

## Mislabelling and species substitution in fishery products retailed in Sardinia (Italy), 2009-2014

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### Abstract

Mislabelling and species substitution are major concerns for fishery products marketed in the EU. The present survey aimed to investigate the correct enforcement of the Community and National rules on the labelling and marketing of fishery products retailed in Sardinia (Italy) between 2009 and 2014. A total of 3000 labels for fresh unpacked fishery products have been considered. A total of 900 labels (30%) presented non-compliance concerning the wrong trade name, the wrong or missing information about the catch area and the production method. The highest percentage of mislabelling and species substitution has been detected in open-air markets (65%) and small-scale retail shops (40%) compared with the big supermarket chains (10%). The high percentage of non-compliances with the European and Italian legislation highlights the need to improve the essential information demanded by consumers on fishery products marketed in open-air markets and small-scale retail shops. While there are laws in place, it is unclear how effective they are and what type of penalties food business operators of open-air markets and small-scale retail shops may incur.

### Introduction

Global fish capture has grown steadily in the last five decades and the production of 93.7 million tons in 2011 was the second highest ever (93.8 million tons in 1996). Moreover, excluding anchoveta (*Engraulis ringens*) catches, 2012 showed a new maximum production (86.6 million tons) (FAO, 2014). The demand for fishery products is growing rapidly especially in emerging markets and today, fish is one the most traded food commodities, often crossing multiple national boundaries on its journey from production to consumption (Kaimakoudi *et al.*, 2014). World per capita apparent fish consumption increased from an

average of 9.9 kg in the 1960s to 19.2 kg in 2012. This impressive development has been driven by a combination of population growth, rising incomes and urbanisation, and facilitated by the strong expansion of fish production and more efficient distribution channels (FAO, 2014). The EU is the largest single fish market, with imports amounting to US\$ 47.0 billion and representing 36% of total world imports on a quickly rising trend (FAO, 2014). The fishery products imported in Europe come from more than 120 countries from all over the world: the EU puts high demands on products, regarding product quality, fishing, processing and traceability along the supply chains, which is increasingly important to meet food safety and sustainability requirements and standards (Asensio and Montero, 2008; Maralit *et al.*, 2013; FAO, 2014). There are over 1200 species traded in the EU with great diversity in appearance, presentation, quality and safety that must be known and recognised properly by consumers (Galal-Khallaf *et al.*, 2014; EUMOFA, 2014). In the trading of these products consumers need to have sufficient and reliable details about fishery products origin and other essential characteristics (Pieniak *et al.*, 2011). Mislabelling in fishery products marketed in the EU occurs frequently and in different forms, as well as at any stage in the supply chain (Rasmussen and Morrissey, 2008; Logan *et al.*, 2008; Filonzi *et al.*, 2010). A part of mislabelling that occurs is probably unintentional as fishery species identities may be easily incorrect. Morphological characteristics represent the first and obvious line for fishery products identification (Bottero and Dalmaso, 2011). However, consumers are not able to identify the fish species when diagnostic traits are absent, such as in the case of fish fillets (Galal-Khallaf *et al.*, 2014). Confusion may also arise due to the fact that various fishery species can be referred to by common slang names in different regions (Buck, 2009). Non-detailed labelling or mislabelling may cause consumers' misunderstanding: in order to protect consumer's rights, regulations related to fishery products labelling are essential (Asensio and Montero, 2008). Between 2009 and 2014, labelling of fishery products marketed in Italy has been regulated by European and Italian legislation. Commission Regulation (EC) 2065/2001 (European Commission, 2001) provided the detailed rules for consumer information about certain fishery and aquaculture products through improved marking or labelling at retail level. Subsequently, Council Regulation (EC) 1224/2009 (European Commission, 2009) stated that Member States shall ensure that these requirements are available to the consumer at retail stage sale. The following information is indicated on the label or appropriate mark of the fisheries and aquaculture products offered

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for retail sale, including imported products.

