the narrow and shallow Bosphorus Strait. Its continental shelf is significantly wider in the northwestern and northern coastline, characterized by shallow waters with a depth of up to 200 m, than in the rest of the coastline. The northwestern basin provides most of the riverine input of the Black Sea, mainly from the Danube, Dniester and Dnieper rivers. Eukaryotic life is only supported in a surface layer extending until 100 m. There is an anoxic layer below characterized by high concentrations of hydrogen sulfide and ammonium that only supports anaerobic bacteria (Oguz et al., 2004).

The recent history of Black Sea fisheries is marked by two discontinuous regime shift events that took place at the end of the 1970s and 1980s, which produced dramatic changes in the Black Sea ecosystem that have had a significant impact on small pelagic fish stocks. The aforementioned regime shifts were mainly caused by a combination of anthropogenic effects, namely eutrophication, overfishing, outbursts of alien ctenophore species (*Mnemiopsis leidyi* and *Beroe ovate*) and climate change (Oguz, 2005a, 2005b).

The agricultural revolution in the Iron Curtain countries resulted in intense eutrophication of the Black Sea as a consequence of nutrient discharges (inorganic phosphorus and nitrogen), especially in the

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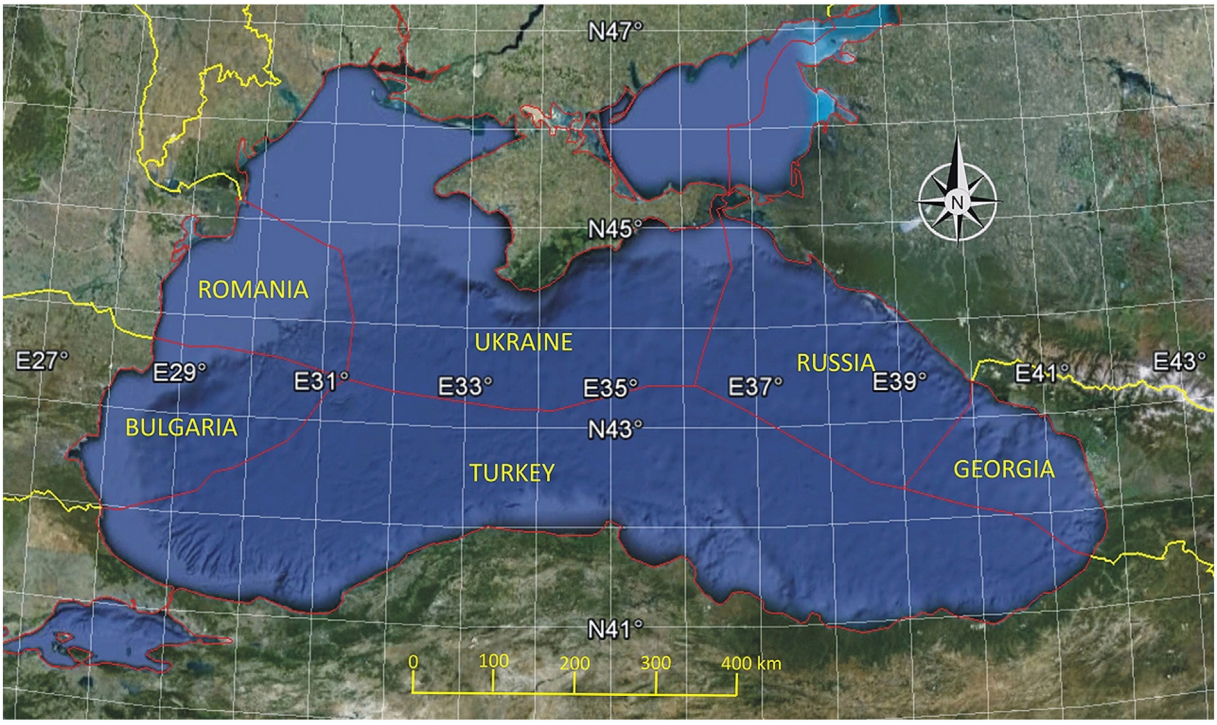

Fig. 1. Black Sea EEZ map (color version available online).

northwestern basin of the Black Sea (Kideys, 2002). The subsequent increase of pelagic primary production and the overexploitation of main small pelagic predators resulted in a significant increase of small pelagic fish stocks, mainly the anchovy (*Engraulis encrasicolus*) in the early 1980s. The combination of overexploitation of small pelagic fish and the accidental introduction of the ctenophore *Mnemiopsis leidyi*, which competes ecologically with small pelagics, resulted in a sharp decrease in the anchovy population at the end of the 1980s (Oguz, 2005a, 2005b).

