GLOBAL REVENUES FROM WILD SEAFOOD PRODUCTS

by

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Abstract

The present study quantifies the revenues generated by marine seafood in the retail and restaurant sectors. Also, since one third of total marine catch is used to produce fishmeal, revenues generated by this commodity were calculated based on the percentage of meat products that originated from fishmeal inclusion in compound-feed formulas. In total, wild seafood products generated revenues of US $318 billion in the year 2005. To arrive at this estimate I first developed a global database of seafood retail revenues, which is used to analyze fish retail values per tonne at the regional and global level. This database includes 192 maritime and non-maritime countries. The findings are that in 2005, revenues, from wild marine seafood in the retail sector alone reached US $210 billion. Revenue from seafood restaurants were calculated based on estimations of country GDP expenditures in the hotel and restaurant sector. By analyzing the data on 30 countries (US and EU countries) where primary data on restaurants and hotel were reported separately, I estimate that on average, in the US and the EU countries where data is available, 43 percent of revenues from hotels and restaurants are attributable to restaurant sales. Wild seafood restaurant sales represented 17-25% of global restaurant sales generating revenues of US $94 billion. Finally, in order to estimate the revenues from the fishmeal sector, calculations were made based on farmed fish and animal meats, which include fishmeal in their compound feed preparation. Revenues derived from animal and fish meats were calculated based on their FCR (food conversion ratios) and inclusion rates of fishmeal for each species. I estimated that US $14 US billion were generated by the inclusion of fishmeal in meat products.

Table of contents

List of tables

List of figures

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"***If at first, the idea is not absurd, then there is no hope for it" ~Albert Einstein***

Dedication

To the fish,

1. Introduction

1.1 Problem statement

The world's oceans continue to face overfishing pressures despite increasingly widespread understanding of the state of decline of fisheries worldwide (Pew Oceans Commission, 2003). Consumer demand, amongst other factors, is a main driver of fish over-exploitation, of certain species, which have selectively driven species to extinction (Hunter and King, 2008). Estimating the revenues generated by seafood products are as important as estimating the revenue generated by all other activities associated to fisheries (FAO, 2007).

As stated by Pauly and Maclean (2003), it is hard to imagine, as we walk down the aisle of a supermarket that, as individuals, we are an integral part of the food web of marine ecosystems. Thus, the food chain should be thoroughly studied and described. Fish and seafood consumption raises a set of significant questions: where are fish being consumed? In what form and what is the annual revenues generated by seafood products? Yet, this aspect of the commercial fishing industry has received scant attention from scientists (Le Gallic, 2002).

Fisheries provide a vital source of food, employment and trade to the global economy. While the contribution of agriculture to the Gross Domestic Product (GDP) is decreasing globally, that of fisheries is increasing in most countries; nevertheless, the rising interest in marine

products has not been matched by supporting economic information (Venugopa, 2005).

The following work focuses on estimating the revenues generated through consumer expenditures on fish and seafood in retail and restaurant establishments. Also, since one third of capture fisheries is used to produce fishmeal, revenues generated by fishmeal in animal feedstuffs are calculated. As will be discussed later in this thesis, the purpose of this work is to estimate the revenues generated by the sectors that depend on wild fish in the final stages of the value chain (fishmeal, restaurants and retail); as a partial indicator of the contribution of marine fisheries to global economic activities. This estimation will account for the total contribution of consumer expenditure on marine fish and seafood products to the global economy and therefore reveal the economic contribution these sectors to the global economy.

1.2 Research objectives

This research is part of a larger study (the Global Oceans Economics Project; (GOEP; www.feru.org/goep) at the Fisheries Centre, University of British Columbia. The Global Oceans Economic project's objective is to provide valuations of the contributions of ocean fish populations to the global economy. The context of this particular work is to provide an estimate of global revenues generated by seafood and fish at the final point of sale to consumers.

A second goal is to estimate the global consumer expenditures[1] in fish and seafood in the retail and food-service sectors by building a global database, which will be available publicly for future reference.

Finally, I analyze the economic revenues generated by fishmeal inclusion in animal feedstuffs in order to quantify the revenues generated by all fish and seafood marine catch products globally.

1.3 Thesis outline

This thesis is organized into five chapters. Chapter 1 introduces the reader to the main issues in estimating revenues generated by the seafood retail, restaurant and fishmeal sectors and also how information is processed along the value chain.

Chapter 2 estimates global revenues generated by seafood retail. These revenues are estimated through interpolation of data obtained from secondary sources, and the application of a benefit transfer valuation approach (Sumaila *et al.*, 2007; Sumaila *et al.*, 2008; Cisneros-Montemayor *et al., 2009*).

Chapter 3 focuses on revenues generated by seafood restaurants and carries out a comparison of estimates between consumer expenditures in retail and restaurants in seafood. Although data availability is scarce, I

[1] Term extracted from the Bureau of Labor Statistics (BLS) survey which collects information on the buying habits of U.S. consumers and refers to combined data that provides a complete account of expenditures and income by sector.

was able to derive estimates by using current industry statistics from private and public sources, and by interpolating information to fill in the gaps.

Chapter 4 determines revenues generated by the inclusion of fishmeal in animal feedstuffs. Revenues derived from animal products that can be attributed to fishmeal were calculated using their FCR (food conversion ratios) and inclusion rates of fishmeal for each species and the revenues generated by the fishmeal sector.

The last chapter summarizes results and discusses the strengths and weaknesses of this work, as well as the potential approaches that could improve its methodology.

1.4 Background information

1.4.1 Marine capture fisheries' contribution to the economy

Fish and seafood make a crucial contribution to the human food supply. The world's fisheries provide more than 2.6 billion people with at least 20% of their average annual per capita protein intake (FAO, 2010). The share of fish proteins in comparison to other animal protein supplies grew from about 14% in 1961 to a peak of 16% in 2004 (FAO, 2010). Economic development as well as population growth is linked to rising fish consumption across the globe. A World Bank analysis of national fish consumption shows a clear correlation with per capita GDP (York and

Gossard, 2004). As populations and income in developing countries grow, consumer preferences for increased fish demand have altered markets for seafood globally. Urbanization in developing countries has made fish and seafood products more accessible to the consumer (Delgado *et al.*, 2002).

Fisheries contribute significantly through global economic activities. Fisheries economic links along the value chain add significantly to global GDP supporting several industrial and service sectors of the economy until it reaches consumers (Agnarsson and Arnason, 2007; Dyck and Sumaila, 2010).

1.4.2 Global fisheries value chain turnover

Total landings from capture fisheries in 2004 were estimated at 85 million tonnes and some 34.8 million tonnes were used for non-human consumption purposes, mainly fishmeal and fish oil (FAO, 2010). It is also important to recall that the contribution of fisheries to the economy may be very different in developing or developed countries (OECD, 2010). According to the *Sunken Billions* study elaborated by the World Bank on marine fisheries, the seafood industry (including aquaculture) represented a US $400 billion global industry in 2005 (Kelleher and Willmann, 2009). The marine capture component accounts for an estimated US $140 billion, which represents the post-harvest economy (Davidsson, 2007).

Estimates of gross revenues from capture fisheries suggest that the direct

value of output for this sector is US $80–85 billion annually (Sumaila *et al.*, 2007; Willmann *et al.*, 2009; FAO, 2008). However, as a primary or a potential economic base industry, there are a vast number of secondary economic activities that are supported by world fisheries.

The Organization for Economic Co-operation and Development (OECD) reported annual turnover of the global fisheries value chain in excess of US $408 billion (Figure 1) (OECD, 2010a).

The total fisheries economic output estimate stands nearly three times larger than the ex-vessel value at between US $225 and $240 billion per year (Dyck and Sumaila, 2010); this value is lower than the one reported by the OECD, because it does not take into account any products derived from aquaculture.

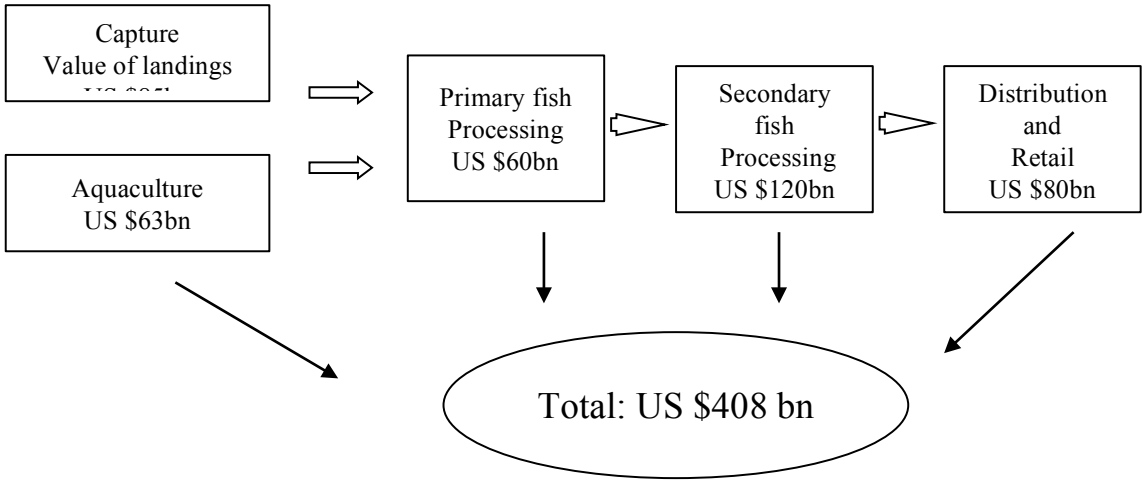

Figure 1. Fisheries value chain turnover breakdown values (OECD, 2010).

1.4.3 Why estimate the revenue generated by global wild fish?

Global marine catches have reached a plateau at around 80 million tonnes (Watson and Pauly, 2001), thus management strategies should be established to secure this resource against extinction while protecting many market and non-market values for the benefit of both current and future generations (Sumaila *et al.*, 2007).

Valuating the economic revenues generated by wild seafood population by country will provide a better understanding of the contribution of this resource to the global economy (Browman and Stergion, 2005).

The retail, restaurant and fishmeal sectors play an important role in the increasing demand for fish and seafood products. Identifying where consumers buy seafood is a crucial starting point in order to generate target efforts to promote any changing consumption patterns to increase sustainability and management recommendations (OECD, 2010a). That is, where consumer buying power is concentrated (fresh markets, fresh fish, frozen or canned) this can be quantified as explained earlier through consumer expenditure.