First, the trade name: the Member States shall draw up and publish a list of the commercial designations accepted in their territory. The current list of trade names for all fishery products marketed in Italy is included in the Italian Ministerial Decree of the Ministry of Agriculture of August 12, 2011 *Italian name of fish and shellfish species supplementing and amending the list annexed to the Ministerial Decrees of January, 31, 2008 and December, 23, 2010* (IMAFFP, 2011).

Second, the relevant geographical catch area: the origin of products caught at sea must be indicated by reference to one (or more, if appropriate) of 12 catch areas based on FAO statistical classifications (Asensio and Montero, 2008; D'Amico *et al.*, 2014). The origin of products caught in freshwater must be indicated referring to the Member State or third country of origin (Asensio and Montero, 2008; D'Amico *et al.*, 2014).

Third, the production method: relevant information on products caught at sea or in freshwater must be given using the terms *caught* or *caught in freshwater* (Asensio and Montero, 2008; D'Amico *et al.*, 2014). Fourth, the scientific name: Council Regulation (EC) 404/2012 (European Commission, 2012) stated that the scientific name of the species may be provided to the consumer at the retail level by means of commercial information such as bill boards or posters. The Community and National rules on the labelling and marketing imply that all the fishery products marketed in Italian fish retail shops must be labelled with the trade name of the species, the catch area and the production method. This information is demanded by consumers and it is essential because of fresh fishery products are a perishable food with different origins (Asensio and

Montero, 2008). On the basis of this information, the aim of the present survey was to investigate the correct enforcement of the Community and National rules on the labelling and marketing of fishery products retained in open-air fish markets, small-scale retail shops and fish shops from supermarkets chains in Sardinia (Italy) between 2009 and 2014. We performed a study on fresh unpacked fishery products with the respective labels to verify if the compulsory information included on fishery products labels (trade name, catch area and production method) is correctly provided at the retail sale stage. To assess the conformity of the fishery products with the trade name reported in the labels, a preliminary visual inspection of the samples by morphological analysis was performed.

## Materials and Methods

### Sample collection

The survey was carried out between 2009 and 2014 by using the method of digital photo documentation. Overall, photographs of 3000 fresh unpacked fishery products (fish, cephalopods and crustaceans) whole or filleted with the respective labels in view, were taken at the retail sale stage (Table 1) with the following digital cameras Nikon Coolpix L3, E8800, D3100 (Nikon Corp., Tokyo, Japan) and Fujifilm FinePix A800 (Fujifilm Corp., Minato, Tokyo, Japan). In more detail, n. 1500 labels have been considered at the fish shops of 10 big supermarkets linked to international supply chains and n. 900 at 40 local small-scale retail shops located in the province of Sassari. The remaining n. 600 labels have been considered at 3 open-air fish markets located in the cities of Cagliari, Sassari and Alghero (SS). The species of fresh unpacked fishery products included in the study were selected among the most caught and marketed species in Sardinia according to the reports of the Institute of Economic Research for Fisheries and Aquaculture for the years 2009, 2010 and 2011 (IREPA, 2010, 2011, 2012). To assess the conformity of the fishery products with the trade name reported in the labels, a preliminary visual inspection of the samples by morphological analysis was performed, followed by the accurate analysis of the photographs according to the identification schemes provided by Manzoni and Tepedino (2008) for fish species and Manzoni (2010) for cephalopods and crustaceans species.

### Traceability and accuracy of European Union and Italian labelling

Relevant information on labelling traceability (trade and scientific name, geographical catch

area and production method) was examined according to Commission Regulation (EC) 2065/2001 and (EC) 1224/2009 (European Commission, 2001, 2009). In accordance with D'Amico *et al.* (2014), the accuracy of Italian labels was assessed according to the Italian Ministerial Decree of the Ministry of Agriculture of August 12, 2011 *Italian name of fish and shellfish species supplementing and amending the list annexed to the Ministerial Decrees of January, 31, 2008 and December, 23, 2010*. The presence of mislabelling and species substitution has been expressed as a percentage of total fishery products and labels examined and was also evaluated with respect to its distribution in the different typology of retail shops.

