



Máster Internacional en
GESTIÓN PESQUERA SOSTENIBLE
(4ª edición: 2011-2013)

TESIS

presentada y públicamente defendida
para la obtención del título de

MASTER OF SCIENCE



**Critical traceability point analysis in a
catalan fresh seafood supply chain:
Implications for sustainability certification**

DAVID MILAN MÜLLER
Julio 2013



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Alicante
a 29 de Julio de 2013

Critical traceability point analysis in a Catalan fresh seafood supply chain: Implications for sustainability certification

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Trabajo realizado en la Cátedra d'Estudis Marítims de la Universidad de Girona, España, bajo la dirección del Dr. Joan Lluís Alegret y de D. Carlos Montero

y presentado como requisito parcial para la obtención del Diploma Master of Science en Gestión Pesquera Sostenible otorgado por la Universidad de Alicante a través de la Facultad de Ciencias y el Centro Internacional de Altos Estudios Agronómicos Mediterráneos (CIHEAM) a través del Instituto Agronómico Mediterráneo de Zaragoza (IAMZ).

Esta Tesis fue defendida el día 18 de Julio de 2013 ante un Tribunal Formado por:

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"This is a village of fishermen and the water
is as clear and as blue as a mermaid's eye.

I get up early because the fishermen leave
at 5 in the morning and make so
much noise that Rip Van Winke
wouldn't be able to sleep.

All this is perfect for my work."

(Truman Capote in a letter written during his time in Palamós)

Acknowledgements

I would like to thank the persons who helped me during the preparation of this thesis. First of all, I want to give a big “Gracias” to José Luis Sánchez Lizaso for organizing this enriching Master of Science which is almost unique in Europe. To Carlos Montero and José Luis for helping me find this topic. To Juan Luis Alegret for bringing me to Palamós and introducing me to the community.

All people from Palamós, the Cofradía and its president, Siscu Benaiges, the participating fishermen, the auction hall employees, the participating fish mongers and special thanks to the two Lluises, Lluís Iglesias y Lluís Leial who took me to the wholesale market in Barcelona. The participating wholesalers and restaurants.

All staff from the Fishing Museum of Palamós, especially Jaume and Xavi, and from the Chair of Maritime Studies, Raul and especially Alfons. The president of the Fishing Museum, Miquel Martí. Special thanks to Margret who helped me to organise my stage in Palamós.

Ramon Franquesa for his advice, Anna Garriga for the facilitation of information about the auction.

The staff from MSC, especially Marnie Bammert and Stefano Minischetti.

Thanks to Xavi for taking the photos in Barcelona and thanks to the reviewers.

Thanks to my family for the support and especially to Maria.

Abstract

Sustainability certification schemes of wild caught seafood like that of the Marine Stewardship Council (MSC) are market-driven tools of fisheries management which are ought to reduce overfishing of fish stocks. Being able to trace the seafood to its certified source is vital for guaranteeing that only seafood certified as sustainably caught bears an eco label. This is assured by seafood supply chains' compliance with a chain of custody standard and by documenting full traceability of the product.

This study analyses the traceability performance of a supply chain of a decapod crustacean, blue and red shrimp (*A. antennatus*, RISSO 1816) in a case study of a harbour in North-Eastern Spain, Palamós. A quality label ("Marca de Garantía de la Gamba de Palamós") and its chain of custody standard serve as a reference for traceability in this study. The main objective was to find out if the supply chain was ready for a certification against the MSC Chain of Custody (CoC) Standard. Traceability was examined using Process Mapping and Critical Traceability Point Analysis (CTPA), a combination of the qualitative methods structured interview, observation and documentation analysis. The results show that there are deficiencies that could hamper a potential certification. This is mainly due to a lack of unique identifiers on the traceability documentation, potential origin fraud and undocumented sales. Traceability performance was found to be better at companies with a wider distribution range. While some businesses seem to be ready to get certified, the majority does not. Potential improvements include the implementation of a central traceability model, product packing and organisation of the buyer collective. Recommendations focus on enhanced traceability controls by authorities and fishermen's association and correct multiplication of commercial labels when splitting occurs. More research about traceability performance of non-industrialised supply chains is needed.

Keywords: Marine Stewardship Council, Chain of Custody Standard, Traceability, blue and red shrimp, Palamós

Resumen

Los programas de certificación de sostenibilidad como el del Consejo de Gestión Pesquera Sostenible (MSC) son herramientas de la gestión pesquera que pueden reducir la sobreexplotación de los recursos pesqueros. Es fundamental una correcta trazabilidad hasta el suministrador certificado para garantizar que solo el pescado certificado lleve la eco-etiqueta del MSC. Para asegurarlo, las cadenas de suministros de pescado tienen que cumplir con un estándar de cadena de custodia y tienen que documentar la trazabilidad del producto.

Este estudio analiza el estado de trazabilidad en la cadena de suministros de un crustáceo decápodo, la Gamba Roja (*A. antennatus*, RISSO 1816) en el puerto de Palamós, situado en el noreste de España. Para esta especie existe una marca de garantía (“Gamba de Palamós”) cuyo reglamento contiene un estándar de cadena de custodia que sirve como referencia en esta tesis. El objetivo principal es averiguar si la cadena de suministros está preparada para una certificación por el Estándar de Cadena de Custodia (CoC) del MSC. La trazabilidad se analiza con la visualización de los procesos físicos y los flujos de información. Además se emplea el Análisis de los Puntos Críticos de Trazabilidad (CTPA), una combinación de los métodos cualitativos de la entrevista estructurada, la observación y el análisis de documentos. Los resultados demuestran que hay debilidades que pueden representar un obstáculo para una futura certificación. Esto se debe a la falta de identificadores únicos en la documentación de trazabilidad, a la posibilidad de cometer fraude de origen y a la venta fuera de lonja y no documentada. Los operadores con rangos de distribución grandes muestran un mejor tratamiento de la información trazable. No obstante, parece que la mayoría de las empresas no están preparadas para certificarse.

Las mejoras del actual sistema de trazabilidad incluyen la implementación de modelos de trazabilidad centrales, del envase del producto y de la organización del colectivo de compradores. Se recomienda mejorar y aumentar los controles por parte de las autoridades y de la cofradía de pescadores así como realizar un correcto etiquetaje en el caso de los lotes fraccionados. Se necesitan más estudios sobre la trazabilidad en cadenas de suministros no-industriales.

Palabras clave: Consejo de Gestión Pesquera Sostenible (MSC), estándares de cadena de custodia, trazabilidad, Gamba Roja, Palamós

Résumé

Les programmes de certification des pêcheries durables et bien gérées comme celui du Marine Stewardship Council (MSC) propose des outils de gestion des pêches afin de réduire la surexploitation des ressources marines. Ainsi, retracer l'origine des produits de pêche jusqu'à l'unité de certification est un élément essentiel pour garantir que seuls les produits certifiés puissent porter l'écolabel. Ceci est assuré par la conformité de la chaînes d'approvisionnement en produits de pêche aux standards de la traçabilité et les documents y afférents.

Le présent travail propose d'analyser les performances de la traçabilité de la chaîne d'approvisionnement d'un crustacé décapode, la crevette rouge (*A. antennatus*, Risso 1816) pour le cas du port de Palamós, Nord-Est de l'Espagne. Le label de qualité ("Marca de Garantía de la Gamba de Palamós") et ses standards sur la traçabilité des produits nous ont servi de référence. L'objectif final est de vérifier si la présente chaîne d'approvisionnement est prête pour l'obtention de la certification en relation avec les standards de traçabilité du MSC.

La traçabilité a été suivie via la cartographie des processus, l'Analyse de Points Critiques de Traçabilité (CTPA), une combinaison des méthodes qualitatives telles que des interviews structurées ou la consultation des documents. Les résultats ont montré que des déficiences peuvent entraver une possible certification. Ceci est principalement dû au fait qu'il n'existe pas un identifiant unique pour la documentation de traçabilité ajouté à des fraudes potentiels des documents originaux et la vente dans le circuit parallèle. Par ailleurs, les performances de traçabilité ont été jugées meilleures dans les entreprises avec une large gamme de distribution. Toutefois, si certaines entreprises semblent être prêtes à obtenir une certification, la majorité d'entre elles ne l'est pas.

Les mesures correctives touchent principalement à la mise en place d'un modèle de traçabilité centrale, l'emballage du produit et l'organisation d'un collectif d'acheteurs. Les recommandations se focalisent en le renforcement du contrôle de la traçabilité par les autorités locales et les associations de pêcheurs et l'amélioration de l'étiquetage des produits fractionnés. De plus, il importe d'étudier les performances de traçabilité des chaînes d'approvisionnement non industrialisés.

Mots-Clés: Marine Stewardship Council (MSC), standard de traçabilité, traçabilité, crevette rouge, Palamós

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List of Abbreviations

ASI	Accreditation Services International
Auc Hal	Auction Hall
BSE	Bovine Spongiform Encephalopathy
C4/8	Standard Index of Concentration which describes the market share of the four / eight most important buyers
CoC	Chain of Custody
CodTrawl	Cod Trawl Vessel
CTP(A)	Critical Traceability Point (Analysis)
DNA	Deoxyribonucleic Acid
EC	European Council
EU	European Union
FAO	Food and Agricultural Organisation of the United Nations
FEDEPESCA	Federación Nacional de Asociaciones Provinciales de Empresarios Detallistas de Pescados y Productos Congelados – Spanish Fish Monger Federation
Fis Mon	Fish Monger
FisVes	Fishing Vessel
GIS	Geographic Information System
HACCP	Hazard Analysis and Critical Control Points
ID	Identifier / Identification
ISEAL	International Social and Environmental Accreditation and Labelling
ISO	International Standards Organisation
IUU	Illegal, Unreported or Unregulated
JRC	Joint Research Center
LPUE / RPUE	Landings / Revenues per Unit of Effort
MAGRAMA	Ministerio de Agricultura, Alimentación y Medio Ambiente – Spanish Ministry of Agriculture, Alimentation and Environment
MSC	Marine Stewardship Council
NGO	Non-Governmental Organisation
Nofima	Norwegian Institute of Fisheries and Aquaculture
QR	Quick Response Code
Rest	Restaurant
RFID	Radio Frequency Identification
SIF	Danish Fisheries Traceability System
Trans	Transport Company
TU	Traceable Unit
VAT	Value Added Tax
Whole	Wholesaler
WWF	World Wildlife Fund
XML	eXtensible Markup Language

1 Introduction

1.1 Motivation and Objectives

This thesis is presented in order to fulfil the requirements of the International Master of Science on Sustainable Fisheries Management held at the University of Alicante, Spain from October 2011 till June 2013. The study was conducted in collaboration with the Marine Stewardship Council (MSC), the Chair of Maritime Studies from the University of Girona and the Cofradía de Pescadores de Palamós. Cofradías (literal translation: “brotherhood”) are the traditional associations which represent both fishermen and vessel owners to equal shares. Lacking an adequate translation, the term “Cofradía de Pescadores (of Palamós)” will be used in the study.

In this thesis, traceability is understood as a direct contribution to sustainable fisheries resource exploitation. The overall goal of the thesis is to optimize the traceability systems in fresh seafood supply chains and to prepare them for independent third-party supply chain certification. The approach of this master thesis is to identify problems and deficiencies of traceability of fresh fish in the Catalan Mediterranean. Process Mapping and Critical Traceability Point Analysis (CTPA) are used in a case study of the blue and red shrimp (*Aristeus antennatus*, RISSO 1816) fishery and supply chain in the Catalanian harbour of Palamós. The supply chain was chosen, because of the existence of the quality label “Marca de Garantía de la Gamba de Palamós”. This is a label audited by the certification company Bureau Veritas and is managed by the municipality of Palamós and the Cofradía de Pescadores of Palamós. It sets freshness and origin criteria where traceability is essential to prevent from fraud. In this study, the quality label is used as a reference for traceability and Chain of Custody standards implementation. With the aim of improving traceability models applied in the supply chain, results on the performance of the blue and red shrimp supply chain are compared to the requirements of the MSC Chain of Custody Standard in order to optimize the used models. Further steps are providing and evaluating possible solutions and propositions with the objective of facilitating fresh fish supply chain certification. The study seeks to give access to certification also for other harbours as Catalan Mediterranean trawl fisheries have a similar commercialization structure. The analysis covers the identification of systematic errors and their causes. The solutions shall contribute to the sustainable management of the fishery, Chain of Custody certification and the credibility of the quality label of Palamós blue and red shrimp.

The thesis is structured as follows: The first part embeds the objectives of the thesis in the context of the International Master of Science in Sustainable Fisheries Management explaining the importance of traceability for sustainable fisheries management. Besides, it outlines objectives and hypotheses of the study. The second part focuses on the meaning, concepts and models of traceability. Furthermore, legal traceability requirements in the European Union and in Spain will be studied and the Marine Stewardship Council standards for fisheries and for supply chains are introduced. Thirdly, material and methods for analysing traceability are explained in detail. The fourth part contains the case study which itself is divided into three chapters: First, a description of the case study using data about traded volumes, important operators and information about the quality label “Marca de Garantía de la Gamba de Palamós”; second, a presentation of the results of CTPA

connecting them to the MSC Chain of Custody standard; and third, solutions to the encountered problems will be provided. In the fifth part, methods and results will be discussed by evaluating their risks, strengths and weaknesses and an outline on further research need will be given. The last part is the conclusion of the reached objectives and offers recommendations for stakeholders.

1.2 Rationale and State of the Art: The Importance of Traceability for Sustainable Fisheries Management

The certification of sustainable fisheries is a market-based tool of fisheries management which can contribute to reduce the overexploitation of fisheries resources (ERWANN 2009; GUTIÉRREZ *et al.* 2012). It has proven to be an effective conservation strategy in addressing past fisheries-related conservation problems (LOGAN *et al.* 2008). Amongst the seafood certification programs, the Marine Stewardship Council (MSC) is the global market leader (GUTIÉRREZ *et al.* 2012; GULBRANDSEN 2009). This non-gouvernemental organisation is a standard-setting international entity which defines and manages criteria for the sustainability performance of fisheries. Fisheries may decide voluntarily to undergo an independent third-party auditing process with the aim of a certification against the MSC standard and the use of its eco label.

Although its positive impact on the conservation of fisheries resources is controversial for certain stocks, certified seafood products are two to five times less likely to come from overexploited stocks than those that are not certified (GUTIÉRREZ *et al.* 2012; AGNEW *et al.* 2013; FROESE AND PROELSS 2012, 2013; SHELTON 2009). However, sustainability certifications can only be reliable and credible when there is a transparent and reliable supply chain. Traceability is a key requirement to maintain and guarantee for the sustainable production of a good or food stuff to the end consumer (LYNDON 2009). For this reason, the MSC developed a Chain of Custody standard. The aim is that every member of a supply chain that wants to trade MSC certified seafood has to be evaluated on its traceability performance by an independent third-party. Only then can a seafood product be sold with the blue and white MSC label. In the case of fishery products it is crucial to "know the origin of the fish to make sure it is a fish caught sustainably" (BAMMERT 2013). It is clear that traceability of fish products itself does not mean sustainable fishing; it is rather a tool to assure that sustainably caught fish can be identified as such and therefore can be differentiated from fish that might come from overexploited fish stocks. Hence, a basic assumption of this study is that with traceability it is possible

- For the consumer to make a buying decision based on the guarantee of the origin, production method and environmental impact of the seafood and its production. A system of traceability in food supply chains helps to document the history of a product, generating reliability and confidence among consumers (PALACIOS ESTEBAN 2006; JACQUET AND PAULY 2008).
- For authorities to prove correct documentation of landings and to assure an efficient land-bound fisheries control and management. Documentation is essential for obtaining accurate landings data, serving as an important tool of fisheries resource management, for instance as a part of stock evaluation methods like Landings Per Unit of Effort (LPUE) -analyses (LOURENÇO AND PEREIRA 2006; LOGAN *et al.* 2008; FUNDACIÓ PROMEDITERRANEA 2011). Besides, traceability and proper

documentation of seafood are indispensable in the fight against illegal, unregulated or unreported fishery (IUU).

Those two facts show the importance of traceability for compliance not only with obligatory legal requirements but also with voluntary standard requirements. According to (CAULKINS 2011), the main factor is to combine traceability systems with criteria of Chain of Custody standards. These standards shall guarantee that only certified bodies may participate in the supply chain of a certified product. For these reasons, transparency of supply chains is increasingly important in fisheries management (ILES 2007).

In Spain, there are currently few fisheries certified by the MSC and no fishery has been certified in the Mediterranean Sea so far (as of June 2013). However, there are several quality labels for different species that incorporate features like origin, freshness, size classification and socio-cultural associations as might be the heritage of the fishery community; those labels involve a Chain of Custody standard in some way. One of those quality labels is the “Marca de Garantía de la Gamba de Palamós” of a specialized blue and red shrimp (*Aristeus antennatus*) fishery and commercialization circuit in the Catalonian harbour Palamós. It also applies a Chain of Custody standard and serves as a reference for traceability in this study.

In the MSC Chain of Custody certification traceability is used to differentiate and market seafood with subtle or undetectable properties (GOLAN *et al.* 2004). As no physiognomic difference exists between certified and non-certified individuals it is impossible to distinguish them physically – for this reason the biggest challenge to the MSC in this sense is to make it as difficult as possible to mix non-certified with certified product. The MSC uses different tools to validate if a certified product contains the corresponding content: DNA analysis and tracebacks.

Furthermore, the challenge of preventing from mislabelling increases when we deal with certifying fresh fish sold in bulk which is the main buying option of seafood in Spain: Data from the Spanish Ministry of Agriculture, Alimentation and Environment (MAGRAMA) for the statistical period of October 2011 - October 2012 show that fresh fish accounts for 79% of the total fish consumption, while marine invertebrates are consumed freshly at 57% (see Table 1). The low percentage of fresh products in the case of shrimp and prawns reflects the fact that most of the products are imported frozen from South American and South East Asian countries. However, the majority of blue and red shrimp caught in the Mediterranean is sold fresh. This table shall prove the importance that fresh fish has in Spain. In comparison with the Dutch (45%) and German market (10%) the Spanish fresh fish market is of outstanding significance (FISCHINFORMATIONEN-ZENTRUM (FIZ) 2013; VISBUREAU 2012). Another important factor is that “traditional” fish mongers, i.e. street fish mongers and fish markets are the most important buying location for fresh fish (66%) in Spain (MARM 2011).

This circumstance has implications for the traceability requirements of the product: Most of the frozen and conserved products sold in supermarkets are packed. This makes it easier to trace the product as the process is industrialised and post-production manipulation is hardly possible. However, this does not guarantee that the information was correct, as several studies about mislabelling of seafood products show (MILLER *et al.* 2012; GARCIA-VAZQUEZ *et al.* 2011).

Table 1: Fish Consumption and Expenditures in Spanish Homes October 2011- October 2012.
Source: Unpublished data by MAGRAMA 2013

Presentation Modus	Consumption (1000t)	Expenditures (m €)
FISH	686	4,624
Fresh	540	3,702
Frozen	146	922
<i>% Fresh</i>	79	80
MARINE INVERTEBRATES	337	2,544
Fresh	191	1,328
Frozen	115	946
Cooked	31	269
<i>% Fresh</i>	57	52
CRUSTACEANS	101	929
Fresh	20	211
Frozen	62	554
Cooked	19	164
<i>% Fresh</i>	20	23
CANNED SEAFOOD	190	1,725
TOTAL	1,214	8,892

Literature and studies about traceability analyses in specific supply chains predominantly focus on industrial supply chains of seafood (KARLSEN AND OLSEN 2011; KARLSEN *et al.* 2011; KARLSEN *et al.* 2012, 2013; KARLSEN AND OLSEN 2010; OLSEN AND BORIT [in press]). Besides, there are few studies about operators' willingness to certify to CoC standards, especially in non-industrialised supply chains. One example is furniture manufacturers' readiness to embrace CoC certification (RATNASINGAM *et al.* 2008): Willingness to get certified was low, because the lack of price premiums, limited market potential and high cost were seen as impediments for adopting Chain of Custody certification. Given the importance of small-scale and non-industrial fish trading for the Spanish and probably Mediterranean fish markets it seems necessary to extend traceability studies to non-industrial supply chains.

JACQUET AND PAULY (2008, p.314) state that a "lack of traceability and re-labelling of fish undermines environmental regulations; renaming and mislabelling of seafood also prevents 'eco-aware' consumers from making effective purchasing decisions on behalf of conservation. Many exporters and even domestic suppliers are able to sell their fish as eco- friendlier versions due to the lack of traceability. Perhaps the best method to ensure labelling standards is with a third-party validation from 'cradle to plate'".

To conclude, deficiencies in traceability could impede a potential Chain of Custody certification and have further implications for the credibility of the guarantee label "Gamba de Palamós". In the next paragraphs, the research questions of this study are presented.

1.3 Hypotheses and Research Questions

This study deals with the analysis of traceability in a fresh fish supply chain. The idea was raised because traceability is a crucial tool for guaranteeing a certificated product to the end consumer. In the case of a fishery product it can assure a sustainable provenience of the fish which is the base for directing consumption to a reasonable demand of seafood. The following research hypotheses and questions were derived from literature and background research.

Fresh fish supply chains in Spain face various accusations from science and the fishing sector itself when it comes to traceability. On the one hand there is an accusation from a study of (ASENSIO AND MONTERO 2008) which refers to serious labelling deficiencies in traditional fish mongers. On the other hand, it is “vox populi” even within the fishing sector that unreported selling outside the auction occurs and thereby weakens the implementation of the Common Fisheries Policy and the Common Market Organisation as some mechanisms (minimum sizes, documentation of catches) are skipped over. The Catalan fishing sector itself estimates that undocumented sales of seafood range between 20 and 30% (FUNDACIÓ PROMEDITERRANEA 2011; CELMA 2011). Considering the definition of illegal, unreported and unregulated (IUU) fishing, this undermines traceability and legal requirements. It not only transforms the fish into an illegal issue, it also harms the fishing community itself and distorts competition (EUROPEAN UNION 2012). Additionally, tax income is reduced which could be used to improve fisheries management in the broadest sense. The rationale for the first hypothesis is as follows:

I. There are gaps in fresh fish traceability at different stages of the production of fresh seafood in Palamós

At first, to determine traceability needs of a specific supply chain, it is important to know if the production is supply-driven (bottleneck: Access to raw materials) or demand-driven (bottleneck: Ability to sell) because this might settle the application of an improved traceability system: While operators of a supply-driven supply chain might be interested in increasing yields and the information might be used for production optimisation, businesses of a demand-driven supply chain might focus on recording and transmitting data about production details (fisherman, origin, fishing method) to add value to the product and to guarantee market access (KARLSEN AND OLSEN 2010). There are examples for companies that successfully profiled their seafood by putting additional data on the label, in the accompanying documentation to the buyers or openly on the company web site. This is why the first three questions are:

1. *How is the supply chain of blue and red shrimp structured and characterised?*
2. *Which types of enterprises exist in the supply chain and how are their traceability capacities?*
3. *Which traceability model is employed and how are responsibilities distributed?*

After the description of traceability in the case study, the question rises where errors and deficiencies occur and if they are systemic in order to be able to treat these problems:

4. *In which stage of the commercialisation process do gaps occur in the information flow and in traceability?*
5. *Do systemic errors exist?*

6. *What are the social and political reasons for the deficiencies?*

The second hypothesis is constructed to gain knowledge about the consequences of traceability deficiencies in the supply chain. These consequences will be analysed for the Marine Stewardship Council's Chain of Custody certification.

II. The failures in traceability have consequences for the credibility of the Quality label and may impede MSC CoC certification

1. *Are the requirements of the MSC Chain of Custody already met? What is still missing?*
2. *Are the actors of the supply chain willing to get certified?*
3. *What can be done to meet the standard?*

In order to understand the concept of traceability in fresh fish commercialization, the next chapter deals with an introduction and definition of related terms before describing concepts and models of traceability and the role of third-party certification in seafood traceability.

These hypotheses are to be understood as a guide for the analysis of the problems that are mentioned above. After verifying or rejecting those hypotheses, a fundamental part of this study is to find solutions to the detected traceability gaps in the supply chain.

2 Traceability Theory and Legal Aspects

Traceability describes a concept of controlling and monitoring of commercial processes. In the food industry it is valued as an important aspect of safety and quality which was pushed by an increased standard of living, food information, consumer demand of high quality products (GONZÁLEZ DE ZÁRATE 2006) and the complexity of globalised supply chains (ALMEÍDA 2005; BEVILACQUA *et al.* 2009). This complexity makes consumers value reliable information about the origin (species, country / fishing area, production method), transformation and distribution of food products (FREDERIKSEN AND GRAM 2004).

Council Regulation (EC) 178/2002, further called “Food Safety Regulation” defines traceability as “[...] the ability to trace and follow a food, feed, food-producing animal or substance intended to be, or expected to be incorporated into a food or feed, through all stages of production, processing and distribution” (EUROPEAN COMMUNITY 2002, I (3), 15.). The International Standards Organisation (ISO) standard number 8402 defines traceability as “the ability to trace the history, application or localization of an entity through means of registered identifications” (ISO 8402). For products “traceability may relate to the origin of materials and parts, the product processing history and the distribution and location of the product after delivery” (KARLSEN AND OLSEN 2010, p. 314). This is a definition suggested by (OLSEN AND BORIT [in press]) who compared 101 scientific articles dealing with traceability in order to find an appropriate definition.

