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Importance of temporal and spatial factors in the ex-vessel price formation for red shrimp and management implications

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ABSTRACT

The importance of temporal (such as the day of the week, month and year) and spatial (port of origin, distance to main market) factors are measured in the price determination of a luxury seafood item, the red shrimp (*Aristeus antennatus*), using a hedonic price function. In hedonic analysis the price of a product is specified as a function of the attributes and factors that characterize the product, such as quality or origin. In this analysis there are used the daily ex-vessel data of red shrimp caught by the deep-water trawl fishery for the main fishing ports in Catalonia (North-West Mediterranean) for the period 2000–2012. Results show the importance of port of origin, seasonality, volume of landings and a decrease in price since 2008 due probably to the current world financial crisis. The day of the week, although of relatively lower importance in the models, shows that red shrimp prices are lower in Tuesdays and Wednesdays (14% lower than on Fridays). Management measures based on effort reduction in this input-controlled fishery could target these days when red shrimp price is lower in order to minimize the short-term adverse economic effect of effort reduction on the trawl fleet.

1. Introduction

Product prices depend on temporal and spatial factors. Considerable attention has been given to temporal fluctuations, especially daily price variations in the stock exchange [1–5]. However, little attention has been paid for other products such as seafood [6,7], even if it may have important policy implications.

A large number of fish stocks are overexploited worldwide [8–10] and reductions of fishing mortality on these stocks are often recommended [11,12]. Red shrimp (*Aristeus antennatus*) is not an exception an also overcapacity is estimated in the fishery [13]. Fishing mortality is often reduced through effort reductions, and this can be mainly done by decreasing the number of vessels or the fishing days.

Deep water red shrimps are one of the main fishery resources in Mediterranean fisheries in terms of landings and economic value [14,15]. Two species red shrimp species are caught by a specialized trawl fleet operating on the upper and middle continental slope: *Aristaeomorpha foliacea* and *A. antennatus*. The distribution of the two species varies geographically and in the NW Mediterranean catches are composed exclusively by *A. antennatus*. The biology and fisheries of *A. antennatus* is well known from many studies in recent decades, see. Orsi Relini [16] for a recent review, but economic or bioeconomic analyses have been very limited, even for the entire Mediterranean sea [13,17]. Its average ex-vessel price for the period 2000–2012 is more than 36 Euros, one of the highest seafood prices on first sale in Europe, and consequently red shrimp can be considered as a luxury product. The trawl fishery in Catalonia is regulated by input control and effort is controlled by limiting the time at sea: fishing is permitted for 12 h/day from Monday to Friday [13], stopping the fishing activity completely on weekends.

Therefore, one way to reduce effort could be to ban fishing another day a week (apart from Saturday and Sunday), and consequently allow fishing only 4 days a week, equivalent to a 20% effort reduction [18]. Because daily effects can be significant in some fisheries, it would be important to establish their relevance for a particular fishery, in order to determine which day of the week is better to ban the fishery.

There are many attributes and factors that can influence fish prices. They can be estimated using hedonic analysis, which specifies the price of a product as a function of the attributes that characterize the product [19].

Hedonic analyses have been previously conducted at the ex-vessel level to investigate the value of quality attributes such as freshness, size, fat content, colour and shape [20–22]; at the

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wholesale market to investigate the importance of fishing method, size and origin [23]; and at the retail level to investigate attributes such as product form, branding, eco-labels, packet size, species and origin [23–25].

In this paper it is used daily ex-vessel data by port in Catalonia for the period 2000–2012 to estimate the importance of temporal and spatial factors determining the formation of price in this luxury seafood item using a hedonic price function.

2. Methodology

2.1. Data

For this analysis it is used ex-vessel price and quantity data by port from the daily transactions where red shrimp (*A. antennatus*) was commercialized in Catalonia (North-West Mediterranean, see Fig. 1) for the period 2000–2012.

Prices higher than 80 €/kg or prices lower than 15 €/kg were excluded from the analysis to avoid the inclusion of outliers. This implied the exclusion of less than 1% of the higher and lower prices, resulting in almost 24,000 observations available for the analysis. Data used in the analysis is characterized in Fig. 2.

Each data observation is compounded of price, quantity landed, day of the week (Monday to Friday), month (January to December), year (2000 to 2012), port (Arenys de Mar, Barcelona, Blanes, l'Atmella de Mar, Llançà, Mataró, Palamós, Port de la Selva, Roses, Sant Carles de la Ràpita, Tarragona, Torredembarra and Vilanova i Geltrú) and travel time between the landing port and Barcelona wholesale market (from 25 to 146 min).

