Enhancing the performance of quota managed fisheries using seasonality information: The case of the Portuguese artisanal dredge fleet

M.M. Oliveira [a,b,c,*,1], A.S. Camanho [b], M.B. Gaspar [c]

[a] Centro de Investigação Operacional, Faculdade de Ciências da Universidade de Lisboa, Bloco C6, Piso 4, Campo Grande, 1749-016 Lisboa, Portugal
[b] Faculdade de Engenharia da Universidade do Porto, Rua Dr. Roberto Frias, s/n 4200-465 Porto, Portugal
[c] Instituto Português do Mar e da Atmosfera I.P./IPMA, Avenida 5 de Outubro, 8700-305 Olhão, Portugal

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ABSTRACT

Several fisheries across the world are managed by a quota regime. These quotas can be set yearly, monthly, weekly or daily. However, for some fish species demand seasonality may occur, which should be taken into consideration in the establishment of the quota (especially in those fisheries managed by daily or monthly quotas). This would allow fishermen to catch more fish at times of the year with higher demand in detriment of periods when demand is low. The present work investigates the existence of demand seasonality for bivalves from the artisanal dredge fleet. This fleet operates along the entire coast of the Portugal mainland. The analysis of fleets' revenue efficiency is assessed with Data Envelopment Analysis models, and the monthly seasonality effects on the revenue efficiency were tested using a Tobit regression. The results revealed that on the South coast there is a strong demand in the summer whereas on the western coast (northwest and southwest fishing areas) demand increases during Christmas and New Year festivities. Since this fishery is managed by weekly/daily quotas, it is proposed that these quotas should be redistributed in order to adjust them to periods of higher demand, thereby increasing the profitability of the vessels. The approach followed could be applied to similar fisheries worldwide.

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1. Introduction

Seasonality is invariably present in worldwide fisheries. This presence could be detected through the abundance of different species [1,2] related to their life cycles and migration [3–5], their distribution in different fishing grounds [6] and the body size of different species caught at different times of the year [7–9]. In addition to these factors, seasonality could also be felt in fisheries due to the variation of commercial demand throughout the year [10,11].

Behavior of demand seasonality is an important factor that should be considered in fisheries policy, especially in those fisheries that are managed by maximum catch quotas regimes. Indeed, the adequacy of quotas should consider not only the adjustment of the catches to the status of the resources but also the fluctuations of demand which could represent a significant improvement to fisheries sustainability through maximizing the profits of the vessels. Unfortunately, the lack

of studies addressing this issue is quite significant, the works carried out by Floros and Failer [10] and Floros and Advelas [11] being an exception. In the former work, the authors examined the evidence for seasonal effects and cointegration among fisheries prices of main species landed in Cornwall (South West England). The form and magnitude of seasonal fluctuations was explored, and it was concluded that their reflection on fish prices can be beneficial to fisheries managers in their decisions regarding policy, development and management. In the latter work the seasonal behavior of fish prices in Greece is explained and it is argued that the main factors that influence the demand for species are weather conditions, public holidays and demand fluctuations during the year. Yet, to the authors' best knowledge, the present work is the first that focuses on demand seasonality applied to an artisanal fishery managed by maximum daily/weekly quotas.

Among the artisanal fisheries in mainland Portugal, the bivalve dredge fishery is one of the most important, both in terms of the number of vessels, fishermen, and employment in fisheries-related activities, as well as in terms of weight and value of catches [12]. From a management point of view, the Portuguese coast is divided into three main fishing areas, namely: Northwest, Southwest and South. This fishery differs in features and operability along the Portuguese coast and is managed by a seasonal closure (from 1st of May to 15th of June), minimum landing sizes, gear restrictions and a

* Corresponding author at: Instituto Português do Mar e da Atmosfera, I.P./IPMA, Av. 5 de Outubro, 8700-305 Olhão, Portugal. Tel.: +351 289700503; fax: +351 289700535.
E-mail addresses: moliveira@ipma.pt (M.M. Oliveira), acamanho@fe.up.pt (A.S. Camanho), mbgaspar@ipma.pt (M.B. Gaspar).
[1] Permanent address. Rua Aresta Branco, 8 – 2 esquerdo, 2775-159 Parede, Portugal.

regime of maximum fishing quotas per vessel's tonnage and species. The present paper aims to understand if bivalves demand is subject to seasonality by analyzing the monthly fluctuations of fleets' revenue efficiency (RE) in the three areas between 2006 and 2012. The mean wave height (MWH) was also analyzed by fishing area to screen any effects on the RE of the fleets. With this purpose, Data Envelopment Analysis (DEA) models were applied to measure vessels' RE, and Tobit regression was used to explore the monthly impact.

