Marine Pollution Bulletin xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Pollutants and parasites in bycatch teleosts from south eastern Spanish Mediterranean's fisheries: Concerns relating the foodstuff harnessing

Margarida Casadevall [a,*], Jordi Torres [b], Ahmed El Aoussimi [c], Ana Carbonell [d], Eulàlia Delgado [a], Lídia Sarrà-Alarcón [a], Cristina García-Ruíz [e], Antonio Esteban [f], Sandra Mallol [c], José María Bellido [f]

[a] Universitat de Girona, Departament de Ciències Ambientals, Facultat de Ciències, Campus Montilivi, 17071 Girona, Spain
[b] Universitat de Barcelona, Departament de Microbiologia i Parasitologia Sanitàries, Av. Joan XXIII, 08028 Barcelona, Spain
[c] Universitat Politècnica de València, DIHMA, Camino de Vera s/n, 46021 València, Spain
[d] Instituto Español de Oceanografía, Centro Oceanográfico de Baleares, Muelle de Poniente s/n, 07015 Palma de Mallorca, Spain
[e] Instituto Español de Oceanografía, Centro Oceanográfico de Málaga, Puerto Pesquero s/n, 29640 Fuengirola, Málaga, Spain
[f] Instituto Español de Oceanografía, Centro Oceanográfico de Murcia, C/ Varadero 1, 30740, San Pedro del Pinatar, Murcia, Spain

ARTICLE INFO

Article history:
Received 19 October 2015
Received in revised form 21 January 2016
Accepted 25 January 2016
Available online xxxx

Keywords:
Fisheries
Bycatch
Heavy metals
Toxicology
Parasitism
Feeding habits

ABSTRACT

This research provides an evaluation of the quality and health status of some locally abundant fish species, usually otter-trawl bycatch species. The study was conducted in the southern and eastern Spanish Mediterranean coast. Mean concentration of heavy metals in muscle and parasitisation indices showed moderate levels. Higher lead concentration was found in fish from the western Alboran and arsenic, cadmium and mercury were more present on fishes from the eastern Alboran area, although most species analysed contain moderate levels of heavy metals in muscle. Concerning parasitisation, F. Anisakidae nematodes were present in all the species, except sardine. Only mercury showed a positive relationship with parasitisation.

We also considered three feeding guilds. Metal mean concentrations were higher in benthivores and more littoral fishes. Pelagic planktivores species are the healthiest and the more suitable for consumers from the sanitary point of view.

1. Introduction

Fish discards and by-catch issues are highly topical subjects that are permanently under a social focus. In Europe, several measures have been enforced by the European Commission to reduce the practise of discarding. According to Uhlmann et al. (2013), variability in discard rates for most species across regions was greater than across fisheries, suggesting that a region-by-region approach to discard reduction would be more relevant. In the Spanish Mediterranean the discarded fraction of otter-trawl catches ranges from 20 to 70% by weight, mainly depending on the area and the depth of trawling (Carbonell et al., 1998; Carbonell and Mallol, 2012). Of the 300 species caught by otter-trawl fishery, only around 10% are consistently marketed and 30% are occasionally retained (depending on the sizes and market demands), whereas up to 60% are always discarded (Bellido et al., 2014). Understanding reasons for discarding and factors affecting discarding (Rochet and Trenkel, 2005; Bellido et al., 2011; Feekings et al., 2012) is an important step towards the management of the discards ban issue.

On the other hand, interest in increased bycatch valorisation may arise from a greater demand of fish products, and the use of low-value species for fishmeal, seafood or pharmaceutical and cosmetic products. However, contaminants present in bycatch and discards may be transferred to their valorised products, leading to possible long-term bioaccumulation and subsequent adverse health effects (Antelo et al., 2012).

Of the various environmental contaminants, metals and metalloids are among the most commonly accumulated toxins in fish and seafood which can lead to health effects when consumed in amounts, exceeding safe consumption levels and metals such as cadmium, arsenic, mercury and lead predominate (Llobet et al., 2003). Considering their potential harmful effects to consumers, they will be the metals of focus in the current paper.