The economic revenue generated by other protein sources (meats, eggs and dairy products) are well known. The oceans provide a substantial portion of the world's protein needs. Fishing enterprises generate unquantified revenue on a resource, that if present trend continue, could collapse in the next decades together with their supporting ecosystems

(Pauly and Maclean, 2003; Pauly *et al.*, 2005). This phenomenon will drag down, not only the fishes it exploits, but also a substantial portion of the global economy. Therefore, quantifying the economic contribution generated by seafood will reveal the increasing importance of seafood in human diets, not only with respect to the world's food security needs, but also, in its contribution to the world's economy.

Healthy marine ecosystems generate a range of intangible values, which are "difficult to estimate in the absence of robust global datasets and agreed valuation methods" (World Bank, 2009). Information and data on seafood market structures and arrangements within the post-harvest supply chain are scarce. The multitude of outsourcing possibilities has made it very difficult, from a statistical point of view, to establish the location and destination of seafood sources. Intensified demand and technological innovations have made the seafood industry a fast-growing sector. Thus, linkages along the value chain are hard to identify and have created a misleading sense of verticality to the consumer (Kooiman *et al.,* 2005*)*.

At least a billion people rely on the oceans as their key source of protein and many more consume fish as part of their diet, increasingly so as incomes rise in high-growth economies such as China and India (World Ocean Summit, 2012). Quantifying the economic contribution generated by seafood will provide the basis to accomplish an efficient and stable fishing sub-sector; and thus sustain the sector's contribution to the GDP (World Bank, 2010). This will also place a dollar value to the seafood resource for informed policy decisions.

2. Revenue from the retail seafood sector

2.1 Introduction

Although seafood is the most highly traded food internationally it is an often overlooked component of global food security (Smith *et al.*, 2010). Little attention has been given to the steps followed by seafood once it leaves the vessels. Evaluating global seafood retail revenues will accentuate the importance of this sector to the global economy and hopefully encourage further research.

Aside from quantifying the revenues generated from seafood, which is the main focus of this thesis, I will try to answer some questions such as in what form is seafood consumed and what percentage of weight and value accrues to developed and developing countries.

These fundamental questions although basic, have yet not been studied. Therefore, as mentioned before, identifying where consumers buy seafood and what is the final sale value of seafood globally is a crucial starting point (OECD, 2010a).

2.1.1 Definition

The word retail is defined as the direct sales to consumers. Under this premise, in order to quantify the total retail revenues of fish and seafood to the economy, all sales of fish and seafood reported through consumer expenditures are considered.

The fish and seafood retail sector sells directly to consumers and it is therefore the final stage in the food supply chain. Retail revenues include sales in mobile commerce, internet shops, convenience stores, shopping centres, speciality stores, fishmongers, supermarkets and department stores.

Fish use varies according to continent, region and even within countries. Globally, marine seafood is sold mainly as fresh, frozen and canned in retail stores.

A clear definition of marketable fresh, frozen and canned marine fish and seafood products does not exist; nevertheless in global fish markets, fresh fish is considered to be all fish that has not been stiffened at any time by any cooling process (this definition is commonly used for other meats). These products are sold refrigerated and under ice (Euromonitor, Market Research and Sorensen, 2009).

By definition, seafood products that are frozen by a flash or a rapid freezing process, sometimes while still on board the fishing vessels are known as frozen fish. Depending on the type of fish, these are stored under (-18˚C to -28˚C). Freezing technology has allowed fish products to reach consumers living far away from the place of capture and allowing for fishing activities to be carried out a long distance away from home markets and ports. Defrosted fish is indistinguishable to consumers from fresh fish without proper labelling (FAO, 2010).

Frozen fish is usually exported to China from countries around the world (actually only 10% of all fish imported to China stays in the country) where it is processed and later re-exported to Europe, the US, Japan and Korea (Sanchez *et al.,* 2006).
Canned fish are defined as all seafood that is put into tins, as soon as the fish is caught, also that are processed and later canned under high pressure and temperature.

2.1.2 The seafood retail sector

In order to have a comprehensive understanding of the global economic contribution of activities supported by healthy fish populations now and in the future, contributions of related activities such as the contribution of fish retail sector need to be quantified.

Global fisheries statistics are available from only a few sources. The United Nations Food and Agriculture Organization (FAO) developed an interactive database of staple food prices, which, however, does not include fish or seafood values. Efforts to

compile and analyze available economic data have been made at the ex- vessel level (Sumaila *et al.,* 2007); findings are that, the estimated landed value of fish globally, was about US $24 billion in 1950. It increased steadily to about US$90 billion in the early 1970s, reached a peak of US $100 billion at the end of the 1980s, and declined to about US $80 billion in 2000. The top 15 fishing countries cumulatively account for 79% of total real landed value, with Japan leading, even though the value of its landings has been declining (Sumaila *et al.*, 2007).

Globally, retail values of fish and seafood are not well documented. Fish and seafood retail data are usually analyzed at the country level by private market research and rarely by governmental institutions. Data is scarce and widely scattered, making it very difficult for researchers to retrieve and analyze.

The fish and seafood retail sector is known to contribute to the total revenue of the food industry. It also plays an important role in the socio-economic behaviour of food retail markets (OECD, 2008). Knowing the socio-economic contribution of fish and seafood to the global economy, retail prices are essential economic information for assessing the economics of global fisheries and attaining sustainable management (Sainsbury and Sumaila 2001, Le Gallic 2002, Christensen *et al.,* 2009). However, this data are neither documented nor available for public use.

It has long been recognized that fish is a valuable source of animal protein. In 2005, more than 110 million tonnes (i.e., 77% of the world fish production) were used for direct human consumption. The remaining 33 million tonnes were destined for non-food products; in particular, fishmeal and fish oil (FAO, 2009). From the 77% used for human consumption, 46% came from marine fish and seafood products, 28% from aquaculture and 3% from fresh water fish (FAOSTAT, 2008).

In this paper, I describe the development of the first seafood retail database. Using this information, this study analyzes fish retail values at regional and global scales, and attempts to calculate the total revenue generated by the global seafood retail sector.

The seafood supply chain has become a complicated process with many intermediate points, at which information flows can break down or be deliberately concealed, the main problem with finding data along the seafood value chain is that all data focuses on market value at a general level rather than at the level of fisheries or species. Industry practices may complicate traceability: fish can be caught on different days and in varying locations yet be placed together in storage tanks, processing plants and distribution systems. Traceability after wholesale of fish species and fisheries is not possible for consumers or researchers (Iles, 2007).

2.2 Methods

2.2.1 Creating a database

First, I gather global data on retail sales where available per country. Second, I extracted fish consumption derived from aquaculture to segregate consumption of marine fish and seafood. Third, I filled in the gaps by interpolating available information.

I targeted data recollection on all 192 UN member countries from which 165 are maritime, and 27 are non-maritime countries. Non-maritime (or 'land-locked) countries tend to be excluded in most valuation of marine fisheries calculations because they lack information on, for example, ex-vessel values. However, these countries were included here, to quantify the magnitude of consumer expenditure in seafood products. Detailed data on seafood and fish retail values were collected from 51 (46 maritime and 5 non-maritime) countries for the period from 1990 to 2008 (Prior to 1990 data on fish sales and expenditure were not reported publicly. Indeed, this information was not compiled in any formal way; it was the rise of supermarket stores that created the need to report this kind of information).

For the 51 countries detailed data was provided from their respective statistical governmental agency (Appendix B, Table 7). Some countries report industry revenue at the category level (segregating retail sales of fish and poultry) and others report this retail information under the food expenditure level as a whole (including all meat expenditures for that year).

In order to provide accurate estimations, all seafood retail values reported by the private industry were compared as a reference to government reports and public information (if available) to consumer expenditure values on seafood and fish for each particular country. The comparisons were used to monitor data consistency. Total expenditures in countries can be divided into business (production of goods and services), governmental expenditures and consumer expenditures. Consumer expenditure includes all expenses incurred by consumers (expenditures in food and beverages, clothing, housing etc.). Some countries report consumer expenditures in detail, even specifying expenditures in animal and other meats. Values reported by governmental statistical agencies are used as a basis for estimating expenditures of given sectors in the economy, in this case the seafood sector (Wrenn *et al.*, 2007).

In order to capture as much data as possible, values of seafood expenditures were gathered for country fish retail sector from independent private and public sources such as Euromonitor www.euromonitor.com , Mintel www.mintel.com , Thomson Financial services www.thomsonreuters.com , The World Bank www.worldbank.org, the Organization for Economic Cooperation and Development www.oecd.org , the International Monetary Fund www.imf.org , the Food and Agriculture Organization of the United Nations www.fao.org and the scientific literature, both peer-reviewed and not. Public and private resources rarely report disaggregated data for the simple reason of protecting any private information.

Disaggregated retail seafood and fish values were reported as chilled, frozen and canned seafood. Fresh fish and seafood were reported separately due to large price

variability and includes retail sales from local markets and in situ sales by fishers, making it very difficult to desegregate the use and the value of all types of fresh fish. Wherever possible, attempts were made to distinguish between retail sales derived from marine fisheries and those derived from aquaculture and freshwater fisheries. However, under current reporting systems for fish and seafood retail sales (e.g., Harmonized System Codes); distinctions between products from wild and farmed origins cannot be made. Through secondary literature and information provided by FAO and other national and international agencies (e.g., OFIMER, Eurostat, OECD), which report the export destination of farmed fish and seafood products, the likely origin of products for human consumption can be determined. Thus, an algorithm that determines the likelihood of farmed fish and seafood products using relative proportions of aquaculture export destinations is used (Swartz *et al.*, 2010) (Appendix A).

In order to allow comparisons amongst countries and regions, I converted the data collected, which were expressed as nominal value, into 2005 real values. I use consumer the price index (CPI) to adjust to real values and the exchange rate provided by the World Bank (2008) to convert from countries' local currencies to US dollars (US $).

2.2.2 Estimating fresh fish values

The difference between chilled and fresh fish only affects shelf life and could potentially affect fish quality; nevertheless, it is not reflected in fish and seafood retail prices. In fact, most fish and seafood go through some form of chilling process during retail distribution (FAO, 2007b).

In order to estimate the possible value of fresh seafood for each country, the average consumer expenditure value per tonne of chilled seafood and fish for each country found in the literature were used to calculate past and present values by multiplying by the respective 2005 CPI.

Developing and developed countries were classified according to the United Nations HDI (Human Development Index) score, which is a statistical measure that gauges a country's level of human development. The HDI index scores countries on three components: health, education and living standards. While there is a strong correlation between having a high HDI score and a prosperous economy, the UN points out that the HDI accounts for more than income or productivity. Unlike GDP per capita, the HDI takes into account how income is turned into education and health opportunities and therefore into higher levels of human development.

The HDI ranges from 0 to 1, and I assume in this study as in Khan *et al. (*2006) that countries with scores ranging from 0 to 0.79 are developing, while those with scores of 0.79 and above are developed countries.

To allow comparative analysis of retail consumer expenditures from regions and countries, I standardized consumer expenditure data to annual average fish price per tonne (US$/tonne).