Food scandals and crises like the outbreak of the Bovine spongiform encephalopathy (BSE) in 1996, the dioxin contamination in chicken and eggs (i.e. in Belgium in 1999) (MAI 2010; OLSEN AND BORIT [in press]) or listeria in processed fish in Germany and Austria (FISCHMAGAZIN 2010) demonstrate the necessity of a guaranteed knowledge about the provenience of food stuffs. This is crucial in order to be able to identify, localize and react to a specific problem in the supply chain (FREDERIKSEN AND GRAM 2004). Besides, mislabelling is a typical phenomenon which occurs when traceability is deficient. In Germany a recent study revealed that more than 30% of sole was not the scarce and hence expensive North Sea Sole (*Solea solea*), but a tropical flatfish species (BURGER 2013). With the increased implementation of “Good Manufacturing Practice (GMP)” the quality of traceability systems improved and covered more information and more production steps (Moe 1998). Besides impeding and detecting food scandals, traceability is also an indispensable tool for the protection of labels and product differentiation (GONZÁLEZ DE ZÁRATE 2006; FREDERIKSEN AND GRAM 2004) and can be part of competition strategies (OLSEN AND BORIT [in press]). These strategies are a reaction to consumer demand for environmental aspects like production method, CO₂ footprint or the impact on the marine ecosystem and fish stocks (TRIENEKENS 2009; CAULKINS 2011; BRÉCARD *et al.* 2009; SOGN-GRUNDVÅG *et al.* 2012). Besides, sustainability is becoming a push factor for supply chain traceability (CAULKINS 2011).

For seafood products, traceability has various important uses: Quality management, hygiene and food safety, consumer information (avoiding deception of consumers in relation to species, species origin and date) and compliance with legal requirements. Sustainable production of seafood is an attribute which is gaining importance for buying decisions of consumers and requires seafood products to be safeguarded against unus-

tainably obtained seafood products in order to be credible to consumers (WOGNUM *et al.* 2011). It is noteworthy that the perception of importance of those attributes can differ greatly between countries (MYAE AND GODDARD 2012).

In order to understand the definitions given above, it is important to know the underlying concepts which will be explained in the following paragraphs.

2.1 Concepts of Traceability

There are four general concepts of traceability that are important to be understood and to be differentiated: Tracking vs. tracing and internal vs. external traceability. Besides it is important to introduce the role of granularity for traceability. Figure 1 shows those concepts graphically on the example of a seafood supply chain.

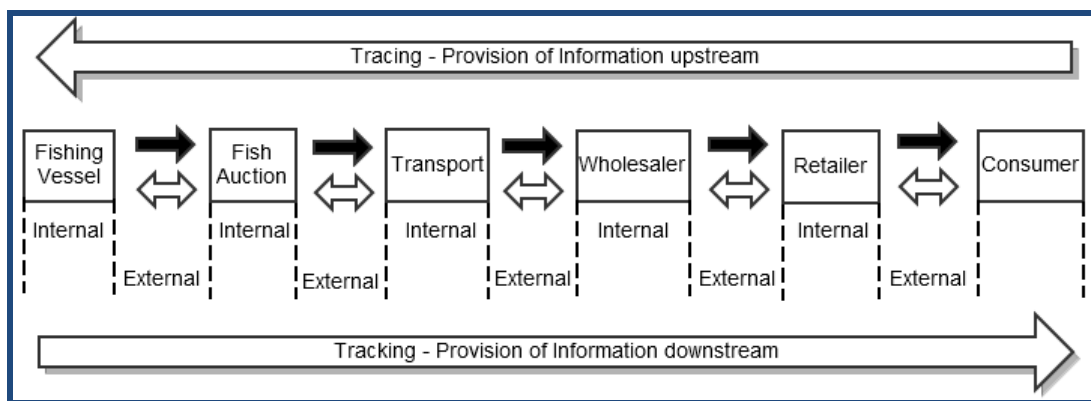


Figure 1: Traceability along the seafood supply chain: Important concepts: Tracing vs. tracking and internal vs. external traceability. Source: Modified according to RANDRUP *et al.* (2008)

Tracking is the ability to follow the path of a specified unit of a seafood product and / or batch through the supply chain and to identify the location as it moves between operators towards the final point of sale. It starts at the fishing vessel, goes through the hands of the auction, logistic service providers and distribution centre(s) and ends at the retail point-of-sale and is useful for product recalls and to find the cause of a problem. Besides, it is a useful tool for storytelling when tracking codes are attached to the seafood product, because it enables consumers to examine the product life.

Tracing is the ability to identify the origin or attributes of a seafood unit and / or batch of seafood located within the supply chain by reference to registered records (downwards / upstream). It includes producers of raw materials, ingredients, packaging and all intermediate suppliers until the seafood product reaches the company and is used to find the source of a problem.

Internal traceability is the ability to follow the path of a specified unit of a product and / or batch within one company. It is the system that ensures the link management and data communication of every unit of raw materials and ingredients during the processing at each step until the final product.

External traceability is the ability to follow the path of a specified unit of a seafood product throughout the entire supply chain (from fishing vessel to the end consumer). It is based upon internal traceability. This system ensures the links management and the data

communication between the steps of the production chain (RUBIN 2007; GONZÁLEZ DE ZÁRATE 2006; NGUYEN 2004; MAI 2010).

Granularity means the description of different levels of traceability units. This includes the definition of the size of the good or product that is to be traced. Generally spoken, fine granularity levels are necessary in a case where traceable units are small but the number of these units is high and vice versa (Figure 2).

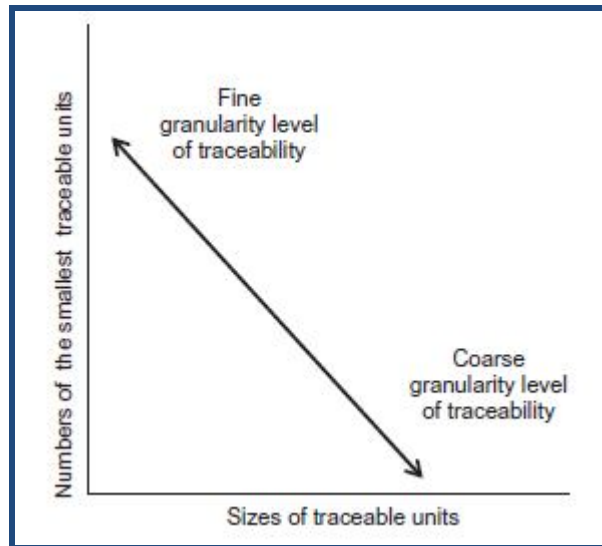


Figure 2: Different granularity levels of traceable units
Source: KARLSEN *et al.* (2012)

To conclude, tracking refers to the parallel dynamic identification of a product whilst tracing refers to the identification of a product's origin based on recorded data about its processing or logistical life. Granularity is the relation of the number and the size of traceable units.

Based on the instruments of internal and external traceability, two basic ways of reaching traceability in a supply chain is the use of centralized and distributed models. These will be described with their strengths and weaknesses in the following paragraphs.

2.2 Traceability Models

There are different models for implementing traceability in supply chains. Their application depends on various considerations like company size, management capacities and motivation. The following descriptions are taken from (GONZÁLEZ DE ZÁRATE 2006).

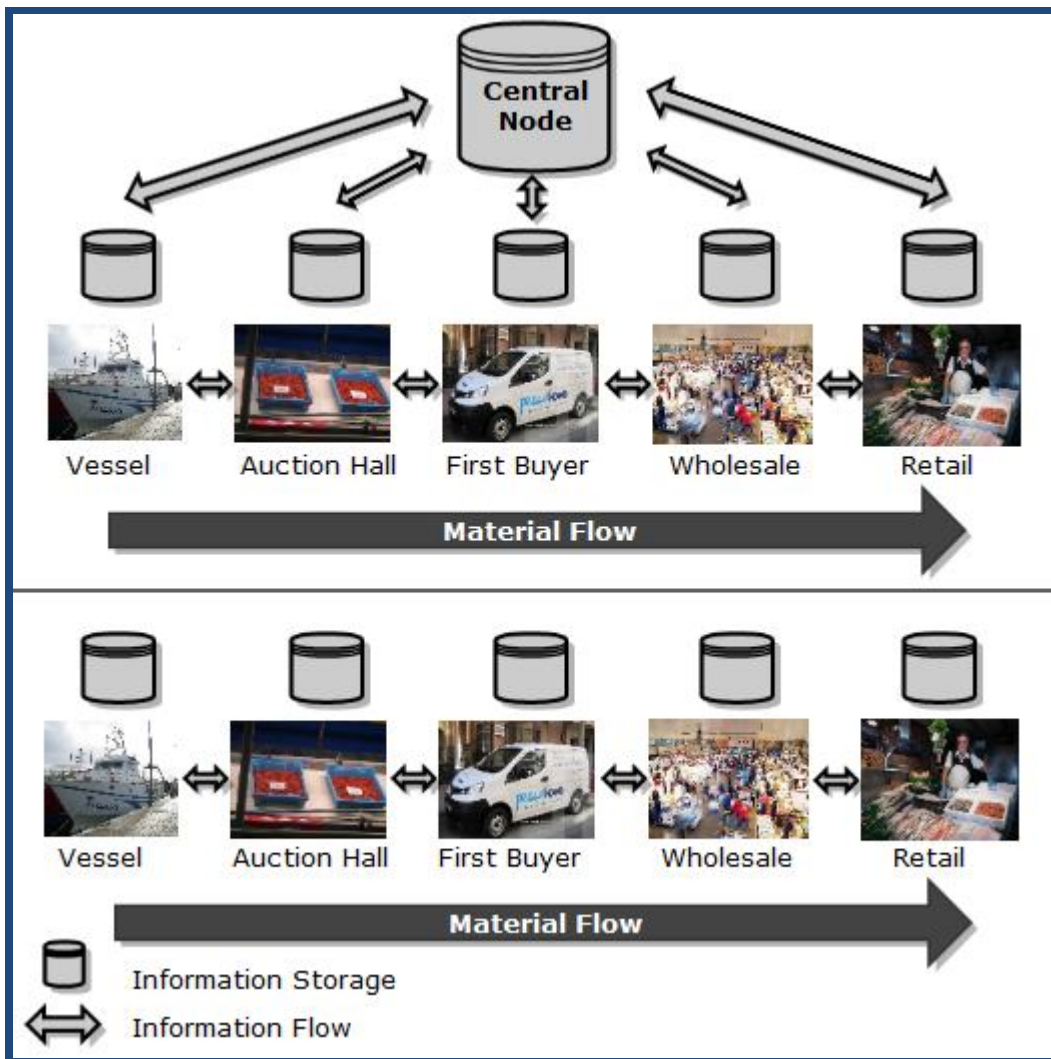


Figure 3: Centralised (top) and distributed (bottom) traceability models,
Source: Own charts according to GONZÁLEZ DE ZÁRATE (2006)

Centralized models rely on a horizontal separation of the functions, but not of the responsibilities (Figure 3). There is one central node which registers and provides the traceable information to all members of the supply chain. These members have to send the information about the internal sub-processes to the central node. This requires the supply chain to have a central data base where the information is stored, one interface to store the process information and one for queries about the traceability information. The advantage of this system is that the information can be obtained simply and quickly; administrative controls or audits of the traceability system can be easily carried out as the information is centrally available. Disadvantages are that the function of the central node goes along with the responsibility for the entire chain, the technical difficulties that may occur in small-scale businesses and a confidentiality problem that arises with the sharing of business data.

Distributed Models are characterized by shared functions and responsibilities. Every member of the supply chain registers the traceable information. Their big advantage is the simplicity of information flow, reduced technical requirements and investment costs. The disadvantage is that it is far more difficult to obtain the traceable information of all agents in the supply chain, it takes longer and has higher costs.

Mixed models can be applied in the form of having centralized models in a specific part of the supply chain and distributed models in other parts. Mixed models might be the easiest form of traceability models as it is possible to employ them according to the necessities of the stakeholders. Generally, centralized traceability models can be installed at the first production site and distributed models at the logistics and distribution site.

The use of these models, however aim at a certain goal: The legal requirements and obligations of traceability. The following paragraphs detail the legal framework for traceability in the study area.

2.3 Legal Requirements to Traceability in Fresh Seafood Trade in Spain

One of the most important instruments for the implementation of traceability in a paper-based documentation system is labelling of the products. The Spanish fresh seafood trade has to comply both with communitarian and national legislation. At European Union level there are three important regulations that affect fresh fish traceability, each having different approaches to traceability:

Food Safety Regulation (EC) 178/2002

Article 18 of the food safety regulation deals with traceability and states, that each food / feed business operator (persons who imported, produced, processed, manufactured or distributed a food / feed product and those who undertake retail activities which do not affect the packaging, labelling, safety or integrity of the food or feed) must

- *Be able to identify their suppliers and customers (one up, one down) and convey this information to the Competent Authority on demand*
- *Have a system to withdraw / recall unsafe products;*
- *Inform the competent authorities of unsafe food.*

The Food Safety Regulation does not define the exact methods of how to identify suppliers and customers and it does not require internal traceability.

Regulation about the establishment of a control system for ensuring compliance with the Common Fisheries Policy (“Control Regulation”) (EC) 1224/2009

This is why the Control Regulation goes further and details traceability in its article 58. A lot is here referred to a quantity of fisheries products of a given species of the same presentation, coming from the same relevant geographical area fishing vessel or group of fishing vessels. However, the actual size of the lot is left open to the practical business situation.

- *All lots of fisheries and aquaculture products shall be traceable at all stages of production, processing and distribution, from catching or harvesting to retail stage*

- *Products placed on the market shall be adequately labelled to ensure the traceability of each lot*
- *Lots may only be merged or split after first sale if it is possible to trace them back to catching or harvesting stage*

The obligatory information that has to accompany every lot is the

- (a) *Identification number of each lot;*
- (b) *External identification number and name of the fishing vessel;*
- (c) *FAO alpha-3 code of each species;*
- (d) *Date of catches or date of production;*
- (e) *Quantities of each species in kilograms expressed in net weight or, where appropriate, the number of individuals;*
- (f) *Name and address of the suppliers;*
- (g) *Information to consumers provided for in Article 8 of Regulation (EC) 2065/2001: the commercial denomination, the scientific name, the relevant geographical (FAO) area and the production method;*
- (h) *Whether the fisheries products have been previously frozen or not.*

Regulation for consumer information about fishery and aquaculture products (EC) 2065/2001

As to read in (g), Council Regulation (EC) 2065/2001 points out the four categories that are to be delivered to the end-consumer. So, only commercial and scientific name, FAO area and production method have to be delivered to the end-consumer although it would be possible to give more detailed information to the consumer.

In Spain, Royal Decree 121/2004 (Identification of Fresh, Cooked or Chilled Seafood Products) implements the European labelling regulations and expands the requirements to information about the presentation modus and about the first expeditor. Furthermore, it makes the business operators of the supply chain responsible for identifying and storing the information they manage; specifically, they shall re-label fish boxes in the event of itemizing, grouping, mixing or re-packing of the original content in the first point of sale (auction hall → wholesale market).

Although not a legal requirement but a recommendation for correct labelling in the Spanish fish trade, the manual of the implementation of HACCP (Hazard Analysis and Critical Control Points) and hygiene standards published by the Spanish fish monger federation FEDEPESCA gives some advice for their members. It implies the capacity of identifying the provenience (via documentation of bills and invoice) and the destiny (final consumer). Besides, fish mongers are obliged to demand correct labelling from the supplier and have to guarantee for an efficient information transfer to the final consumer. Additionally it claims the necessity of assured correct labelling and the implementation of auto control system in fish mongers businesses. By using labels, bills, invoice and registers that be-

long to the management system of the fish monger traceability is to be put forward. The main questions to ask are: Which products enter to the fish monger? Who are the suppliers of this product? When has it been acquired?

Lastly, labels have to be resistant and impermeable; bills and invoice have to correspond to the label, so every delivery of a product has to bare the label with the accompanying documents. That means that also split parts (further called “sub-lot”) of an original lot have to be labelled.

As stated above, perhaps the best method to ensure labelling standards that go beyond the legal requirements is a third-party validation from ‘cradle to plate’ (JACQUET AND PAULY 2008). The present study uses the MSC Chain of Custody (further called CoC) Standard as a reference which therefore is examined more closely in the following section.

2.4 Third-Party Certification as Additional Enforcement for Traceability Rules – The MSC Chain of Custody Standard

To begin with, third-party certification means that a person or body is recognized as being independent of the parties involved, as far as the issue in question is concerned (FAO 2009). The concept involves three steps: Accreditation, certification and labelling (see Figure 4). In the case of the MSC, a third-party certifier must be nominated by an accreditation body (Accreditation Services International – ASI) which shall guarantee that the certifiers are a third-party without proper interest in the issues in question and the staffs have the required training. The accredited certifier – the third-party – audits the fishery checking its performance against the MSC standard for sustainable fishing. Furthermore the certifier audits the supply chain which wants to trade the certified product (buyer) against the MSC CoC standard. If the two steps are passed, the product can carry the blue and white eco label of the MSC.

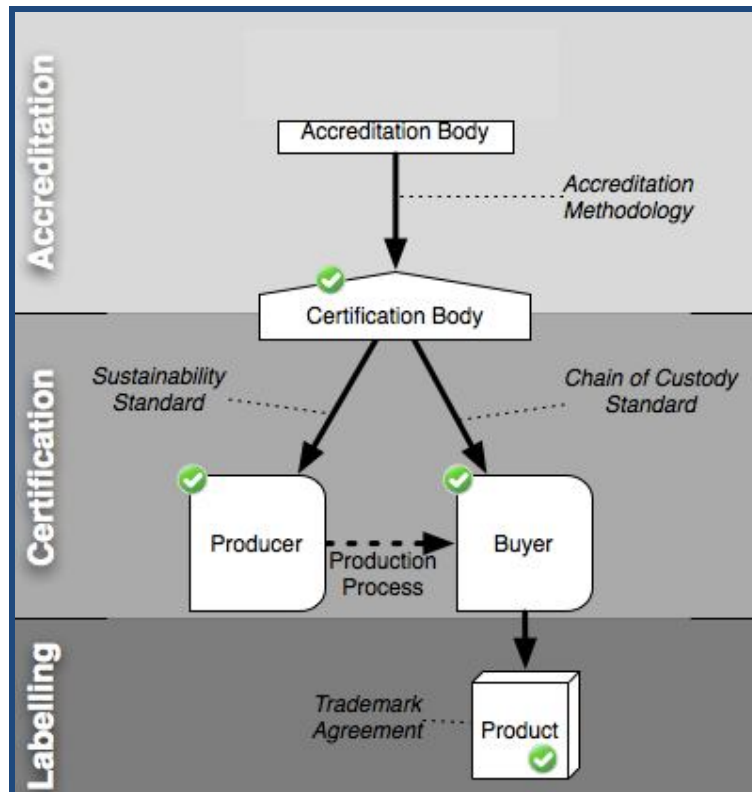


Figure 4: Third-Party Certification,
Source: ASI INTERNATIONAL 2013

When parts of a supply chain operate with insufficient traceability for product differentiation and lack the guarantee of sustainability or quality, companies and industry groups have the possibility to adopt appropriate measures to monitor and advertise the credibility of this product certification (GOLAN *et al.* 2004). This is one of the main reasons for the use of independent third-party sustainability / quality auditors to assure that the traceability requirements are met by the firms. These certifiers can verify the existence of traceability systems to corroborate consumers' credence claims. Administration could also require companies which produce seafood with credence attributes to support their claims by implementing obligatory traceability systems. If industry is not required to verify that credence attributes exist, the door might be wide open to companies trying to gain price premiums by using credence attributes for products which do not offer a substantial differentiation or advertise for a differentiation which they cannot verify. Mandatory traceability proposals can have difficulties as they often fail "to differentiate between valuable quality attributes, those for which verification is needed, and less valuable attributes for which no verification is needed" (GOLAN *et al.* 2004, p. 7).

The Marine Stewardship Council (MSC) is the world leader of sustainability programmes for seafood products in terms of market presence and traded volume (ERWANN 2009; GULBRANDSEN 2009). It was founded in 1997 by the multinational food company Unilever and the World Wildlife Fund (WWF) as a non-profit NGO with the goal of marketing sustainably sourced seafood. It became independent in 1999 and is financed by licensing fees for the use of the MSC logo, donations and specific projects funding.

The MSC has set two principal standards for the certification of sustainability of fishing activities. The first one deals with the proper extractive process, i.e. the assessment of the impact that a fishery has on the exploited stock, the ecosystem where it acts on and the

organisational form of governance and management. The second one, however, focusses on the possibility of guaranteeing that only those seafood products which meet this first standard are sold as such with the blue and white eco label. Therefore it is vital to assure traceability of the certified seafood, and to employ a chain-of-custody standard, which is the core idea of this study. After explaining the standard for sustainable fisheries, (see Box 1) the chain-of-custody standard will be delineated.

Box 1: The three basic principles of the MSC Standard for Sustainable Fisheries

Source: MARINE STEWARDSHIP COUNCIL 2013a

“Principle 1: Sustainable fish stocks

The fishing activity must be at a level which is sustainable for the fish population. Any certified fishery must operate so that fishing can continue indefinitely and does not overexploit the resources.

Principle 2: Minimising environmental impact

Fishing operations should be managed to maintain the structure, productivity, function and diversity of the ecosystem on which the fishery depends.

Principle 3: Effective management

The fishery must meet all local, national and international laws and must have a management system in place to respond to changing circumstances and maintain sustainability.”

Those principles are detailed by 31 criteria which are assessed by accredited certifiers. These criteria comply with the International Social and Environmental Accreditation and Labelling (ISEAL) Code of Good Practice for Setting Social and Environmental Standards, and the FAO guidelines for the eco labelling of fish and fishery products from marine capture fisheries. The latter are a compilation of minimum criteria and one of the most important documents for the sustainability certification of seafood products. The FAO guidelines set minimum criteria for the aspects of fisheries management, stock exploitation and ecosystem impact as well as assessment methods. They were released in 2005 and revised in 2009. The document contains minimum criteria for organisations setting sustainability standards for fisheries.

A client fishery that wants to get certified for a stock which it exploits (“stock under consideration”) has to be defined to a “unit of certification”. That is only the fish originating from this very stock and fished from this specific unit of certification can be a certified seafood product. Four reference points are used to describe fisheries applying for assessment: The geographic area of fishing, the target fish stock, the fishing gear used and the management group(s) or organisation(s) taking responsibility for the certificate. Together, these are known as the 'unit of certification' and are determined by the client at the beginning of the certification process. The certification unit can include an entire fishery or just certain vessels within a fishery as well as several fisheries exploiting a shared stock, one species or several, and includes reference to the gears or fishing methods utilised within the fishery. Following the FAO guidelines for eco labelling of fish products, certification applies only to products derived from the “stock under consideration”. The impacts of all the fisheries which exploit that “stock under consideration” over its entire area of distribution have to be considered (MARINE STEWARDSHIP COUNCIL 2013a; FAO 2009).

By April 2013 200 fisheries are certified with the MSC label, 100 more are undergoing assessment and 40 - 50 are in confidential pre-assessment. The 200 certified fisheries catch approximately 7 million tonnes of seafood which corresponds to almost 8% of the 90 million tonnes that are caught annually all over the globe (FAO 2012). More than 18 000 different products are sold with the MSC logo. This logo is only applied to fish and seafood products that come from a MSC-certified fishery. This fact required the organisation to launch the CoC standard which was designed to guarantee traceability ‘from boat to plate’, so every link in the supply chain has to undergo an independent third-party audit.

The MSC CoC standard was first published in 2000 based on existing best practice traceability standards, a first review led to the second version in 2005 and the latest version number 3 is valid since August 2011. As the standard for sustainable fishing, the CoC standard complies with the ISEAL Code of Good Practice for Setting Social and Environmental Standards and with the FAO guidelines for the eco labelling of fish from capture fisheries (MARINE STEWARDSHIP COUNCIL 2013c). In the guidelines, Chain of Custody is defined as “the set of measures which is designed to guarantee that the product put on the market and bearing the eco label logo is really a product coming from the certified fishery concerned. These measures should thus cover both the tracking / traceability of the product all along the processing, distribution and marketing chain, as well as the proper tracking of the documentation (and control of the quantity concerned)” (FAO 2009, p. 4). Hence, in the case of the MSC, the overall objective of Chain of Custody certification is to ascertain that only products originating from an MSC-certified fishery are labelled as MSC. In the case of certified, unpacked fresh fish every part of the supply chain has to be certified against the CoC standard: The fishery, the wholesaler, the processor or distributor (as long as he has ownership of the product) and the retailer or the restaurant where the product is sold to the end consumer. If the product is packed consumer-ready and tamper proof at the processor’s site, the up-coming operators in the supply chain may sell those products without being certified against the CoC standard (see Figure 5).

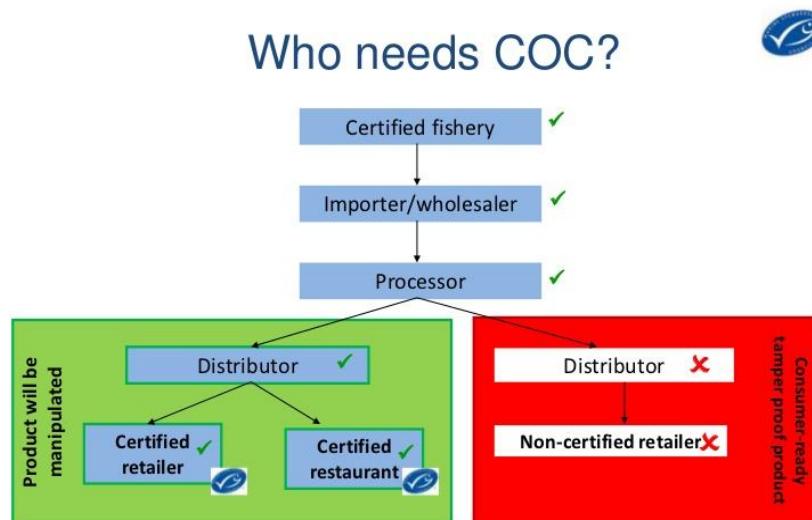


Figure 5: Certification scheme of the MSC CoC Standard
 Source: MSC (2012)

There are four main principles in the CoC standard including the obligation to employ a management system and a traceability system (see box 2). During the audit the certification body has to check if the following working steps are carried out at the business seeking certification:

- Confirming inputs
- Separating and / or demarking MSC certified and non-certified fish inputs and all related processes (receiving, storage, processing, packing, supply)
- Secure product labelling
- Identifying certified outputs
- Recording lot or batch numbers on delivery
- Maintaining traceability from final processed and packaged product back to lot or batch for the product's inputs and vice versa

The systems are verified on the one hand through tracebacks down the supply chain from the point of sale to the fishery. That is, a labelled product is bought at the supermarket and traced to its origin following the documentation (invoice and bills). A recent traceback test of an Alaska pollock supply chain (USA – China – EU) did not indicate product substitution; however, some irregularities were detected. On the other hand verification using DNA testing is carried out. The latest results on DNA testing showed a very small number of mislabelled certified products (3 out of 381 samples contained a different species than that of the package information (MARINE STEWARDSHIP COUNCIL 2013b). However, this method is limited because besides identifying the species it is hardly possible to detect genetic differences between stocks. Hence, a difference between an overfished stock of herring and one which is not overfished cannot be made easily with the current technical possibilities. The MSC CoC standard does not describe any technical requirements for the traceability systems; they are left to the business and market realities as they can be very different from a multinational company to a small fishmonger. Furthermore, only the question whether the product is certified or not must be able to be traced back, no specification on the extent of information to be traced is required. That is, a certified cod from the Barents Sea might be mixed with a certified cod from the Baltic Sea and, hence, traceability from boat to plate would get lost. At least in Europe, as food and labelling regulation already requires identification of origin, this is compensated. Nonetheless, the concept from boat to plate is not applied; it is rather from “certification unit” (in most cases a fleet) to plate.