Heavy metal concentrations are species, location and trophic level dependent (Bosch et al., 2015). In fact, Burger et al. (2014) showed the effects of various external (marine environment) and internal (fish carcass parameters) factors to variation in metal accumulation and inter-metal correlations within and among fish species, locations and seasons. Additionally, some species living on the sediment (benthic organisms) directly uptake pollutants by contact with sediment particles, apart from the feed uptake (Berge and Brevik, 1996).

* Corresponding author.
E-mail addresses: margarida.casadevall@udg.edu (M. Casadevall), jtorres@ub.edu (J. Torres), ahelao@upv.es (A. El Aoussimi), ana.carbonell@ba.ieo.es (A. Carbonell), eulalia.delgado@udg.edu (E. Delgado), u1903397@correu.udg.edu (L. Sarrà-Alarcón), cristina.garcia@ma.ieo.es (C. García-Ruíz), antonio.esteban@mu.ieo.es (A. Esteban), sandra@ba.ieo.es (S. Mallol), josem.bellido@mu.ieo.es (J.M. Bellido).

http://dx.doi.org/10.1016/j.marpolbul.2016.01.040
0025-326X/

The fishing area must also be taken into consideration. Industry impacts on marine resources are numerous and diverse; among the most current and extended are the energy production, metal industry, urban wastewater and chemical treatments (UNEP/MAP, 2012). This industrial activity in the Mediterranean is highly concentrated in the northern-western part. However, in the study area a pollution 'hot spot' is located in the border between Vera and Alicante Gulf. Moreover, some heavy metals would have a natural origin, being its distribution independent from the human activities. For example, high levels of mercury could also be explained by proximity to volcanic and geothermal sources (Bernhard, 1988). Along the Southern coast of Spain, relatively high levels of cadmium were recorded in biota at sites of Alboran Sea (Cabo de Gata) and Vera Gulf (Cartagena), probably due to an ancient intense mining activity (UNEP/MAP, 2012).

Parasitism is another source of concern for both, fish population health and human consumer's safety. Some helminth parasites, particularly the nematodes of the family Anisakidae, can cause digestive disorders and/or allergies in consumers. The European Food Safety Authority (EFSA, 2010) recommends the collection of systematic data on the complete life cycle, geographical and seasonal distribution, prevalence, intensity, and anatomical location of parasites of public health importance in wild caught fishery species.

Healthier fish populations would be more resistant to parasites infections. In contrast, the capacity of some fish helminth parasites to bioaccumulate heavy metals has been widely demonstrated and it seems that some parasites (i.e. Cestoda, Acanthocephalans) and heavy metal pollutants might exert antagonistic reactions over the hosts (Sures, 2003). Thus, and according to Sures (2008), the effects of simultaneously occurring parasites and pollutants can be additive, synergistic or antagonistic and that they cannot be predicted easily.

The present study of the pollutants and parasites on some fish communities, contributes to the healthiness knowledge of the bycatch in the otter-trawl fishery of the southern and eastern Mediterranean Iberian regions. The aim was to assess the accumulation of pollutants in the muscle of some locally abundant fish species, with a secondary commercial interest, in order to valorise their quality status and analyse the relationship with the fishing zone, the feeding guilds and the parasite infection.

2. Material and methods

2.1. Study area

The study area comprises the southern and eastern Spanish Mediterranean coast (Fig. 1). The study sites were from the Gibraltar Strait to the Alicante Gulf in the western Mediterranean, between 36° and 40° North and 5° West and 1° East. Mediterranean countries integrated in the General Fisheries Commission for the Mediterranean (GFCM), established sub geographical areas (GSAs) to assess the fishery resources. These areas have been established considering the fleet characteristics, geomorphology and hydrodynamic environments, which affect the composition of fishing catches and the relative biomass of target and bycatch species.

Thus, in this study the areas are comprised in the Alboran Sea, Vera Gulf (VG) and the Alicante Gulf (AG) corresponding to two geographical GFCM subareas: the GSA1 (Alboran Sea and Vera Gulf) and GSA6 (Alicante Gulf), which were considered by the analysis purposes. Inside the GSA1 three subzones were established from the western to the eastern corresponding to the: 1) Western Alboran (WA) in the westernmost point of the Mediterranean Sea influenced by an upwelling area; 2) the Eastern Alboran (EA) characterised by habitats and associated communities influenced by the plume Andarax river; and 3) the Vera Gulf (VG). The GSA6 corresponds to the latter area: 4) the Alicante Gulf (AG). In the study area, a pollution 'hot spot' is located in the border between VG and AG (UNEP/MAP, 2012).