2.2.3 Filling in the gaps

Complete sets of data were not available for all countries. In order to fill in these data gaps benefit transfer for filling in the gaps were used.

2.2.3.1 Benefit transfer for filling data gaps.

In order to estimate the retail value of fish and seafood for countries where data are not available, I first calculated the apparent consumption, which is determined by national catch, plus total imports minus total exports of aquatic foods. This information is extracted from the *Sea Around Us* project database (Swartz *et al.,* 2010) and FAO regional information. Consumption quantity is then multiplied by the average value of fish and seafood gathered from neighbouring countries, sub-regions or regions (in that order), where data were available. Countries were then classified according to their FAO sub-region (UN 2008) and data gaps filled through the approach of benefit transfer, using regional averages when no sub-regional estimate was available (Sumaila *et al.*, 2007; Sumaila *et al.*, 2008; Cisneros-Montemayor *et al., 2009*).

2.3 Results

2.3.1 General description of available seafood data

The numbers of observations, with their respective detailed reference, collected for each country in the seafood retail database, are summarized in Appendix B, Table B1.

Raw retail data for 51 countries out of the 192 UN member countries covering the period from 1990 to 2007 was gathered. The 51 countries represent 76% of the global retail sales in volume in 2005 (FAOSTAT, 2009). Out of the 51 countries with raw data, 31 were categorized as developed countries and 20 as developing using the criteria described earlier in this chapter.

2.3.2 Seafood retail analysis using raw and interpolated data

2.3.2.1 Developed vs. developing countries consumer expenditures on fish and seafood.

I estimate that total marine fish and seafood retail sales in the year 2005 reached an estimated US $210 billion US dollars (60.5 million tonnes) (Table 1). To place this number in perspective, world retail expenditure on meats and fruits in the year 2005 amounted US $740 billion and US $276 billion, respectively (Euromonitor International, 2005).

Table 1. Estimated marine seafood consumption and fish expenditures per region (a more detailed table of country values can be found in Appendix B Table B1 for 2005.

Region	Total seafood consumption in million tonnes	Expenditure on marine seafood in billion US$
Asia	36.0	97
Europe	8.0	47
North America	2.0	34
Africa	4.0	11
South America	3.0	10
Austral	0.5	1
Rest of the world	8.0	8
Total	60.5	210

Non-maritime countries represent 1% (US $4 billion) of the total global seafood consumer spending in the year 2005 (Appendix B, Table 7). Although historically these countries tend to consume inland water fish in their diets, maritime fish and seafood consumption has recently increased due to imports and the introduction of supermarket retailing (FAO, 2008).

Globalization of retailing throughout the past decade is having a profound transformation on food production and demand. Fish retail markets have experienced exponential growth in developing countries. The seafood retail value in

developing countries grew from US $11 billion in 1990 to US $ 88 billion in 2005 (Figure 2). This overall increase obscures the fact that the increased supply is restricted to certain countries and regions, and is not occurring in poorer African, Asian and South American countries. For Instance, China and India alone spent US $38 billion dollars on marine fish and seafood retail in the year 2005.

Developed countries, on the other hand, have experienced an average growth of 5% a year since the 1990s (Figure 2).

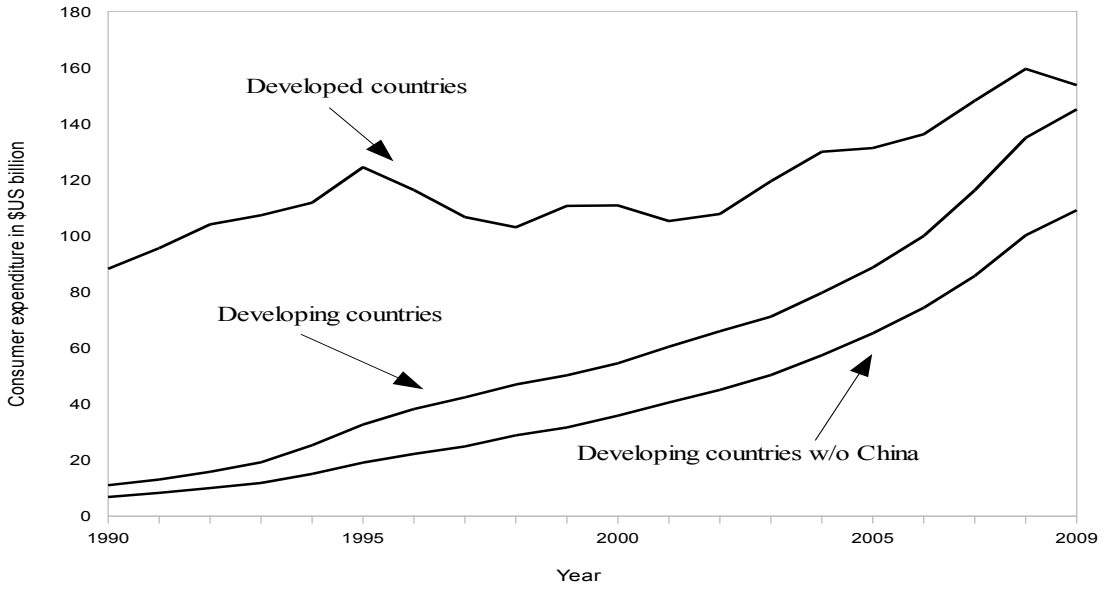

Figure 2. Consumer retail expenditure on fish and seafood for developed and developing countries.

Consumer expenditure, was highest China was the country with the highest consumption, of 19 million tonnes, representing US $32 billion a year. Japan was the second highest spending US $30 billion in the year 2005 in seafood products.

Data gathered from the US showed that retail seafood sales, represented one third of the total seafood value for that country. Food services accounted for two thirds of sales in value. Yearly retail sales growth is estimated at 8%. Since 1996, retail sales of seafood increased by 56% (including aquaculture sales). The US total retail marine seafood sales were estimated to be US $29 billion for the year 2005.

Among Western European states consumption, in seafood in total reached 5.6 million tonnes worth US $34 billion in the year 2005. Fish consumption levels in Central-Eastern European countries are much lower than in western ones (2.8 million tonnes worth US $12 billion). The Baltic States (Estonia, Latvia, Poland and Lithuania) are an exception because their share of coastal population is relatively high; also, seafood is central to their traditional diets (Figure 3).

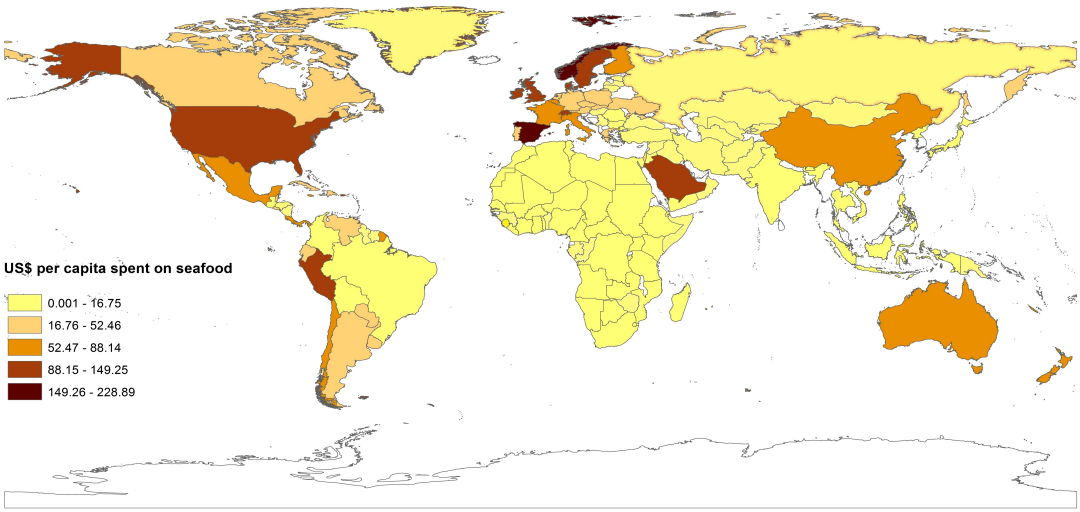

Figure 3. Per capita consumer expenditure on seafood products in US $ in 2005.

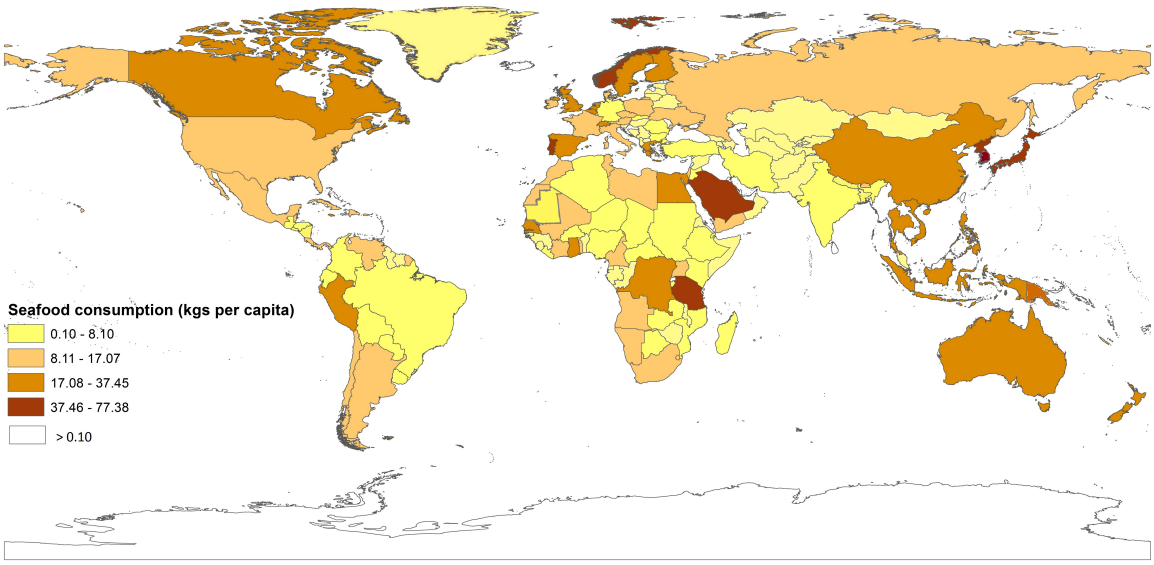

Figure 4. Per capita seafood consumption from retail sales.

In the year 2005, Russia consumed 1.8 million tonnes representing $7.9 billion US dollars.

In the Middle East region, Egypt is the country with the highest fish consumption and expenditure on seafood with 1.2 million tonnes representing $5.9 billion US dollars. Also, emerging economies in Latin America like Brazil, Chile and Argentina together spent $4 billion US dollars in seafood in 2005, representing 40% of Latin Americas' total expenditure on marine fish and seafood.