Most of the entities certified to the CoC standard at end-consumer level are supermarkets. Few traditional fish mongers and restaurants have been certified so far. However, given the preference of Spaniards for buying fish at the “fish monger of confidence”, a paradigm change seems to be necessary. The next section describes materials and methods that were used in the study. A larger part is dedicated to the study design.

**Box 2: The four principles of the MSC Chain of Custody Standard,
Source: MARINE STEWARDSHIP COUNCIL 2011**

Principle 1: The organisation shall have a management system

The company seeking CoC certification shall operate a management system which addresses the principles and criteria in the CoC standard. The personnel of the organisation have to be trained in order to ensure conformity with the principles. Records that demonstrate compliance with the standard have to be kept for a minimum of three years. Potential subcontractors have to be able to demonstrate that the requirements of this standard are met.

Principle 2: The organisation shall operate a traceability system

For any product sold by the organisation as certified, tracing must be made possible from its sales invoice to a certified source and vice versa (one up / one down). The records shall allow confirmation of volumes of certified inputs and outputs over any given period (input-output balance). If processing or packing / repacking occurs, records shall allow conversion rates for certified outputs from certified inputs over any given period to be calculated. The organisation shall only sell products as certified which are covered by its scope of certification. That means every product has to be acknowledged by the certifier and if the organisation wants to source a new product (e.g. from a new fishery, new species or product form, type of storage or product presentation), a scope extension must be requested to the certifying body prior to that.

Principle 3: There shall be no substitution of certified products with non-certified products

Certified and non-certified products shall not be mixed if the organisation wishes to make a claim about these certified products. However, non-certified products can be used as an ingredient in a certified end product if the share of non-certified seafood does not exceed 5%. It must be ensured that packaging materials and other identification materials bearing the MSC logo cannot be used for non-certified products.

Principle 4: There shall be a system to ensure all certified products are identified

A system of internal traceability shall be employed in order to ensure that certified products are identifiable as such at all stages of purchasing, storage, processing, packing, labelling, selling and delivery. Only certified products covered by the scope of certification are identified as such.

3 Materials and Methods

3.1 Data Base of the Cofradía de Pescadores

The Cofradía de Pescadores of Palamós kindly facilitated access to its database on first sales in the auction. In 2012, the buyers made a total of 155 210 transactions in the fish auction of Palamós which corresponds to the same number of entries in the database. For the present study the database served as a helpful tool for the selection of interview partners. The data processing methods will be described in section 3.3.

3.2 Case Study

This study wants to contribute to the development of a strategy to improve traceability in fresh fish supply chains. For this rather general problem, a specific example is needed to visualize this problem concretely. This is why a single case study approach is used in this study. In general, “case studies are the preferred method when (a) “how“ or “why“ questions are being posed, (b) the investigator has little control over events, and (c) the focus is on a contemporary phenomenon within a real life context“ (YIN 2009, p. 2). The problem of traceability in a specific supply chain is certainly a combination of these three features. The case study of traceability in the blue and red shrimp supply chain is conducted not only to gain knowledge about the specific case; rather, it is being investigated because it is regarded as a typical and particularly revealing example of a more general problem of traceability deficiencies in non-industrialized fresh fish supply chains (KARDORFF *et al.* 2008).

Studies of one single case (sectorial investigation) are an appropriate approach if new, historically unique or exemplified phenomena shall be investigated. One “case” refers to a social unity which in the present study consists of all persons and companies who participate in any way in the production chain of blue and red shrimp landed and sold in Palamós. Case studies normally are conducted in order to gain knowledge about the single case which is studied. Nonetheless, they also just prove that certain developments or phenomena virtually exist. Furthermore, following the *ceteris-paribus*-strategy, the knowledge about a single case can be extrapolated to other cases when conditions are equal or similar. This makes clear why an exact documentation of the context, the status quo and the used methodology is so important. The greater the concordance between cases, the greater will be the probability of extrapolation (LEGEWIE 2003). The organisation of commercialization of seafood from trawl fisheries is similar at least along the Catalan Mediterranean littoral because it is regulated and embodied by local fishermen’s associations (Cofradías de Pescadores) so it seems to be justified to carry out case study research in one particular supply chain (ÁLVAREZ-EREIPA *et al.* 2009).

3.3 Critical Traceability Point Analysis (CTPA)

Methodology for encountering deficiencies and optimization of traceability systems of fish and seafood supply chains is a relatively new field of investigation. Most relevant publications origin from the Norwegian Institute of Fisheries and Aquaculture Research

NOFIMA, but focus on industrial supply chains (KARLSEN AND OLSEN 2011; KARLSEN *et al.* 2011; KARLSEN *et al.* 2012, 2013; KARLSEN AND OLSEN 2010; OLSEN, BORIT [in press]). Besides, there are administrative concerns and studies about the role of traceability for quality and environmental labelling of seafood products but they do not focus on methodological aspects (PALACIOS ESTEBAN 2006; LÁZARO JÍMENEZ 2006; GONZÁLEZ DE ZÁRATE 2006).

Critical traceability points (CTP) are referred to as crucial points at which information about the origin, production method and other traceable features of a seafood product is systematically lost. This can happen when product or process information is not linked to a traceable unit (TU) or recorded in a database in a systematic way (KARLSEN AND OLSEN 2011). In this study, critical traceability points also include potential threats to MSC CoC certification. Critical Traceability Point Analysis (CTPA) is a combination of the two methods described by KARLSEN AND OLSEN (2011) and OLSEN AND ASCHAN (2010): Triangulation of the qualitative methods interview, observation, and document analysis in a specific case study and material and information flow analysis (KARLSEN AND OLSEN 2010).

Qualitative methods are especially appropriate for a detailed description and the analysis of subjective phenomena, including organisational and political decision making processes as for example the analysis of traceability in a specific company (LEGEWIE 2003).

However, for the planning of a qualitative study, quantitative screening methods can be employed in order to reach an optimal selection of interview partners (*ibid.*). In this study this will be achieved by a quantitative analysis of the relative economic importance of fishing vessels and first buyers.

Study Design

The design of this study is adopted and modified from KARLSEN *et al.* (2011) (see Figure 6) and detailed in the following paragraphs.

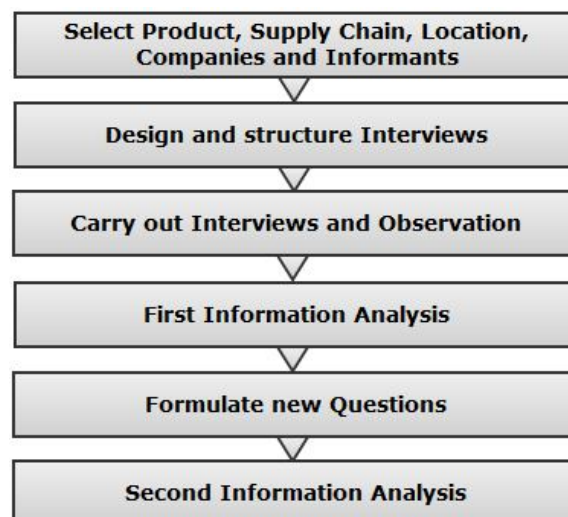


Figure 6: Study design for Critical Traceability Point Analysis

Source: Modified according to KARLSEN *et al.* (2011)

Phase 1: Selection of Product, Supply Chain, Location, Companies and Informants

Selection of product and supply chain

The main interest of this study is identifying deficiencies of traceability in fresh seafood supply chains in order to facilitate MSC CoC certification of those chains and to detect threats to the management system. For this reason, a pilot seafood supply chain was searched. One criterion was that experience with labelling issues existed in this supply chain in order to learn from errors and success. As stated before, there are several quality labels for regional fisheries in Spain, for instance hake (*Merluccius merluccius*) in the Cantabrian Sea (“Alimentos del Paraíso Natural” – Food from the Paradise of Nature); a quality label for fish and seafood caught by the Galician artisanal fleet and sold only in Galician businesses which focusses on freshness (is to be sold max. 24h after discharging) and good hygienic practices; “Fresh Fish from the Coast” in Catalonia and for single species caught on a local level like Norway lobster (*Nephrops norvegicus*) in Llança. However, the label “Marca de Garantía de la Gamba de Palamós” was selected as this is a registered label and auditing was carried out by the international certifying company Bureau Veritas, which is also accredited for MSC certification. Furthermore, blue and red shrimp is a highly lucrative fisheries resource with great commercial interest (MAYNOU *et al.* 2006) and this is the only quality label for this species.

OLSEN AND ASCHAN (2010) propose to gather information about the study object prior or during the first meeting at the production facility; so firstly, suppliers and customers were identified. The scope of this thesis is to study traceability in the blue and red shrimp supply chain on a local scale, so vessels, buyers, fish mongers and restaurants were chosen according to their knowledge of the treatment of information, presence on the market, experience with the guarantee label and importance in the fishing and commercialization of blue and red shrimp. In order to identify the relative importance of the operators in the business, the database generated in the first sale process (fish auction) was analysed.

Selection of interview partners

The selection of interview partners and, hence, the exact extent of the case study is a crucial element of the research process. In qualitative research, the focus does not lie on a preferably high number of interviews and the observation of frequencies, but on the spectrum of potential differences and patterns within the case. With qualitative investigations one does not necessarily seek representativeness, but plausibility; so the selection of interviewees must not be based on an arbitrary random sampling but can contain more subjective and more conscious elements (REUBER AND PFAFFENBACH 2005).

For this study, several strategies were used: Statistical sampling and access through gatekeepers. Statistical sampling is a pseudo-quantitative method which uses variables that are relevant to the research question. In the case of this study these are the differences between operators in the supply chain of blue and red shrimp and the effects on traceability performance. The second strategy is access through gatekeepers. Gatekeepers are key persons who play an important role when it is not possible to identify or to contact potential interview partners. In the present study, gatekeepers were used to identify appropriate restaurants and fish mongers. Gatekeepers’ importance lies also in approaching interview partners in a more familiar environment which can increase their willingness to collaborate (*ibid.*).

The studied facilities are the fishing vessels, the auction hall in the fishing harbour, industrial polygons where processing and packing occurs and restaurants and fish mongers in the city area. Furthermore, analysis of distribution in the nearby coastal villages of Blanes and Sant Feliu de Guíxols and a visit of the wholesale market in Barcelona (Mercabarna) were conducted in order to detail the traceability analysis.

For statistical sampling, quantitative data about first sales in the auction hall of Palamós for the year 2012 were obtained from the Cofradía de Pescadores of Palamós. It was used to identify relevant operators and contains detailed data on transaction level for all species that were landed in Palamós. The original “.mdb” data format was changed to “.odb” databases and worked on with Libre Office Base 4.0. The database contains the following data categories ([x]: analysed categories):

- Transaction date []
- Vessel information (name, registered number, length, construction year and motor power) [x]
- Buyer name [x]
- FAO abbreviation and scientific name of the species [x]
- A description of the traded species and size (for example small shrimp) [x]
- Number, weight and price of boxes and total payment per transaction [x]
- FAO zone (which is Mediterranean Sea in all cases). []

155210 observations were found. The data were filtered according to the species in order to obtain the transactions for blue and red shrimp: The feature FAO abbreviation (“ARA” for blue and red shrimp) was used as filter variable and resulted in 21499 transactions of *Aristeus antennatus* in 2012. The data was grouped according to the analysed categories using queries.

Fishermen

For the selection of relevant interview partners from the producer phase of the supply chain, vessels were selected according to their catch performance. 27 vessels caught shrimp in 2012, of which 20 account for 99.4% of the catches, caught more than 500kg/year and were included into analysis. In order to get a wide range of samples, six fishing masters from high, middle and low catching performance vessels were selected for an interview (see

Table 2). One abstained from the interview, so five fishers were interrogated. The majority (18) of the listed vessels is certified to the quality label and all selected partners also were.

Table 2: Catch performance of the Palamós blue and red shrimp fleet and relative importance of the vessels in 2012;

SOURCE: COFRADÍA DE PESCADORES OF PALAMÓS 2013

Vessel ID	Revenues (€)	Landings (kg)	Mean Price (€/kg)	% <i>A. Antennatus</i> of Revenues of all Species	% Revenues of the Entire Fleet
1*	328,734	14,184	23.18	90.4	9.9
2*	296,539	12,445	23.83	91.4	9.0
3	263,192	10,643	24.73	79.0	8.0
4	244,684	10,335	23.67	72.8	7.4
5**	231,727	9,835	23.56	92.2	7.0
6	238,377	9,648	24.71	78.7	7.2
7	185,779	8,473	21.93	87.6	5.6
8*	196,048	8,457	23.18	85.6	5.9
9*	195,149	8,160	23.92	88.8	5.9
10	193,072	7,893	24.46	76.2	5.8
11	174,976	7,775	22.50	76.4	5.3
12	115,728	5,717	20.24	66.6	3.5
13	128,662	5,617	22.91	58.0	3.9
14	126,240	5,446	23.18	64.2	3.8
15	103,529	4,543	22.79	45.0	3.1
16*	89,318	4,063	21.98	31.9	2.7
17	89,881	4,042	22.24	46.2	2.7
18	43,032	1,857	23.18	42.8	1.3
19	23,738	1,003	23.67	10.4	0.7
20	15,955	598	26.68	10.3	0.5
Mean	164,218	7,037	23.33	64.7	5.0

Vessel names are replaced because of data confidentiality

* selected for interview, ** inactive in 2013

Wholesalers

The analysis of the first buyers was carried out similarly to the selection of fishermen. The same database was used and selected categories were the same as for the fishermen. A total of 127 buyers bid for blue and red shrimp in 2012. However, this only reflects the number of different units which bought shrimp; there are several buyer collectives which account for as one buyer in the data. Buyers with more than one remote control for bidding for the same company are counted as one single buyer in this analysis. Six buyers held the certificate of the quality label's Chain of Custody standard in 2012, while only three of them were holding it during the studied period of time and one newly certified company occurred. Of all buyers, six interview partners were selected in function of their commercial characteristics: It was attempted to get a wide image of the buyer collective (see Table 3).

Table 3: First buyer characteristics selected for analysis in 2012**Source: COFRADÍA DE PESCADORES OF PALAMÓS 2013**

Buyer ID	Payments (€)	Quantity bought (kg)	Mean Price Paid (€/kg)	% Total Payments
1	374,373	15,251	24.55	11.4
2	170,573	4,396	38.80	5.2
3	148,203	5,710	25.95	4.5
4	110,910	4,810	23.06	3.4
5	106,128	4,231	27.12	3.2
6	79,827	2,826	28.25	2.4

Buyer names are replaced because of data confidentiality

Fish mongers and restaurants

The difference between fish mongers and first buyers is fluent as there are fish mongers who run several branches in the region. In Palamós, 12 fish mongers of major importance in terms of size and presence in the town were identified through observation. Ten of them sell at a sales hall situated in the fishing harbour, in the municipal market and in the old town of Palamós. The sales hall carries the quality label “Marca de Garantía” and the fish mongers are permitted to sell their shrimp with certificate. Out of the 12 fish mongers, three were selected for a visit and an in-depth interview. Two of them were certified to the quality label. Due to the lack of data about the structure and economic importance of the fish mongers for the supply chain, the partners were chosen based on information of the Cofradía de Pescadores and access was facilitated through a member of the fisheries museum of Palamós who is affiliated with the fish monger sector.

Seafood restaurants in the Costa Brava region – a coastal area of 220km length which extends from the Northern frontier of Spain with France to the mouth of the Tordera River near Blanes – are surely one of the most important boosters for demand of fishery and seafood products (FUNDACIÓ PROMEDITERRANEA 2011). In Palamós, a total of 57 restaurants dedicated to seafood dishes were identified through observation and interviews to the tourist office. Four restaurants were selected to participate in the analysis. As in the case of fish mongers, data about the structure was not accessible. One selection criterion was quality label certification which applied to one restaurant; the other three were chosen based on recommendations about willingness to cooperate from members of the local fisheries museum.

Before describing the second step of the CTPA, Table 4 shows the details of the interviews such as date, name of the interviewee and his or her organisation or the form of interview.

Table 4: Interview partners

ID	Date	Interviewee	Organisation	Position	Location	Form	Sector
1	21.02.2013	Silvia Romero	Palamós Town Hall	Economic Promotion	Palamos	Face-to-Face	Administration
2	22.01.2013	Marnie Bammert	Marine Stewardship Council	Country Manager	Berlin	Face-to-Face	Certification
3	05.02.2013	Ingeborg Oosterhuis	Marine Stewardship Council	Country Manager	Den Haag	Email	Certification
4	18.02.2013	Oscar Vidal	Bureau Veritas	Auditor	Madrid	Telephone	Certification
5	19.03.2013	Stefano Mischietti	Marine Stewardship Council	Supply Chain Management	London	Skype	Certification
6	14.02.2013	Jordi Fernandez	Peixos Mario/ Buyer Ortefish+Ligurpesca	General Manager	Palamos	Face-to-Face	Commissioner
7	04.03.2013	Gloria	Peixos Celia	General Manager	Palamos	Face-to-Face	Fish Monger
8	12.03.2013	Esther	Peixos Mielgo	Auxiliant	Palamos	Face-to-Face	Fish Monger
9	12.03.2013	Montserrat	Peixos Pilar	Auxiliant	Palamos	Face-to-Face	Fish Monger
10	10.01.2013	Francesc Benaiges	Cofradía de Pescadores Palamos	General Director	Palamos	Face-to-Face	Fishermen
11	02.03.2013	Carlos	Bonomar F	Head of Ship	Palamos	Face-to-Face	Fishermen
12	04.03.2013	Ramon	L'Arjau	Head of Ship	Palamos	Face-to-Face	Fishermen
13	01.03.2013	Conrad Massaguer	Nova Gasela	Shipowner	Palamos	Face-to-Face	Fishermen
14	28.02.2013	Adria	L'Espavil	Shipowner	Palamos	Face-to-Face	Fishermen
15	10.01.2013	Crisitina Mañas	Cofradía de Pescadores Palamos	Quality Management	Palamos	Face-to-Face	Quality Management
16	26.02.2013	Josep Maria Quadrat	Restaurant La Gamba	General Manager	Palamos	Face-to-Face	Restaurant
17	10.03.2013	Jordi Fernandez sen.	Restaurant La Caleta Blava	General Manager	Palamos	Face-to-Face	Restaurant
18	22.04.2013	Agustí	Restaurant Guillermo	General Manager	Palamos	Face-to-Face	Restaurant
19	25.03.2013	Anselm Massaguer	Restaurant L'Espardenya	General Manager	Palamos	Face-to-Face	Restaurant
20	15.01.2013	Francesc Sarda	Institute of Marine Science CSIC-ICM	Dr. of Marine Biology	Barcelona	Face-to-Face	Science
21	18.02.2013	Anna Garriga	University of Girona	Professor of Economics	Girona	Face-to-Face	Science

22	18.04.2013	Luis Leal	Transportes Iglesias	Driver	Mercabarna	Face-to-Face	Transport
23	19.04.2013	Luis Iglesias	Transportes Iglesias	General Manager	Palamos	Face-to-Face	Transport
24	14.02.2013	Juli Torrent sen.	Peixos Torrent	General Manager	Palamos	Face-to-Face	Wholesaler
25	06.03.2013	Octavi Obiol	Congelats Palamos	General Manager	Palamos	Face-to-Face	Wholesaler
26	07.03.2013	n.a.	Cros-Nets	General Manager	Palamos	Face-to-Face	Wholesaler
27	12.03.2013	Jordi Arnau	Peixos Arnau	General Manager	Palamos	Face-to-Face	Wholesaler
28	18.04.2013	Juan Ortega	Ortefish	General Manager	Mercabarna	Face-to-Face	Wholesaler
29	18.04.2013	Angel Martin Sevilla	Otabarna	General Manager	Mercabarna	Face-to-Face	Wholesaler

Phase 2: Formulate questions and structure interview

The questions to the informants were designed to be “simple, short, non-leading, and unambiguous” as proposed by (KARLSEN AND OLSEN 2011, p. 1210). An interview guide was developed for each operator: Fishermen, representatives of the sales organisation, buyers and processing companies, fish mongers and restaurants. Box 3 shows the interview guide for first buyers. The rest of the guides can be found in the annex with their Spanish originals. The interviews were structured according to the results from literature research, the basic principles of traceability in the MSC CoC standard, the regulation of the quality label and partly the draft ISO standard 12875 about traceability of finfish in order to study potential compliance with those standards (the latter is currently the only ISO work on seafood which is why the “finfish” standard has to be used for crustaceans, too).

Besides, the stakeholders’ perception of the success of the quality label was studied to get an approximation to the probability and willingness of additional auditing and certifying. Furthermore, observation was used to support process mapping and to estimate undocumented sales.

Although the interviews are structured, the approach was rather explorative in nature in order not to lose information. This approach was taken because in-depth interviews might reveal profound answers. Additionally, it may help to gain confidence of the interviewee which is particularly important if the researcher moves in an environment unknown to him.

The guide contains the author's main questions that he wants to be answered. However, there is no exact order or rigid formulation of the questions in order to keep the conversation environment as natural as possible. This enables the author to clarify the questions and answers in case of misunderstandings and to anticipate questions at appropriate times. Furthermore, questions that arise from the very interview might be posed although they are not within the original guide. Therefore, the guide is rather a manual of the most important questions in order not to lose the thread (GLÄSER AND LAUDEL 2010).

Box 3: Interview guide used in the interviews

Name of the Interview Partner, Location and Date

First Buyer characteristics

1. Do you consider yourself a wholesaler, a restaurant or a retailer?
2. What is your distribution range?

Information Flow

External Traceability

3. Can you prove that you are able to identify your supplier?
4. Can you prove that you are able to identify your client?
5. Which information do you receive from your supplier and which information do you give to your client?
6. Are you able to make a volume-based input-output check on the invoice and sales?

Internal Traceability and Identification of Lots

7. What is the smallest traceable unit (TU)?
8. Which kind of information do you record about this TU and where and how long?
9. Does mixing of various TU occur?
10. How is the information about the original TU handled if it is split up?
11. Is it possible to identify the TU at every stage of processing or storage in your company?

Other CoC Requirements

12. Do you have a control system?
13. How do you attach the information to the product?
14. Do you check the traceability documentation that you receive from your supplier?

Perception of the success of Quality label “Marca de Garantía”

15. Are you certified and permitted to sell Shrimp de Palamos with the Quality label “Marca de Garantía”? (If answer is no >> 18)
16. Do you store or treat certified Shrimp in a different way than the rest of products? How?
17. How do you treat the certification label when you sell to a non-certified customer?

Sustainability Certification

18. Would you support sustainability efforts in the Palamós fishing fleet by certifying to an environmental label?
19. Do you think your clients would be disposed to pay more for sustainably sourced fish?
20. Would you pay for necessary investments, i.e. in traceability certification in your business?

Phase 3: Observation and interviews

Direct observation of the fishing activity, auctioning and processing was carried out on board of a shrimper vessel, at the harbour and auction hall in Palamós, at a transporter, wholesalers and retailers. An observation form for treatment of labelling was used and photographs were taken for the documentation of labelling. The first face-to-face interviews were carried out on board, at the auction hall, in the fisheries museum or at the company’s headquarter and recorded with a digital voice recorder. The original interview guides were designed and carried out in Spanish and translated to English later.

Phase 4: Analysis of data

Process Mapping

OLSEN AND ASCHAN (2010, p. 315) claim that “[...] a crucial step and a common feature of research and development projects, especially when some sort of process re-engineering in the supply chain is planned is to model the present system. There are several methods for the analysis of supply chains. In this study, a process mapping technique was used, based on findings of DONNELLY AND OLSEN (2012) and RINGSBERG (2011). This tool is appropriate for examining the physical and informative flow in the supply chains for fish. It focusses on the “[...] physical material with symbols for activities, storages, information flow and documents. One of its advantages is the ability to identify strengths or weaknesses within the supply-chain mapped” (RINGSBERG 2011, p. 700). For this purpose, traceability units were defined and their reconstitution in the chain was drawn graphically with their critical traceability points. For mapping the on-line available technical drawing tool *Gliffy Online Diagrams* (www.gliffy.com) was used.

CTPA and MSC CoC standard

Lastly, the results of the traceability performance of the different operators are compared to the requirements of the MSC CoC Standard.

Phase 5: New questions and interviews

After the first interview phase, some questions of the interview manual were changed. These changes mainly referred to more precise questions on the information flow and treatment of traceability documentation which accompanies the product. However, no new partners were interviewed. After reviewing the results of the first data analysis the identified CTP were summarized and translated into Spanish in order to compare the interpretation to the views of the stakeholders.

