Nationwide survey of the Bulgarian market highlights the need to update the official seafood list based on trade inputs

Lara Tinacci[1*#], Deyan Stratev[2#], Georgi Zhelyazkov[3], Ralitsa Kyuchukova[2]; Mariyana Strateva[4]; Daniele Nucera[5], Andrea Armani[1]

[1]*FishLab, Department of Veterinary Sciences, University of Pisa, Via delle Piagge 2, 56124, Pisa (Italy);*
[2]*Department of Food Hygiene and Control, Veterinary Legislation Management, Faculty of Veterinary Medicine, Trakia University, 6000 Stara Zagora, Bulgaria;*
[3]*Department of Biology and Aquaculture, Faculty of Agriculture, Trakia University, 6000 Stara Zagora, Bulgaria;*
[4]*Department of Veterinary Anatomy, Histology and Embryology, Faculty of Veterinary Medicine, Trakia University, 6000 Stara Zagora, Bulgaria*
[5] *Department of Agriculture, Forest and Food Science, University of Turin, Largo Braccini 2, 10095, Grugliasco - Torino (Italy).*

[#] These authors equally contributed to this work

Corresponding author: Lara Tinacci, *Department of Veterinary Sciences, University of Pisa, Via delle Piagge 2, 56124, Pisa (Italy).*
Email: lara.tinacci@unipi.it

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Abstract
An extensive survey of the Bulgarian seafood market was conducted to assess the diversity of fish products available and to compare the provided commercial designations (CDs) and scientific names (SNs) on the products with those on the Bulgarian official seafood designations list, in light of the requirements of Regulation (EU) No. 1379/2013 on seafood labelling. The survey was conducted in 15 different towns belonging to three different geographical macro-areas: North, North-east/South-east and South/South-west. Seventy-one points of sale, including both large and local retailers, were included in the study. In total, 1611 different products were recorded on the market, mostly comprising fresh, frozen and canned fish. Analysis of the product designations showed the presence of 110 different CDs, most of which (n=43, 39.1%) were not associated with any SN. Forty-seven (42.7%) of the 110 CD were compliant with the current EU legislation on seafood labelling, reporting a descriptive common name. A highly significant difference was found in the percentages of non-compliant designations of fresh (57.3%) and frozen (3.9%) product categories (p-value < 0.00001). Overall, the main concerns highlighted regarded the presence on the market of CDs and SNs not included in the official list, thus highlighting the ineffectiveness of the list in supporting fish traceability. CDs already accepted at retail and currently applied throughout the country could represent a starting point to propose an update of the list based on trade inputs, as established by the Regulation (EU) No. 1379/2013.

Keywords
Common Fisheries Policy, Seafood labelling, Bulgaria, Commercial designations, EU seafood market

1. Introduction

Traceability is defined as the ability to trace and follow a food product through all stages of production, processing and distribution, in order to guarantee its forward and backward tracking through the supply chain and control safe and fair trade (Regulation EC No. 178/2002). Preserving the integrity of a traceability system is a complex and challenging endeavour especially in the seafood sector, which is recognized as the third-highest risk food category exposed to illegal practices (Reilly, 2018). Fraudulent incidents within the seafood sector primarily involve species substitution and counterfeit and are generally elicited by inaccurate labelling or utilization of vague or unclear commercial designations. Their occurrence, other than having a general impact on the supply chain, affects the marine environment and possibly consumers' health (Reilly, 2018, Giusti et al., 2018; Stawitz et al., 2017).

The Common Fisheries Policy (CFP) of the European Union (EU) was established to create an effective system to monitor fishery and aquaculture sustainability and constitutes a legislative framework to control seafood authenticity and enhance consumer protection and market transparency. In particular, with the enactment of the Regulation (EU) No. 1379/2013, specific attention was paid to the establishment of a harmonized and compulsory seafood labelling model to enable informed consumer choice (D'Amico et al., 2016). More specifically, with respect to the attribution of product trade names, the single Member States are required to draw up, publish and periodically update a list of the commercial designations (CDs), associated with their scientific names (SNs), accepted in their territory. According to the Article 37 of the aforesaid Regulation, the officially accepted CD may be the name of the species in the official language or languages of the Member State concerned or, where applicable, any other name accepted or permitted locally or regionally. SNs are instead assigned in accordance with the FishBase Information System (Froese and Pauly, 2000) or the Food and Agriculture Organization (FAO) Aquatic Sciences and Fisheries Information System (ASFIS) database (Garibaldi & Busilacchi, 2002). On the basis of Regulation (EU) No. 1379/2013, the single Member States are explicitly called upon to update their list on the basis of trade inputs and in response to the expansion of the variety of species, present, in transit or permanently introduced on the national market. The update is essential to guarantee the clear recognition of the products by consumers and the harmonization of commercial designations within national borders. The Regulation also specifies that any change to the list has to be communicated to the Commission, which is responsible for informing the other Member States. However, since the national lists are compiled independently, this delegation system leads to a disparity in information and number of designations between the lists of the different Member States. For this purpose, the Commission has initially provided an information system gathering all the official national lists accepted in the Member States. A multilingual tool has also been created to facilitate the comparison of all the lists (the lists and the multilingual tool are available at the following links https://ec.europa.eu/fisheries/cfp/market/consumer-information/names_en and https://mare.istc.cnr.it/fisheriesv2/home_en).

Even though the seafood sector still represents a marginal area of the Bulgarian economy, a gradual and progressive growth has been observed in the last years. In fact, seafood consumption estimates have gradually increased from 3 kg per capita in 1990-2000s to 4.9-5 kg per capita in present days (EUMOFA, 2018; Todorov, 2019). In this respect, the number of species available for purchase has consistently increased together with product imports and aquaculture rates, in spite of a slight decrease in domestic Black Sea catches (Todorov, 2019; Stancheva, 2018). Currently, the Bulgarian consumers' choice is widened by local marine and freshwater products (sprat, red mullet, goby, turbot, carp, perch) and mid- and high-end marine and freshwater products, such as cod, hake, mackerel, salmon, tuna, trout and catfish, mainly deriving from European and international trade, as well as from recently developed Bulgarian aquaculture plants (Todorov, 2019). Despite this, the Official Bulgarian list first published in 2006 (Ministry of Agriculture and Forestry, 2006) and based on the principal commercial species available at that time on the national market, has never

been updated. The recent work of Tinacci et al., (2018), aimed at identifying fish species sold on the Bulgarian market by DNA barcoding, highlighted that the Bulgarian list does not fully correspond with the actual variety of fish species sold within the national territory.
This considered, in the present study, a nationwide market survey aimed at assessing the current fish products availability on the Bulgarian market and at comparing the CDs and SNs found on the products with those on the Bulgarian official seafood list, was conducted. Data arising from the survey were analysed and used to propose a functional update of the Bulgarian official list of seafood designations based on trade inputs.