2.3.2.2 Fish and seafood segmentation

Fish and seafood can be sold as fresh, frozen or canned. Most fish, as shown in the table (Table 2) below, is sold as fresh in retail markets. Owing to the high perishability of fishery products, more than 90% of the quantity of international trade of fish and fishery products is conducted in processed form, albeit to varying degrees. On average, 80% of the marine fish sold in retail markets around the world are sold in fresh form (most of these fish undergo some kind of freezing or chilling but are still considered fresh). Live and fresh fish are valuable but difficult to trade and transport and they are often subject to stringent health regulations and quality standards. Nonetheless, trade in fresh fish has increased in recent years as a result of technological developments, improved logistics and increased demand.

Table 2. Seafood segmentation in retail stores in different regions for the year 2005 in thousand tonnes.

Region	Fresh Seafood		Frozen Seafood		Canned Seafood		Dried/salted		Total
	Tonnes	% of total*	Tonnes	% of total*	Tonnes	% of total*	Tonnes	% of total*	
Europe	6558	58	569	15	995	26	-	-	8124
Africa	3967	83	49	1	783	16	-	-	4799
Oceania	328	70	113	24	30	6	-	-	470
S. America	3383	91	15	0	340	9	-	-	3738
N. America	2062	90	71	3	166	7	-	-	2299
Asia w/o China	19047	79	44	9	302	11	-	-	19621
China	18496	96	39	0	197	1	590	3	19322

*Percentage of total seafood consumption per region.

2.4 Discussion

In this Chapter, I described the procedures for developing a global marine fish retail value database. The current version of the database will be useful in helping researchers, fisheries managers and interested parties to assess retail contributions of fish to the economy, these data will be publicly available and easy to access.

Since the expansion of supermarkets in the 1990s, retail markets have exerted major influence on the demand for fish products all over the world. The independent retail fish shops are struggling to survive, especially, in developed countries. Supermarkets offer the convenience of one stop shopping and have influenced easy and cheap access to fish and seafood products all over the world (OECD, 2008), with implications for fish sustainability (Pauly *et al.*, 2003).

The expansion of supermarkets has had a profound change in developed countries. Supermarkets account for 46% of total seafood sales in volume retail sales in the European Union (Ofimer, 2005) and 32% in the United States (NMFS, 2008). In developing countries such as China and India seafood supermarket sales have reached 22% of the total volume (Sanchez *et al.*, 2006).

The most significant factors that drove increasing fish consumption in developing countries, particularly in Asia, are urbanization, income and population growth (Dey *et al.*, 2004). But other factors such as the expansion of supermarkets, with an improved freezing chain transportation, restaurants and healthy food choices (high protein and low fat) have also contributed to the exponential growth in retail demand for fish and seafood products. This change is notorious since the year 2000

in developing countries (Figure 2).

In the results section I described in which form consumers are buying seafood around the world. Consumers prefer by far fresh fish because it is considered a high quality product. Consumption trends have increased slightly towards frozen fish since the 1990s, especially, in developing countries in the past decade, but no major change in segment consumption has occurred during this period. In the past decade, consumers in developed countries have lost interest in frozen fish commodities due to their negative visual image when compared to fresh fish (FAO, 2007).

I have also estimated the contribution of marine fish and seafood to the economy and how fish and seafood are marketed globally. Consumers' perception of fish has changed through the years. Traditionally, fish and seafood retailing has been operationally expensive; it is labour intensive, requires large display space and needs a quick stock turnover. Nevertheless, supermarkets have partially cut these costs, offering cheaper fish and seafood choices for their consumers; especially fresh fish, that is the form which most consumers prefer when buying marine fish and seafood.

Supermarkets have shifted seafood consumptions trends worldwide; not only by increasing supply, but also by generating easy access to seafood, to a portion of the population who regularly did not include seafood in their diets. Demand for seafood in developing countries is expected to grow (Market Research, 2005). There is a strong interest in promoting seafood in these areas. I found a considerable amount of private market research reports focusing on the ever expanding demand for seafood in developing countries such as Brazil and India. Therefore, special attention

should be given to these countries when attempting sustainable seafood consumption campaigns and fisheries management strategies.

This research has estimated that total fish and seafood retail sales in the year 2005 reached 60.5 million tonnes worth an estimated US $210 billion. The world average price per tonne of marine fish in the retail market reached $3800 US/t in 2005.

3. Global seafood restaurants revenue

3.1 Introduction

Seafood has been recognized for its high protein and low fat content. Also, government recommendations of eating two portions of fish per week have increased fish consumption in households and restaurants, despite inconclusive scientific evidence of any significant advantages of increased fish consumption over general health benefits (Veberke *et al.*, 2004; Jenkins *et al.,* 2009).

Seafood is amongst the fastest growing segments in the food market (European Commission, 2007). Key to the success of seafood growth is the increasing buying power of middle and upper classes in developing countries.

Fish and seafood products are also among the most challenging food products to trace along the food value chain (Maegera and Beaton, 2009). Traceability is a major issue when trying to determine seafood quantity and value in restaurants. Traceability is lost at the ex-vessel level because there is no consistent verifiable information system that follows the path of seafood to the final consumer. An average of seven steps have been identified in the distribution process, from when a fish is caught in the ocean until it reaches a consumer's plate (Lovejoy, 2003). In this long process, information on the source and even the name of the product is often lost once it arrives in supermarkets or on restaurant menus (Jacquet and Pauly, 2007).

Fish traceability is still a developing industry. Policy-makers and market players demand more comprehensive information about the path followed by seafood products (Maegera and Beaton, 2009; Hanson *et al.*, 2011). Food safety and access to international markets have been the main drivers to the increase in traceability measures recently, despite efforts by NGOs such as the Marine Stewardship Council (MSC), Seachoice and others, data is still scarce. Although, scarce and segregated some seafood data from intermediaries to restaurants can be found on Western Europe, Australia, New Zealand, and the US and Canada due to fisheries certifications by the MSC; in total 82% of all certifications are located in these regions. Basically, if there is traceability there is information (Sexsmith and Potts, 2009). The lack of information and data availability restrictions have impeded further economic analysis for this industry and the revenue generated by the seafood restaurants globally are unknown.

The global restaurant sector includes restaurants, fast food outlets, catering companies and drinking places. The full-service and cafe sector is the most lucrative, generating over 37% of global restaurants revenue (Datamonitor, 2009).

Restaurants play a crucial role in seafood consumption. Seafood is a popular meal in restaurant menus. As seafood spoils faster than other products, people would rather consume it fresh and thus people consider fish and seafood as a high value product when compared to other meats (Becker, 1991). Seafood restaurants are considered premium markets and only a few chains commercialize seafood as fast food (Datamonitor and Market Research, 2010).

Restaurants versus retail seafood sales are strong competitors in consumer preference choice when selecting seafood. Global seafood market's end products are sold either in supermarkets or restaurants, depending on household wealth, demographics and education (Packaged Facts, 2009). Seafood restaurant consumption patterns cannot be extrapolated between countries, due to cultural and socio-economic variations; thus making the process of revenue estimation more difficult and location-specific. Since restaurants are exempt from reporting nutritional values, and country of origin labelling requirements, it is even harder to estimate what percent of the seafood being used comes from aquaculture (Pew Ocean Commission, 2007).

Actual figures are difficult to estimate, because many seafood restaurants do not release sales information and only large seafood chains report their revenue publicly (Packaged Facts, 2009). The lack of traceability from exporters and even domestic suppliers represents one of the major obstacles in calculating the aggregated value of seafood in restaurant sales to the final consumer.

The global restaurant sector had revenues of US $1370 billion in 2005 (Datamonitor, 2011), the portion that accrues to seafood restaurants is unknown. In this chapter, I attempt to calculate revenues generated solely by seafood restaurants globally and not by restaurants that might have seafood dishes in their menus. I do this by gathering secondary and primary data, from public and private sources. I used this data to estimate restaurant revenues as a whole, and then identified the portion of restaurants that are dedicated exclusively to seafood dish preparations. In this way, I make seafood restaurants tractable to provide an estimate of their revenues.

3.2 Method

3.2.1 Data collection

Countries measure the economy by first categorizing the different sectors involved in economic activities. Every country defines food-services in a number of ways. For taxation and revenue reporting purposes, each category has a different code by which it is identified. For example, the US, Canada and Mexico use the North American Industry Classification System (NAICS) and Europe uses Nomenclature Générale des Activités Economiques dans les Communautés Européennes (NACE).

Most countries classify restaurants together with accommodation (Casinos and Hotels) and report these values publicly as a whole. NAICS and NACE codes have subcategories, the most specific subcategory found reporting restaurant data and revenue are NAICS codes (2007)-7221-Full-service restaurants (as stated by the Bureau of Labor Statistics http://www.bls.gov/bls/naics.htm and NACE code (2009)-5610-Restaurants. Since the majority of food-services sales are in restaurants, rather than institutional food services (Market Research, 2009), I focused on these subcategories to determine what percentage of the total corresponds to seafood restaurants globally.

The US Bureau of Labour statistics http://www.bls.gov/bls/naics.htm, Eurostat

http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database and Datamonitor http://www.datamonitor.com/Default.aspx, provide information on restaurant revenues reporting their 'annual turnover' or total revenues and also a brief description of the restaurant in the US and the EU on restaurants which annual revenue exceeds US $1 million.

Data on full-service restaurants turnover were found for 30 countries and data on country GDP from hotel and restaurant were found for 79 countries. GDP information on hotels and restaurants were gathered from Datamonitor (2010).

According to Datamonitor (2010), the United States and the European Union represent 40 and 27 percent respectively, of the total global restaurant sector value in the year 2005. The analysis of these two regions gives us a spatially restricted, but rather large portion of the revenue generated by seafood restaurants globally. Information on full service restaurants were gathered from public primary data sources (e.g., US Census Bureau and the EU Statistics Unit) and secondary private data sources such as Datamonitor, Packaged Facts, Market research, Mint Global Business Data and I also collected data from magazine articles.

3.2.2 Estimating seafood restaurant operation turnover

Restaurant revenues are invoiced to statistical agencies during the reference period and this corresponds to market sales of goods or services supplied to third parties; it includes all duties and taxes on the goods or services provided to third parties (EU Structural Business Statistics, 2009).

Seafood restaurant operation revenue is hard to estimate since full service restaurant revenues are reported as a whole and reports do not contain data by type of food sold. Through primary and secondary data (Market Research Reports and Restaurant Analysis Sector Reports), revenues were calculated by selecting establishments under NACE-5610 and NAICS-7221 that contain the word seafood and sushi in their names. This way, I can distinguish restaurant revenues that are attributable solely to seafood sales in their menus.