Phase 6: Analysis of data

The view of the stakeholders was analysed and, where considered appropriate, included in the final results of the CTPA.

3.4 Expert Interviews

In order to get to know experiences about MSC certified fresh fish supply chains and their potential traceability challenges, three MSC staffs and one staff from Bureau Veritas were interviewed. The MSC staffs were from the Berlin, Den Hague and London offices and were interviewed about practical solutions to guarantee for traceability, especially in small-scale, non-industrialised supply chains. The Bureau Veritas officer was the responsible for the certification process of the Quality label for Palamós Shrimp and was questioned about his experiences with the implementation of auditing and certification of the companies. Expert interviews were also carried out in order to understand and to categorize results obtained from the CTPA.

The interviews were designed as guided interviews, i.e. a selection of questions was transformed in a manual. The guide started with questions about the functioning of typical fresh fish supply chains in the respective countries in order to be able to compare the

experiences to the Spanish case study. Consequently, questions about the challenges for traceability, applied techniques, and presentation at the fresh fish counter especially for fish sold in bulk were asked.

The next chapter deals with the case study descriptions and the results that were obtained from the CTPA of the blue and red shrimp supply chain in Palamós.

4 Results

One of the requirements to a case study is, as written above, a detailed description of the setting. In the following paragraphs, the study area, the fishery and especially the commercialisation and supply chain of blue and red shrimp will be described answering the first three research questions of the first hypothesis (*How is the supply chain of blue and red shrimp structured and characterised? Which types of enterprises exist in the supply chain and how are their traceability capacities? Which traceability model is employed and how are responsibilities distributed?*).

It is crucial to get the whole picture of the supply chain because market constellation, commercialisation structure, and traceability experience all have direct and indirect implications for an optimised traceability system. Therefore it is important to find out which of these additional driving forces or benefits might exist although they do not directly constitute part of the CTPA (KARLSEN AND OLSEN 2010).

4.1 Setting of the Supply Chain

4.1.1 Study Area

The studied supply chain of blue and red shrimp in the Catalanian harbour of Palamós acts on different geographical scales that range from local to international distribution. However, due to the scope of the study only a part can be studied and the focus is on the regional scale of the supply chain.

Palamós is situated in the North West of Spain and the North East of the Mediterranean Sea in the autonomous community of Catalonia, more specifically in the region of Girona and the regional district of “Baix Empordà”. Its population ranges between about 18 000 and 90 000 people, with a marked annual variance due to tourism in summer. It is a municipality with a fishing tradition, and tourism is of great importance to the local economy (BARGALLÓ 2010).

4.1.2 Description of the Fishery

In 2011, Catalanian shrimpers caught almost 596 tonnes of blue and red shrimp, with Palamós being the most important of the ten harbours listed in

Table 5. The studied harbour accounts for more than 135 tonnes which correspond to 22.8% of the entire Catalan blue and red shrimp catch.

Table 5: Landings, revenues and effort of the Catalan blue and red shrimp fleet from Southern to Northern Harbours 2011; Data source: GENERALITAT DE CATALUNYA 2013. Note: Mataró and Torredembarra left out because of negligible quantities (< 1000kg)

Harbour	Revenues (€)	Landings (kg)	LPUE (kg/day*boat)	RPUE (€/day*boat)	Effort (day*boat)
Sant Carles de la Rápita	49,378	1,322	11	411	120
Tarragona	2,908,475	86,074	43	1,448	2,008
Vilanova i la Geltrú	1,709,062	59,564	31	897	1,906
Barcelona	2,086,919	86,035	63	1,540	1,355
Arenys de Mar	1,168,230	47,792	35	856	1,365
Blanes	1,713,322	78,884	47	1,014	1,690
Palamós	3,084,620	135,709	47	1,074	2,872
Roses	1,254,991	43,509	39	1,119	1,122
Port de la Selva	1,424,078	44,490	53	1,691	842
Llança	399,397	12,373	37	1,210	330
Total/Mean	15,798,472	595,752	40.6	1,126	1,361

The blue and red shrimp fishery is the core of Palamós fisheries economy. There are currently 19 vessels which land more than one tonne of *A. antennatus* annually in Palamós. The crustacean is fished mainly in depths between 300 and 800m according to the catchability of the species (Figure 7). As the daily effort for bottom trawlers is limited to 12 hours in the Spanish Mediterranean and to 11 hours in Catalonia (MAGRAMA 1999) every harbour has its well defined fishing zones. However, there are two fishing grounds which the fishermen from Palamós share with boats from the adjacent harbours: Blanes in the Southern (“La Malica”) and Roses and Port de la Selva in the Northern limits of the fishing grounds (“Gamba de Llevant”) which can have importance for a potential certification of the fishery as several fleets exploit the same fishing grounds.

A potential impediment to the MSC certification of the CoC is the question if the fishery can be certified against the criteria of the MSC fisheries standard. Therefore, a short literature review on the stock status of blue and red shrimp, the fisheries impact the ecosystem and the management system will be done here.

First of all, it is important to determine the extent of the stock as a reproductive unit. This is important as the fishery is almost mono-specifically; hence, single stock-management with a precautionary ecosystem-based management approach seems to be the appropriate management concept. (FERNÁNDEZ *et al.* 2011) identified one single genetic stock in the North Western Mediterranean and recommends a joined management of the fishery. However, the existence of sub- or metapopulations and their extents are not known in detail. (FERNÁNDEZ *et al.* 2011) postulate that the population consists of a network of local populations connected by different degrees of gene flow. If stock management is based on this concept of the blue and red shrimp stock, (SARDA 2008) states that *A. antennatus* still does not seem to be overfished although the stock is at the limit between full and over exploitation (MAYNOU *et al.* 2006). One of the explanations for the resilience of this stock despite the high exploitation rates is the source-sink-theory which refers to a source of new recruits in greater depths and a sink of individuals and biomass in the shallower waters where fishing activity is exercised. Seasonally, the share of small

shrimp in the fishery is of high concern which can be seen in the decision of the Cofradía de Pescadores to close specific fishing grounds where abundance of small shrimp is high.

A study about the ecosystem impact of the *Aristeus foliaceus* deep-sea trawl fishery in the Strait of Sicily which is similar to the one of *A. antennatus* concluded that “demersal towed gear can have dramatic effects on the structure and functioning of marine ecosystems” (DIMECH *et al.* 2012, Abstract). A comparison of trawled and non-trawled areas using an experimental otter trawl net (cod end 20mm, mean depth of the experimental hauls was 616m vs. 556m for trawled vs. non-trawled zones) showed changes in length structure for all species except for the velvet belly lantern shark, *Etmopterus spinax*. At community level, higher biomass, density and diversity indices were recorded at the non-trawled sites; however, despite the clear evidence of ecosystem changes due to fishing, the main target species was found to be highly resilient to trawling activities.

The management system for this fishery can be best described by co-management of the national and regional authorities and the Cofradía de Pescadores of Palamós. This is reflected in a jointly elaborated management plan for the blue and red shrimp fishery based on the initiative of the Cofradía de Pescadores. The main features include the obligatory use of the 40mm square mesh cod end, the definition of the five exclusive fishing zones for the Palamós fleet, haul limitations, seasonal closures and fleet reduction by capacity adaption. Seasonal closures were introduced in 2011 in order to protect the resource. In 2013, the duration was of consecutive 1 month and 1 month with altering weeks where fishing was prohibited. Unfortunately, this plan has not been approved by the national government in Madrid which is responsible for the so-called exterior waters where shrimp fishing is carried out. Although the shrimp vessels are all included in this management plan there is no Vessel Monitoring Systems surveillance put forward in relation to the boundaries of the fishing areas without the support of the national authorities.

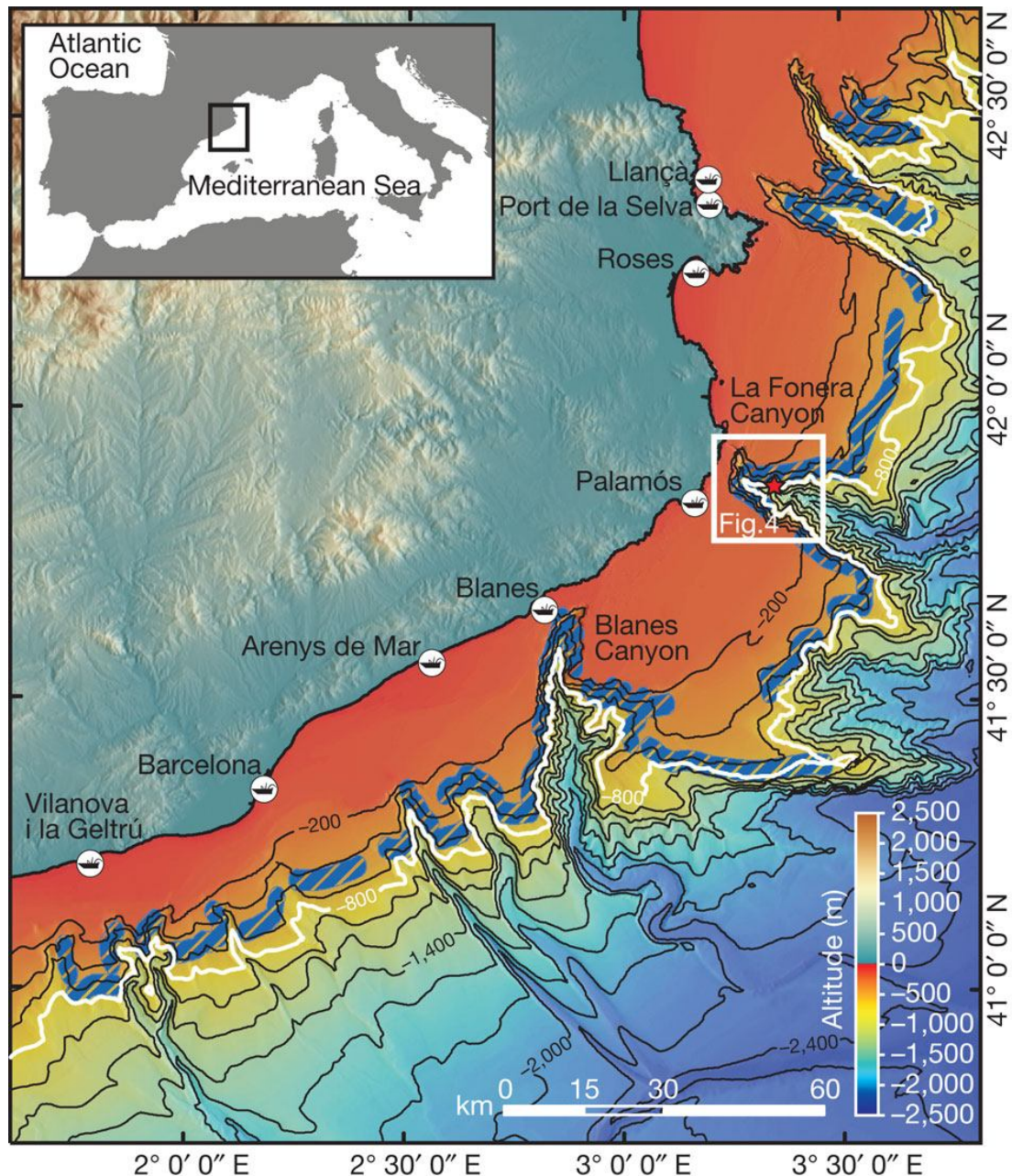


Figure 7: Bathymetric map of the Northern Catalan margin (North-Western Mediterranean) showing the main trawling grounds on the open continental slope and canyon flanks (blue hatching). The largest ports of the area (vessels in white circles) and the 800-m isobaths;
 Source: PUIG *et al.* (2012)

To conclude, from the author's view, it is questionable if the fishery is ready for certification yet. It is rather probable that far stricter measures have to be adopted in order to obtain a sustainability certification. Main deficiencies are seen in a lack of protection for recruits due to unselective gear, high exploitation rates, seafloor disturbance, impact on by-caught species and unreported catches.

4.1.3 Market and Commercial Structure

Blue and red shrimp is certainly the most important species for the fisheries economy of Palamós in terms of revenues and prestige. As Table 6 shows, almost 38% of the sales, but only 9% of the landings come from *A. antennatus* accounting for more than 3.3 mil-

lion € This results in a mean price which is nine times higher than for the rest of the species.

Table 6: Market share of blue and red shrimp in the Palamós fish market 2012

Source: COFRADÍA DE PESCADORES OF PALAMÓS 2013

Species	Sales (€)	Landings (kg)	Mean Price (€/kg)
<i>A. antennatus</i>	3,304,173	141,482	27.11
Other Species	5,465,267	1,435,077	3.81
All Species	8,769,440	1,576,559	5.56
% <i>A. antennatus</i>	37.7	9.0	

The importance of this fishery increased drastically in the 1980s as one can see in Figure 8: From almost one million € in 1979, sales went up to 3-5 million during the 2000s. The peak of the mean price with 45 €/kg in 2005 reflects an event of so called “cascading” which causes migration and decreased catchability of blue and red shrimp in the Palamós Canyon and leads to sharp declines in landings. In 2012, the annual production was 141.7 tonnes.

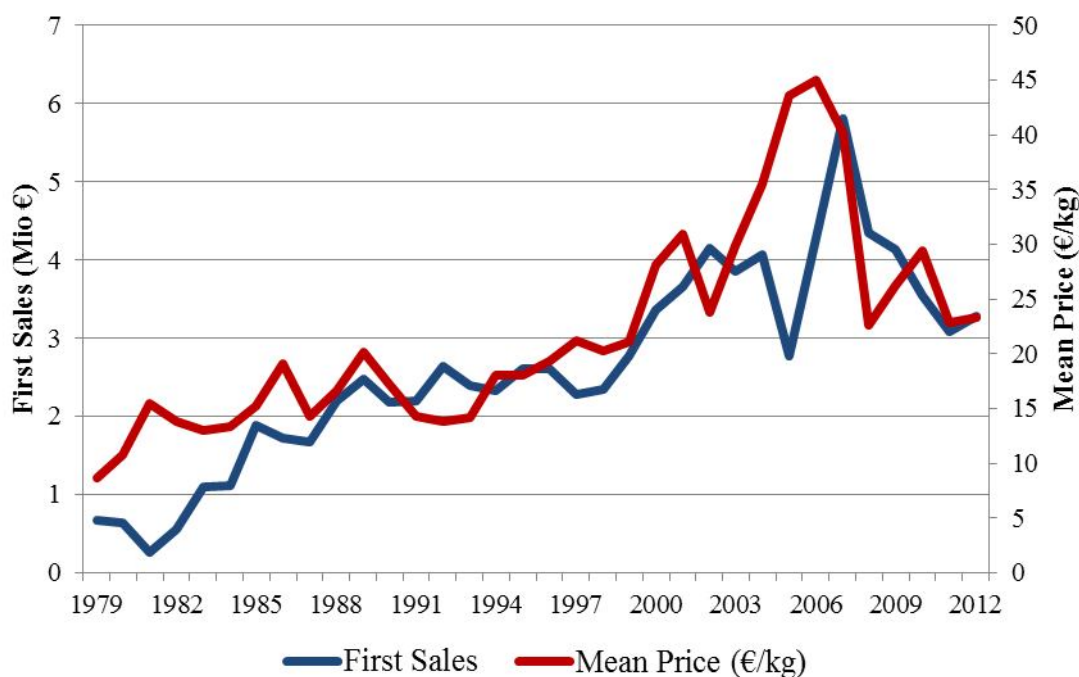


Figure 8: First sales of *A. antennatus* and mean price in Palamos 1979-2012.

Source: COFRADÍA DE PESCADORES OF PALAMÓS (2013) (Note: Not adjusted for inflation)

The buyer collective is structured heterogeneously with operators of different economic importance and capacities. This can be measured by the standard index of concentration C_4 which describes the market share of the four most important buyers. PASCUALE AND QUAGLIANU (2005) and ÁLVAREZ-EREIPA *et al.* (2009) describe this method as follows: the market share of the buyers is the gross annual payments of every buyer (a_j) in relation to the total gross revenues of the Cofradía de Pescadores (A); where (m) are the “ m ” most important buyers in the market and (p_i) is the market share.

$$C_m = \frac{\sum (a_j)}{A} = \sum p_i$$

GARRIGA (2006) calculated C_4 to be 0.35 for blue and red shrimp in the Palamós auction in 2005. That means that 35% of the catch was bought by the four most important buyers in terms of payments. In 2012, C_4 was found to be 0.30. The standard index of concentration C_8 , the share of the eight most important buyers, was 0.48. PASCUALE AND QUAGLIANU (2005) defines this value of C_8 as moderately concentrated ($0.25 < C_8 < 0.50$). This indicates a certain variety of distribution channels.

Blue and red shrimp are classified in various categories according to their size, presenting huge price differences which justify studying them separately (Figure 9). Since May 13, 2010, the entry date of the quality label, there are seven different categories: Small, Medium / certified Medium, Large / certified Large and Extra / certified Extra. These seven different commercial categories of blue and red shrimp all have an impact on the traceability performance of the supply chain as we shall see later on.

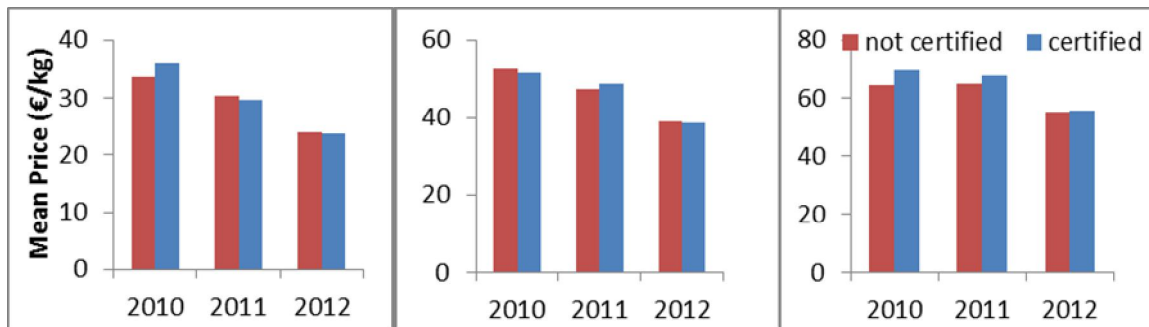


Figure 9: Effect of certification: Difference in mean price 2010-2012 for certified and non-certified Shrimp: Size categories Medium, Large and Extra (from left to right). Source: COFRADÍA DE PESCADORES OF PALAMÓS (2013)

Furthermore, Figure 9 shows the potential price premium that is gained by obtaining the quality label in the first sale. Note that small shrimp are excluded from the analysis yet this size category cannot be certified to the quality label. However, the price premium can be a fallacy since many factors influence the price. One of those is that the quantity of certified product is far bigger than that of non-certified (Table 7). The same table shows an effect of certification that seems to be overseen both by fishermen and by first buyers: Certified shrimp present lower standard deviations than non-certified shrimp. This suggests the conclusion that the quality label contributes to stabilise prices. Nonetheless, this phenomenon needs to be analysed in a detailed study.

The supply chain of blue and red shrimp in Palamós starts at the fishing vessels. Fishing trips last about 10 hours with haul durations of 1.5-5 hours and haul frequencies of 1-3 times. After heaving the net, shrimp are classified according to their size and quality by the fishermen, put in plastic boxes and covered with a thin plastic film and ice. The composition of the boxes, i.e. the quantity per box and the arrangement may differ from vessel to vessel which results in certain preferences by the buyers for some vessels (reflected in price differences between the vessels that can reach 4€/kg). The vessels arrive to port at about 4:30 PM; the boxes are then transferred to the auction hall in handcarts and put on the quality label control. From that point, certified shrimp are defined as such and form a traceable unit with the guaranteed properties.

Table 7: Effect of certification: Accumulated differences in mean price, standard deviation and observations of for certified and non-certified Shrimp: Size categories Medium, Large and Extra. Source: COFRADÍA DE PESCADORES OF PALAMÓS 2013

Mean Price (€/kg)	Non certified	Certified
2010	50.37	52.50
2011	47.59	48.80
2012	39.32	39.36
Standard Deviation		
2010	13.24	12.15
2011	11.19	10.20
2012	9.95	7.51
Observations		
2010	3331	8401
2011	1831	10280
2012	2204	12059

The auction is organised and managed by the Cofradía de Pescadores; the order of vessels is determined by the chronological order of entering the harbour: The first boat sells first, the second one second etc. Usually, the auction of shrimps is from about 4:45 PM until 6:15 PM. As described earlier, the commercialisation of trawled fresh fish is similar across the Catalan Mediterranean; most of the fishermen's associations sell their catches via so called "Dutch Auctioning". This auction is characterised by a starting price which is set by the auctioneer according to species, size category, mean prices in the past, personal experience and last-minute information such as weather, catches in other harbours and expected degree of competition (FLUVIÀ *et al.* 2012). The fish boxes are placed on the auction belt and when reaching the marked area, buyers bid for the box. Prices decrease from the starting price, so the buyer who bids first wins the auctioned case. Commission fees for the Cofradía de Pescadores and Value Added Tax (VAT) are added to the auction price and form the end price paid.

After the auction shrimp are portioned and packed into polystyrene boxes according to the quantities demanded by the buyers and their clients. The bigger buyers have small storehouses in the back of the auction hall. The packed shrimp are then transported in vehicles with refrigerators. The size differs between transformed pick-ups and 12t trucks.

The supply chain of *A. antennatus* continues on different geographical scales which are determined by the size of the buying operator. To verify this fact, information about the size and structure of the companies was gathered which may determine the interest in and capacity of building improved traceability systems. This was done by an interview to the quality manager of the Cofradía de Pescadores of Palamós and using information collected from the interviews with the wholesalers about the radius of economic activity. The interview resulted in a segmentation of three commercial levels for wholesalers and one for retailers: International wholesalers (I), over-regional wholesalers (II), and regional wholesalers with own fish monger branches (III).

- **Local Level:** A part of the auctioned catch is directly sold at the previously described sales hall in the same building. The hall is open till 7 PM, so the catch is sold directly on the same day. What is not sold at the sales hall is transported to

storing houses or directly to local fish mongers in Palamós and neighbouring villages. Most of the fish mongers present in this hall have stalls at the municipal market where the shrimp are sold the next day. Furthermore, local fish restaurants are supplied with shrimp. They normally store the product frozen.

- **Regional Level (III):** A big part of the auctioned catch is transported to processing facilities of regional fish mongers and small wholesalers who sell on a regional level in a radius of about 30-40km around Palamós. Processing refers to storing and repacking but without changes to the physical nature of the product in this case. These companies also buy in other harbours. This is one of the suspected critical traceability points in the supply chain as mixing may occur.
- **Over-regional Level (II):** A good share of the shrimp is sold to companies with an over-regional focus. These firms come from Girona or sell at the Barcelona wholesale market, Mercabarna. This market is said to absorb a vast quantity of fresh fish in Palamós and to influence the price drastically. In fact, 25% of blue and red shrimp that were caught in the province of Girona were sold at Mercabarna in 2011, according to data from Mercabarna (2013) and the regional government of Catalonia (2013). Most of these firms have so called “brokers” who buy for several clients at different auctions and who provide for the logistics. An important question in the context of certification and CoC standards is whether these brokers do have ownership of the product or whether they buy for the companies without taking direct ownership. Another form of over-regional selling is carried out by specialised firms who directly supply high-class restaurants in the Barcelona area. Business relations are traditional and of many years’ standing in this case. A third form of over-regional selling is the online platform “www.gambadepalamos.com”, which is run by an individual but in partnership with the Cofradía de Pescadores who in this case acts like a normal buyer in the auction. This is done to order and is packed in a polystyrene box with the quality label on it and transported by an external logistics provider. The range of distribution is national. However, this service just started in February 2013.
- **International Level (I):** At least one company acts on an international scale, i.e. the company ships blue and red shrimp from Palamós directly to international clients in 17 countries worldwide, from the USA, the Dominican Republic and Europe to the Middle East (Kuwait, Qatar) and South East Asia (Thailand, Hong Kong, Singapore). In this case, the shrimp are shipped deep frozen.

It is noteworthy that a certain preference for different size categories of shrimp was found within the different buyers. Whereas local fish mongers tend to buy more small shrimp, over-regional and international level operators tend to buy higher priced, larger categories; a pattern which will also be reflected in traceability issues as we will see in the CTPA.

Concerning the question if the supply chain is demand or supply-driven, an exact answer seems to be impossible, but it tends to be supply-driven: Usually all fish landed on one day is sold at the auction. However, prices are very volatile and closely related to the season in the year. This is why the supply chain can be also demand-driven in spring and autumn when demand is low and the ability to sell is important. Hence, strategies like the quality label that help to sell the product might be a good option to add value.

4.1.4 Quality Label and Chain of Custody Requirements

The quality label “Marca de Garantía de la Gamba de Palamós” has existed since 2009 as a registered label according to Catalan and to Spanish law and is owned and managed officially by the municipality of Palamós (GENERALITAT DE CATALUNYA 2009; BOLETÍN OFICIAL DEL ESTADO 2001).

The label surged from an initiative of the gastro-tourism sector in the 1990s to create the “Menu of Shrimp of Palamós”. However, cases of fraud and misuse were suspected when Palamós fishermen had not landed shrimp in a while, but menus were sold with shrimp of Palamós. This made the Cofradía de Pescadores take initiative and it got involved in the creation of a quality label in order to protect the local shrimp fishery. Although the legal proprietor is the municipality of Palamós, the Cofradía de Pescadores acts as co-managing body of the label, financing the first audits for the fishing vessels. Both organisms are joined in the technical committee of the label. This committee represents all interested groups that participate in the certification process: Users of the label, consumers and conformity evaluators. The committee is the executive organ of the managing bodies which implements and monitors their policies. Its principal function is conceding the certificate of compliance with the criteria of the quality label once the audit has been passed.