2. Materials and Methods

2.1 Selection of survey geographical areas and retail channels

In order to perform an extensive market survey throughout the national territory, the country was preliminarily divided into three macro-areas based on the classification proposed by Popescu (2011) and corresponding to: 1) North region (NR) bounded externally by the course of Danube, 2) North east to South-east region (NE-SER) mainly extending along the Black Sea coastline and partially overlooking the border with Turkey 3) South to South-west region (S-SWR) including the Country capital city and overlooking the border with Greece (Figure 1). Then, 15 provincial capital cities (five per macro-area) were selected for the survey according to their size and to the presence of fishery and/or aquaculture activities. In particular, Vidin, Pleven, Veliko Tarnovo, Ruse, Silistra were selected for the NR, Dobrich, Shumen, Varna, Sliven, Burgas for the NE-SER and Kardjiali, Haskovo, Plovdiv, Blagoevgrad, Sofia for the S-SWR.
The selection of the retail channels was carried out through a preliminary online search highlighting a variable distribution of large and local fishery retailers according to fishery and aquaculture activities relevance within the three macro-areas (Popescu, 2011). The following retail channels to the final consumers (as defined by the Article 5 of the Regulation (EU) No. 1379/2013) were included in the survey: large-scale retail trade, local grocery stores and local fish markets located in each selected city. Restaurants, caterers, and ready to eat local vendors were not included. Seventy-one points of sales consisting of 49 wholesale markets, hypermarkets and supermarkets belonging to four different large retail chains, 11 local grocery stores and 11 local fish markets were finally selected (Table 1).

2.2 Data collection and analysis

During the survey, carried out from April to July 2019, all the fish products presented on sale within each point of sale were checked. In particular, the product category (fresh, frozen, canned, marinated, breaded precooked, dried, alive fish, smoked, salted) as well as the CD and the SN were recorded for each product and organized in an excel sheet. The data were subsequently analysed to:
1) calculate the total number of products and the number of products for each category for distribution channel and per macro-area;
2) perform a descriptive analysis of the CDs;
3) calculate the total number of designations (commercial and scientific) used for describing the products and the CD frequency rates.
In addition, compliance with the requirements of the Regulation (EU) No. 1379/2013 was also assessed.

2.3 Statistical analysis

Statistical analyses were performed using chi-square test (SPSS for Windows, Version 16.0. Chicago, SPSS Inc.) and the significance assessed at $p<0.05$. The following parameters were compared:
1) proportions of sample typologies across areas and retail channel types;
2) proportions of CD compliances;

3) proportions of CD- and SN- identified samples were compared across areas, retail channel types and sample typologies**.**

3. Results and discussion

3.1 Products by area and retail channel .

In the survey, 1611 different seafood products were recorded, with an overall average number of 22.7 different products per vendor with slight differences within the three surveyed macro-areas (24.4 in NE-SER, 22.4 in S-SWR and 20.7 in NR). Highly significant differences (χ^2= 78.9, p<0.001) were found in the overall number of products within each category sold at different retail channels (large retail, local grocery and local fish market) included in the survey. The highest number of products was observed in large retail channels (n=1281 products, 79.6% of total products) in which all product categories were sold, whereas fewer products were observed in fish markets (n=178, 11%) and grocery stores (n=152, 9.4%). This distribution trend is plausibly related to the significant turmoil that the Bulgarian retail sector has experienced in the latest years, with the domestic supermarkets chains and local grocery distribution downscaling their business in favour of large hypermarkets and supermarket chains belonging to foreign companies (Export Enterprises SA, 2019). This is also confirmed by the fact that the large-scale retail trade was widely and homogeneously distributed within the national territory, while local grocery stores and fish markets were mainly concentrated in the NE-SER cities (Table 1), especially along the coast.

With regards to products categories, fresh fish made up the largest proportion of the products (n= 596, 37%), followed by canned fish (n=473, 29.4%) and frozen products (n=405, 25.1%). The other categories (marinated, breaded precooked, dried, alive fish, smoked, salted) were less or marginally observed (Table 2). These outcomes agree with a recent survey conducted by Stancheva, (2018) which showed that Bulgarian consumers seem primarily orientated towards fresh/frozen and tinned products. Nonetheless significant differences among the product number per categories among the three macro-areas were observed (χ^2= 14.8, p<0.01) (Figure 2 and Table 1SM). In fact, in NE-SER, a relevant increase in the mean percentage of fresh products per vendor (42%) and a decrease in canned products percentage (26%), compared to the overall rate, were highlighted. The higher prevalence of fresh products recorded in the five cities included in NE-SER (Dobrich, Shumen, Varna, Sliven, Burgas) could be explained by virtue of their fishing activity and the presence of recently growing marine aquaculture plants. Therefore, this outcome could be plausibly attributed to the local catching activities and to the growing need to diversify the market offer in relation to the rise of Bulgarian restaurant sector and seafood demand on the Black Sea coastline (Todorov, 2019; FAO, 2020). Considering the remaining categories, the average frequency rate appeared stable within the three macro-areas except for salted products, only marginally recorded during the survey and not found in NE-SER (Figure 2; Table1SM).

3.2. CDs recorded on the market and compliance with the Regulation (EU) No. 1379/2013.

3.2.1 Descriptive analysis of the CDs.

Seventy-one of the 110 CDs (65.4%) consisted only of a common name referring to a group of species (e.g. Сьомга/Salmon; рибаТон/Tuna fish; Треска/cod, Хек/hake). In other 22 of 110 CDs (20%) the name was accompanied by an adjective referring to the geographical origin (e.g. Атлантическа сьомга/Atlantic Salmon; Норвежка сьомга/Norway salmon), in 11 CDs (11%) by an adjective related to a specific morphological character (e.g. Червена сьомга/Red salmon; Розова сьомга/Pink salmon), while the remaining 6 CDs were general terms, terms referring to the product processing, terms not related to any specific products or terms referring to specific traditional specialties.