For example, in the US, the Bureau of Labor Statistics of the US reports consumer expenditures through the Consumer Expenditure Survey. For the year 2005 restaurants found under the count of existing (NACE-5610) full-service restaurants amounted to 247,282 establishments. When filtering results, a total of 25,234 establishments contained the word 'seafood' or 'sushi'. Furthermore, all restaurants that generated over 1 million dollars a year of total sales were checked to see if they based their sales on seafood (i.e., Red Lobster, Long John Silver's etc.). I chose to analyze restaurants that generate over one million dollars and up because market research reports and databases provide a brief description of restaurant sales for this category and not for restaurants which sales are under 1 million dollars.

By analyzing full service seafood restaurants data in the US and the EU, I was able to narrow my scope in order to separate restaurants that provide seafood sales to consumers; this provides information on yearly revenue. The purpose of using this approach is to estimate the average revenue of seafood restaurants and,

therefore, extrapolate this information to estimate numbers for other countries for which there are no reported data.

3.2.3 Filling the gaps

Extrapolations were made in order to segregate global seafood restaurant revenue from all other restaurant revenue. Since most countries report restaurant and hotel revenue together, I analyzed the data for 30 countries (US and EU countries) which separate restaurants and hotels when reporting their GDP. This information allows me to make a generalized assumption on the average distribution ratio of hotels to restaurants revenue. Thus, the analysis revealed that restaurants generate 43% of revenues earned by hotels. Subsequently, I was able to use this number to separate restaurants from hotels when GDP values data are reported as a whole in other countries.

Information on Seafood Restaurant Sales estimates were only reported for the US, which accounts for 40% of world restaurant revenue (Datamonitor, 2011). With this estimate and the average restaurant turnover averages explained earlier I was able to estimate that seafood restaurants account for 17-25% of total restaurant revenue.

Through secondary literature and information provided by the FAO (which report the export destinations of farmed fish and seafood products for human consumption) an algorithm was constructed to segregate farmed seafood from

wild marine seafood (Appendix A). The algorithm determines the likelihood of farmed fish and seafood products in the aggregated data, using relative proportions of aquaculture export destinations (Swartz *et.al.,* 2010); this is used in order to determine the percent of the value that accrues to farmed fish and seafood in restaurant sales.

3.3 Results

3.3.1 Global seafood restaurant revenue

Primary data on restaurant revenues were available for 30 countries (Appendix B Table 8). In total 250,000 restaurants for the US and 950,000 for the EU were analyzed to estimate total percentage of seafood restaurants. By filtering all restaurants which names contained the word 'seafood' or 'sushi' a total of 17,000 for the US and 240,000 for the EU fell on this category. Also, all restaurants which revenues were higher than 1 million dollars were analyzed by filtering their description section by the words 'seafood' or 'fish'. From this a total of 25,000 restaurants in the US and 10,000 restaurants in the EU fell under this category.

This procedure was used in all countries where restaurant revenue primary data was available, in order to estimate the average percentage of seafood restaurants in several countries. In total in the US a total estimated 42,000 restaurants out of a total 250,000 restaurants were considered to be seafood restaurants. In the EU 250,000 restaurants were considered to be seafood restaurants out of a total

950,000 registered restaurants. By this ratios found I was able to determine that seafood restaurants accounted for 17-25% of total restaurant revenues.

Data on full-service restaurants turnover were found for 30 countries and data on country revenue generated from hotel and restaurant were found for 79 countries; covering approximately 90 percent of global restaurant turnover.

Primary data on restaurant revenues were available for 30 countries (Appendix B Table 8). These data were gathered from accounted for 250,000 restaurants in total mentioned before; I estimated that on average 43 percent of GDP revenues from Hotels and Restaurants are attributable to restaurant sales (Appendix B Table 8).

Information on seafood restaurant sales total value estimates were only reported for the US, which accounts for 40% of world restaurants revenues.

With this estimate and the average restaurant revenues averages explained earlier, I was able to estimate that seafood restaurants account for 17-25% of total restaurant revenue. Under these assumptions, I estimate that globally, seafood restaurants generated US $151 billion in 2005. From this total approximately, US $94.5 billion are from marine fish catch.

Table 3. Seafood restaurant and retail revenue from marine catch by region in 2005 in billion US.

Region	Seafood restaurant expenditure (US $ bn)*	Seafood retail expenditure (US $ bn)**
Asia	24	91
Oceania	2	1
Europe	28	46
South America	4	10
North America	37	36
Africa	1	18
World Total	94	202

* Note that seafood restaurant expenditures were extracted from countries data on GDP

**Note that seafood retail expenditures were estimated in this study

Western Europe and North America spend as much in restaurants as they do at home in seafood (Table 3). Other countries, mainly developing ones, make most of their seafood expenditures in retail stores such as supermarkets, and eat mostly at home. This gap between restaurant and seafood retail sales is expected to narrow as the middle class gets richer in developing countries.

Table 4. Top ten countries with highest seafood restaurant expenditures.

Country	Consumer expenditure in seafood restaurants (US $ bn)*	Consumer expenditure in hotels and restaurants (US $ bn)
USA	50	371
Japan	25	234
China	11	110
Spain	8	75
France	8	45
Italy	6	59
United Kingdom	6	60
Germany	4	41
Canada	2	25
Australia	2	21

*Values include aquaculture.

I estimated that expenditures in seafood restaurants were highest in the US, Japan and China (Table 4). These countries also have the highest retail seafood expenditures, representing 54% of total marine catch seafood restaurant consumption. As estimated in Chapter 1, Japan, Spain and the US also have the highest seafood retail expenditures (excluding China) and the highest reported

rates of seafood consumption per capita, with 66, 43 and 21 kg per capita, respectively, according to FAO Statistics (FAOSTAT, 2011).

3.3.2 Seafood restaurant sector in the US

I analyze the seafood restaurant sector in the US due to the large amount of publicly available data and also because this country represents 40 percent of global restaurant sales. NAICS codes and information were extracted from Datamonitor, the information is organized by code numbers and subsequently by "restaurant turnover" as a rounded figure, for the year 2005, some also provide specific information on their main product sold and total visits per year.

In 2005, from a total of 256,000 full-service restaurant establishments (US Census Bureau, 2007), I estimated that approximately 25,000 were seafood only establishments and generated US $50 billion in seafood sales that year this amount was also reported by Market Research (2008).

Seafood chains like Red Lobster and Landry's Restaurants have reached US $2.5 billion and US $1bn respectively in sales in 2005. Per trip consumers spend as much as US $30 for seafood per meal in full-service seafood restaurants in the US (Revenues/visits per year).

The seafood segment in fast food chains consists of two major seafood chains, i.e., Long John Silver's and Captain D's. In the year 2005, these fast food chains together generated US $1.2 billion in sales and had an average US $5.50 (cost of average meal in 2005) per visit expenditure with nearly 4 million visits per week. These chains aim for “health-conscious consumers” and have become increasingly popular.

3.4 Discussion

Restaurants are responding to trends with nutritious options and a variety in portion sizes and protein content. People in developed countries eat out 5.8 times per week (snack, lunch or dinner) (Market Research, 2008). The global restaurants sector had a value of US $1329 billion in 2005 (Datamonitor, 2009). According to this study, restaurants specialized in seafood accounted for 17-25% of total restaurant revenue generating US $151 billion in 2005, from this 60 percent (i.e., US $94 billion), is attributable to marine catches.

The US and the EU account for 70% of total seafood restaurant revenue. The augmentative potential of seafood restaurants in developing countries is imminent and therefore seafood restaurant sales are expected to increase with increasing incomes.

Since on average 17% of full-service restaurants specialize in seafood, there is an urgent need for seafood traceability. Following perishable food products along the value chain is fairly easy for most meats and vegetables due to the importance of food-borne diseases; nevertheless this is not the case for seafood. The seafood value chain is presently untraceable and information systems following seafood wholesaler's distribution patterns are unavailable.

This study does not include restaurants which have seafood dish option on their menus; therefore, estimates are a conservative attempt to calculate total revenues generated by seafood restaurants. Nevertheless, it is a worthwhile first attempt to quantify global consumer seafood restaurant expenditures.

Restaurant revenues are reported under broader categories, which include gains generated by hotels. In this case, only the US and the EU report restaurant revenues separately; thus, for the rest of the world (30% of global restaurant revenue) estimations were made based on the data gathered from these regions. For countries where no data were found, estimations were made to calculate the value generated by seafood restaurants and also the revenues generated by restaurants as a whole, estimating the percentage that accrues to hotels and restaurants also extrapolating information from the EU and the US.

Efforts to calculate restaurant seafood revenues were limited due to time constrictions of this thesis. Data availability is very limited and therefore calculations are conservative and further work should be conducted.

3.5 Conclusion

It is important to note that final revenue of seafood restaurants stated in this work is an underestimation, since the total should include restaurants seafood revenue in non-hundred percent seafood restaurants that serve seafood as a one dish option and fast food serving fish and seafood.

By interviewing several restaurant managers in Vancouver, I noted that restaurants purchase their seafood from different sources, including wholesalers, retailers and the fisherman themselves. As I followed the seafood value chain, information is lost at the level of ex-vessel value and therefore estimating the quantity used by each restaurant even in a city like Vancouver, British Columbia, is not viable due to this works' time constrain. By following a 'generalized to specialized' approach (gathering data from countries GDP, allocating consumer expenditure in restaurants and then seafood restaurants), I was able to calculate a conservative estimate of seafood restaurant expenditures, albeit with some limitations.

Given the reported limitations, I estimate that seafood restaurants generate US $151 billion in revenue worldwide, of which US $94 billion is estimated to come from marine caught species. The US and the European Union together spent US $65 billion in seafood restaurants.

Several government agencies have emphasized the importance of the seafood sector in their economy. According to NOAA, the seafood restaurant industry in the US is highly lucrative, estimates that any future seafood consumption growth would have to rely on an increase of imports of aquaculture products (NOAA, 2010).

The assumption that aquaculture does not rely on wild marine species has given governments a false sense of security that the growing demand for seafood in the retail and restaurant sector can be met by increasing aquaculture production of farmed species. In contrast, the heavy reliance on wild marine species for aquaculture and other protein sources used for human nutrition is examined in the following chapter.

4. Fishmeal revenue: from fish to meal to meat

4.1 Introduction

Of the world's total marine catch of fish, approximately 33 per cent goes to produce fishmeal (FAO, 2009). In 2005, 28 million tonnes of a total catch of 84.2 million tonnes of wild fish were used for this purpose (FAO, 2009). Due to the increasing demand of this commodity by the aquaculture and animal feed industry, the price of fishmeal has become highly volatile while trending upwards since 1980, reaching its peak in 2009 (IMF, 2011).