The label was designed to be voluntary and third-party audited. Compared to the MSC standard setting and certification practice, there are some differences: In the case of the quality label, the only external auditor is *Bureau Veritas*, but it is the technical committee which approves the certification. That means a body which can influence the setting of standards can approve or deny the certification of a client. In the case of the MSC by contrast, there are several certifiers that are accredited by one single accreditation body, and the certifiers do the auditing independently from the standard setting organisation, the MSC. That is, the MSC does not interfere in the certifying process. *Bureau Veritas* is accredited to certify fisheries and supply chains against the MSC standard.

A key reason to create the label was the differentiation from competitors by protecting the geographical denomination Palamós as origin and the standardized treatment on board and at the quality check point (OLSEN AND BORIT [in press]). The way of fishing and treating the crustacean was considered to be distinctive enough to justify a quality label for this product. In terms of regulations of the fishing effort, the only criterion of the label is to fish with the 40mm square or 50mm diamond mesh which is imposed by law anyway. The abovementioned management plan which includes more (although not sufficient) measures for protecting the resource is stated in the regulation text of the quality label. Formally, the label only makes the plan binding when it is approved by the national authority in Madrid; but as the entire shrimpers fleet already adapts to the imposed measures this paragraph could be changed in the regulation text.

The competitors differ according to the geographical level the shrimp is sold. At local level and regional level it is fresh shrimp from neighbouring harbours where no specific norms concerning quality and freshness exist; whereas at the big wholesale market in Barcelona it is fresh shrimp from other Catalan provinces and frozen shrimp from the East African Region (Madagascar, Mozambique).

Traceability is a fundamental requirement to the credibility of this label. The regulation text states few specific preconditions that go beyond of what is expected in EU food safety regulation 178/2002 (“*Be able to identify the origin of a product in all phases of its*

production as well as suppliers and clients”). One of them is a kind of CoC standard. It contains prerequisites for all agents involved in the commercialisation of *A. antennatus* with the aim of guaranteeing the unequivocal use of the label and the logo, impeding the mix of certified and non-certified product. The regulation text defines that users of the quality label – that is all operators of the supply chain – must “[...] establish all appropriate measures to prevent from contamination with non-certified raw material in the process of marketing and distribution. Adequate product identification and separation (traceability) must be provided. The reliable identification of the product shall be made possible through documentation systems that cover all relevant aspects of the production process to ensure that it is impossible to mix certified and non-certified product” (EXCSMO. AYUNTAMIENTO DE PALAMÓS 2010, p. 19). Buyers and distributors have to guarantee for maintaining temperatures between 0-4°C from the moment of purchase until the sales point to the end-consumer. Besides they have to demonstrate that they store all relevant information about the certified product. Restaurants have the same obligations and they have to make this information available to the client if so requested, with the aim of being transparent and credible to the final consumer.

Shrimp are certified when they comply with the requirements of the label regulation and when fished by a certified vessel in one of the five fishing grounds that are mentioned by the regulation text. These are the habitual fishing areas of the Palamós fleet. As of March 2013, 18 vessels were certified to the quality label. The decision whether a box of shrimp landed and sold in Palamós is certified or not is left to the control point before the auction belt. There are two possible obstacles for the certification of a specific lot of shrimp: Either the fisherman does not want to let his catch get certified because he already knows that it would not pass or the control assistant detects a deviation from one of the following required criteria: Temperature must be below 4°C and calibres must be <70 pieces/kg. Three commercial size categories were created according to the number of shrimp per kilo: Medium (56-70 pieces/kg), Large (33-55 pieces/kg) and Extra (19-32 pieces/kg).

After passing control, a certificate (Figure 10, left) is emitted from a printer which is placed just on top of the auctioning belt. It can be understood as a supplement to the label that is stipulated by law. It contains information about the first expeditor and its official registration number (Cofradía de Palamós), the commercial denomination (e.g. Gamba Grossa, large shrimp), scientific denomination (*Aristeus antennatus*), landing date, fishing vessel, calibre, fishing ground and an approximate number of individuals per kilo. Additionally, every certified box gets a unique certification number assigned (blue frames). This information is also displayed by a barcode on the same certificate.

When put on the auction belt, the box of shrimp bears the certification label on top. If the buyer is certified as well, the certificate persists in the box after leaving the belt. If not, it is withdrawn by an agent of the Cofradía de Pescadores. The unique certification number has to correspond to the commercial label, where the number is displayed as well (blue box in Figure 10, right).

Currently, the CoC is difficult to apply given the fact that only very few operators of the supply chain for fresh shrimp are certified with the exemption of the fishing vessels: 18/20 vessels, 1/1 auction hall, 4/127 first buyers, 10/12 fish mongers and 1/57 restaurants in Palamós hold the quality label. The most recent certified company sells shrimp online. Note that the high number of fish mongers certified is only due to the certified sales hall that is property of the Cofradía de Pescadores and rented to the fish mongers. If the hall would not be certified, nor would be the fish mongers who sell there.



Figure 10: Certificate of the quality label "Marca de Garantía" (left) and commercial label with corresponding certification number (right)

4.1.5 Traceability System

The employed traceability model can be best described by a so called mixed model (see again section 2.2 and see Figure 11). The registration of traceable information starts with the creation of the quality label control before the auction process and the commercial sales label afterwards. Both processes are run by the Cofradía de Pescadores of Palamós. The database of this entity can be seen as a central traceability node because it stores information of two operators: fishermen and first buyers. This results in several traceability advantages as it permits to link every transaction and lot from the fishing vessel to the first buyer which is a crucial step in the traceability of seafood.

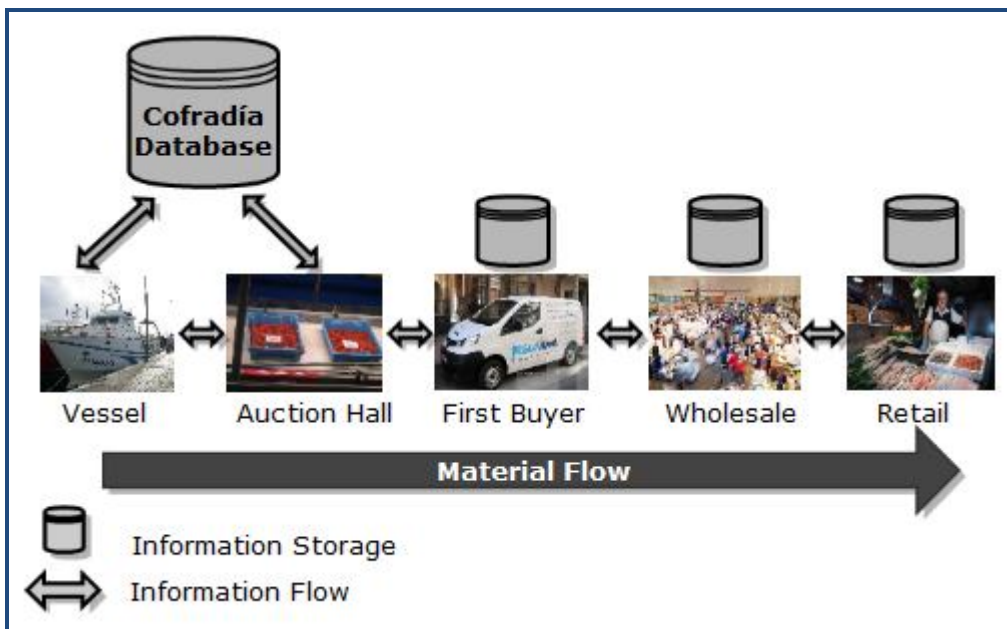


Figure 11: Mixed traceability model applied in Palamós.
Source: Own chart according to GONZÁLEZ DE ZÁRATE (2006)

Besides, the database facilitates the information flow because the reproduction of commercial sales labels is possible for first buyers in case of splitting the original lot. Continuing the supply chain, the information flow is established by a documentation-based traceability system which is characterised by a decentralised structure. Every operator has

to guarantee for internal traceability, but the information of downstream operators is not recorded in an external, central database.

In order to describe with maximum detail the information flow in the documentation system, Table 8 explains shortly the terms “invoice”, “bill” and “label” and characterizes which information they contain.

Table 8: Documents used to check the information flow.

Source: Modified according to TORAL SANCHEZ (2008)

Document Type	Contained Information	See Figure
Invoice/Bill	<ul style="list-style-type: none"> • Data about all products of a shipment • Traceability data* • Administrative data** 	
Label without barcode	<ul style="list-style-type: none"> • Data about all products of a shipment • Traceability data 	Figure 10 (right)
Label with barcode (quality label certificate)	<ul style="list-style-type: none"> • Data about all products of a shipment • Traceability data • Barcode containing all information 	Figure 10 (left)

*Traceability Data:

- Supplier
- Product data (Latin and commercial name, presentation modus and calibre)
- Catch date
- Catch area
- Production method
- Original lot number

**Administrative Data:

- Physical name and address of the supplier
- Supplier code

That means that in case of a loss of the sales invoice of one lot, the accompanying commercial or quality label, the lost information cannot be recovered if not linked to the original lot.

The sales labels are linked to an invoice via the lot number and a bill that the first buyer receives after the auction. On this bill lot number, species, weight, price and date are recorded and displayed. In every following downstream sales process, for example from first buyer to an operator of the wholesale market in Barcelona, a new bill and invoice are created with the information about the characteristics detailed above. During the whole process until reaching the end consumer, the information of the commercial sales label has to be stored and transferred. At the final point of sale, the only consumer relevant information that has to be displayed is common and scientific name, capture area or land of origin, if the fish was caught or farmed and whether the product was frozen or not.

The next chapter contains detailed studies of the traceability performance of every operator in the supply chain.

4.2 Identification of Critical Traceability Points

In this chapter, the findings related to research questions I 4 (In which stage of the commercialisation process do gaps occur in the information flow and in traceability?) and I 5

(Do systemic errors exist?) are presented. The identified CTP will be checked on infringements of criteria of the MSC CoC standard in order to determine they constitute an obstacle to certification or not.

The studied supply chain operators consist of fishing vessels, the auction market, transporters and storers with and without ownership of the product, traders and wholesalers and retailers and gastronomy. This is a typical supply chain for unprocessed fresh fish in Catalonia. Therefore the processors site was left out in this analysis according to the definition of the ISO finfish traceability standard 12875 and the requirements of the MSC CoC standard. Figure 12 shows the vertical structure of the supply chain of blue and red shrimp.

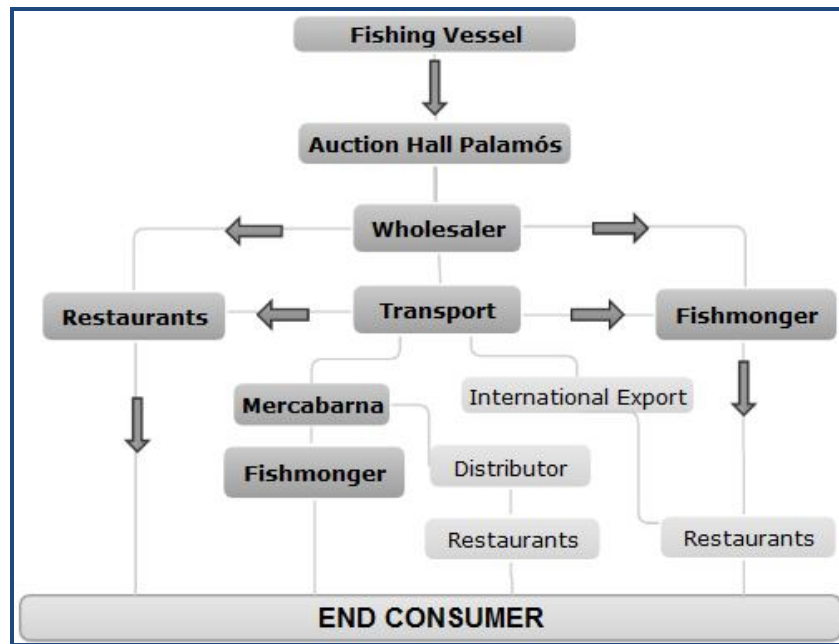


Figure 12: Structure of the supply chain of fresh blue and red shrimp landed and sold in Palamós. The dark grey part (bold letters) was covered by the study.

Source: Own chart according to *ÁLVAREZ-EREIPA et al. (2009)*

As stated in 3.3, the results in this study are presented in a frame: Process maps were designed for every operator in the supply chain. The outcomes will be presented in the logic order of the supply chain starting at the fishing vessel and ending at the point of sale to the end consumer. For a better understanding of the process maps, photographs shall visualize the meaning of certain symbols and terms that are used in the process maps (see Figure 13).



Figure 13: Visualization and description of important terms ((1)-(4) from upper left to lower right);

- **Original Lots** (1) refer to the cradles / boxes of fish as they leave the fishing vessel and are sold in the auction.
- **Sub-lots** (2) refer to split fractions from the original lots after leaving the auction belt. Mostly sub-lots are stored in polystyrene boxes
- **Batches** (3) refer to assembled / merged original lots or sub-lots that are grouped as a delivery for a client.
- Selling **in bulk** (4) refers to selling a produce individually without packing it.

4.2.1 Fishing Vessel (FisVes)

The traceability analysis of the five vessels quickly revealed that no product information is generated and no labels are put on the boxes on board the fishing vessels. This does not necessarily have implications for the ability to trace the product: In order to know what information to trace, a traceable unit (TU) or lot has to be defined; in this case it can be referred to as one catch of the same species of one vessel on one day, because the trips only last ten hours and it is obvious that the fish is discharged before auction. For means of the quality label control, the specific fishing grounds are documented. Usually only one fishing ground is visited per trip which makes it likely that the whole lot origins from this fishing ground. Every lot is marketed on the day of its catch and the names of the vessels appear later on the label emitted by the Cofradía de Pescadores. Additionally, the fishermen's income is documented on bills from the Cofradía which detail the sales in-

formation of every lot on a weekly base. Thereby, traceability is assured at vessel level for the lot size described above.

“If there is the assumption that the fisherman lands the product in optimal conditions and the buyer then does not treat the product with the same care as the fishermen, it offends”. (pers. Comm.)

One of the two critical traceability points that were encountered at vessel level is undocumented sales (CTP 1 in Figure 14). The interviewed fishermen gave an estimation of 5-25% of undocumented selling in Palamós.

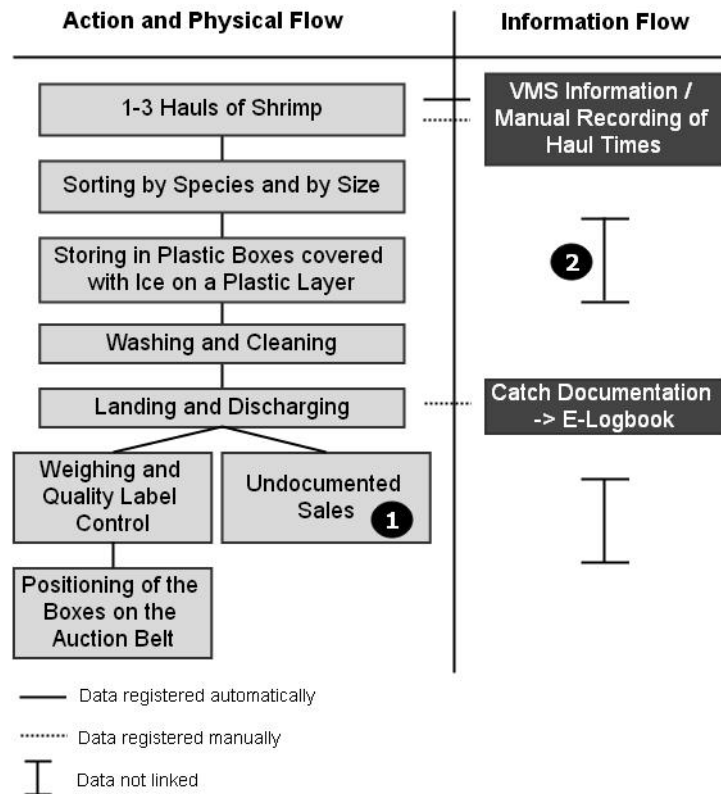


Figure 14: Process Mapping of Physical and Information Flow at the fishing vessel
Source: Own Chart

This phenomenon has three important implications: Firstly, traceability is broken because the buyer does not receive any guarantee or label which states where the fish comes from. This is inconsistent with the 4th criterion of the MSC CoC standard because the product would not be identifiable and is an obstacle to certification both of the fishery and the supply chain. Secondly, it is an economic problem on the medium term. The five interrogated fishermen were asked about the estimated share of undocumented selling of the total catch with the result that between 5-25% of specific high valued catch are traded without passing the auction belt. This would mean an equivalent of 7 tonnes and 165 200 € for a precautionary estimation and 35 tonnes and 826 000 for a pessimistic estimation for the year 2012 in Palamós if one takes the mean price of shrimp as an example of a high valued species. Considering a share of 2.5% for the Cofradía de Pescadores this results in losses of 4 000 - 20 000 € per year for the fishermen’s association which directly strives the fishermen themselves. Thirdly, the losses of tax income that occur impede the use for an improved fisheries management. These implications have to be taken into

account both for the certification of the fishery and for the supply chain. Management has to take into consideration that the biomass withdrawn from the stock is far higher than shown in the official catch statistics and that the artificial shortage of product in official sales canals may lead to increased prices on the short term; but with a reduced quantity there will be fewer buyers and prices decrease. The supply chain has to be aware of the loss of control, traceability and income for the Cofradía de Pescadores. Apart from the interviews, observation of undocumented changes of ownership of seafood was conducted. During the studied time (5 days) those were detected every day with quantities varying from several 100g to a whole box of seafood. Blue and red shrimp was one of the most important species involved. One fisherman pointed out the different qualities of this phenomenon: On the one hand side private sales of the catch to neighbours or friends of the fishermen and secondly, sales to restaurants or buyers:

“Besides being vox populi, there is evidence that there are buyers who approach to some fishermen and give them envelopes.” (pers. Comm.)

A second critical traceability point (2), or at least a point which deserves to be optimised not only in this fishery, but in general is the lacking linkage of the logbook information and the information which has to be transferred to the end consumer: Traceability ends at vessel and species level and does not include the geographic positions of the catch, which can be important for determining if the shrimp has been caught within the boundaries of the five fishing grounds included in the regulation text of the quality label. As required by the EU Control Regulation (EC) 1224/2009, catches bigger than 50kg of a species have to be documented in the e-logbook. Together with the information of Vessel Monitoring Systems (VMS) which every shrimp vessel in Palamós has installed on board, every lot can be linked to the specific fishing areas. Hence, theoretically it is possible to trace the shrimp from the genuine fishing ground which is a basic criterion for preventing from origin fraud. Unfortunately, this information is not linked to the commercial labels as no labels are generated on the vessels. Consequently, smaller lots and the information that will accompany the product are only generated at the control point and the auction hall (Auc Hal).

There are no problems of identifying the clients on vessel level. Information flow is gapless for shrimp that are sold in the official sales canals in the auction hall. An important question in terms of traceability and the implementation of additional measures is the importance that the stakeholders attach to it. The interviewed fishermen perceived it as a problem that they do not possess the ability to safeguard their product against possible frauds in later points of the supply chain. Further outcomes of the interviews show that traceability is of high importance to the fishermen's business:

The main gaps that the fishermen see are located at the middlemen, first buyer and restaurant levels mainly because of the risk of manipulation, substitution and information loss of the further steps of the supply chain. In their opinion, this is mainly due to the lack of controls and of political will and to the lack of interest by the consumers.

4.2.2 Auction Hall (Auc Hal)

The auction hall is the link between the fishermen and the buyers and incorporates a fundamental role for commercialisation and, thus, for traceability of seafood products. In Palamós, it is run by the Cofradía de Pescadores. The process mapping in Figure 15 shows the four main steps in which the auction hall is involved in the material and infor-

mation flow of blue and red shrimp (see also again 4.1.4): The reception of the discharged boxes of shrimp and quality label control, the assigning of the quality labels certificates, the auctioning and weighing and assigning of the commercial labels and the control of the quality label certificates. These are withdrawn when the buyer is not certified. The light grey boxes represent trade units which are still without unique identifiers. This is changed when they are assigned the labels.

The first critical traceability point (3) refers to the appearance of the commercial label emitted by the Cofradía de Pescadores: The document analysis revealed that whilst the quality label certificate bears a unique identifying number and a barcode which is scanned before the auction, the commercial label does not bear barcodes (compare Figure 10 in 4.1.4). This makes it difficult to facilitate a digitalization of the product information which would be a basic condition for the implementation of a centralised traceability system as will be shown afterwards. CTP (4) represents the major threat for certification at this stage of the supply chain. This critical traceability point refers to the problem that there are buyers who run a counter in the certified sales hall of the Cofradía de Pescadores. In this installation the buyers are allowed to sell certified shrimp. The problem appears when those buyers run fish monger branches outside the certified space at the same time. In this case the buyers could use the label certificate in their not-certified fish mongers as well. They are only partly users of the certificate labels. During interviews with the buyers it was revealed that the certificate labels are not treated with special attention. Hence, it cannot be ruled out that an infringement of the MSC CoC criterion number 3 is committed.

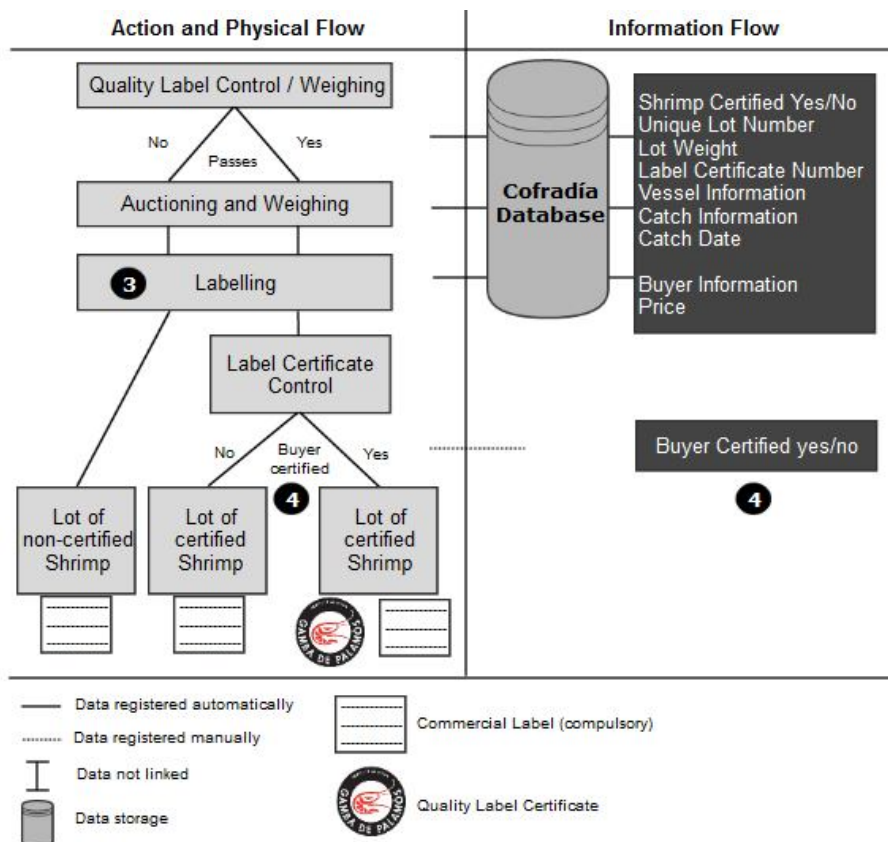


Figure 15: Process Mapping of Physical and Information flow at the auction hall
Source: Own Chart

Concerning MSC certification, the willingness to train the personnel on the criteria of the MSC is not thought to be an obstacle to certification as they are already familiar with the quality label requirements. However, being the Cofradía one of the two managing bodies of the quality label, the problem of the use of the label certificates by partly users should be solved in a near future. It would have consequences for a MSC certification as it cannot be guaranteed that the buyers only use the labels in the certified space.

4.2.3 Wholesale (Whole)

As stated before, the wholesalers are active on different geographic levels. This is expressed in the different commercial levels (I, II, III) mentioned earlier. Additionally, they can be differentiated by the point of acquisition of product (reception). First, there are wholesalers who buy physically at the auction of Palamós and distribute the shrimp to their branches, to restaurants or to other fish mongers. These are further called first buyers. Secondly, there are wholesalers who buy in the auction via middlemen (but on their own company's name) and receive the product at the wholesale market (e.g. Mercabarna). They are called second buyers in the following paragraphs. Out of the six visited companies, four wholesalers buy physically in the auction of Palamós and two receive the product at Barcelona wholesale market Mercabarna (see Table 9).

Table 9: Segmentation of wholesalers according to their point of acquisition and the commercial level

Buyer ID	Point of Acquisition	Commercial Level
1	Palamós, 1 st Buyer	Regional (III)
2	Palamós, 1 st Buyer	Regional (III)
3	Palamós, 1 st Buyer	Over-Regional (II)
4	Barcelona, 2 nd Buyer	Over-Regional (II)
5	Barcelona, 2 nd Buyer	Over-Regional (II)
6	Palamós, 1 st Buyer	International (I)

In the analysis it became clear that not all the wholesalers who participated in the analysis are prepared to face the challenges that arise from traceability according to the MSC CoC standard. The different traceability performances lead to a segmentation of the buyers. Interestingly, this segmentation follows the commercial level clustering: The CTP that were revealed at this stage of the supply chain were all found within commercial level II and III enterprises. They are mapped in Figure 16. The first CTP (4) is a consequence of a weakness in the quality label management by the Cofradía de Pescadores, described already in 4.2.2: The handling of wholesalers who run a fish counter in the certified sales hall of the Cofradía but who are not certified in their own branches. The label certificate could be used both at the certified sales hall and the branches because of a lack of control and sanctions through the label management bodies. This was the case with buyers 2 and 3. Together with the second point (10) it becomes clear why the combination of the two is problematic: Water, ice and a salt are added to the shrimp without being recorded as additives on the label. This manipulation alters the nature of the product. The additives shall maintain the product chilled for transport, however, this practice leads to a gain in weight of the shrimp after a certain period of time. This is not only an intransparent behaviour towards the consumer, it also might be an obstacle for certification as volume-

based input-output balance traceability exercises can not be carried out correctly. As a matter of fact, this explains the importance of the first two CTP – a control of the quantity sold at the certified sales hall and the non-certified fish counters is not precisely possible.