Bulgarian commercial designations were used for 89% (98/110) of the terms collected from the market. In the remaining 11% (12/110), terms of Russian (n=6 CDs), Ukrainian (n=4 CDs), Greek

(n=1 CD) and Portuguese (n=1 CD) origin were found. In particular, the Russian terms referred both to freshwater (Сулка/Pike perch) and marine fish (Сельодка/herring; Сайда (Saida)/Saithe; Минтай (Mintai)/pollack; Бротола/Brotola; Сайра (Saira)/Pacific saury); the Ukrainian terms were used to describe four marine fish of local interest (Шпроти/Sprat; Ватус/ Thornback ray; Кольос/chub mackerel; Салака/Herring) three of which are fished along the Black Sea coastline and likely directly imported to Bulgaria (GAIN, 2019); the term Ципура (Tsipura) has been directly transferred from the Greek language to refer to the gilthead seabream (*Sparus aurata*) which represents one of the main fish products imported from Greece to Bulgaria. Finally, the term Бакаляро/bacaliaro, derived from Bacalao, has been directly transferred from Portuguese to Bulgarian language to describe a typical salted-dried fish product mostly imported from Spain to Bulgaria.

Only 47 (42.7%) out of the 110 CDs (see section 3.2.2) were compliant with the Regulation requirements. Nevertheless, the 68 remaining CDs records were found compliant with the definition of "food name" provided by the Regulation EU No. 1169/2011 (Art 11) intended as "*the legal name or customary name, or, descriptive name*" allowing the product's characterization by the consumer. Relevant exceptions were represented by the few CDs using vague descriptive terms (Бяла риба/white fish), terms referred to processing (Чироз/dried fish), terms directly belonging to the name of a traditional local or imported dish (Килка/kilka fried buttered sprat; Бакаляро/bakaliaro), or terms not directly associated with any fish product (Капитан/Captain). In all these cases the CDs applied were not informative enough for the recognition of the product by the consumer at the time of purchase. Examples of common names referring to a group of species highlighted through the survey are: Риба Тон (Tuna fish) for three different *Thunnus* species (*T. albacares*, *T. alalunga*, *T. obesus*) and Скумрия (Mackerel) for three different *Scomber* sp. species (*S. Colias*, *S. japonicus*, *S.scombrus*). In this regard, the most complex scenario was highlighted within the Gadiformes order, with respect to the use of Треска (cod) and Хек (hake) as common names. The term Треска was indeed recorded to be applied in association with three different species belonging to the family Gadidae, namely *Gadus chalcogrammus*, *Gadus morhua*, *Gadus macrocephalus*, and the taxonomically distant species *Alepocephalus bairdii*, belonging to the Osmeridae family. Similarly, the term Хек (hake) was associated with the genus *Merluccius* sp., and several species belonging to the Merluccidae family (*Merluccius hubbsi*, *Merluccius productus* and *Merluccius gayi gayi*, the latter still indicated with the obsolete SN*Merluccius gayi*). The same term was thus applied in association with the species SN *Gadus chalcogrammus*, *Micromesistius australis* (Gadidae) and *Alepocephalus bairdii* (Osmeridae). The use of vague common names such as cod/Треска, hake/Хек, should be further clarified in order to provide the market with effective and unambiguous CDs. In fact, the overlapping and ambiguous use of the two general terms Треска and Хек for the CD of species belonging to separate and distant taxonomical Families and characterized by an heterogeneous commercial value may contribute to consumers' confusion on fish value and to market exposure to deceitful incidents for economic gain (Lowell et al., 2015; Xiong et al., 2016).

3.2.2 CDs and SNs found on the products.

The compulsory association of a CD and a SN is imposed for live fish, fresh and frozen raw products (whole or filleted) and, among processed seafood, for salted, dried and smoked products. Contrariwise, all the other processed seafood falls out of the scope of the regulation. For them, the declaration of the SN is exclusively subject to the will of the Food Business Operator (FBO), although strongly advocated by the European Parliament to elicit an informed consumers' choice (Tinacci et al., 2019; Giusti et al., 2019; D'Amico et al., 2016; European Parliament Resolution No. 2016/2532).

A total of 110 different CDs were used for the 1611 products: 43 CDs were not associated with any SN, 28 CDs were associated with SNs attributable to a species or a genus, and the remaining 39 were used both alone and in association to a species/genus SNs (Table 1SM). CDs associated with a SN were reported on 1202 products (74% of the total) while in the remaining 409 (26%) only the