The economic failure of the communist regimes after the fall of the Iron Curtain during the 1990s and a new international management framework for the management of the Black Sea caused a significant reduction of nutrient river discharges (Mee et al., 2005). The reduction of nutrient inputs combined with the introduction of the ctenophore *Beroe*, that predates *Mnemiopsis leidyi*, resulted in a slight recovery of anchovy fish stock. The anchovy fish stock then reached the current mean level with landings of at most 10% of that of the 1980s. The anchovy fish stock only increased in Turkey with a capture that is roughly two times over the Maximum Sustainable Yield (MSY — Oguz and Velikova, 2010; Oguz et al., 2012).

The aforementioned reduction of landings caused a significant reduction of the revenues coming from fishing in Black Sea coastal communities. The adoption of the Law of the Sea worsened this situation since 1982 by obliging a significant portion of the fleet that operated offshore to move back to their respective EEZs. This move resulted in dissipating even more rent of fishermen due to the higher number of vessels fishing in territorial waters. This situation occurs in Georgia, which experienced a significant increase of purse seiners operating in its EEZ (a total of 220) together with a significant reduction of their productivity — the capture decreased from 175 mT in 1989 to 4.7 mT in 1990. Consequently, the profitability of the coastal communities depending on these fishing fleets declined along with the employment they could offer (Van Anrooy et al., 2006).

The fall of the Iron Curtain worsened the aforementioned situation due to the new economic order that was implemented. In the case of fisheries, the changes included the destruction of traditional commercial relations and the accompanying destruction of the different linkages of market agents along the market chain. At this point, a significant portion of the offshore, unprofitable Georgian fishing fleet was sold to Ukraine, and the Georgian fishery almost disappeared during the 1990s despite a small recovery of the Black Sea anchovy fish stock in the mid-1990s.

The sharp reduction of the fleet mentioned above produced a recovery of the Georgian anchovy fish stock at the end of the 1990s; thus, the anchovy fish stock size reached 380 mT in 1999–2000 season (Van Anrooy et al., 2006)[1]. However, the operating Georgian fleet at the beginning of the 2000s was not able to fully exploit this stock due to a considerable level of undercapacity, which encouraged the Georgian state to rent 90% of the total allowable catch (TAC) [2], set in the 1999–2000 season at 120 mT, with no restrictions on vessel size but with restrictions on fishing gear, to Turkish and Ukrainian companies[3]. Vessels were not allowed to bottom trawl, and the fishing gear mesh size and dimensions were limited. In addition, a control and inspection system was posted in place to guarantee the TAC.

Currently, the joint exploitation of anchovy fish stock by Georgian, Turkish and Ukrainian vessels has resulted in a significant increase in the capture of anchovies (Fig. 2), whose fish stock has decreased to less than half its earlier size in 1999–2000 season to 170 mT in the 2003–2004 season, according to fish stock assessment surveys conducted using acoustic methods. The decrease of the anchovy fish stocks again puts this fish species at risk, which is the only one that has registered captures of commercial interest in the last five-year period.

Overfishing of the Georgian–Turkish fleet caused by an inappropriate setting of the TAC seems to be the origin of the aforementioned reduction of the anchovy stock in Georgian fishing grounds. This overfishing is worsened by the significant pressure that the overcapacity of

[1] An anchovy fishing season lasts 7 months from October until April.

[2] Order no. 512 of the Minister of Environment Protection and Natural Resources (MEPNR) on approval of the rules, dates, guns and methods of taking from the wild according to species, 7-12-2005.

[3] Ukrainian companies were exploiting Georgian EEZ anchovy stocks until 2005, when the new management framework set a limit of 20 vessels to the license owners. This encouraged renting vessels of higher capacity, especially Turkish vessels.

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