Commissioners and middlemen connect Palamós with Mercabarna, i.e. Palamós and the second buyers. The following critical points are basically located around the process of splitting and merging shrimp after auction and before transport. They were found at buyer 1 and 2 again. CTP number (7) is caused by an imperfect practice of multiplying commercial labels after splitting. The original lot size at reception for first buyers is the plastic box (4-8kg) that leaves the auction belt. It is very common for most of the buyers to split this original lot into fractions of about 2-2,5kg. After weighing and sorting, these fractions are packed into polystyrene boxes and the above mentioned adding of ice, water and the salt is carried out. Article 18 of the Control Regulation (EC) 1224/2009 obliges the agents to have every lot identifiable to vessel name level even when new lots are generated.

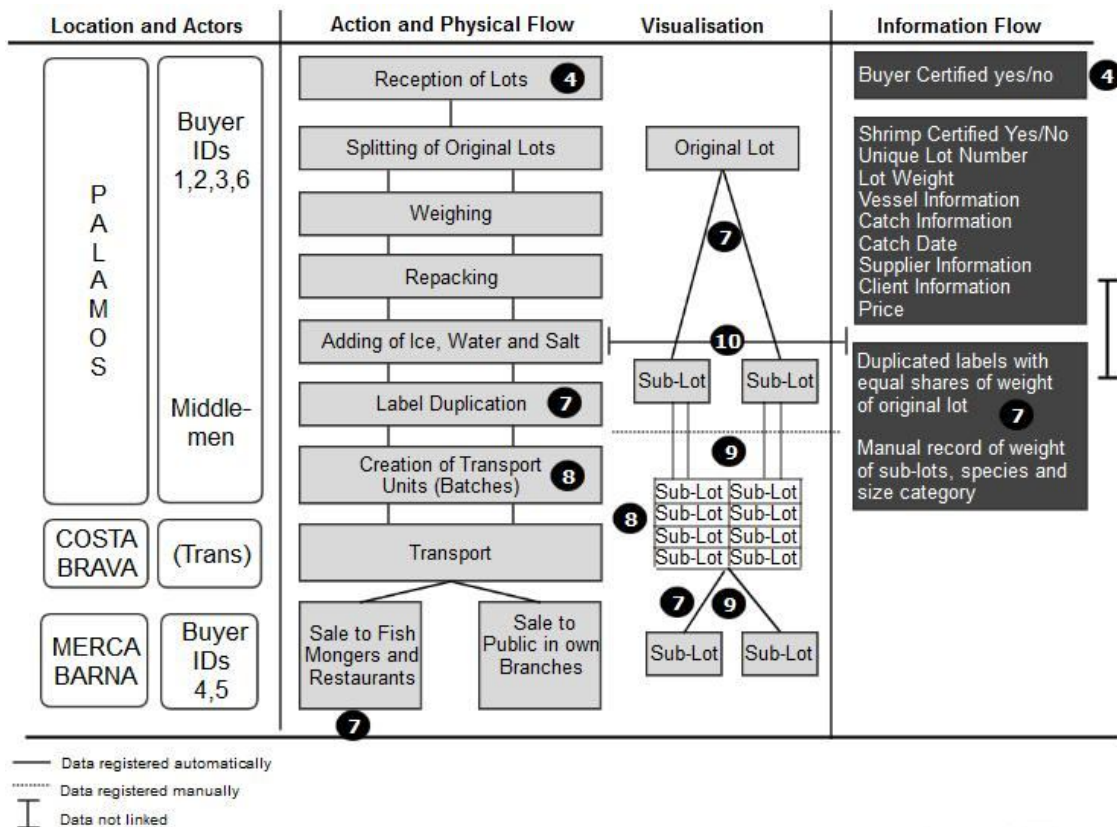


Figure 16: Process Mapping of the location and actors, Physical Flow, visualisation and Information flow at the wholesaler
 Source: Own Chart

The Cofradía de Pescadores disposes of a machine which is able to multiply labels on the base of its database. The weight of the sub-lot can only be divided into equal shares of the original lot (e.g. 4 fractions á 2 kg out of an original lot of 8 kg). Hence, fractions which are not dividable to equal shares (which are the majority) cannot be labelled correctly. This is why there is the necessity of the buyers making their own labels with their business information and the information mentioned in the Control Regulation. At least one of the interviewed buyers stated that he had problems doing his own labels because of technical limitations. It was observed that several polystyrene boxes which were about

to leave the facility were not labelled because the labels were not multiplied. A common treatment of this problem is to record the size of the shrimp and the weight of the box. Nevertheless, this information cannot be linked to any label or lotnumber. This point is a repeated or “shared” CTP with the transport company when shipped to Barcelona. The consequence, as stated above is CTP (8): When assembling the generated sub-lots to batches for transport, the lack of linkage between single sub-lots and the invoice for the entire batch leads to a shift in granularity. Now, only the entire batch is traceable to the pool of all vessels whose catch is in that batch – the individual sub-lots are not traceable back to the vessel. Albeit this is not per se an obstacle to CoC certification, this shift of granularity level might cause severe problems when a food scandal requires the supply chain to identify every box of shrimp. Without the generation of uniquely identifiable sub-lots after splitting, an information loss is inevitable. The reason for this is CTP (9). Mixing products or committing origin fraud is possible as the shrimp are not packed tamper proof and the label is not physically stuck to the box. This was the case at buyer 1, 2, 4 and 5

The same problem as with CTP (7) but at a different place occurs at the facilities of the second buyers 4 and 5 in Barcelona (7). The agents collect the original commercial labels which they receive from their suppliers jointly with the product. Yet, it was observed that they sell their sub-lots to fish mongers and do not duplicate the label. Although the sales system at Mercabarna is automatized, the sub-lots are not identifiable without the label.

The certified wholesaler with international and high-class clientele (commercial level I) has the most precise traceability programme. The company disposes of a highly automatized traceability system and uniquely identifiable lots that make it possible to label an individual fish. In the case of shrimp the traceable unit are buckets of 1 kg. This is a very fine granularity level compared to the rest of the analysed companies. Splitting and merging, an important point of traceability is not a problem in this company. As proposed by the manual about the application of traceability systems published by the Spanish fish monger federation FEDEPESCA (SAN MARTÍN, CALVIÑO IGLESIAS 2013), every newly created sub-lot is assigned a unique identifier which links the sub-lot to its original lot. This is done by creating a numeric code and by recording the weight before and after splitting. During the walk-through at the company’s facility, no critical traceability points were found in Table 10.

Table 10: Traceability performance of the buyers

Buyer ID	CTP 4	CTP 7	CTP 8	CTP 9	CTP 10	Total
1		x		x	x	3
2	x	x		x	x	4
3	x			x		2
4			x	x		2
5			x	x		2
6						0

CTP 4: Access to label although not certified

CTP 7: Duplication of labels after splitting does not allow precise reconversion of weight

CTP 8: Individual lots are not identifiable in merged batches

CTP 9: Label is not tagged firmly to the lots / not uniquely identifiable

CTP 10: No recording of adding of ice, water and salt

4.2.4 Transport (Trans)

The analysed transport company is specialised on the transport to the wholesale market in Barcelona. Additionally it has several more tasks which make a traceability analysis necessary: Buying on behalf of external clients in Mercabarna and preparation of the product batches. The latter task is exercised in cooperation with other middlemen and consists of repacking the boxes after they are auctioned. For transport, new logistic units (LU) are created by merging different boxes for the clients. These CTP are described in the wholesaler section. The transport company does not only buy in Palamós but also in other harbours along the Catalan coast. After the transport to Barcelona several clients are supplied at the wholesale market. Figure 17 visualizes the steps undergone at the transport company.

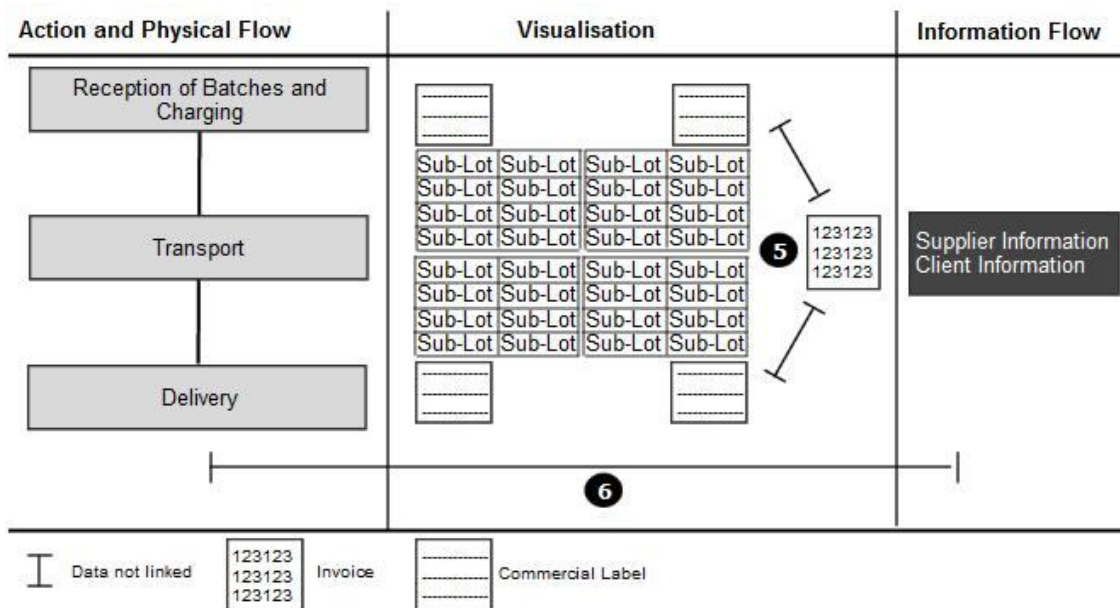


Figure 17: Process Mapping of Physical and Information Flow and visualisation at the transport company

Source: Own Chart

The analysis of the transport company’s traceability performance is not of importance for the MSC CoC certification because the company does not have any property over the seafood product. Nonetheless, it is included in the analysis because this operator might interfere in the constellation of transport units and the manipulation of product. Besides, there are some weak points which can have implications for the traceability of the entire supply chain. Two critical traceability points were detected at this stage of production.

CTP 5 is derived from problems with the full ability to identify the product at every stage of the supply chain: Due to a strict protocol of arriving hours (12PM) in Barcelona, time is a highly important factor for the transport company. For this reason, little time can be spent for “paper work” after batching the product so the documentation might be incomplete at the transport. This is not relevant to the external traceability, as transport is only a service and the buyer / proprietor of the batch can be identified; for internal traceability, however, it is problematic, because bills and invoice cannot be linked to the single commercial labels of the seafood boxes. CTP 6 shows that the transport is not documented and registered in the product history. This is a potential threat to the ability to identify the product at every stage of production. The transport company plays an important role in

the linkage between the sales organisation and the wholesalers. The latter will be analysed in the next section.

4.2.5 Retailers and Fish Mongers (Fis Mon)

One of the major threats to traceability that was found in the analysis is the problem of seafood sold in bulk. It has to be constated that the critical traceability point which is caused by not firmly attaching a label to the lot (9) is found at all stages of the supply chain. This is mapped in Figure 18. As the label is not physically fixed to the product, it is possible to commit origin fraud. Substitution of product was witnessed by an interviewed proprietor of a fish monger:

“I worked many years in the fish section of the municipal market of the neighbour village and I saw with my own eyes how they handled a box of shrimp, bought in Mercabarna, coming from Málaga, where they had put some “magic powder”. They bought one box of shrimp from here and 5 boxes of shrimp from Málaga, saved the label of one of the boxes of Palamós and sold it as if everything was from Palamós. It is impossible to prevent from this if there is nobody who would denunciate this.”(pers. Comm.)

This might also happen in the sales hall of the Cofradía. Seafood from days before or coming from Mercabarna is sold with the label of the Cofradía de Palamós. Further evidence was encountered at the Barcelona food market “La Boquería” where blue and red shrimp Palamós (Gamba – Palamos / Gamba Playa Palamós, see Figure 19) were sold at a time of a seasonal closure of the shrimp fishery in Palamós. Hence, it was impossible for the fish monger in Barcelona to sell fresh shrimp from Palamós. Another case is the use of the quality label logo in a space which is not certified (and on this photograph even with small shrimp “gambeta” which are excluded from certification, see Figure 20). The two certified fish mongers at the sales hall only sell certified shrimp and put the quality label certificate aside of the product. A random check of the other fish mongers at the sales hall lead to the result that seven of ten fish mongers presented the certificate while three did not.

Another CTP (11) was found during the visit to Mercabarna. The interviewed fish monger did not control the commercial labels and did not ask the supplier for correct labelling which makes it probable that information is lost at this point of the supply chain. Wholesalers confirmed that fish mongers seldomly ask for the labels when buying a box of fish.

Additionally it is problematic that small fish mongers do not register the sales per species so that it is not possible to trace back a sold product to a (certified) species. This hampers carrying out an input-output balance check.

Supplementary to the CTPA, the three fish mongers were asked if their customers were interested in origin information and verification for it. Although some clients ask for the origin, a verification (e.g. by checking the documentation) had never been demanded.

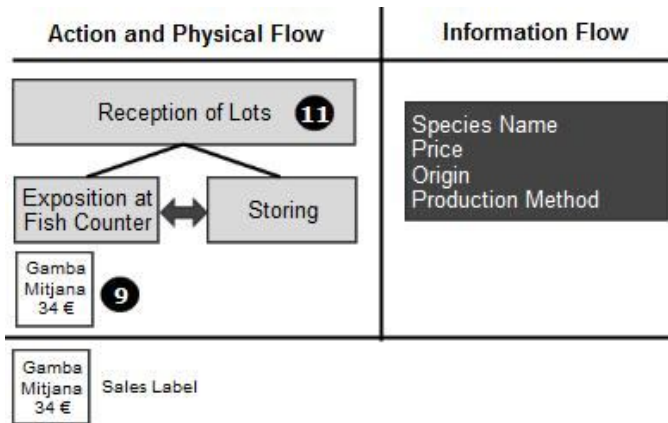


Figure 18: Process Mapping of Action and Physical Flow and Information Flow at the fish monger
 Source: Own Chart



Figure 19: Blue and red shrimp at "La Boquería" fish market in Barcelona. The label clearly shows that the presentation modus is "fresh". The photograph was taken at the end of the seasonal closure of the Palamós shrimper fleet (16.2.2013)
 Source: XAVIER CORRALES RIBAS (2013)



Figure 20: Misuse of the Quality label at a fish monger in Calonge

4.2.6 Restaurants (Rest)

Restaurants in Spain mainly source their seafood from wholesalers (76%) (FUNDACIÓ PROMEDITERRANEA 2011). Within the restaurants analysed in this study this trend was confirmed. Only one of four restaurant managers buys in the auction himself or through a cooperative. The others are supplied by wholesalers. As a consequence, those restaurants are likely to be “supplied” also with the CTP that occur at the wholesalers.

In Palamós there is a restaurants association called “Plat Blau” which collaborates with the quality label. The associated restaurants made an effort to get certified, but none of them passed the audit because of problems to comply with the conservation rules for certified shrimp. Only one restaurant that had passed the audit before becoming part of the association is officially certified. In order to promote the quality label, the collaboration is characterized by the obligation of “Plat Blau” to receive its shrimp from certified suppliers of Palamós shrimp only. Besides, they must record any acquisition and sale in order to be able to do a volume based input-output balance for these shrimp. In return, the restaurants can make use of the quality label logo. However they also work with small shrimp “Gambeta de Palamós” which is not certified. Hence, they don’t have to comply with the above mentioned traceability criteria. The association consists of 17 restaurants that offer a special “Menú de la Gamba”.

Two interviewed restaurants are part of the association and two are not. They range from medium to high priced restaurants and all are specialised on the preparation of blue and red shrimp. It is the most important species for those restaurants. 20-25% of the entire sales are assigned to “Gamba de Palamós”, varying in function of weekday and season. The tasks that are related to traceability from reception to serving are the following:

Receiving and checking of the correct documentation (invoice and labels), splitting up the received lots in portions of about 200-300g, freezing and storing, and preparing, cooking and serving the dishes.

Process mapping shows that the first encountered traceability point (8) is related to the documentation of the product whilst frozen (see Figure 21). It should be identifiable at all stages of its production so it must be labelled. However, this is not the case in three of the four restaurants. The second CTP (12) is the problem that even in the certified restaurant, it turned out to be virtually impossible to record the sold portions of shrimp as required by the CoC standard. This is undoubtedly an important issue as this is the only possibility to make traceability checks at this stage of the supply chain. However this criterion is difficult to implement in the daily work of a small-scale restaurant for the following reason stated by the owner of the certified restaurant:

“The traceability information about every sold portion should be documented and stored internally in an automatized system: But this is very complicated to achieve. I buy all the big sized shrimp in Palamós, but the monitoring is more complicated than it looks like. If you asked me ‘would you know how many shrimp you have sold?’, my answer would be: no. For a family business it is too time consuming to control and check every single box of shrimp.” (pers. Comm.)

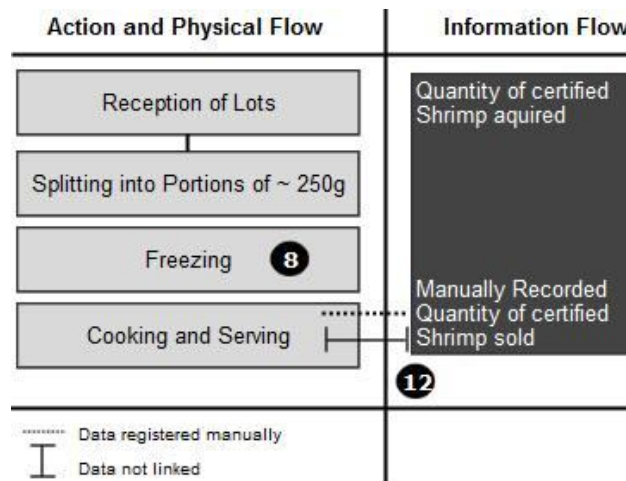


Figure 21: Process Mapping of Physical and Information Flow at the restaurant
 Source: Own Chart

Another problem which is related to the lack of a link between label and lot is that the menus of restaurants usually do not contain any traceability information as for example would be the case at a fish mongers counter. Besides, the restaurant managers stated that so far, no client had ever asked for origin or origin verification. That means that a client cannot base his or her ordering decision on important features of the origin of the product. In this case, a label put in the menu could help. After analysing directly critical traceability points at each stage of the supply chain, the next chapter focuses on the question which CTP lead to systemic gaps in the information flow.

4.3 Systemic Gaps in the Traceability of the Supply Chain

The traceability point analysis resulted in 17 problematic sites along the supply chain, i.e. points where a link between information and physical flow is potentially missing. The majority (five CTP) were encountered at the wholesalers, with different performances according to the commercial level of the wholesalers. Three missing links were identified at the restaurant and at fish monger level, two CTP were found at the transport company, fishing vessel and auction hall (Figure 22).

It was made an effort to identify those CTP which occur at more than one stage of the supply chain: CTP that are transmitted downstream from one operator to his client and so on. These missing links are assumed to be systemic gaps because they are intrinsic in the mixed traceability model applied in Palamós with its documentation-based traceability system. Table 11 resumes which CTP were identified at which stage of the supply chain. In the table those which were found more than once are marked in yellow (4), orange (7), blue (8) and red (9). As can be seen, one CTP (4) is generated at the auction hall and is found at the wholesaler as well. The stage of wholesale is the one where most repeated errors occur (4, 7, 8, and 9) and three of the four CTP that occur at the downstream based actors come from the wholesalers (7,8 and 9).

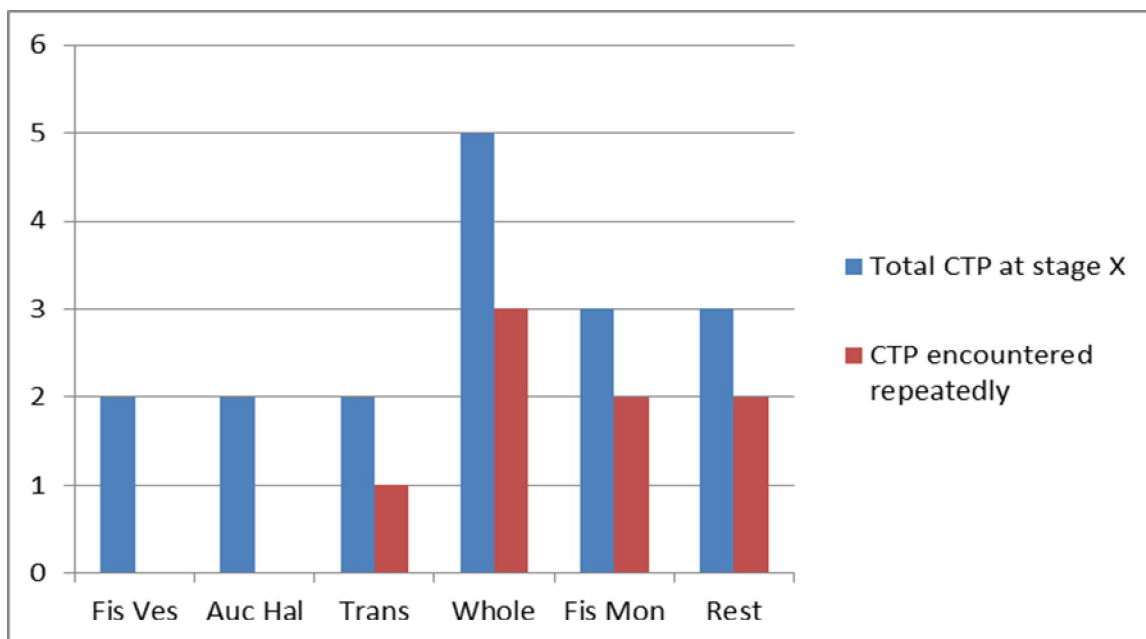


Figure 22: Identified number of CTP along the supply chain and CTP that were encountered repeatedly

Table 11: Distribution of encountered CTP and CTP that were found repeatedly

Stage of the Supply Chain	CTP 1	CTP 2	CTP 3	CTP 4	CTP 5	Total CTP at stage X	CTP encountered repeatedly
Fis Ves	1	2				2	0
Auc Hal	3	4				2	0
Trans	5	6				2	1
Whole	4	7	8	9	10	5	4
Fis Mon	7	9	11			3	2
Rest	8	9	12			3	2
CTP ID	CTP Description						
1	Undocumented sales						
2	Haul not traceable						
3	Barcodes are not used if shrimp is not certified						
4	Access to label although not certified						
5	Individual invoice cannot be linked to batches during transport						
6	Transport not linked to the product history						
7	Label duplication after splitting does not allow input-output-balance						
8	Single Lots not identifiable in merged batches after splitting						
9	Label is not stuck to the lots						
10	Adding of Ice, Water and Salt not recorded						
11	No control of traceability information						
12	No recording of information for balance check due to lack of time						

To conclude, the access to the quality label certificate to wholesalers who are only partly users links auction hall and wholesalers (4); the problems with the multiplication of commercial labels and the loss of information in merged batches of sub-lots after splitting

original lots are generated by the wholesalers and transmitted to the fish monger and the restaurants respectively (7 and 8).

In order to decide if these critical points have consequences for a potential MSC CoC certification for the agents of the supply chain, they will be tested in the context of the MSC CoC standard in the following section.

4.4 CTP and MSC CoC Certification

After having analysed the traceability performance of the supply chain, the second hypothesis (*The failures in traceability have consequences for the credibility of the Quality label and may impede MSC CoC certification*) is checked. In order to answer research question II 1 (*Are the requirements of the MSC Chain of Custody already met? What is still missing?*), the CTP that were found will be compared to the MSC CoC standard. In return, the MSC criteria will be examined on their fulfilment by the actors of the supply chain.

Table 12 shows which CTP are interpreted as a potential risk to CoC certification. In total, seven CTP are seen as problematic for certification. In the next paragraphs, the reasons are formulated by analyzing the four principles of the MSC CoC standard.

Table 12: Comparison between the identified CTP and the principles of the MSC CoC Standard

CTP (ID)	Affected MSC CoC Standard Principle
(1) Undocumented sales	4 Product cannot be identified
(4) Access to label although not certified	3 Acknowledgement of being a certified source
(5) Individual invoice cannot be linked to batches during transport	2, 4 Product cannot be identified or invoice cannot be traced back
(7) Label duplication after splitting does not allow reconversion of weight	2 Input-Output balance not possible
(8) Single Lots not identifiable in merged batches after splitting	2, 4 Product cannot be identified or invoice cannot be traced back
(9) Label is not stuck to the lots	3 Possibility of substitution of product (but is common practice in MSC)
(10) Adding of Ice, Water and Salt not recorded	2 Input-Output balance not possible

Principle 1: The organisation shall have a management system

Principle 1 does not constitute an obstacle for certification. All agents are operating a management system for practical reasons already. The training of the staff in order to ensure conformity with the principles can be reached easily.

Principle 2: The organisation shall operate a traceability system

Out of the seven CTP interpreted as hazardous, four are assigned to the second principle.

-
- (5) Individual invoice cannot be linked to batches during transport
 - (7) Label duplication after splitting does not allow input-output-balance
-

(8) Single Lots not identifiable in merged batches after splitting

(10) Adding of Ice, Water and Salt not recorded

CTP (5) is a severe problem which is mainly caused by a lack of time to deal with the traceability information. If tracing is not made possible from its sales invoice at any given time, this infringes the second principle: “For any product sold by the organisation as certified, tracing must be made possible from its sales invoice to a certified source and vice versa (one up / one down)”. CTP (8) can become a problem, but only if not all vessels were certified, because a merged batch does not contain shrimp from different harbours. However, having certified the entire shrimp fishery in Palamós, it would be less important to be able to identify single sub-lots.