CD was available (Table 3). The 1202 products presenting both CD and SN mostly belonged to canned fish (n=463, 38.8%) and frozen fish (n=354, 29.4%), followed by fresh fish (n=235, 19.5%), and, to a lesser extent, by marinated fish (n=41, 3.2%), breaded precooked fish based products (n=37, 3.2%), dried fish (n=17, 1.4%), smoked (n=1) and salted (n=1) products. The 1202 products were described by a total of 67 different CDs associated with 66 different SN consisting of 64 species SNs (Table 2SM) and 2 genus SNs (*Oncorhynchus* sp. and *Merluccius* sp. recorded in 10 and 2 products, respectively). Four-hundred and nine products in which the CD alone was available on the label were described by means of 83 different CDs mainly represented by fresh products (n= 340, 83.0%) and marginally by the following categories: marinated (n=17, 4.1%), frozen (n=16, 3.9%), alive fish (n=15, 3.7%), canned products (n=10, 2.4%), smoked (n=7, 1.7%) and salted fish (n=4, 1.0%) (Table 3, Table 1SM). As regards fishery products falling into the scope of the Regulation (EU) No. 1379/2013 (Article 35 and Annex I), overall labelling non-compliances were observed for 382 of 1029 product (37.1%). In particular, a high non-compliance percentage was highlighted for fresh products (340 of 596, 57.3%) opposite to a significantly lower non-compliance rate (χ 2=296.6574. The p-value < 0.00001) highlighted for frozen products (3.9%). High non250 compliance rates were also highlighted for product categories minimally represented on the market as: live fish (15 of 15, 100%), smoked products (7 of 8, 87.5%), salted products (4 of 5, 80%). Details of labelling non-compliances in all retail channels, within the three macro-areas and product categories are reported in Figure 3. Furthermore, the chi-squared analysis highlighted significant differences in the non-compliances distribution both in terms of retail channels (χ 2= 38.9, p-value <0.01) and geographical macro-areas (χ 2=18.4, p-value <0.001). In this respect, an overall higher non-compliances percentage was recorded at local fish markets (81%) mainly due to the lack of SNs related to fresh products exposed at purchase. In addition, the greater percentage of non compliance on fresh products was found in the NE-SER macro-area where the fisheries sector has significant importance in the local economy and, particularly, for freshwater products, and marine species of national interest, which plausibly came from local aquaculture or local fishing production. The same products were also found non-compliant when offered for sale as frozen or alive fish. All these evidences contributed to underline a lack of insufficient training of sector operators in terms of correct labelling and presentation of fish products for sale.
Contrariwise, an opposite trend was observed for canned, breaded precooked and marinated products. In fact, although falling out of the requirements listed in the Article 35 of the Regulation (EU) No. 1379/2013, the voluntary association of a CD with a SN was highlighted in a high products percentage corresponding to 98%, 100% and 74.5% respectively. According to Todorov, (2019) these product categories, albeit affected by a relevant demand decrease in the latest years, are often imported from neighbour European countries already prepacked and labelled to be directly presented for sale. Therefore, such a high degree of voluntary compliance with Regulation (EU) No. 1379/2013 terms on imported products, may reflect the growing level of awareness by European FBOs towards the protection of consumers' rights pursuing the European Parliament Resolution No 2016/2532. Similar evidences have been recently highlighted for anchovies and herring products (Giusti et al., 2019; Tinacci et al., 2019).

3.3 CD frequency rates.

The CD frequency rate (overall, for CDs associated with SNs and for CDs found alone) was calculated to highlight the CDs most frequently applied at retail. Overall, CD frequency rates highlighted values ranging from 0.01 to 2.14 products/vendor;. In general, the present survey confirmed consumption and import data collected in the 5-year period 2013-2017 by Todorov, (2019). Our analysis indeed, in accordance with the author, highlighted the expansion of the Bulgarian seafood market, originally mainly addressed to freshwater fish species, towards marine Mediterranean, Atlantic and Pacific species belonging to Clupeids, Salmonids Scombrids, Gadids and Merluccids, all of them well represented at purchase both as fresh and variously processed

products. Moreover, Todorov, (2019) highlighted a relatively large import volume of sardine, herring, hake, salmon and trout and an increasing import rate of fresh and frozen mackerel products to satisfy the national market demand. The products most frequently recorded at retail were also in agreement with the most sought-after species emerged from Stancheva, (2018) and from a report of the European Market Observatory on EU consumer habits regarding fishery and aquaculture products (EUMOFA, 2017).
The frequency rate calculated only on CDs associated with SNs records showed frequency rates similar to the overall values highlighting that the products presenting the overall highest frequency rate were generally found on sale with a complete designation and thus generally compliant with the European Regulation (Section 3.2). A relevant exception was represented by the Cyprinidae family, for which the CD+SN frequency rate dramatically fell. In this respect, the majority of Cyprinids products were indeed associated with a high CD frequency rate. Similarly, locally farmed freshwater fish (African catfish/Африкански сом and Бял амур/White amur) together with local marine (Морски език/Sole, Халибут/Halibut, Писия/Plaice and Mullet/Кефал) and fresh water fish (Костур/Perch, Щука/Pike, Сулка/Pike perch, Бяла мряна/white barbel) showed that frequency rates calculated on CDs alone exceeded the overall values. In all the cases, the products, sold both at large and local retails or at fish markets sale counters, belonged to fresh or alive category. Data are available in Table 2SM.
Finally, the calculation of partial frequency rates of CDs without a scientific identification led to emphasize, for fresh and alive products, sold in bulk, on the sales counter of all commercial channels, a general non-compliance with the Regulation (EU) No.1379/2013 which imposes for non-packaged products to display all the mandatory information for fish product identification through the use posters, billboard and sales tag. These data, together with those highlighted in section 3.3, confirmed the evidence gathered in the previous study conducted by Tinacci et al., (2018) on seafood labelling compliance sold on the Bulgarian market and were in agreement with the data collected in a similar study conducted in Sardinia on not pre-packaged products sold within different retail channels (Esposito & Meloni, 2017). In fact, in both studies a high frequency of missing or incomplete indication of SNs had been reported for such products.
The comparison of the frequencies of CDs alone and of the CDs found in association with SNs highlighted a different species distribution according to the three macro-areas (NR, NE-SER, S-SWR) (Table 2SM). This could be in relation to the fish resources of the territories and import trends. In particular: in NE-SER, higher CDs frequencies of marine species of national interest (sprat (*Sprattus sprattus*), Mediterranean Horse Mackerel (*Trachurus mediterraneus*), Horse mackerel (*Trachurus trachurus*), Flathead Grey Mullet (*Mugil cephalus*), Bonito (*Sarda sarda*), Bluefish (*Pomatomus saltatrix*), Turbot (*Scophtalmus maximus*) and Gobies (Gobiidae) were highlighted as a result of the local fishing activities (FAO, 2020); in S-SWR, higher CDs record frequencies of fresh water farmed species (sturgeon and rainbow trout), plausibly attributable to the greater presence of dedicated aquaculture facilities in the area (PROJECT BG0713EFF-511-220270) and of imported marine species (seabass, seabream, red porgy,) belonging to the Greek and Turkish fishing and aquaculture activities both reported as the main exporter to Bulgaria for these kind of products (Turkish Statistical Institute, 2017) were verified. Finally, in NR, relatively higher CDs frequencies rate describing freshwater local wild or cultured freshwater species (rainbow trout, carp, catfish, Danube peak and pike) were highlighted, in accordance with fishery national production data (PROJECT BG0713EFF-511-22027). This area is in fact the principal basin of small and medium-sized inland aquaculture plants for the production of common freshwater species.