The top ten countries with the highest fishmeal revenue account for 86% of total fishmeal production, most of these countries utilize more fish for fishmeal production than they do for human consumption (Table 5).

Table 5. Forage fish vs. fish used for human consumption in 2005 (FAO, 2008a)

Country	Forage fish produced (thousand tonnes)	Per capita forage fish use (kg)*	Per capita human fish consumption in (kg)
Iceland	545	1843	70
UK	810	13	20
Norway	877	179	50
USA	1139	4	21
Denmark	1425	255	23
Germany	1148	18	13
Chile	2070	121	15
Japan	2921	23	66
China	4845	4	28
Peru	5114	173	20
Other	3747	1	18

* t of forage fish/countries' population

Despite decades of research focusing on its replacement, fishmeal is still a key ingredient in most animal and fish feeds, accounting for between 15 and 50 percent of weight of most of the salmon, trout, marine fish and, in less amounts, in pig and poultry feed (Tacon and Metian, 2008). Historically, fishmeal has widely been included in poultry, pork and farmed fish diets for its high content of essential amino acids and protein. Fishmeal is considered amongst the best sources of protein (FAO, 2010). Thus, the quality of a protein source is positively correlated with the digestibility, bio-availability, and proportions of the amino acids in the protein source. Fishmeal proteins provide the closest amino acid composition relative to an animal's requirements.

The demand for fishmeal seems to be endless; even as the pig and poultry industries have found partial replacements to fishmeal, new industries such as aquaculture, experimental laboratory animal husbandry feed and pet foods are increasing their demand (Dust *et al.*, 2005).

Increasing economic and environmental concerns on fishmeal production have led to developments in replacement strategies mainly focusing on soy meal. Replacement of fishmeal has been successfully implemented for terrestrial animals but not for aquaculture where fishmeal is still an essential component of fish diets (Elkin *et al.,* 2007*)*.

Using forage fish to feed animals and farm fish has been highly controversial because they could instead be used directly for human consumption especially in poorer countries (Alder and Pauly, 2006). But the reliance of compound feed on fishmeal for aqua feeds and terrestrial animal feeds has transformed fishmeal into a tradable commodity essential for the production of other protein sources for human consumption.

There is obviously an economic drive to use fishmeal in compound feed rather than utilize forage fish for direct human consumption. Researchers state that fishmeal is a relatively inexpensive source of dietary energy in compound feeds (Tacon, 2006; Alder *et al.*, 2008). In this paper, I attempt to answer questions surrounding fishmeal inclusion in feeds: Is fishmeal a key ingredient in animal and fish feed? What is the average price of a tonne of transformed fish compared to wild marine fish? And finally, determine and compare the returns of transformed fishmeal for different meats and farmed fish species.

4.2 Method

In the following, I describe the methodology to calculate the revenue generated from forage fish, fishmeal and animal meats, which include fishmeal in their compound feed preparation.

4.2.1 Revenue generated from animals which include fishmeal in their compound-feed

Revenues derived from animal meats were calculated based on their food conversion ratios (FCR) and the inclusion rates of fishmeal for each species.

FCR (compound feed-conversion ratio) is the traditional measure of efficiency in commercial animal feeding (FAO, 2000). Efficiencies of conversion of feed to live-weight gain are usually quoted in terms of feed conversion ratio (FCR, units of weight gain per unit of feed consumed). Naylor *et al.* (2000) calculated a typical global feed conversion ratio of 2 for terrestrial animals; this means that for every 2 kg of compound feed the animal will gain approximately 1 kg in its total weight. Feed conversion ratios were gathered from the literature for different species under experimental conditions, almost no FCRs achieved in commercial practice are published, either in the scientific press or in manufacturers' literature (FAO, 2000).

Fishmeal Inclusion rates for different species were gathered from the literature. Typical inclusion rates for fishmeal in animal diets are around 2-10% for terrestrial animal species, but can rise to 40% for fish diets (FIN, 2003). Asgard and Austreng (1995) stated that efficiencies of feed conversion are higher for fish compared with poultry, pigs and sheep at 30%, 18%, 13% and 2%, respectively. Inclusion rates of fishmeal in terrestrial animals are usually standard in diets since this source of protein could also affect negatively the palatability of the feed and the final product itself if used in large quantities. Also, increasing fishmeal

price has led to considerable fishmeal reduction into feedstuffs over time.

4.2.2 Calculating revenue from forage fish and fishmeal

In order to estimate the revenue generated from fishmeal, annual fishmeal (all processed products combined, including feed) import, export and production data for the year 2005 were obtained from FAOSTAT and UN Trade Statistics Database (UN-Comtrade). Adding domestic production and imports and subtracting exports allowed estimation of domestic supply. These data are multiplied by the quoted price for this commodity to obtain the revenue. It is worth noting that these prices are usually driven by the price fixed by the fishmeal trade from Peru, whose fishmeal contains about 65% protein, the highest quality in the industry (Durand, 1998). Also, fishmeal price is set on the world market and hence imposed on local producers (Durand, 1998). Unlike other commodity markets (e.g., soybean, wheat), transactions usually remain private and therefore are not regularly publicized. Since fishing remains a highly uncertain activity, fishmeal markets are highly volatile; the price is highly affected by natural phenomena such as El Niño and any other natural causes that influence a change in supply. Fishmeal yearly prices were gathered from the IMF commodity price database.

Several authors have studied average yield values to convert this forage fish to fishmeal. Pike and Tacon (2008), in two separate experiments, came up with a global processing yield of 22.5%. I assumed this value of 22.5% to make all fishmeal and forage fish revenue estimations.

(1)

$$TC_a = X_a * P_{fm} * Q_{fm}$$

a : { salmon, shrimp, Tilapia, Eel, Catfish, Marine finfish, Milkfish, Carp, Poultry, Pig and Petfood}

Where TC_a denotes total fishmeal cost in compound feed of specie *a ;*
X_a denotes amount of fishmeal used to produce 1kg of specie;
P_{fm} is price of fishmeal per kg in 2005;
Q_{fm} represents total quantity of fishmeal used in feedstuffs.

4.2.3 Estimating fishmeal use in animal compound feed

In order to estimate how much fishmeal is used in compound feeds, feed conversion ratios and inclusion rates of fishmeal for determined species found in the literature were used. The multiplication of these values by total animal production in confinement using compound feeds reported by FAO gives the total quantity of fishmeal used by that species for the year 2005 (FAO, 2010; FAO, 2008a; FAO, 2007). Using fixed FCR and inclusion rates result in simplified assumptions, given the diversity of production systems, but these formulas are the starting point for calculating costs in any animal feed production system (FAO, 2000).

(2)

$$X_a = FCR_a * FM_a$$

a: { salmon, shrimp, Tilapia, Eel, Catfish, Marine finfish, Milkfish, Carp, Poultry, Pig and Pet food}

Where X_a denotes amount of fishmeal used to produce 1kg of specie *a;*

FCR represents Feed conversion ratios of sector a*;*

FMa is percent fishmeal inclusion of sector a.

4.2.4 Estimating revenue from animal and fish meat produced with compound feed that include fishmeal in their formulations.

Due to fishmeal inclusion in animal and fish diets in compound feeds, a certain percent of meat weight can be attributed to fishmeal. This amount can be estimated by the FCR and the inclusion level in their formulation diets. For aquaculture values using, were drawn from Tacon *et al.*, 2008 (Table 6). In order to calculate the revenue generated by fishmeal in animal and fish meats, I can then multiply the estimated fishmeal percentage use in meats times their recorded wholesale price. This value can be used for further comparison to other fish meats and protein sources for human consumption. Poultry, pork and fish production estimates for the year 2005 were gathered from FAOSTAT, FISHSTAT and *Sea Around Us* database. Average wholesale meat prices for 2005 were gathered from Globefish and FAO price databases.

(3)

$$TR_a = X_a * Panimal * Q_a$$

a : { salmon, shrimp, Tilapia, Eel, Catfish, Marine finfish, Milkfish, Carp, Poultry, Pig and Pet food}

Where TR_a denotes total revenue generated from fishmeal inclusion in feedstuffs and converted to animal meat;

Panimal is price of one kg of sector $_a$ in the year 2005;

Q_a is total quantity in kg of meat of sector a sold in 2005.

Table 6. Fishmeal use in 2005 for different species groups.

Species (group)	FCR**	FM inclusion*	Meat produced in confinement (Thousand t.)	Meat produced from fishmeal (Thousand t.)	Final weight from FM %***
Salmon [1,5]	1.25	0.3	389	14	38
Shrimp [2,3,5]	1.7	0.2	2500	850	34
Tilapia [2,3,5]	1.7	0.05	51000	5000	10
Eel [5]	1.5	0.55	41000	33000	83
Catfish [3]	1.5	0.02	5000	137	3
Marine finfish [7]	1.9	0.32	2000	1200	61
Milkfish [5]	1.8	0.03	398	22	6
Carp [4,5,6]	2	0.05	1400	126	9
Poultry [8]	3.28	0.02	1200	48	4
Pig [8]	2	0.01	332	10	3
Pet food [7]		0.05	5374	537	10

[1] Anon (2006); [2]Deutsch *et al.,* (2007)[3] Hardy and Tacon (2002); [4]Huang (2007); [5] Tacon and Metian (2008); [6]Tidwell and Allan (2001); [7] De Silva *et al.*, (2008); [8]FIN (2003).

****FCR:** Feed conversion ratios of feed fed for each kg of live-body weight
***FM Inclusion:** inclusion of fishmeal in animal or fish diets per t.
*****Final weight from FM%**=Tonnes of meat produced from FM per t of meat produced in confinement.

4.2.5 Estimating per capita consumption of forage fish in top producing fishmeal countries

To estimate per capita consumption of forage fish, a wet fish to fishmeal global processing yield of 22.5% was applied (Shepherd, 2005; Tacon, 2008). Population divided by forage fish values were compared to fish and seafood for human consumption per capita data reported by FAO (FAOSTAT, 2011). Population data was extracted from UN Statistics Division (UN, 2010).

4.3 Results

When I analyzed fishmeal prices quotes provided by Bloomberg stock archives I noticed that fishmeal prices have doubled since the 1980s. Nevertheless forage fish seems well under-priced when compared to fish sold in other markets. In the year 2005, 28 million tonnes of forage fish were used to produce 5.5 million tonnes of fishmeal worth US $3.8 billion dollars at USD $855 a tonne. If I consider that wet fish to fishmeal has a processing yield of 22.5%, this would mean that a tonne of forage fish costs US $195. The world average price of marine fish in the retail market reached US $3800 per tonne in 2005 as estimated by this study in Chapter 2.