## Results and Discussion

Visual inspection of the fishery products by morphological analysis together with the analysis of the respective labels enabled us to highlight that out of the 3000 examined labels between 2009 and 2014, n.900 (30%) were not in compliance with the Community and National rules on the labelling and marketing of fishery products (Table 2). Our results highlighted the highest percentage of non-compliances in the 600 labels examined at the open-air fish markets (65%) and in the 900 labels examined at the small-scale retail shops (40%). The non-compliances detected in the 1500 labels examined at the big supermarket chains accounted for 10%. The prevalent non-compliances on labelling were related to the incorrect or incomplete indication of the official trade name as provided by the Italian Ministerial Decree of the Ministry of

Agriculture of August 12, 2011 *Italian name of fish and shellfish species supplementing and amending the list annexed to the Ministerial Decrees of January, 31, 2008 and December, 23, 2010*.

### Fish species

Among filleted fishery products, the most frequent case of mislabelling and species substitution regarded *Lates niloticus* (Nile perch) specimens marketed as *Perca fluviatilis* (European perch). Nile perch is the most important commercial fish species in East Africa (Muyonga *et al.*, 2004) and its aquaculture is highly valuable (Hassan *et al.*, 2013). In the EU markets is a species of considerable interest and is regularly present both whole and filleted. According to previous studies (Galal-Khallaf *et al.*, 2014) in Nile perch, mislabelling was frequently associated with wrong or missing information about the catch area and the production system (Figure 1). Nile perch is one of the most diffused species in fish frauds and in the latest years was subjected to repeated commercial prohibitions, because of its provenience from polluted African waters (Filonzi *et al.*, 2010). Frequent cases of mislabelling and species substitution among whole fishery products regarded the marketing of *Mullus barbatus* (Red mullet or Goatfish) and *Pseudupeneus prayensis* (Red mullet or Goatfish) as *Mullus surmuletus* (Striped red mullet). The striped red mullet is of great commercial interest in the Mediterranean seafood markets, where it is commonly marketed fresh. The striped red mullet is easily identifiable because of the coloration from reddish to scarlet-red with a longitudinal red or orange strip from the eye to the caudal fin. Moreover, the first dorsal fin

**Table 1. Total of labels included in the survey and distribution according to typology of retail stores.**

Typology of retail stores	Retail stores (n)	Labels according to typology of retail stores (n) (Tot=3000)
Fish shops of supermarkets	10	1500
Local small-scale retail shops	40	900
Open-air fish markets	3	600

**Table 2. Total number and percentage of mislabelling and species substitution in fishery products according to typology of retail stores.**

Typology of retail stores	Retail stores (n)	Mislabelling and species substitution according to typology of retail stores (n and %) (Tot=900; 30%)
Fish shops of supermarkets	10	150 (10%)
Local small-scale retail shops	40	360 (40)
Open-air fish markets	3	390 (65%)

presents two dark transverse bands (Figure 2). Less important in terms of commercial value of the species, but also very common in Sardinian fish markets, was the marketing of *Spicara flexuosa* (Picarel) and other species belonging to the *Spicara* genus and *Centracanthidae* family instead of *Centracanthus cirrus* (Curled picarel). The

Picarel presents a rectangular black spot between the lateral line and the top edge of the pectoral fin. The Curled picarel presents reddish-brown coloration dorsally and white-silver ventrally. The dorsal and pectoral fins are rose colored. A circular black spot is present at the bottom of the pectoral fins. Very often, the two different species are marketed mixed in the

same batches and without the compulsory information (Figure 3).

### Cephalopods species

Frequent non-compliances of labelling and species substitution regarded *Illex coindetii* (Broadtail shortfin squid) and other non-Mediterranean squids marketed as *Loligo vulgaris* (European squid) or *Octopus Cyanea* (Big blue octopus) and other Indopacific Octopuses marketed as *Eledone cirrhosa* (Horned octopus). Minor non-compliances regarded the frequent use of the *local* and *dialectal* identification names instead of the official trade names for several fishery species marketed whole in the local small-scale retail shops and open-air markets (Figure 4). Where applicable, Member States shall indicate, any other name or names that are accepted or permitted locally or regio-



Figure 1. Mislabelling and wrong information about the catch area and the production system in Nile Perch marketed in a big supermarket chain.