3.3 Main deficiencies of the Bulgaria seafood list and proposal for its update

The comparison of the data collected in this study and the current Bulgarian seafood list highlighted the presence of: 1) a total of 50 CDs associated with SNs, in which both the CD and the

SN registered on the market were not included in the official list; 2) 22 CDs recorded alone and not listed among the Official CDs reported in the ministerial document. The comparison between the SNs reported on the list and the 66 SNs retrieved on the market highlighted the presence of 34 species SNs and 2 genus SNs not included in the document and described by 60 different CD+SN designations (Table 4; Table 3SM). Furthermore, the comparison highlighted minor issues concerning: 1) the association of a SN (valid or obsolete) included in the list with a CD not included in the list (12 CDs); 2) the editing of officially accepted CDs by adding or removing an adjective related to the fish origin or to specific morphological features (5 CDs); 3) the extended use of CDs already existing in the official list in association with a valid SN not included among the official records (6 CDs) (Table 4).

The survey results confirmed the current presence of the majority of the species already verified as commercial leading products on the Bulgarian market (EUMOFA, 2017; Tinacci et al., 2018). Moreover, the analysis of the CDs describing alone the fresh products sold at retail contributed to complete the panorama of fish species currently present on the national market for which an update of the list is necessary. CDs and CD+SN combinations reported in Table 4 and Table 2SM might represent an objective starting point for the selection of new designations to be included in the Official Bulgarian list by allowing the identification of a basket of fish species not yet characterized through the use of CDs and SNs already recognized, on the national market, by the final consumer and FBOs.

Nevertheless, harmonizing seafood labelling and providing a system of CDs punctual updated in relation to the exponential growth of the number of species available on the market seems impossible, Thus, the choice of a CD for several related species may still represent a sustainable compromise in association with the addition to the generic name of references to the geographical area or morphological peculiarities of the different species (Tinacci et al., 2019). Thus, the selection of specific descriptive terms referring to the geographic origin and or morphological features in association to one or a limited number of species belonging to a common genus would be desirable to elicit a clear and immediate identification of the product by the consumer.

4.Conclusions

This survey confirmed the ineffectiveness of the current official list of Bulgarian seafood designations in describing the products present at retail and the need to provide a substantial revision to meet the offer of an expanding market and harmonize the terms applied for products identification. This work highlighted also high non-compliances rates to the Regulation (EU) No. 1379/2013 requirements on the labelling of fresh raw, alive, smoked and salted products due to the absence of the scientific name declaration. Thus, an effective training of FBO (both at large and local retail level) is necessary, especially on how to correctly display raw products on fish counters in order to properly inform the final consumer. Finally, the present survey could represent a starting point for a more oriented sampling aimed at molecularly identify by DNA barcoding techniques products lacking scientific names (Tinacci et al., 2018; Lewis & Boyle, 2017; Martinsohn, 2013).

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Figures captures

Figure 1: Bulgaria Statistical Regions. The three geographical macro-area were obtained by merging contiguous statistical regions proposed by Popescu (2011) as follow: North Region

(NR): North-western + North-central region; North-east/South-east Region, (NE-SER): North-eastern + South-eastern Region; South/South-west Region (S-SWR): South central + South-Western region. The name of the Provincial cities included in the study are indicated. Image modified from Popescu, (2011).

Figure 2: Percentage of the nine commercial product categories/vendor highlighted on the market during the survey within the different pinpointed macro-areas.

Figure 3: Details of labelling non-compliances in retail channels for the three macro-areas and product categories

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Macro-Area	City	Retail channel type			Total
		Large retail	Local retail	Local fish market	
NR	Vidin	2	1	2	5
	Pleven	4	2	0	6
	Veliko Tarnovo	4	1	0	5
	Ruse	4	0	0	4
	Silistra	2	0	1	3
	Area Subtotal	**16**	**4**	**3**	**23**
NE-SER	Dobrich	3	2	0	5
	Shumen	3	1	3	7
	Varna	4	1	1	6
	Sliven	3	3	1	7
	Burgas	4	0	1	5
	Area Subtotal	**17**	**7**	**6**	**30**
S-SWR	Kardjiali	2	0	0	2
	Haskovo	2	0	1	3
	Plovdiv	4	0	0	4
	Blagoevgrad	4	0	1	5
	Sofia	4	0	0	4
	Area Subtotal	**16**	**0**	**2**	**18**

Table 1. Number of different retail channels surveyed in each macro-area. NR: North Region; NE-SER: North-east/South-east Region; S-SWR: South/South-west Region

Product type	Retail channel type			Total
	Large retail (N=49)	Local retail (N=11)	Local fish market (N=11)	
Fresh	382	49	165	596
Frozen	358	41	6	405
Canned	418	53	2	473
Marinated	44	8	3	55
Smoked	5	1	2	8
Salted	5	0	0	5
Dried	17	0	0	17
Breaded precooked	37	0	0	37
Alive	15	0	0	15
Total	**1281**	**152**	**178**	**1611**

Table 2. Number, overall and within different retail channels, of products belonging to different categories checked in the survey**.**

Designation at retail	Product category	Retail channels			Total
		Large ratail	Local retail	Local fish market	
CD associated with SN	Fresh	235	16	5	257
	Frozen	354	35	0	389
	Canned	411	52	0	463
	Marinated	35	3	0	41
	Smoked	0	1	0	1
	Salted	1	0	0	1
	Dried	17	0	0	17
	Breaded precooked	37	0	0	37
	Alive	0	0	0	0
Subtotal CD + SN		**1090**	**107**	**5**	**1202**
CD alone	Fresh	147	33	160	340
	Frozen	4	6	6	16
	Canned	7	1	2	10
	Marinated	9	5	3	17
	Smoked	5	0	2	7
	Salted	4	0	0	4
	Dried	0	0	0	0
	Breaded precooked	0	0	0	0
	Alive	15	0	0	15
Sub-total CD alone		**191**	**45**	**173**	**409**

Table 3. Overall CDs number in different product categories found within the three retail channels included in the survey