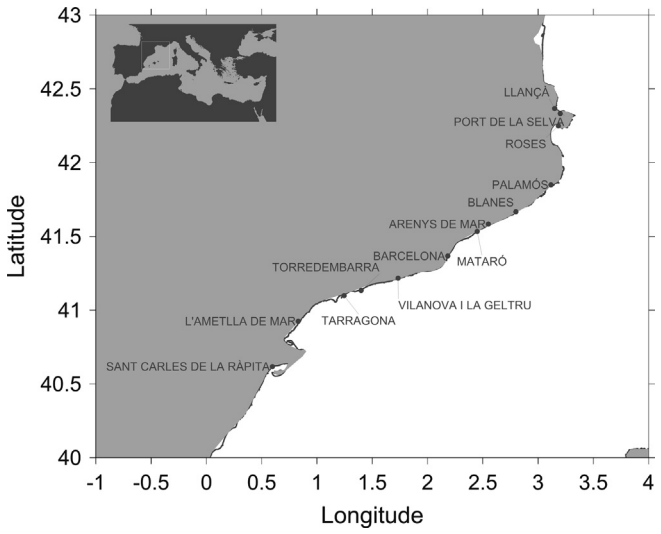

Fig. 1. Map of the area.

2.2. Statistical analysis

The hedonic model assumes that people select a product by equating the marginal utility of each attribute of the product to its marginal price, and consequently, there is a continuous function (the hedonic price function) relating the price of a good to its attributes. The model can be generally represented as:

$$P_{it} = f(a_1, \ldots, a_n) \tag{1}$$

where P_{it} is the price of good i at time t, and $A=(a_1,\ldots,a_n)$ is a vector of attributes that determines the price of the good. The following attributes are examined: total landings of red shrimp during the same day by the local fleet $landings_{it}$, port of origin $port_{ikt}$, year $year_{int}$, month $month_{imt}$ and day day_{ilt}.

As such, the function allows a test of the value of each attribute, given that all other attributes are held constant as well as the combined effect of a group of attributes. Each attribute j can be measured on a continuous scale or by a discrete (dummy) variable depending on its type. A multiplicative functional form has been assumed, and then the general linear mixed model (GLMM) to be estimated is specified as:

$$P_{it} = \beta_0 \times \beta_j landings_{it} \times \beta_k port_{ikt} \times \beta_l day_{ilt} \times \beta_m month_{imt} \times \beta_n year_{int} \times e_{it} \tag{2}$$

where i indexes the observation (price), k indexes the landing port, l indexes the day, m indexes the month, n the year, and e_{it} is a random error term.

An alternative GLMM model is estimated where the discrete variable port is replaced with a continuous variable: the travel time between the landing port and Barcelona wholesale market (the main wholesale market in the area).

$$P_{it} = \beta_0 \times \beta_j landings_{it} \times \beta_d time_{it} \times \beta_l day_{ilt} \times \beta_m month_{imt} \times \beta_n year_{int} \times e_{it} \tag{3}$$

where *time* is the travel time between the landing port and Barcelona wholesale market.

In this analysis, apart from the continuous variables: price, landings and travel time that are expressed in natural logarithms, all other factors are expressed as discrete (dummy) variables: day, month, year and port. This follows established methodology of the previous literature using GLMM and hedonic methods to estimate the marginal value of attributes of seafood products [20,21, 23–26], as well as the more general literature.

The constant term indicates the price for the base category: red shrimp commercialised in the port of Torredembarra on Tuesdays of March in the year 2000. The parameters are interpreted as the deviations in percentage from this base category. The combined effect of several attributes can be obtained by multiplying over the relevant parameters.

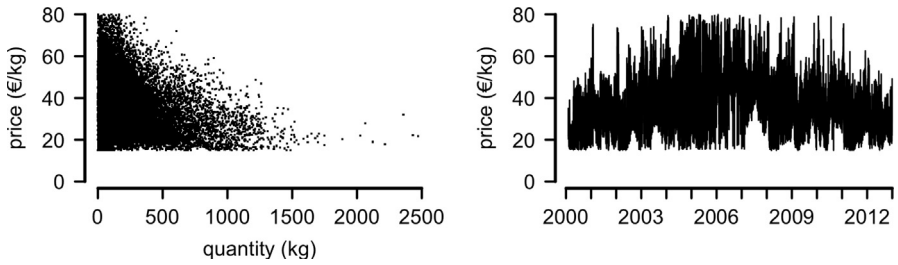

Fig. 2. Price quantity relation and price evolution over time of the data analyzed.