In the literature, the analysis of fisheries RE attracted increased attention recently, with a few studies considering not only the species landings but also their revenue. Lindebo et al. [13] proposed an economic measure of capacity for the Danish North Sea trawlers. Oliveira et al. [14] estimated RE as a complement to the technical efficiency analysis, using the annual quota per vessel as a contextual factor. The procedure adopted allowed a two-dimensional representation of vessel performance and enabled the identification of benchmark vessels in the artisanal dredge fleet operating in the Portuguese South coast. The study of Pascoe and Tingley [15] analyzed the segments of the Scottish fishing fleet concerning their profit maximizing behavior. Alam and Murshed-e-Jahan [16] applied DEA to study technical efficiency and the ability to minimize costs in the aquaculture of the prawn-carp in Bangladesh.

In the absence of any previous study addressing demand seasonality in artisanal fisheries, this paper provides basic knowledge that will be useful to other artisanal fisheries managed by quotas. Based on the results achieved, some considerations concerning managerial policies are provided aiming to enhance the sustainability of the Portuguese bivalve dredge fishery.

2. Portuguese artisanal dredge fleet

Currently the artisanal dredge fleet comprises 93 vessels (11, 25 and 57 vessels operating in the Northwest, Southwest and South coast, respectively) (Fig. 1) with an overall length ranging from 5 to 16 m, an engine power between 20 kW and 130 kW, a gross tonnage (GT) between 1 and 24 tons and a crew composed of one to five fishermen. The vessels are classified as local or coastal according to the area in which they operate. Local vessels can only operate near the homeport or adjacent fishing ports, whereas coastal vessels can fish within the fishing area for which they are registered. In the Northwest and Southwest fishing areas only coastal vessels operate due to the distance of the bivalves' beds from the fishing ports, as well as the hydrodynamic conditions observed in these areas, namely high MWH.

The bivalve dredge fishery in the Northwest area is mono-specific targeting the surf clam (*Spisula solida*), contrasting with the other two areas where the fishery is multispecific, targeting four species. In the Southwest area the target species are the surf clam, the smooth clam (*Callista chione*), the donax clam (*Donax spp.*) and the pod razor clam (*Ensis siliqua*), whereas in the South the target species are the surf clam, striped venus (*Chamelea gallina*), donax clam and the pod razor clam.

Although the majority of the management measures are similar in all three fishing areas (e.g. seasonal closure, the minimum landing sizes and the gear specifications), there are differences in terms of the quota regime. In the Northwest and Southwest maximum weekly fishing quotas are currently in force , whereas in the South coast the fishery is managed by maximum daily fishing quotas. The quotas are reviewed on an annual basis considering the result of the annual monitoring surveys carried out by the Portuguese Institute for the Ocean and Atmosphere (IPMA), and can be changed if necessary to adjust the catch to the status of the stocks [17]. The different quota regimes adopted are justified by the harsher oceanographic conditions observed in the western Portuguese coast from operating on the South coast, which frequently hamper the dredge fleet to operate most of the days (Table 1), especially during the winter when high wave heights are observed.

3. Methodology

3.1. Dataset

The dataset used in the present study was provided by the General Directorate of Natural Resources, Safety and Maritime
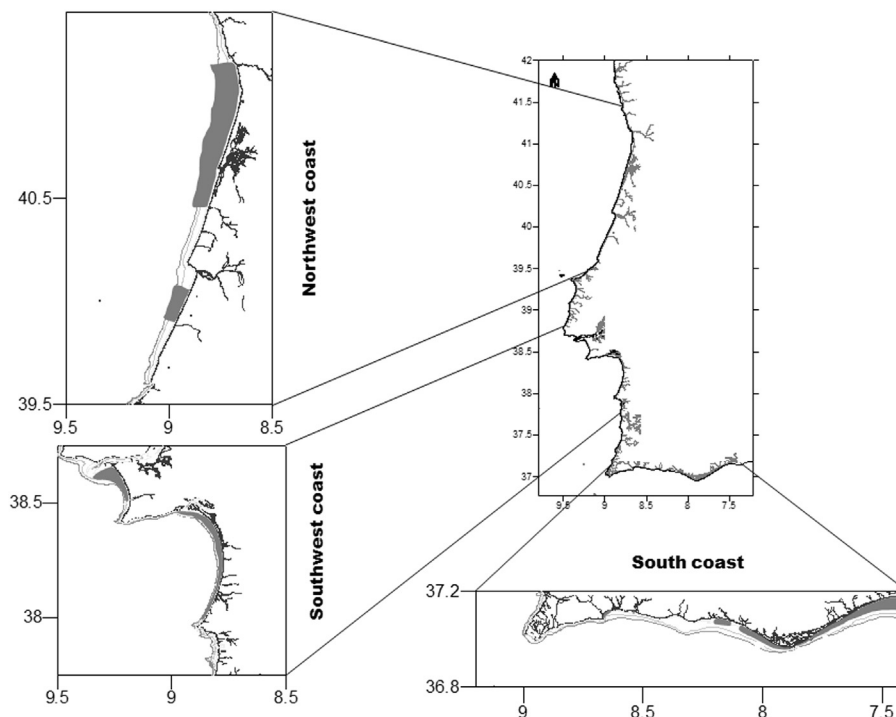

Fig. 1. Distribution of bivalve beds (gray areas) in the three fishing areas of mainland Portugal (A - Northwest area; B – Southwest area; C – South area).