CD record	English term	SNs associated	Valid SN	Overall freq. rate	Comparison with official Bulgarian list
Трицона	Herring	*Clupea harengus*	*Clupea harengus*	1,7%	SN associated with a CD not included in the official list
Балтийска херинга	Baltic herring	*Clupea harengus membras*	*Clupea harengus*	18,6%	Editing of an existing CD (Херинга)
Салака (Ukranian)	Herring	*Clupea harengus*	*Clupea harengus*	1,7%	SN associated with a CD not included in the official list
		Clupea harengus balticus		6,8%	Obsolete SN associated with a CD not included in the official list
		Clupea harengus membras		20,3%	Obsolete SN associated with a CD not included in the official list
Бейби херинга	Baby herring	*Clupea harengus*	*Clupea harengus*	8,5%	SN associated with CD edited from an approved CD
Сельодка (Russian)	Herring	*Clupea harengus*	*Clupea harengus*	40,7%	SN associated with CD not included in the official list
Капитан	(Captain) Herring	*Clupea harengus membras*	*Clupea harengus*	23,7%	Obsolete SN associated with a CD not included in the official list
Чироз	Dried fish	*Clupea harengus membras*	*Clupea harengus*	28,8%	Obsolete SN associated with a CD not included in the official list
Балтийска Цаца	Baltic sprat	*Sprattus balticus*	*Sprattus sprattus*	3,4%	Obsolete SN associated with CD edited from an approved CD
Килка	Sprat	*Sprattus sprattus sulinus*	*Sprattus sprattus*	1,7%	SN associated to CD not included in the official list
Сардина	Sardine	*Sardinella logiceps*	*Sardinella logiceps*	3,4%	Extension of use of CD already associated to a valid SN
Аншоа	Anchovy	*Sardina pilchardus*	*Sardina pilchardus*	20,3%	SN associated to CD not included in the official list
		Engraulis encrasicolus	*Engraulis encrasicolus*	16,9%	Both CD and SN absent
		Engraulis ringens	*Engraulis ringens*	11,9%	Both CD and SN absent
Сафрид	Horse mackerel/scad	*Trachurus trachurus*	*Trachurus trachurus*	61%	Extension of use of CD already associated to a valid SN
Скумрия	Mackerel	*Scomber scombrus*	*Scomber scombrus*	88,1%	SN associated with CD edited from an approved CD
		Scomber japonicus	*Scomber japonicus*	67,8%	SN associated with CD edited from an approved CD
		Scomber colias	*Scomber colias*	64,4%	Both CD and SN absent
Бяла рибаТон	White tuna	*Thunnus alalunga*	*Thunnus alalunga*	10,2%	SN associated to a CD not included in the list

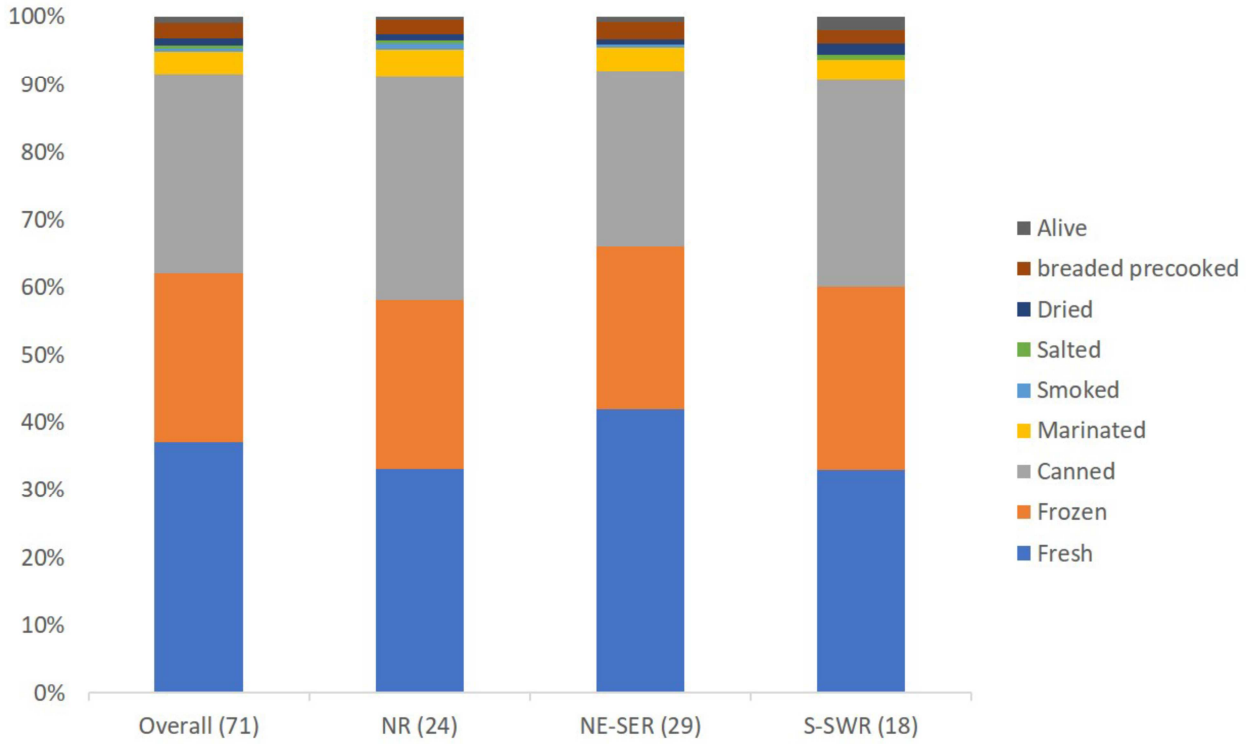
Жълтопер тон	Yellowfin tuna	*Thunnus albacares*	*Thunnus albacares*	8,5%	Both CD and SN absent
Риба Тон	Tuna	*Katsuwonus pelamis*	*Katsuwonus pelamis*	76,3%	Extension of use of CD already associated to different valid SN (*Thunnus thynnus, Thunnus obesus*)
		Thunnus albacares	*Thunnus albacares*	81,4%	
		Thunnus alalunga	*Thunnus alalunga*	6,8%	Extension of use of CD already associated to different valid SN
Треска	Cod	*Theragra chalcogramma*	*Gadus chalcogrammus*	44,1%	Extension of use of CD already associated to different valid SN
		Gadus macrocephalus	*Gadus macrocephalus*	6,8%	
		Alepocephalus bairdii	*Alepocephalus bairdii*	8,5%	
Морска треска	Sea cod	*Theragra chalcogramma*	*Theragra chalcogramma*		Editing of CD present in the list and already associated to different valid SN
Тихоокеанска треска	Pacific cod	*Gadus macrocephalus*	*Gadus macrocephalus*	8,5%	Editing of CD present in the list and already associated to different valid SN
Мерлуза	Hake	*Micromesistius australis*	*Micromesistius australis*	6,8%	Extension of use of CD already associated to different valid SN
		Macruronus magellanicus	*Macruronus novaezelandiae*	15,3%	
		Merluccius hubbsi	*Merluccius hubbsi*	18,6%	
Сайда	Saithe	*Pollachius virens*	*Pollachius virens*	20,3%	SN associated to a CD not included in the list
Хек	hake	*Merluccius sp.*	*Merluccius sp.*	3,4%	Both CD and SN absent
		Merluccius australis	*Merluccius australis*	1,7%	Both CD and SN absent
		Merluccius gayi	*Merluccius gayi gayi*	5,1%	Both CD and SN absent
		Merluccius hubbsi	*Merluccius hubbsi*	20,3%	Both CD and SN absent
		Merluccius productus	*Merluccius productus*	15,3%	Both CD and SN absent
		Theragra chalcogramma	*Gadus chalcogrammus*	54,2%	Both CD and SN absent
		Alepocephalus bairdii	*Alepocephalus bairdii*	11,3%	Both CD and SN absent
Нототения	Nototenia	*Merluccius hubbsi*	*Merluccius hubbsi*	1,7%	Both CD and SN absent
Бяла риба	White fish	*Merluccius hubbsi*	*Merluccius hubbsi*	8,5%	Both CD and SN absent
		Theragra chalcogramma	*Gadus chalcogrammus*	23,7%	Both CD and SN absent
Бакаляро (Portuguese origin)	“Bacaliaro” Hake	*Merluccius hubbsi*	*Merluccius hubbsi*	1,7%	Both CD and SN absent
Минтай (Russian origin)	Cod	*Theragra chalcogramma*	*Gadus chalcogrammus*	54,2%	Both CD and SN absent
		Pollachius virens	*Pollachius virens*	8,5%	Both CD and SN absent
		Macruronus novaezelandiae	*Macruronus novaezelandiae*	8,5%	Both CD and SN absent
Хоки		*Macruronus magellanicus*	*Macruronus novaezelandiae*	13,6%	Both CD and SN absent
Новозеландски макруронус	New Zealand macruronus	*Macruronus novaezelandiae*	*Macruronus novaezelandiae*	5,1%	Both CD and SN absent