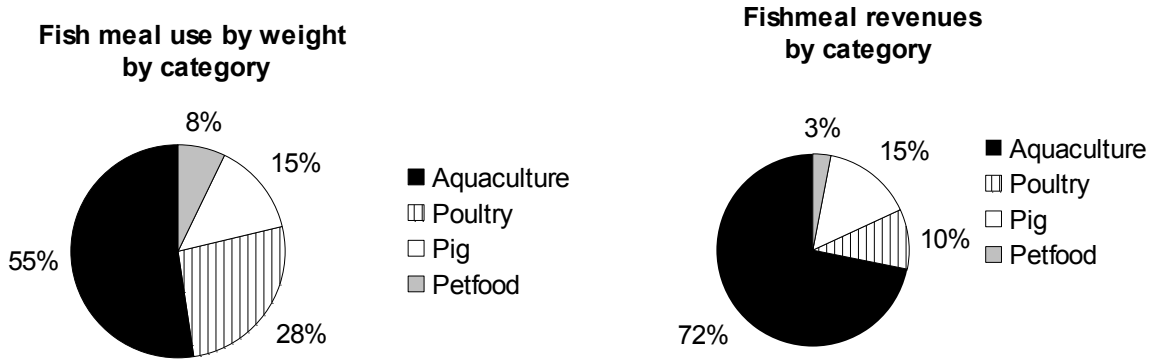

Figure 5. Fishmeal use vs. Fishmeal revenue in 2005.

But in order to compare equivalent revenues, one must compare the final yield of fishmeal into its final product. I assume that for every kilo of farmed salmon produced, there is a percentage of fishmeal that accounts for its weight and therefore its retail value. If this calculation is done for all species that use fishmeal in their compound feed formulation, the revenue generated by transforming fishmeal into animal or fish meat is US $14.5 billion (US $573 per tonne of forage fish).

In 2005, aquaculture utilized 14 million tonnes of forage fish (55% of total forage fish transformed into fishmeal) worth US $3 billion dollars to produce 3 million tonnes of farmed fish worth US $9 billion dollars. Fish are highly efficient in the use of fishmeal and therefore produce large returns for every tonne of fishmeal used in compound fish feed Figure 5). Fishmeal is an essential component in aqua-feeds and its inclusion and later transformation into fish meat accounts for

up to 37% of farmed salmon total weight, 42% in shrimp and 75% in total eel production (Table 6).

The poultry industry utilized 6.6 million tonnes of forage fish worth US $1.2 billion dollars to produce 48 thousand tonnes of chicken meat worth US $2 billion. Three million tonnes of forage fish were also utilized to produce 10 thousand tonnes of pork meat worth US $3 billion (Table 6).

In order to compare and also estimate the revenue generated by fishmeal inclusion in feedstuffs for different species, I include the cost of fishmeal in the diets (Figure 6). This way, I can illustrate the returns of a tonne of fishmeal into different animal meats.

In 2005, with fishmeal prices at US $855 per tonne, shrimp and salmon farming generated the highest revenue from fishmeal inclusion (5 and 8 times, respectively) (Figure 6).

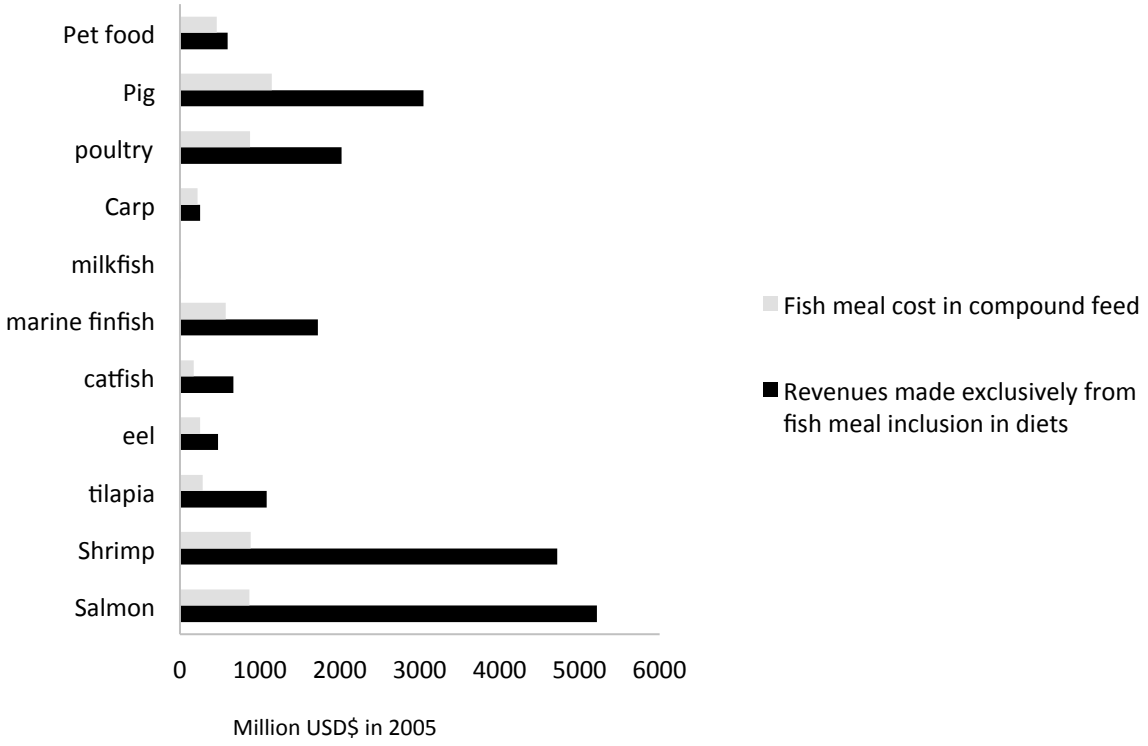

Figure 6. Revenues and costs of fishmeal inclusion in animal and fish diet.

4.4 Discussion and conclusion

The reliance on fishmeal in compound feed formulations can be attributed to the high metabolic efficiency and the relatively low price of this commodity versus the generation of substantial revenues on final meat products as shown on Figure 6. Fishmeal has become an important protein source not only for aquaculture but also for terrestrial animals.

Aquaculture has the highest returns from this commodity. According to the Food and Agriculture Organization, feeds for aquaculture manufacturers are not convinced of completely removing and substituting fishmeal for other products because availability is not constant and performance has not yet been tested under industrial environments (FAO, 2002). Thus, the economic surplus given by the transformation of fishmeal into fish meat in sectors such as salmon and shrimp makes this commodity a relatively inexpensive source of protein for the inclusion in aquaculture feeds.

Although forage fish are not typically consumed directly by most people in industrialized countries, they are present in everyday life as an important component of the diet of the meat and fish that we consume (Pickitch *et al.*, 2012). Fishmeal is essential to the interdependency of human protein sources availability and has become a relatively cheap commodity used in most animal and fish compound feed formulations. Thus, the conversion of forage fish to fishmeal to fish and animal meat is another form of natural subsidy, where "forage" fish is sold at a very low price in order to supply the demand of compound feed markets. Naylor et al., 1998 also stressed the lack of environmental regulation and suggested that the ecological impacts are not reflected in either local nor international prices for aquaculture inputs or outputs.

There are several reasons to why forage fish is diverted to fishmeal production rather than human consumption. First, fishmeal is relatively cheap compared to other protein meal sources such as soymeal and as the total demand for protein meals increase so does the price; therefore increasing the likelihood that small

pelagic fish will continue to be used to produce fishmeal (Alder *et al.*, 2008; Durand, 1998). Second, the market for small pelagic fish requires fast preservation techniques to prevent its rapid deterioration, which increases the costs of a product that is considered of low value in retail markets (Hanse, 1996). And finally, the market for pelagic fish where these species were traditionally consumed (mostly Peru, Africa and the Sub-Saharan region) is very limited and is sold as a very low cost species (Tacon and Metian, 2009).

Forage fish have been and still are consumed by humans as part of a larger suite of fish that were historically consumed. Forage fish contribute to more than 50% of the total food fish supply in more than 36 countries in Africa, Asia and elsewhere. Market competition is the final driver which determines whether small pelagic fish are used for feed or food (Tacon, 2009). There are some areas in the world where consumption of these fish is increasing, especially in the developing world, where traditional stocks are depleted as well as other sources of protein being too expensive or difficult to buy. In other areas of the world, especially in developed countries, consumption is declining as consumers substitute these fish for more affordable farmed fish (Alder and Pauly, 2006)

In this chapter, I calculated the revenues generated by fishmeal at different levels (forage fish, fishmeal and meats) produced by the inclusion of fishmeal in their compound feed formulation. Also, I calculated the revenues from aquaculture, poultry, pig and pet food industries from the use of fishmeal in their compound feed diets.

The findings are, first, that fishmeal is still a key ingredient in most animal and fish feeds, and were used to produce 3 million tonnes of farmed seafood, one million tonne of poultry products, one million tonne of pig meat and one thousand tonnes of pet food worth US $14 billion in 2005. Second, that the average price of a tonne of transformed fishmeal into farmed fish meat reached US $537 in 2005, which is substantially low when compared to the average retail price of wild marine fish meat of US $3800 per tonne, respectively in 2005. Finally, I calculated the returns of fishmeal for different farmed fish species and concluded that salmon aquaculture produces the highest return per tonne of fishmeal, followed by the shrimp and catfish farming.

5. Conclusion

5.1 Discussion

Estimated values along the fisheries value chain have been calculated by several authors at the ex-vessel, processing, distribution and retail level (e.g., Dyck and Sumaila, OECD, 2010). Total fisheries value chain turnover is estimated at US $408 billion including all those revenues generated by aquaculture (OECD, 2010). Through input–output methodology to estimate the total direct, indirect and induced impact of marine capture fisheries on the world economy estimates calculate that the value is between US $225 and $240 billion per year (Dyck and Sumaila, 2010). The present study isolated marine catch fish and seafood products from all other sales; Thus, consumer expenditure returns generated in retail and food-service sectors, to some extent, should reproduce the estimations generated by Dyck and Sumaila.

Dyck and Sumaila, 2010, calculated a multiplier of three along the value chain; that is from the ex-vessel value (US $85 bn) until it reaches the consumer, fish would increase three times its value through processing and other added value reaching a total US $225 to $240 billion, this value does not include subsidies, aquaculture nor fishmeal values. According to Sumaila and Pauly 2006, subsidies account for US $34 billion yearly. If we add fisheries values, subsidies and fishmeal a total estimated US $288 billion dollars would be the final output of revenues generated by global seafood sales. The present study estimates that

the total global revenues of seafood products account for US $308 bn.