Figure 3. Picarel and Curled picarel mixed in the same batch and marketed without the compulsory information in an open-air fish market.



Figure 2. Morphological identification of a striped red mullet marketed in a small-scale retail shop by means of the presence of the two dark transverse bands in the first dorsal fin.



Figure 4. Use of the *dialectal* identification name for Cephalopods marketed in an open-air fish market.

nally together with the name of the fishery species in the official language or languages of the Member State designated as trade name. In the list of the trade names accepted in Italy together with their scientific names, any other names accepted or permitted locally or regionally were reported.

### Crustaceans species

In Sardinian fish markets frequent non-compliances of species substitution regarded *Metanephrops australiensis* (Northwest lobster), *Metanephrops rubellus* (Urugayan lobster) and *Metanephrops challengerii* (New Zealand lobster) marketed as *Nephrops norvegicus* (Norway lobster). Very often, mislabelling and species substitution is associated with wrong information about the production system, as in the case of *Penaeus japonicus* (Kuruma prawn) specimens marketed as *Penaeus kerathurus* (Caramote prawn). Kuruma prawn is an important farmed species in Southeast Asia, Australia and in the Mediterranean area.

### Conclusions

Looking at the results of the present survey, it can be said that they are in agreement with previous studies carried out in Italy and Spain (Orefice *et al.*, 2005; Asensio and Montero, 2008; Campagna *et al.*, 2011; Dambrosio *et al.*, 2012). Fishery products labelling information is more complete in big supermarket chains than in open-air fish markets and small-scale retail shops and, as a rule, the smaller is the fishery products shop the more incomplete is the information (Asensio and Montero, 2008). The lowest percentage of non-compliances detected at the big supermarkets linked to international supply chains should be related to the greater information transmission along this trading circuit than the other fishery stores (Asensio and Montero, 2008), to the strict procedures for the referencing of the suppliers and to the specific training programs of the respective staff in charge (Dambrosio *et al.*, 2012). In order to reduce the presence of problems in labelling in the fish shops at the retail stage, Food Business Operators should correctly identify and carefully store the information they receive in writing either on a label on the packaging or on the accompanying invoices. Subsequently, this information should be reported on the label in the fish shops (Frederiksen and Bremmer, 2001; Pérez-Villareal *et al.*, 2003). The non-compliances highlighted in this study are in deep disagreement with the aim of the Community and National legislation on traceability and marketing of fishery products, which is to provide all

the essential information to the consumers (Asensio and Montero, 2008; Armani *et al.*, 2012). Labels help consumers to consciously choose a product according to desirable qualities, so it is, nowadays, the most efficient and affordable way to provide information about the product and the most influential point in the customer's decision of purchasing and consuming (Brom, 2000). Moreover, mislabelled fishery products can represent a health concern when toxic species are marketed (Civera, 2003). As reported in other international markets where has been revealed fishery products mislabelling (Von der Heyden *et al.*, 2010; Barbuto *et al.*, 2010; Crego-Prieto *et al.*, 2012; Espiñera and Vieites, 2012; Di Pinto *et al.*, 2013; Maralit *et al.*, 2013; Cutarelli *et al.*, 2014; Di Pinto *et al.*, 2015), the results of the present survey confirm that species substitution is a generalized practice worldwide and pointed out the need for an improvement of the control system about labelling of fishery products retailed in Sardinia (Italy). Food business operators must be appropriately trained on correct labelling and marketing of fishery products. They should be aware of the potential consequences resulting from mislabelling and of the penalties provided by the Community rules in case of commercial frauds resulting from species substitution. To the best of our knowledge, this is the first survey reporting data on mislabelling and species substitution in fishery products retailed in Sardinia (Italy). In the next future, further studies focusing on application of reliable and effective methods such as those based on DNA barcoding (Ogden, 2008; Filonzi *et al.*, 2010; Di Pinto *et al.*, 2013; Galimberti *et al.*, 2013; Pappalardo and Ferrito, 2015; Armani *et al.*, 2015) are needed in order to reveal increasing fishery products mislabelling in our region.

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