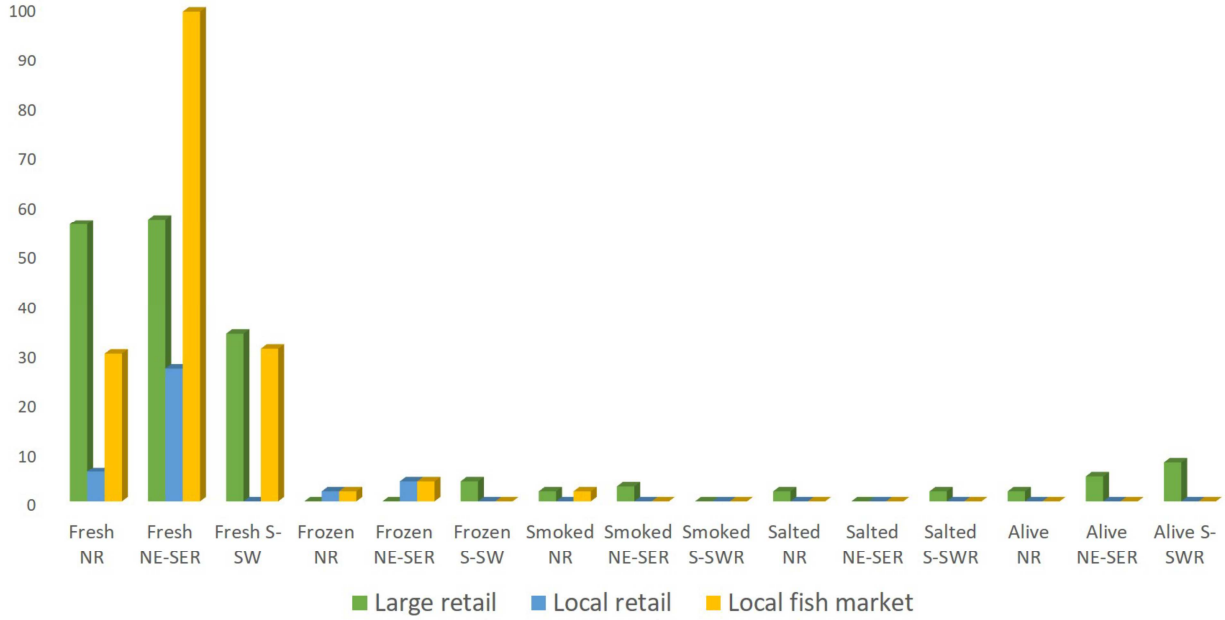
Хек - Аляска	Alaska Hake	*Merluccius productus*	*Merluccius productus*	3,4%	Both CD and SN absent
Аржентински хек	Argentine hake	*Merluccius hubbsi*	*Merluccius hubbsi*	30,5%	Both CD and SN absent
Сьомга	Salmon	*Oncorhynchus gorbuscha*	*Oncorhynchus gorbuscha*	8,5%	Both CD and SN absent
		Salmo salar	*Salmo salar*	13,6%	Both CD and SN absent
Атлантическа сьомга	Atlantic salmon	*Salmo salar*	*Salmo salar*	66,1%	Both CD and SN absent
Норвежка сьомга	Norwegian salmon	*Salmo salar*	*Salmo salar*	8,5%	Both CD and SN absent
Пъстърва	Trout	*Oncorhynchus mykiss*	*Oncorhynchus mykiss*	11,9%	Both CD and SN absent
		Salmo gairdneri irideus	*Oncorhynchus mykiss*	10,2%	Both CD and SN absent
Дъгова пъстърва	Rainbow trout	*Oncorhynchus mykiss*	*Oncorhynchus mykiss*	57,6%	Both CD and SN absent
Сьомгова пъстърва	Salmon trout	*Oncorhynchus mykiss*	*Oncorhynchus mykiss*	13,6%	Both CD and SN absent
		Salmo gairdneri irideus	*Oncorhynchus mykiss*	5,1%	Both CD and SN absent
Сребриста сьомга	Silver salmon	*Oncorhynchus kisutch*	*Oncorhynchus kisutch*	1,7%	Both CD and SN absent
Розова сьомга	Pink salmon	*Oncorhynchus gorbuscha*	*Oncorhynchus gorbuscha*	5,1%	Both CD and SN absent
Куча сьомга	Chum salmon	*Oncorhynchus keta*	*Oncorhynchus keta*	18,6%	Both CD and SN absent
Тихоокеанска сьомга	Pacific salmon	*Oncorhynchus* sp	*Oncorhynchus* sp	16,9%	Both CD and SN absent
		Oncorhynchus keta	*Oncorhynchus keta*	18,6%	Both CD and SN absent
		Oncorhynchus nerka	*Oncorhynchus nerka*	1,7%	Both CD and SN absent
Кета	Keta	*Oncorhynchus keta*	*Oncorhynchus keta*	1,7%	Both CD and SN absent
Червена сьомга	Red salmon	*Oncorhynchus nerka*	*Oncorhynchus nerka*	3,4%	Both CD and SN absent
Ципура (Greek origin	Seabream	*Sparus aurata*	*Sparus aurata*	64,4%	Both CD and SN absent
Фагри	Red Porgy	*Pagrus coeruleostictus*	*Pagrus coeruleostictus*	1,7%	Both CD and SN absent
Лаврак	European seabass	*Dicentrarchus labrax*	*Dicentrarchus labrax*	37,3%	Both CD and SN absent
Чернокоп	Bluefish	*Pomatomus saltatrix*	*Pomatomus saltatrix*	1,7%	SN associated to a different CD (Лефер)
Зарган	Garfish	*Scomberesox saurus*	*Scomberesox saurus*	16,9%	Both CD and SN absent
Унаги	Unagi /Eel	*Anguilla japonica*	*Anguilla japonica*	1,7%	Both CD and SN absent
Лакедра (Greek origin)	Lunar-tailed bigeye	*Priacanthus hamrur*	*Priacanthus hamrur*	1,7%	Both CD and SN absent
Акула	Shark	*Prionace glauca*	*Prionace glauca*	23,7%	Both CD and SN absent
		Isurus oxyrinchus	*Isurus oxyrinchus*	15,3%	Both CD and SN absent
		Squalus acanthias	*Squalus acanthias*	1,7%	SN associated to a specific CD (черноморски регионa Акула)
Тилапия	Tilapia	*Oreochromis niloticus*	*Oreochromis niloticus*	8,5%	Both CD and SN absent
Нилски костур	Nile perch	*Lates niloticus*	*Lates niloticus*	8,5%	Both CD and SN absent
Пангасиу	Pangasius	*Pangasius hypophtalmus*	*Pangasius hypophtalmus*	39,0%	Both CD and SN absent
Морски кефал	Flathead greymullet	ND	-	2,1%	Absent