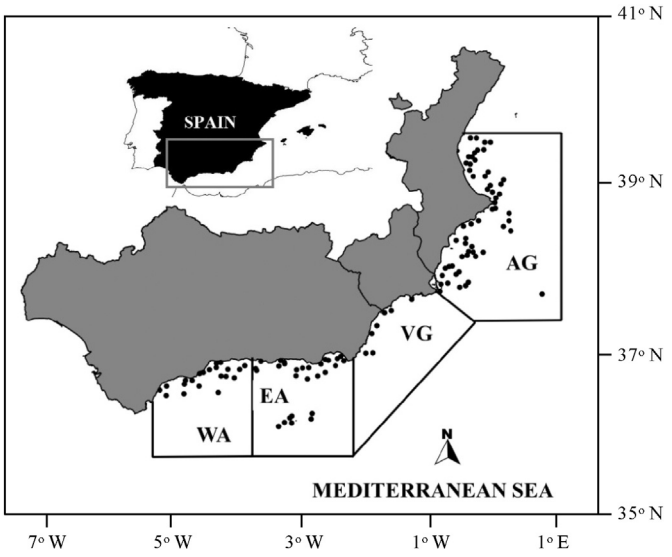

Fig. 1. Map of the study area showing the four subareas (WA: western Alboran; EA: eastern Alboran; VG: Vera Gulf and AG: Alicante Gulf) and the location of sampled hauls sites (black spots).

2.2. Data collection and sampling

Samples used to quantify heavy metals were obtained and stored frozen during the 2014 MEDITS survey programme (International bottom trawl survey in the Mediterranean), a regular trawl sampling survey conducted along the Spanish Mediterranean Coast by the Spanish Institute of Oceanography (IEO). MEDITS surveys (2013), intend to produce basic information on benthic and demersal species in terms of population distribution as well as demographic structure, on the continental shelves and along the upper slopes at a global scale in the Mediterranean Sea.

According to the MEDITS standardised protocol (Bertrand et al., 2002), the surveys take place in spring, since 1994, every year. Sampling stations were chosen by applying a stratified random sampling scheme, using depth as the stratification parameter, to define the following bathymetric limits: 30, 50, 100, 200, 500 and 800 m. The haul duration is 30 min at depths lower than 200 m and 60 min at greater depths. The gear used for sampling is a bottom trawl gear (GOC-73) designed for experimental purposes and with a codend mesh size of 20 mm (stretched mesh), average vertical opening of 2.5 m and average horizontal opening of 18.5 m. Samples were collected at a mean towing speed of 3 knots.

Species studied (Table 1) were selected according to their importance in trawl captures, by quantities or because they are species valued by the market and discarded by management regulations of minimum conservation reference size ((EC) No 1967/2006). In total we selected ten species grouped into three categories by their feeding guilds: i) planktivores, epipelagic species such as sardine (*Sardina pilchardus*) and European anchovy (*Engraulis encrasicolus*); ii) plankto-piscivores species, with a mixed diet, epipelagic like horse mackerel and mackerel species (*Trachurus trachurus* and *Scomber scombrus*), and mesopelagic species like blue-whiting (*Micromesistius poutassou*); and iii) benthivores demersal species, like sparid species (*Pagellus bogaraveo*, *Pagellus erythrinus*, *Pagellus acarne*, *Diplodus annularis* and *Diplodus vulgaris*).

For each specimen sampled, the station depth and geographical position were recorded, as well as their biological parameters of length and weight. A portion of muscle tissue, between 150 and 200 mg wet weight (ww) was extracted and frozen stored, in order to analyse the muscular concentration of potentially toxic elements (As, Cd, Pb and Hg). These samples were digested in Teflon vessels with HNO_3 (2 ml)

Please cite this article as: Casadevall, M., et al., Pollutants and parasites in bycatch teleosts from south eastern Spanish Mediterranean's fisheries: Concerns relating the foodstuff harnessing, Marine Pollution Bulletin (2015), http://dx.doi.org/10.1016/j.marpolbul.2016.01.040