CTP (7) and (10) have to be seen as a risk when they occur parallel. The problem of multiplication of the labels is that the weight that is recorded on the fractioned sub-lots does not always correspond correctly to the original lot. Only equal parts of the original lots can be labelled. For certified lots, this means that standardized fractions of the original lot would be needed. If not, it is possible that the “[...] records [cannot guarantee] confirmation of volumes of certified inputs and outputs over any given period (input-output-balance) [...]” as claimed in the second principle. Adding ice, water and the salt lead to a gain in weight. It is possible to calculate the real weight with a conversion rate; however, if this is combined with the incorrectly documented weight on the split sub-lots, there is a huge margin of error.

Principle 3: There shall be no substitution of certified products with non-certified products

Two CTP are assigned to principle 3:

(4) Access to label although not certified

(9) Label is not stuck to the lots

Point (4) is a potential risk to certification. Let it be assumed that the quality label is a MSC certificate which arrives at a company which has a fish counter in a jointly used certified sales hall, but not for his own business. The risk that misuse occurs undoubtedly exists. The CoC standard states: “Certified and non-certified products shall not be mixed if the organisation wishes to make a claim about these certified products. It must be ensured that packaging materials and other identification materials bearing the MSC logo cannot be used for non-certified products.”

CTP (9) is an intrinsic problem of fresh seafood sold in bulk. Given the case that the blue and red shrimp fishery in Palamós gets certified for its efforts to fish sustainably, it would not be possible to distinguish the origin of the shrimp from Palamós to other harbours which are not certified. Genetic tests cannot help to identify the origin as the stock of *A. antennatus* in Palamós is genetically almost identical with any other blue and red shrimp in the North-Western Mediterranean. Hence, it is indispensable to have a guarantee that the harbours are not mixed and no certified product is substituted.

Principle 4: There shall be a system to ensure all certified products are identified

Three CTP were assigned to the fourth principle:

-
- (1) Undocumented sales
 - (5) Individual invoice cannot be linked to batches during transport
 - (8) Single Lots not identifiable in merged batches after splitting
-

Apart from the risk that undocumented sales (1) bear for a certification of the fisheries management they also represent a severe limitation for CoC certification. According to the results of the present study, about 10-25% of the landings are sold undocumented. This share, although caught “certified as sustainably” could not be sold as “certified as fished sustainably”. Yet, principle four concludes that certified products have to be “identifiable as such at all stages of purchasing, storage, processing, packing, labelling, selling and delivery”.

Being critical points of internal traceability, CTP (5) and (8) refer to this prerequisite as well: Currently it seems, that the internal traceability systems of the transport company and restaurants are not sufficient for ensuring the ability to identify certified products at all stages. This is due to the limited bureaucratic effort that companies on this level spend on exact information about all criteria that are specified in the Control Regulation. Information about vessel name, harbour and catch date might get lost on sub-lot level in a merged batch.

Three more reasons that could be limiting to certification are the following: First, the fishery itself has not been certified as sustainable yet. Though, this study is written for the case that the fishery will be certified. Secondly, it is important to analyse if consumers would be willing to accept that blue and red shrimp are not available during all months of the year in Palamós due to seasonal closures. Furthermore, the quantities are very limited (130 tonnes/year); this should not be problematic, however, as there are fisheries which produce less and bear the MSC label. In addition, there is still no fishery certified against the MSC standard in the Mediterranean and this would be a great opportunity for marketing. Thirdly, it would be necessary to see, how consumers think about certified shrimp. To date, due to consumers’ little knowledge about the Quality label, there is hardly any specialised demand for shrimp bearing the Quality label.

Before presenting suggestions for how to solve these problems in order to meet the MSC CoC standard principles, the attitude towards sustainability certification by the interviewed supply chain actors is explored.

4.5 Supply Chain Actors’ Attitude towards Sustainability Certification

The following paragraph tries to answer research question II.2 (*Are the actors of the supply chain willing to get certified*). The operators of the supply chain of blue and red shrimp are generally in favour of a protection of the resource and are disposed to accept seasonal closures for the shrimp fishery.

The fishermen stress their efforts made towards an improved management of the shrimp fishery, including the seasonal closures and other technical measures like the limitation of hauls. As the majority of vessels are certified to the quality label, the owners are familiar with the process of auditing.

The fishermen's association generally welcomes sustainability certification as a potential confirmation of their efforts. The Marine Stewardship Council attended a meeting about the future of Palamós shrimp fishery. However, the fishery needs robust scientific data to assure their sustainability.

The wholesalers varied greatly in their attitude towards certification. The tenor among the regional wholesalers was that certification is rather interesting for large wholesalers, caterers or the fishermen's association. It was affirmed that this could only be carried out with the help of public money.

"It could be interesting if they would grant us subsidies to compensate for the costs of certification, be it authorities or fishermen's association. For one single company and especially one with several branches, certification costs are too high." (pers. Comm.)

Besides, the Spanish market was not seen as receptive for certified fish as commented a commissioner:

"I think if you want to sell certified fish you have to have a market. And currently I do not see this market in here. But in Italy it could work." (pers. Comm.)

A third quote demonstrates that there is a will to invest in certification, but it depends on the perceived demand of the clients if it can be implemented:

"I am very interested in long term sustainability in fisheries; otherwise I would be ruined. I would welcome a temporal closure for shrimp which is longer than the one they have now. However, I think we have to sensitize the consumers. It might be valuable to build up a project which includes the restaurants; or an official body would make advertisement for a certain project to raise the consciousness of the consumers." (pers. Comm.)

Within the collective of fish mongers, the opinions varied, too. General support for sustainability was found in several cases. However, the fish mongers perceive that their local clients are demanding the cheap categories of shrimp and certification generally makes the product more expensive.

Two of the four restaurant managers rely on the confidence of their clients and consider more important to serve high-quality dishes than being certified by an external label. One restaurant manager stated, that *"in earlier times shrimp were only caught in summer. Shrimp are a seasonal product, like anchovies or other species; they all have an optimum period within the year. So why not return to these practices?"* (pers. Comm.). These attitudes are also related to the concern about future supply with shrimp which are by far the most important species in the restaurants of the region. Nonetheless, their opinions about the need of an own initiative to protect the resource vary. Generally, the responsibility of the commercialising sector is perceived to be low. The actors state that this problem is caused by the fishery and, hence, it should be solved by the fishery.

To conclude, being in favour of sustainable fishing does not mean being in favour of sustainability certification. It is argued, that confidence of the customers in the quality of-

ferred by the businesses is more important than certification. 19 out of 22 interviewed businesses refused to get certified because of the high costs of certification and the uncertain benefits. Especially wholesalers with several branches argued that the cost of certifying every branch would be too high. The actors claim that a public-private-partnership project could be useful in order to get financing for CoC certification.

4.6 Analysis of Social and Political Reasons for the Identified Critical Traceability Points

This chapter deals with potential explanations for research question I 6 (*What are the social and political reasons for the deficiencies?*). In the analysis, all encountered CTP are included in order to optimize the currently used traceability system in Palamós. The reader should be aware, however, that those findings are assumptions by the author that are made based on the empirical findings, observations and on-going dialogue with stakeholders.

- (1) **Undocumented Sales:** There is a long-standing tradition of undocumented sales which are also a fundament for the social inclusion of the fishing sector in the village community. BAS I PEIRED (2006) writes that there are tendencies to minimize catch declarations as much as possible and includes the lack of control of this activity. Fishermen sell fish to their neighbours and friends cheaper than the fish monger would because both of them save on taxes and costs. On the short term this might be beneficial for individuals. On the long term, however, it might cause damage to management, individual buyers and the fishermen themselves. This is problematic for the documentation and control of catches which is a basic function that traceability fulfils.
- (2) **Loss of information on haul level:** The use of VMS data for story telling purposes requires an organised and centralised system of registration for the information to be traced. To date, only some companies involved in rather large-scale, industrial fishing operations (freezer-trawlers, freezer-purse-seiners) are equipped with an informatics system which permits to connect haul and log-book data. This system requires investments which may not be viable on a semi-industrialised vessel per se. Furthermore, VMS data are considered to be highly confidential as they contain business data. However, in the light of consumers who more and more demand transparency in food supply chains it might become an important voluntary step of the industry that could generate added value.
- (3) **Lack of barcodes and thus obstacle for implementation of automatized supply chain system:** Barcodes were introduced as a part of the labelling requirements of the quality label and they are scanned before the auction. Presumably, the Cofradía was not interested in equipping all labels with barcodes because of an additional effort. Still, it would be necessary in order to implement an automatized traceability system.
- (4) **Partly users of the certificate can obtain the quality label for both certified and not certified selling points:** The reason for this is an organisational mistake of the Cofradía which makes it possible for fishmongers who run various branches to use the label logo in their stores.

- (5) **During transport the information of invoice and bills is not always accompanying:** This is due to a lack of time. Fresh seafood is a highly perishable food stuff which has to be handled with the shortest timespans between one link in the supply chain and another. Documentation and paperwork are thus not always possible to be correct.
- (6) **Transport is not connected to the product history:** Transport is not linked to the product history, because the responsibility for the compliance with the quality label and the legal requirements is taken over by the commissioner and the second buyer. However, as the company consists of a commissioner and a transporting agent it should be linked although there is no possession of the product by this company. There is not seen the necessity of recording the trip information.
- (7) **Label duplication after splitting and**
- (8) **Splitting and Merging lead to a loss of product information:** Splitting is a necessity in the daily business of wholesalers who have different clients. Still, they are obliged to maintain the information about the original lots to any split sub-lots (vessel name, harbour and catch date must be transferred to the next step of the supply chain). The Cofradía facilitates splitting and merging of the lots by duplicating the commercial labels. However, if the label of first expedition is put on the sub-lot at the wholesalers business after splitting, the information about the original lot might get lost. One of the principal reasons for this deficiency is that it is difficult to guarantee that every lot is identifiable with its label for a business of this size. This might be due to a lack of time or a lack of awareness of the operators.

The identification of every single lot, however, is obligatory by law. Another reason for the lack of awareness or willingness to have every lot identified might be the low frequency of control by authorities. A deeper reason suspected to be the following: Government does not have any priority on the control of fish trade and is not interested in closing businesses in times of crisis. Hence, only businesses where the authorities know that they operate according to the regulations are controlled. This was reported by an interviewed wholesaler.

Besides, wholesalers have their own economic interest in hiding the origin of fish, if it is possible to obtain higher prices for species that origin from a different zone than indicated. This is also due to a deficiency of the labelling law: The obligatory indication of the provenience of fish is very imprecise. Especially species that do not underlie special labelling compromises have a high risk of manipulation of origin. A big exception is species which require specific catch documentation like Blue Fin Tuna (*Thunnus thynnus*) or Swordfish (*Xiphius gladius*) and thus are controlled more frequently. It is furthermore beneficial to the economic agents that consumers hesitate to ask for origin or origin verification of fish. So, the fish mongers can sell shrimp incorrectly as if from Palamós, because this name sounds more familiar to the customers. This ironically generates more confidence.

- (9) **Label is not stuck to the lot:** This problem is assumed to arise from an intrinsic error in the labelling law which in the end is really expensive to control but still leaves room for fraud.

- (10) Water, ice and salt are not mentioned but lead to alter product properties:** Gaining weight in a product like blue and red shrimp, where a kilo can cost up to 90€ is the main incentive for economic agents and explanation in this case. By contrast, the wholesalers have very little interest to indicate this fraud publicly.
- (11) Fish mongers do not control the traceability information:** The reason for this CTP can be put down both to the lacking willingness and sensitivity for the importance of traceability by the fish mongers and to the lack of control by authorities.
- (12) Restaurants do not identify their portions:** Similar to (5), time is the limiting factor responsible for this CTP. It is one of the most important production factors and it costs time to identify every ration.

To conclude, there are several reasons for the traceability deficiencies of the blue and red shrimp supply chain in Palamós that are both related to social and political issues. On the one hand, those weaknesses are ascribed to economic interests of the actors in the supply chain, little sensitivity about traceability and its´ purpose, high costs of implementation and little control by the authorities. On the other hand, there are shortcomings which are clearly rooted in organisational and traceability system related problems. This can be seen by the fact that responsibility for traceability is distributed, but the only organisation that seems to be prepared for dealing with the deficiencies is the Cofradía – the central node of the supply chain which links fishery and commercialization. Lastly, it cannot be denied that the labelling law of the European Union leaves many possibilities to commit fraud. Although this has no direct consequences for certification, it is worth to be mentioned here as authority control and consecutive audits by a 3rd party certifier can be mutually beneficial.

Given the current situation, sustainability certification could be a potential way if some criteria concerning the traceability system are met. In the next section, potential improvements that facilitate an optimization of the traceability system is studied and steps that are necessary for MSC CoC certification will be named.

4.7 Potential Improvements

As mentioned at the beginning of the study, the main objective is to optimize the currently used traceability system in order to make sure that all criteria of the MSC CoC standard are met. In the upcoming paragraphs improvements for the deficiencies and CTP will be presented in the following manner: First a reference to the CTP which shall be covered by the improvement will be made, secondly the idea will be presented, thirdly the tasks for implementation will be described, fourthly limitations to the implementation are analysed and lastly, a cost-benefit-estimation will be carried out.

4.7.1 Packing of the Product and Use of Quick Response Codes

Covered CTP: 5, 7, 8

Idea

The main problem for traceability that was detected in this fresh seafood chain was the problem of losing the information about the origin of different lots. Although at local level mixing might not be problematic, it is at over-regional level where mixing of trade units of different harbours occurs. In order to avoid this potential source of fraud, the product is packed at the Cofradía de Pescadores auction hall. Package size is related to usually demanded quantities adapted to the needs of customers: e.g. 200/300/500g/2kg for Small / Medium sized and 10/20/30/50 pieces for large / extra sized shrimp. The fisherman who opened his own fish monger shop during the period of the elaboration of this study sells his shrimp in 300g packages. Considering that packaging will generate a quantity of residues and following the thinking of environmental sustainability, the packages shall be made of biodegradable plastic. Additionally it seems reasonably to use modified atmosphere in order to prolong the shelf life of the highly perishable shrimp. Unique identifiers shall be assigned to every package using Quick Response (QR) codes which contain the catch date and lot number and the legally binding information which is displayed on the commercial sales label now. Moreover, information about the quality label and, in case of a certification of the fishery, the MSC and the geographical position of the haul(s) are depicted on the package. Besides, both logos are displayed if the shrimp is certified. Those QR codes have to be safe and must not be falsifiable. They could be put inside the box in order to avoid manipulation. At retail level, the packages shall not be opened. The package shall allow an all-round view of the quality and freshness of the shrimp.

Expected Improvement

The packing of the shrimp shall help to build consumers' trust and to increase the credibility of the quality label. Besides, it should be impossible to commit origin fraud because of a tamper proof package.

Tasks to carry out for implementation

Before the implementation of the packing system it is recommended to carry out a survey with the involved stakeholders (fish mongers and wholesalers) and consumers in order to find the appropriate package size. It is fundamental to have support from all stakeholders. Likewise, it is crucial to carry out a study about the consumers preferences.

The next task is the installation of a packing machine at the facility of the Cofradía (see Figure 23 as an example). It could be installed right after the auction belt and the buyer shall chose which size he wants to have it packed. Guaranteeing the maximum quality of the product it shall be avoided that the shrimp come in contact with the packing material and too many hands. Therefore, an inlet for the shrimp (in case of the bigger packages) shall be used. The material that is used has to be robust as the shrimp have various sharp components that make plastic easily tear. The best would be a rigid solution in order not to damage the product.



Figure 23: Shrimp packing machine
Source: MAREL 2013

Limitations

One limitation of packing shrimp is that wholesalers will probably insist on being able to control shrimp manually and visually because they suspect that shrimp are too small for their size categorisation. Yet, it is in the genuine interest of the quality label to maintain the size classes correctly after certification.

Although packing would solve many problems of traceability, another limitation is that it is possible that customers do not want to buy the shrimp packed. So it might be possible that this model is only useful for a certain group of consumers.

Estimated Cost-Benefit-Analysis

According to a Google search (“shrimp packing machine”) the costs of acquiring a packing machine are estimated at 20 000 - 60 000 € Used machines could be cheaper. However, extra costs like additional labour costs for installation and maintenance, running and maintenance costs and expenditures on packaging material (especially for biodegradable one) may be substantial but difficult to estimate. The project should be co-financed by subventions from the EU fisheries fund and the shrimp fishermen and Cofradía. This investment would have to be amortized by passing on the costs to the customers which results in higher but possibly also more stabilized prices.

4.7.2 Direct Sales

Covered CTP: 1

Idea

Direct sale could be a solution to the problem of undocumented selling. Sales will be documented and the contribution to the Cofradía de Pescadores will be maintained. The incentive both for fishermen and for former “illegal” clients lies in lower prices and high-

er income, because no middlemen or other traders interfere. It is absolutely essential to organise this initiative jointly with the involved operators of the supply chain, because it means competition for the established wholesalers and fish mongers in the sales hall of the Cofradía. In a former project of implementation of direct selling (GiroPesca), the wholesalers blocked the sales channels. It is clear that not all undocumented sales will be documented as the share of landings that could be sold directly will not be very big. However, it could be a complementary activity and may be used together with a promotion programme for quality label and MSC.

Expected Improvement

It is expected to reduce undocumented sales and to obtain higher first sale prices for the product. Traceability will be perfect if the supply of fresh fish is controlled (by an external) as it is a producer-customer relationship.

Tasks to carry out for implementation

As explained above it is of high importance to sensitize fish mongers and wholesalers elucidating that it does not harm their business. Although there is clearly a competition between direct sale and the fish mongers in the sales hall of the Cofradía, direct sale would be a legal competition. It has to be decided how a direct sale is organised: Shall it be run by the Cofradía or directly by the fishermen?

Limitations

It should be noted that those buyers who buy undocumented fish not for private but for business reasons (e.g. restaurants) might not be covered with this sales channel. The only remedy in this case is an increased control by the authorities and a self-commitment of the fishermen to treat undocumented sales with strict sanctions.

Estimated Cost-Benefit-Analysis

The installations and the marketing may require moderate investments. Fish mongers in the sales hall facing decreased prices might require financing through the European Fund for Fisheries (EFF) destined to improve economically viable enterprises in the fisheries sector.

4.7.3 Linkage of E-Logbook Data to Product Information

Covered CTP: 1, 3

Idea

Fishing vessels registered in the European Union have to record catch information in their electronic logbooks and send them to the national authority. The information about haul positions could be used for the verification that the shrimp were caught within the boundaries of the fishing grounds mentioned in the quality label regulation. This information could be linked to the lot by vessel name, species, catch date and quantity. Besides, it gives details about fishing time, haul frequency, catch weight, fishing area and fishing gear type and dimension. This should make it possible to detect undocumented sales and

to sanction them, because the transmitting of data has to be carried out before arriving at port and after selling.

Tasks to carry out for implementation

First of all, fishermen must decide if they want to share this information and to what degree.

A case study of catch-to-landing-traceability on board an industrial cod freezer-trawler ("CodTrawl") describes the implementation as follows: "At the start of each trawl for a haul of fish, the position, time and type of trawl is registered. This generates a 'trip number' which is then linked to all the fish in that haul. On each fishing trip several hauls will be made. These proprietary 'trip' numbers contain the information above plus date and a unique sequential number and a 'haul' number. Each haul is then frozen in one of the seven possible freezers capable of containing 52 blocks or trade units of fish of approximately 25 kg with each of these blocks receiving a unique ID that also links back to the 'trip' number. This ID enables the identification of boat, date, time, type of trawl, and area of trawl [...] CodTrawl has excellent electronic traceability systems on board the boat. This includes online integration [...] and the ability to send XML in standard format and automatic upload of product information to the company internet pages" (DONNELLY AND OLSEN 2012, p. 231).

Limitations

It is not realistic to implement such a system at a shrimp trawler. However, the use of a software system that links the VMS data to a central database should be possible as implementation is rather easy. Currently, before and after carrying out a haul the fishermen push a button on the VMS box to initiate the fishing activity. This permits to estimate the time spent at a geographic position quite precisely.

Estimated Cost-Benefit-Analysis

The installation of a software system linking VMS is not estimated to require a high cost. The benefits would possibly be constituted of increased sales prices and of facilitating MSC certification.

4.7.4 Centralised Traceability Model, Use of Smart Goods Technology and Tracing and Tracking Tools

Covered CTP: 3, 5, 6, 7, 8, 9, 10, 12

Idea

The reason for the CTP mentioned here above all is the lack of a system that guarantees that no information is lost along the supply chain although lots are split and although the label is not physically fixed on the lot.

In order to give a response to the demand of label systems that can deal with goods that are sold in bulk, smart good technologies shall be used. In this light, technologies like Radio frequency identification (RFID) and Geographic Information Systems (GIS) deserve special attention.

Smart Goods are characterized by a higher level of sophistication than traditional goods identification. It is now possible to identify the freight, either individual items (sub-lots) or the load unit (batches), with new smart technologies like (RFID) tags as a carrier of data. RFID is a technology that uses radio waves to automatically identify objects, often considered the next stage in the barcode (KRAISINTU AND ZHANG 2011). This means that CTP 3 (lack of barcoding on labels) could be stepped over. Generally, “[...] RFID tags are difficult to counterfeit and have extremely high data integrity. Even under stringent operating environments such as snow, dust, corrosion, and vibration it can still function well” (ibid, p. 16). Besides they enable the good to

- Possess a unique identification;
- Be capable of communicating effectively with its environment;
- Retain or store data about itself;
- Deploy a language to display its features, production requirements;
- Be capable of participating in or making decisions.

CHRYSOCHOU *et al.* (2009, p. 324) names the benefits of RFID tags: “Its wide range of unique product information can be carried throughout the supply chain; at the same time the information can be actively updated. Technology advancements in RFID tags have added extra functions. For example, they can provide monitoring of temperature that informs manufacturers, and even final consumers, if temperature abuses have occurred”, which is certainly an interesting feature for the quality label “Marca de Garantía de la Gamba de Palamós”. RFID tags can also be read from a long distance, allowing products to be easily tracked inside the store which saves time and makes internal traceability far more efficient.

GIS are computer-based tools for the analysis or description of spatial information. GIS can organise, analyse, manipulate and manage spatial information in an intuitive way and provide the user with visual information accurately.

Since GIS can provide general configuration and features of the earth's surface and the origin of fisheries products, the fishing zones can be divided and coded according to the geographical information that GIS obtains. Each area is assigned a unique code ID in the database which connects with the production information, e.g. fishing method, MSC certification, stock status in that area, thus, the origin place of production becomes visualized in the whole supply chain management system.

An important strength of GIS is that in the distribution process the product information is dynamic, real-time and variable. At this stage, technology such as RFID will play its role to supplement the traceability of the distribution process as well as the supply chain (KRAISINTU AND ZHANG 2011).

A result of the CTPA was that an important factor for the loss of information is the amount of time that businesses are willing to spend for traceability purposes. Hence, it seems reasonable to optimize the efficiency of the traceability system. Another principal reason is that it is difficult to guarantee that every lot is identifiable with its label for a small-sized business. These facts are arguments for an integrated automatized system which features the use of smart good technology.

Besides, as CTP 7, 8 and 9 are points that were detected at several stages of the supply chain it appears logical to move the focus from distributed to central traceability models.

CAULKINS (2011) concludes that without a centralised traceability system it can be a hard to measure how much certified product is sold along the supply chain. Ideally, environmental NGOs and administration raise sensitivity campaigns and industry would adapt the product information to the amount of information demanded by the consumer in order to make an informed choice. This information can only be provided with an external traceability system that covers the whole supply chain. To put this forward, a system is needed that is efficient and flexible in terms of the attributes it traces and it has to be safe and secure to protect confidential data. Only the information that the different operators agree on shall be exchanged or shared. However, the quantity of information must meet the demand of the consumers.

An outstanding example for an integrated centralised traceability system was developed in Denmark and resulted in SIF – The Danish fisheries traceability system. It provides full tracking from vessel to customer, including all information that is required by article 58 of the Control Regulation. Furthermore it also permits an indefinite number of transformation operations such as merging or splitting of lots – the main reason for CTP 7 and 8. As stated from the project site “effort has been made to ensure affordability for small scale operators” – a point that is of special importance to the studied supply chain. Besides, “SIF is prepared to document discard and register compliance to MSC or other eco labels” (SIF 2013). The system is prepared to work with any input data, whether smart good technology, barcode or manual. Additionally, data interfaces are established in order to reduce the workload of operators. Data collection is automated in order to make it the most precise possible. As the database is centralised, every actor of the supply chain and customers can track the data and trace it back to its origin (see Figure 24).