Илария	Leaping mullet	ND	-	2,1%	Absent
Халибут	Halibut	ND	-	2,1%	Absent
Попче	Goby	ND	-	14,6%	Absent
Попче/Кая	Goby/Kaya	ND	-	4,2%	Absent
Махи махи	Mahi mahi	ND	-	2.1%	Absent
Риба меч	Swordfish	ND	-	14,6%	Absent
Марлин	Marlin	ND	-	2,1%	Absent
Минокоп	Shidrum	ND	-	4,2%	Absent
Фриса	Black Sea Roach	ND	-	4,2%	Absent
Червена риба	Red fish	ND	-	2,1%	Absent
Скат	Scat	ND	-	2,1%	Absent
Есетра	Sturgeon	ND	-	12,5%	Absent
Обикновен сом	Common catfish	ND	-	2,1%	Absent
Африкански сом	African catfish	ND	-	22,9%	Absent
Дунавска мряна	Danube barbel	ND	-		Absent
Облец	Danube bleak	ND	-	2,1%	Absent
Ледена риба	Icefish	ND	-	2,1%	Absent
Кликач	Antartic toothfish	ND	-	2,1%	Absent
Мойва	Capelin	ND	-	2,1%	Absent
Полярна пъстърва	Polar trout	ND	-	2,1%	Absent
Сарпа	Salema	ND	-	2,1%	Absent

Table 4. List of CDs (associated to SN or alone) not included in the Official Bulgarian list.


VIDIN
SILISTRA
RUSE
NORTH-EASTERN
NORTH-WESTERN
NORTH-CENTRAL
DOBRICH
PLEVEN
SHUMEN
VARNA
VELIKO TARNOVO
SOFIA
SLIVEN
SOUTH-WESTERN
BURGAS
SOUTH-EASTERN
PLOVDIV
BLAGOEVGRAD
HASKOVO
KARDJIALI
SOUTH-CENTRAL


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Overall (71)
NR (24)
NE-SER (29)
S-SWR (18)
Alive
breaded precooked
Dried
Salted
Smoked
Marinated
Canned
Frozen
Fresh


100
90
80
70
60
50
40
30
20
10
0
Fresh NR
Fresh NE-SER
Fresh S-SW
Frozen NR
Frozen NE-SER
Frozen S-SW
Smoked NR
Smoked NE-SER
Smoked S-SWR
Salted NR
Salted NE-SER
Salted S-SWR
Alive NR
Alive NE-SER
Alive S-SWR
Large retail
Local retail
Local fish market

- A survey on the Bulgarian seafood market for assessing fish products availability was conducted
- Products availability was then compared with the current seafood official list
- The ineffectiveness of the list in describing products available on the market was highlighted
- Main concerns regarded the presence on the market of CD and SN not included in the list
- CD already applied throughout the country represent a starting point to propose an updating of the list

Authors declare no conflict of interest.