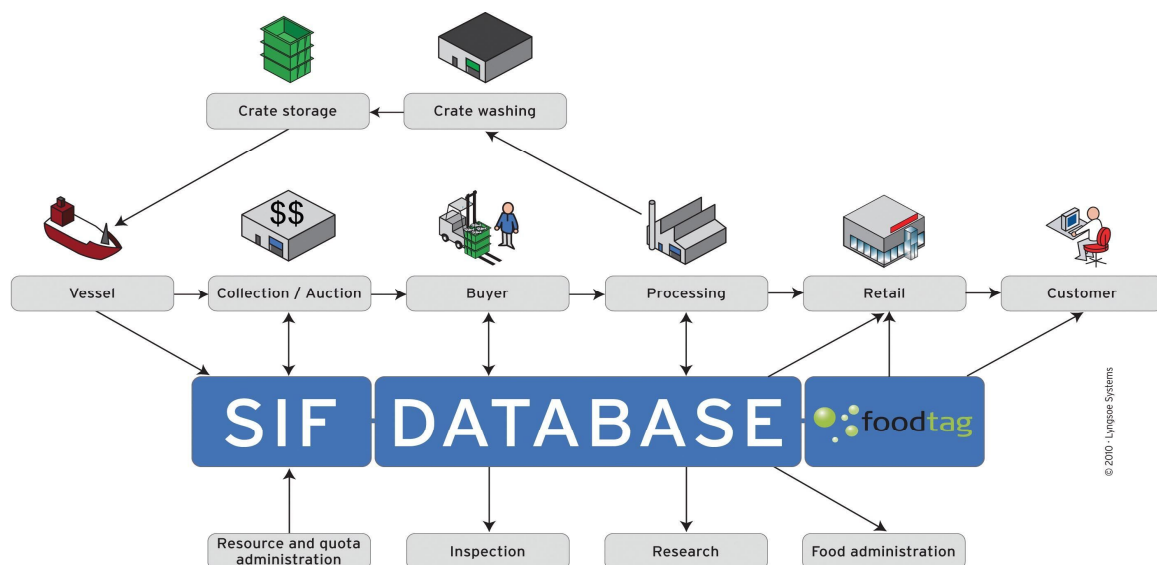


Figure 24: Example for an integrated centralised traceability model: Danish Fisheries Traceability System SIF

Source: © LYNGSOE SYSTEMS 2010

Tracking can increase credibility to the customer by making the supply chain more transparent. In general, to introduce tracking systems easily in a supply chain with a simple structure and centralised responsibility of information management, i.e. a central database. This is more realistic for a supply chain that lies in the hands of one single company (company owns fishing vessel, landing site, processing facility and transport vehicles). One good example for such a supply chain is German company Kutterfisch (visit <http://cuxhaven.kutterfisch.de/rueckverfolgung.html> for more information) which owns a

MSC certified pollock (*Pollachius virens*) fishery, landing site and commercialisation channels. Traceability from haul to plate is guaranteed and used for “story telling”: A tracking code is displayed on every package and can be tracked to the exact coordinates of the haul. These can be compared to a public stock evaluation board provided by the German Ministry of Agriculture (fischbestaende.portal-fischerei.de/faofangebiete/). This leaves consumers the possibility to check whether the fish was sourced sustainably from a scientifically evaluated stock or not. Another example which covers a supply chain with several individual actors is the thisfish network (thisfish.info). A tracking code provides information about the species, the vessel and captain, the fishing method and its environmental impact and the processors.

Expected Improvement

It is expected to save a substantial amount of time in the repacking and re-labelling process, increasing drastically the traceability performance of the supply chain and its transparency from haul through the whole supply chain. Besides, added value will be generated. Authority controls can be directed more directly and tracebacks are exercised far quicker. This is also a great development for auditing.

Tasks to carry out for implementation

As for the other improvements it is crucial to have a common base of aims within the stakeholders. It should be decided, which operator gives which kind of information and which information will be available publically. Another central issue is the question who manages the central database and who has the control. Once clarified which information is to be shared, this should not be problematic, however. In order to implement this centralised traceability system a series of necessities need to be met. First, internal traceability software systems have to be introduced, electronic automatic recording (RFID) at reception and delivery has to be established and standardized identification for traceable units has to be fixed, as well as the desired granularity level.

Karlsen *et al.* (2011) studied the implementation of electronic chain traceability in a (industrial) fresh fish supply chain in Norway. The main conclusion of this study is that early identification of the benefits of implementation of chain traceability is essential for success. If there is no benefit, a company will not be willing to invest in necessary technology. Motivation is thus the most important factor for the successful implementation of electronic chain traceability.

Limitations

The implementation of something that was originally designed for industrial supply chains might be difficult in a supply chain like the one analysed in this study. Techniques as the ones presented here might be limited to a small number of companies analysed here, so it seems hardly possible to reach chain traceability in the nearer future.

Estimated Cost-Benefit-Analysis

The implementation of the here presented techniques and systems are surely “futuristic”. RFID tags still are costly and may not be affordable for most of the operators in this supply chain.

4.7.5 Organisation of Buyer Collective and Group Certification

Covered CTP: 4; Besides, this improvement refers to the fact that 21 out of 22 agents refused to certify because of high costs and because small-scale fish mongers fear to be emarginated in favour of bigger wholesalers

Idea

Several small fish mongers argued that the lack of power in decisions or in the defence of their interests to the Cofradía hinders them from participating. It is proposed to establish a buyer collective with representatives from wholesalers and small fish mongers and restaurants. This shall empower small fish mongers and encourage them to adopt to the traceability standards. Additionally, traceable information requested by customers on the wholesale market in Barcelona may also be requested by local consumers in a future, so traditional fish mongers could adapt themselves to this new reality and expectations.

Besides, as a result of the expert interviews, group certification is proposed. This is a recent idea of the MSC in order to reduce the costs for certification, the most frequently heard criticism to certification. A buyer collective, a single company with several branches or a restaurant association can seek group certification. An external certification manager is installed who organises and manages the certification process. A general rule is that the certifier audits the square root of the number of participants in the group certification, e.g. in a group of nine fish mongers three would be visited and audited. Costs per business including the certification manager are of about 650 € in comparison to 1000 € before (BAMMERT 2013, pers. Com). This could also solve the problem of CTP 4, buyers who are partly users of the quality label.

Expected Improvement

The desired outcomes of this idea are an increased willingness to get certified within the supply chain, empowerment of small-scale actors, and a political representation of the buyers.

Tasks to carry out for implementation

This improvement has to be carried out sensitizing the corresponding actors of the supply chain.

Limitations

No limitations were detected.

Estimated Cost-Benefit-Analysis

There are no additional costs more than those of certification.

4.8 Summary

To end with the fourth chapter, the main findings are resumed shortly in relation to the hypotheses and research questions.

I. There are gaps in fresh fish traceability at different stages of the production of fresh seafood in Palamós

1. How is the supply chain of blue and red shrimp structured and characterised?

This supply chain is a typical supply chain of fresh seafood caught by trawl fishing in the region on Northern Catalonia. It is constituted by the following actors: Trawl fishing vessels, landing and sales organisation (Cofradía), first buyers, transporters, regional, over-regional and international wholesalers, restaurants and fish mongers. 27 vessels landed blue and red shrimp in Palamós in the year 2012. In the database of the Cofradía 127 different entities were identified as first buyers in the auction hall of Palamós. Although there are more, 12 fish mongers were identified to be of major importance in Palamós because they run several branches, or are active both in the auction hall of the Cofradía and at the municipal market. Being seafood gastronomy an important pillar for tourism, 57 restaurants specialized in seafood was found in Palamós. The supply chain tends to be supply-driven as usually all fish landed on one day is sold at the auction. However, due to the seasonality of tourism (high demand in summer and on holidays, low demand in winter), the chain can be also demand-driven in spring and autumn when demand is low and the ability to sell is important. Hence, strategies like certification (MSC, Quality label) which help to increase the ability to sell might be a good option to add value and to reduce the seasonal dependence of the fishery.

2. Which types of enterprises exist in the supply chain and how are their traceability capacities?

Generally, the enterprises vary from small-scale companies with one or two employees to enterprises which are among the most important ones in fish and seafood commerce in Spain. The participating companies act on local, regional, over-regional and international levels. Their traceability capacities vary considerably. Interestingly, internal traceability seems to be stronger at companies with a wider distribution range. Only one of the studied companies was certified to the quality label. This company sells 45% of its products internationally and shows an excellent internal traceability system. Likewise, traceability performance decreased with the commercial level.

3. Which traceability model is employed and how are responsibilities distributed?

In this supply chain, a mixed traceability model is employed. One central database with relevant traceability information is run by the Cofradía. The rest of the supply chain uses paper-based documentation in order to guarantee for up- and downstream traceability. The responsibilities for safeguarding correct traceability practices are therefore distributed along the supply chain.

4. In which stage of the commercialisation process do gaps occur in the information flow and in traceability?

Points where traceability information was not linked to the product history, or where potential obstacles for MSC CoC certification occurred, were found at all stages of the

commercialisation process. The majority was found at the wholesaler stage and at retail level while fewer points were encountered at the fishing vessels, the auction hall and the transport company.

5. *Do systemic errors exist?*

Four gaps that appeared repeatedly were identified as systemic errors. Those include the access to the Quality label certificate to wholesalers who are only partly certified; the problems with the multiplication of commercial labels and the loss of information in merged batches of sub-lots after splitting original lots.

6. *What are the social and political reasons for the deficiencies?*

Several reasons for the traceability deficiencies and refusal of certification of the blue and red shrimp supply chain in Palamós were detected. They are assumed to be caused by the economic interests of the actors in the supply chain, little awareness about traceability and its purpose, high costs of implementation and little control by the authorities. Additionally, CTP which are clearly rooted in organisational and traceability system related problems were identified. This can be seen by the fact that responsibility for traceability is distributed, but the only organisation that seems to be prepared for dealing with the deficiencies is the Cofradía. To date, some requirements of article 58 of the Control Regulation, especially the treatment of split lots and unique identification cannot be met by small-scale businesses. The control of the correct implementation of labelling however is costly in personnel and financing and thus not always with a frequency that would enforce labelling law. Given the current situation, sustainability certification could be a potential way if some criteria concerning the traceability system are met.

II. The failures in traceability have consequences for the credibility of the Quality label and may impede MSC CoC certification

1. *Are the requirements of the MSC Chain of Custody already met? What is still missing?*

Currently, there are seven points that are challenging CoC certification. They are mainly related to the MSC CoC Standard principle 2, 3 and 4. Of special importance is the lack of the ability to identify the product because of a missing link to the traceability documentation, the potential possibility of substitution of certified products and the lacking capacity of carrying out input-output balances. Another threat to certification is the risk of undocumented sales that are estimated to sum up to about 10-25% of total landings. Besides, it seems, that the internal traceability systems of the transport company and restaurants are not sufficient to identify certified products at all stages: Information about vessel name, harbour and catch date might get lost on sub-lot level in a merged batch.

Two more reasons that could be limiting certification are that the fishery has not been certified as sustainable yet and that willingness to get certified was low within the collective of interviewed companies.

2. *What can be done to meet the standard?*

One of the most important solutions is the implementation of a centralized traceability system that allows unique identification of all lots, sub-lots, batches or transport units. Examples from Denmark (SIF) or Canada (ThisFish) show, how a supply chain can be

fully connected in order to ensure external (chain) traceability. Another important element helping to meet the standard could be packing the product and, since, avoiding label misuse or substitution of certified product. On a social level in order to reach an increased willingness to get certified within the supply chain, sensitizing of involved businesses about the benefits of certification should be carried out. With an empowerment of small-scale actors and a political representation of the buyers it might also be easier to build trust for sharing information within the supply chain. Group certification shall be promoted to facilitate affordability for small enterprises.

CTPA resulted in various positions that require potential improvement concerning the traceability performance of the supply chain. After this short summary, the obtained results are discussed and the methods used are critically examined in the next chapter.

5 Discussion

The discussion contains two general parts: Firstly, the used methodology is critically reviewed and validity is checked. Furthermore, experience gained by the use of the methodology is compared to literature in order to explore the limitations of using CTPA in non-industrial supply chains. Secondly, the results will be discussed in the context of literature and their implications for traceability theory, sustainable fisheries management and sustainability certification are highlighted.

5.1 Critical Analysis of the used Methodology

This study focusses on traceability in a fresh seafood supply chain in Catalonia. It is a supply chain that is characterized by a heterogenic structure of small and big agents who act on different geographic and commercial levels. Studies about the traceability performance of small-scale operators in seafood supply chains are scarce. Likewise, there is little research about the adaptation of supply chains to Chain of Custody standards like that of the MSC. Due to the lack of research experience about methodical approaches to non-industrial supply chains and CoC certification, the chosen methodology – CTPA – stems from studies about industrial supply chains of fish products in Norway. CTPA had to be adapted to the realities of the supply chain of blue and red shrimp, where little traceability information is recorded compared to an industrial supply chain. Hence, this study gives new empirical findings about problems and weaknesses that are faced in a non-industrialised supply chain.

The used methods, structured interview, observation and document analysis are qualitative methods. Due to the stated lack of recording of traceability information this approach has been without alternative for this supply chain. A potential improvement of CTPA would be to examine the traceability performance of a supply chain through virtual trace-back tests in the studied supply chain (RANDRUP 2012). However, without a researcher being institutionalized in the field of food control or environmental authorities it seems to be very difficult to get access to the necessary information and insight to documentation.

Being a real life research environment it is important to discuss the validity of the methods and results in a multidimensional way. In the next paragraphs this will be done following the propositions of KARLSEN AND OLSEN (2011).

5.1.1 Internal Validity

First of all, as this study focussed on the case study of blue and red shrimp in a Catalan harbour it is apposite to analyse the intern validity of the results. KARLSEN AND OLSEN (2011) used the categories history, maturation, selection and instrumentation for this analysis.

History is related to the fact that when carrying out a study for a longer time, many changes can occur in the environment of the interviewed partners. Hence, collected data may suffer from the so-called history threat. In fact, some changes occurred during the studied period of time: For instance, the management plan of the fishery finally came into

effect, one fisherman opened his own fish monger shop and on-line sales started in cooperation with the Cofradía. Nonetheless, these changes are not considered to have an impact on the collected data, because these were no changes that directly influenced the interviewees.

Another category that can affect internal validity is maturation: If the interview partners have participated in many similar studies and are saturated or have learnt how to respond to the questions asked. Although this did not constitute a problem in the present study, it cannot be denied that a double discourse has been observed within some interviewees: They refused to admit to sell undocumented fish, but were caught in the act.

Selection refers to the question whether the right sample has been chosen. This is certainly a point of debate in this study. Whereas for fishermen and first and second buyers, statistical sampling was applied, restaurants, fish mongers and transporters had to be selected using recommendations of gatekeepers. Besides, the sample size does not allow obtaining representative results. Yet, this is not the aim of this study. A wide range of different actors was chosen in order to demonstrate that traceability can be implemented differently within the same supply chain. Another issue that has to be taken into account was the access to information. As stated above, a good share of the interviewees were selected using recommendations of gatekeepers. Hence, given the circumstances of the study (little time, researcher as a foreigner), this was the only possibility of being granted access to information.

Instrumentation means a bias in the methods used: “Have the right questions been asked in the right way; have the appropriate parts of the production process been observed; and have the right documents been analysed?” (KARLSEN AND OLSEN 2011, p. 1213). One issue that would deserve an own project is the question how to estimate the amount of undocumented sales. It has to be questioned whether random observation can reveal the real extent of undocumented selling. One difficulty is that sometimes seafood is given to former fishermen for free undocumented. The second difficulty when bigger quantities are affected, they are traded hidden to restaurants or individuals. Furthermore, it is impossible to observe all discharge activity since there are several vessels which arrive at port at the same time. The only feasible approach was thus to combine results from the interviews with daily observations at the harbour. Another potential limitation of the methodology is that it has not proven practical to conduct the field work solely. It would have been valuable to have a second person during the collection of data in order to be sure that no questions or doubts are left out or remain unclear. Apart from this little shortcomings, stakeholder dialogue and the use of triangulation (a combination of several methods where weaknesses are compensated for by the strength of another) are thought to have avoided that the work was carried out incorrectly. To conclude, the studied case is considered to be internally valid.

5.1.2 External Validity

The question whether the results of this case study are able to be generalised is subject to a testing of external validity. As stated earlier before, following the *ceteris-paribus*-strategy, the knowledge about a single case can be extrapolated to other cases when conditions are equal or similar. In Palamós, traceability in the supply chain of blue and red shrimp is in that sense particular that a quality label with Chain of Custody requirements exists. However, this quality label does not seem to have a major influence in traceability

practices in the supply chain as very few operators are certified and comply with the CoC requirements. This makes it generalizable to harbours with a similar functioning of commercialisation. In most of the studied companies *A. antennatus* landed in Palamós share the same commercialisation channels with shrimp from several, mostly Catalan harbours. That means that actors of the supply chain of shrimp landed in Palamós also handle shrimp landed in neighbouring harbours like Port de la Selva, Roses, Blanes, Arenys de Mar, or Tarragona. The traceability practices of the studied businesses are very likely not to change if they are not certified to the quality label. The few businesses that are certified do have a different attitude towards traceability. However, despite those similarities it remains unclear if the results are transferable to those harbours; according to MENTZER AND FLINT (1997) a single case study cannot produce external validity, because the collected data is not sufficient.

KARLSEN AND OLSEN (2011) described the way from mapping the real situation in a specific seafood supply chain to the generalization of this data. As can be seen, after mapping a specific supply chain, a crucial step is to map real situations in other seafood supply chains in order to generalize results and to contribute to theory on traceability (Figure 25).

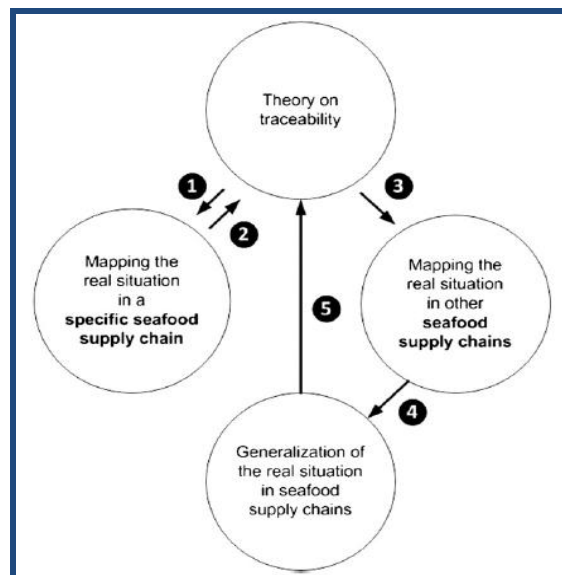


Figure 25: From mapping a specific seafood supply chain to generalisation of the collected data.
Source: KARLSEN and OLSEN (2011)

5.2 Implications for Traceability

First of all, it has to be stated, that it is likely that perfect traceability does not exist in food supply chains, especially in those where small-scale businesses are involved. In this study, several points which prevent traceability from being perfect were found. It was interesting that the majority of CTP were found at wholesalers that acted on a regional level. They mostly had to do with the ability of uniquely identifying every sub-lot and potential fraud. In literature, this tendency is confirmed: The most frequent critical point for traceability in at least 75% of the companies is non-unique traceability unit (TU) identification. Many times, only internal batch number or production date or best-before date

are recorded, so it is impossible to record or trace any information related to one specific TU, for instance where it was at a given time (KARLSEN AND OLSEN 2010).

In a mixed traceability model as it is used in Palamós, responsibilities are distributed along the supply chain and so are risks of fraudulent practices.

Two solutions to the mentioned problems are of major importance in this context: The implementation of a centralised traceability system and the implementation of a packing machine at the Cofradía. The location of installation is important, because this organisation has the biggest incentive to protect its own resource.

NOLAN (2004, p. 3) concludes, that “the characteristics of good traceability systems vary and cannot be defined without reference to the system’s objectives. Different objectives help drive differences in the breadth, depth, and precision of traceability systems.” For the studied supply chain’s current objectives, the mixed traceability system might be the most adequate solution. Nonetheless, if the operators seek a more transparent system which is adapted to requirements of CoC certification, it would need to change.

5.3 Implications for Sustainable Fisheries Management

As cited before, it is important to “know the origin of the fish to make sure it is a fish caught sustainably” (BAMMERT 2013). Cases of consumer deception in fish trade have been widely documented in literature (GARCIA-VAZQUEZ *et al.* 2011; JACQUET AND PAULY 2008; LOGAN *et al.* 2008; MILLER *et al.* 2012). For blue and red shrimp from Palamós, deception is mainly related to origin fraud. This was shown by the example of shrimp sold in Barcelona as “Gamba de Palamós” during a temporal closure of the Palamós shrimper fleet.

Traceability is not only important for certification, but also for fisheries management *per se*. Fishery is an activity that sources from a public resource and which is managed by public authorities and governments. Given the character of a common resource, it is crucial that only those fishermen extract fish who are licensed to do so and who can document that they are. The same is valid for the supply chains: If a company wants to trade fish, it has to document that the fish was not caught illegally, unreported or unregulated. Fisheries policy needs control over inputs and outputs in fisheries. The main body for policy enforcement is the Control Regulation (EC) 1224/2009 where Article 58 is dedicated to traceability. However, the results of the present study show that the current traceability practice does not fully comply with legislation. Especially the treatment of lots that are split and unique identification as specified in the regulation can hardly be met by small-scale businesses. The control of the correct implementation of labelling however is costly in personnel and financing. It should be thus thought of a paradigm change of labelling and traceability legislation.

Of special importance to that is splitting (“Lots may only be merged or split after first sale if it is possible to trace them back to catching or harvesting stage”) and undocumented / unreported fish. As was shown, it was not always possible to trace split sub-lots back to the catching stage in the supply chain of blue and red shrimp. Hence, splitting must not be allowed if the landing harbour cannot be identified on the split lots. Furthermore, undocumented selling is an activity which is contrary to the principles of the Control Regulation and of Common Fisheries Policy.

5.4 Implications for Sustainability Certification

There are certainly numerous points of potential improvement in the studied supply chain and generally in fresh seafood supply chains. Their effects on sustainability certification can be substantial when is dealt with undocumented sales and origin fraud.

Besides, just as Quality label certification, MSC certification of actors of the supply chain is voluntary. By far not all actors want to get certified and many stated that their clients are looking for the cheapest alternative. Hence, there would not be any demand for certified products. It is important to stress that different actors have different traceability systems and some meet the requirements of the MSC CoC Standard better than others. A project jointly organised by public and private institutions could be a key to certification for smaller businesses. For this reason, it is particularly important to build trust and consciousness about the benefits from certification, because high certification costs can hinder small companies from participation in such programmes (RATNASINGAM *et al.* 2008). Group certification seems to be an appropriate tool, but is also limited to bigger fish mongers with several branches, if no collective exists.

The European Union Joint Research Centre (JRC) and the MSC promote the use of genetic tests to assure species identification and origin verification by the use of DNA-based identification techniques and forensic genetics. However, where the spatial resolution of genetic analysis does not allow tracing the seafood to its exact origin, these methods cannot guarantee for correct origin identification. For *A. antennatus*, the use of genetic analysis is not appropriate when wanting to verify origin on North-Western Mediterranean scale. Furthermore, these tests are still expensive.

5.5 Further Research Need

As stated above, methods for analysing the traceability performances of supply chains which do not focus on genetic methods are important to strengthen. Besides, in order to get a more externally valid image of non-industrial supply chains in the context of Chain of Custody certification and the commitment to contribute to sustainable resource use, more case studies have to be conducted. Likewise, the role of small-scale businesses in Chain of Custody certification should be rethought. Hence, what does remain clear is that more research is needed in the field of traceability in non-industrialised fresh seafood supply chains.

6 Conclusions and Recommendations

Various conclusions can be drawn by this study. A crucial condition for the certification of the supply chain is that the fishery itself gets certified. In return, certified shrimp also depend on a supply chain which is able to comply with the requisite to transfer certified shrimp to the market. It became clear that there are several deficiencies in the studied supply chain which need to be improved. There are points which are obstacles to a CoC certification, mainly the impossibility of carrying out input-output balance checks correctly, lacking product identification and potential mislabelling. The supply chain is heterogeneous and some enterprises dispose of better traceability systems than others. The willingness to get certified is low among the majority of operators. This leads to the conclusion that only few businesses would seek certification.

The method Critical Traceability Point Analysis was used in this study. It has been adapted from industrial supply chains and was fitted to the studied supply chain. It is recommended to focus traceability research in non-industrial supply chains to develop tools to facilitate good traceability practices for small businesses.

One recommendation for the MSC is to include middlemen and transport companies in the MSC CoC Standard. Although they only provide shipment service, it is crucial to have certified fish always identifiable – at all stages of the supply chain. These two actors are responsible for the creation of transport units and thus play a fundamental role for the functioning of chain traceability. Additionally, it is recommended to implement a database where all certified businesses have to document their traded in- and outputs which must be publically available. A tracking solution that allows tracing a certified product back to vessel level should be developed in order to gain consumers trust.

Authorities should focus on enhanced traceability controls especially via tracebacks of a specific product. Economic crisis should not be an excuse for controls that are self-fulfilling prophecies.

The fishing sector and all entities involved in undocumented sales shall be aware of the risk that unreported landings cause both for the management of the fishery and for sustainability certification. It is recommended that the Cofradía undertakes measures to avoid unreported catch.

The companies of the supply chain shall follow the example of the business that had the best traceability system installed and improve their internal traceability. More attention is to be paid on correct multiplication of commercial labels when splitting occurs. Split sub-lots must be uniquely identifiable and traceable to their original lot.

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El Máster Internacional en GESTIÓN PESQUERA SOSTENIBLE está organizado conjuntamente por la Universidad de Alicante (UA), el Ministerio de Agricultura, Alimentación y Medio Ambiente (MAGRAMA), a través de la Secretaría General de Pesca (SGP), y el Centro Internacional de Altos Estudios Agronómicos Mediterráneos (CIHEAM), a través del Instituto Agronómico Mediterráneo de Zaragoza (IAMZ).

El Máster se desarrolla a tiempo completo en dos años académicos. Tras completar el primer año (programa basado en clases lectivas, prácticas, trabajos tutorados, seminarios abiertos y visitas técnicas), durante la segunda parte los participantes dedican 10 meses a la iniciación a la investigación o a la actividad profesional realizando un trabajo de investigación original a través de la elaboración de la Tesis Master of Science. El presente manuscrito es el resultado de uno de estos trabajos y ha sido aprobado en lectura pública ante un jurado de calificación.

The International Master in SUSTAINABLE FISHERIES MANAGEMENT is jointly organized by the University of Alicante (UA), the Spanish Ministry of Agriculture, Food and Environment (MAGRAMA), through the General Secretariat of Fisheries (SGP), and the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM), through the Mediterranean Agronomic Institute of Zaragoza (IAMZ),

The Master is developed over two academic years. Upon completion of the first year (a programme based on lectures, practicals, supervised work, seminars and technical visits), during the second part the participants devote a period of 10 months to initiation to research or to professional activities conducting an original research work through the elaboration of the Master Thesis. The present manuscript is the result of one of these works and has been defended before an examination board.