Other studies (OECD, 2010; Keller and William, 2009) estimate, that the fisheries value chain turn over, accounts for US $408 billion, including aquaculture products. At farm gate, aquaculture products account for US $63 bn (OECD, 2010). By using the input-output multiplier of three used by Dyck and Sumaila in marine fisheries along the value chain, total aquaculture value at final sale should reach US $189 bn. This would mean that according to the OECD study, wild seafood products account for US $219 bn per year. As this research has shown this is an underestimation of the total revenues generated by wild seafood products which reached US $308 bn in 2005.

The effect of globalization on retail and food-service sectors has generated economies of scale by making fish and seafood accessible to the public on a regular basis. I quantified the economic contribution of fish and seafood through consumer expenditure in retail and food-service sectors. Since one third of the total marine catch is used to produce fishmeal, consumer expenditures on this product were calculated based on the percentage of meat products generated from fishmeal inclusion in compound-feed formulations. I estimate that consumer expenditure on marine seafood and fish sales revenue reached US $202-$215 billion in retail establishments, US $94.5 billion in seafood restaurants and US $14.5 billion in meat and fish products derived from fishmeal. A total estimate of US $311 billion in 2005 was the consumer expenditure in final sale of marine fish and seafood. To put this into perspective marine seafood represent 5% of total global food sales which were estimated at

US $4 trillion including sales through food-service establishments in 2005 (Gehlar and Regmi, 2005).

The retail sector findings estimate that consumer expenditure on marine fish and seafood reached US $202 -$215billion in 2005. Retail consumer expenditure on fish and seafood is concentrated in the European Union, Japan and the United States, accounting for 80% of the global total expenditure on this resource. Fish retail markets have experienced exponential growth in developing countries. Marine fish and seafood retail value in developing countries grew from US $11 billion in 1990 to US $88 billion dollars in 2005. On average, 80 percent of the marine fish sold in retail markets around the world are sold in fresh form (most of these fish have undergone some kind of freezing or chilling process but they are still considered fresh).

The development of the first global seafood retail database, which is used to analyze fish retail values at regional and global scales, was created to calculate the economic value of the seafood retail sector. This global database includes 192 maritime and non-maritime countries. The top 15 countries account for 88 percent of the total retail seafood consumer expenditure, with Japan leading; even though the country's consumption of marine seafood has declined due to a higher intake of aquaculture fish and seafood. At the global scale, the increase of seafood consumption can be attributed to many factors including the success of supermarkets generating economies of scale, higher demand of developing countries and increasing trade globalization (Goldberg *et al.,* 2007; OECD, 2010). I demonstrated the procedures for developing a global marine fish retail

value database. The current version of the database will be useful in helping researchers, fisheries managers and interested parties to assess retail contributions of fish to the economy, this data will be publicly available and easy to access.

Seafood restaurants contributed with US $151 billion to the world GDP, from this US $94 billion come from marine caught species globally. The US and the European Union together spent US $65 billion dollars in seafood restaurants eating marine caught species.

Last I analyze consumer expenditure on meats from confined animals and farmed fish that have used fishmeal in their feed formulations. Fishmeal is still a key ingredient in most animals and fish feeds, accounting for between 15 and 50 percent of the weight of most of salmon, shrimp, marine fish, and in less amounts, in pig and poultry feed. In this paper I calculate the revenue generated from forage fish, fishmeal and animal meats which include fishmeal in their compound feed preparation. Revenues derived from animal meats were calculated based on their FCR (food conversion ratios) and inclusion rates of fishmeal for each species. The findings are, first, that fishmeal is still a key ingredient in most animal and fish feeds, and were used to produce 3 million tonnes of farmed seafood, one million tonnes of poultry products, one million tonne of pig meat and one thousand tonnes of pet food worth US $14 billion in 2005. Second, that the average price of a tonne of transformed fishmeal into farmed fish meat reached US $537, substantially lower than the average retail price of wild marine fish meat of US $3627 in 2005. Finally, I calculated the

returns of fishmeal for different farmed fish species and concluded that salmon aquaculture gets the highest return per tonne of fishmeal, followed by the shrimp and the catfish industries.

In this study, I have demonstrated the procedures for developing a global marine fish retail value database. The current version of the database will be useful in helping researchers, fisheries managers and interested parties to assess retail contributions of fish to the economy, this data will be publicly available and easy to access. I have also estimated the contribution of marine fish and seafood to the economy and the components that make up consumer expenditure of fish and seafood globally. Traditionally, fish and seafood retailing has been operationally expensive; it is labour intensive, requires large display space and needs a quick stock turnover. Nevertheless, supermarkets have partially cut these costs, offering cheaper fish and seafood choices for their consumers; especially fresh fish which is the form which most consumers prefer when buying marine fish and seafood. Consumers perceive seafood as a healthy choice when selecting their meals; it is clearly a highly valuable product. Therefore, quantifying the revenue generated by this industry will certainly stress the importance of keeping fish populations healthy.

Throughout this study, I have also stressed the importance of the revenue generated by wild marine seafood and also emphasized the steady reliance of countries on aquaculture to increase their seafood demand. Most studies forget the importance of forage fish in human nutrition, how neatly linked a vast percentage of the foods we consume actually have an impact on wild ocean species and in our economy. The future of expanding seafood supply relies mostly on maintaining healthy forage fish populations, by either diverting them for human consumption or by following the unsustainable aquaculture expansion.

Prior to this study many authors have discussed the biological scrutiny of fishmeal use in aquaculture and animal feeds, nevertheless this is the first attempt to quantify the economic importance of fishmeal in aqua and animal feed inclusions. Therefore, stressing the economic heavy reliance of aquaculture on forage fish populations is also an important step to generate proper management strategies for this essential commodity in fish farming.

This is the first attempt to understand and quantify the revenue generated by global seafood consumption. Further work is needed to understand the seafood chain and their distribution patterns.

5.2 Strengths, limitations and further work

When calculating fish revenue globally, fishmeal tends to be excluded even

though one third of the global catch is used for this purpose. Estimating the contributions of fishmeal final products is primordial, specially now, that protein sources for a growing compound feed for meat markets is being slowed down due to grain price increase (Brown, 2011). Also, since proteins derived from fish, crustaceans and molluscs account for between 13.8% and 16.5% of the animal protein intake of the human population (WHO, 2010), quantifying the monetary contribution of this resource is essential.

In Chapter 2, I have provided global estimations of retail fish and seafood consumer expenditures. As in any global study the nature of the data can be a potential drawback to this type of study. The best way to deal with this type of uncertainty is to approach the stated problem in a systematic and structured manner in such a way that it could be reproduced (Nelson and Kennedy, 2009). I have attempted to do so by presenting a list of primary sources and calculation sheets (Appendix A). Even so all extrapolations methods can be questionable; it is however, a well-established method to deal with data poor situations (Rosenberg and Loomis, 2001).

Another limiting factor is estimating consumer expenditure on fresh fish. Fresh fish represents 80% of total fish and seafood retail sales worldwide. Fresh fish and seafood has been given price estimates from observed chilled fish and seafood for each country where information is available, the real value of fresh fish is uncertain and unreported (FAO, 2007). Chilled fish consumer expenditure is reported by Market Research reports and is therefore the closest estimation to calculate fresh fish and seafood values. Therefore the true values

for fresh fish could be underestimated.

Restaurant consumer expenditures are reported by some countries under very broad economic categories as “hotel and restaurants” assuming that there is a positive correlation between hotels and restaurants. Double counting is possible in the case when restaurant establishments purchase fish from retail establishments. Studies conducted in Australia and the US confirms that most restaurants purchase their seafood and fish products from wholesalers rather than fishmongers or supermarkets (Department of Agriculture and Fisheries Australia and NOAA, 2007).

Further work filling in the gaps created in the value chain of seafood distribution channels and identifying the steps taken by fish and seafood to reach consumers are needed, not only to quantify the economic impact of seafood products, but also to establish critical points in order to generate sustainability practice measures; even though it has proven to be extremely hard due to the nature of the catch and the several steps taken by seafood products before they reaches final sale markets (Logan *et al.*, 2008).

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APPENDIX A

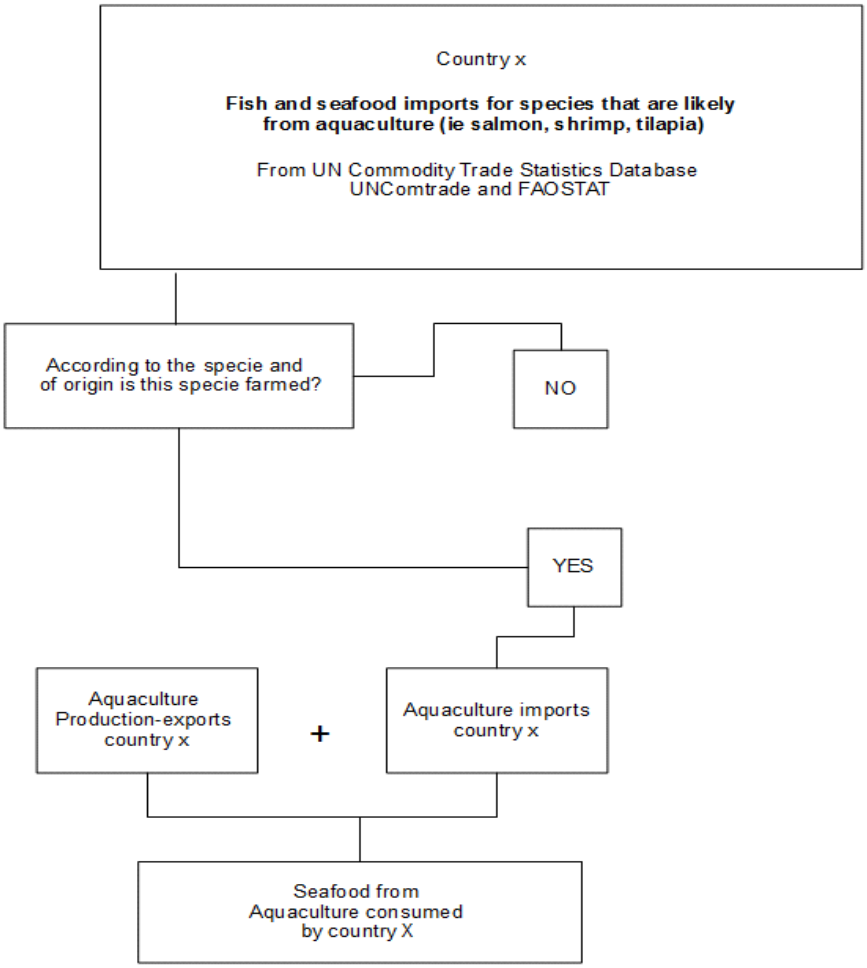

Figure 7. Probable aquaculture consumption in country x algorithm.

APPENDIX B

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
North America		
Canada	Seafish Marketing. 2008. Seafood Export profiles-Canada. 17p. www.seafood.org	4
	Statistics Canada. 2006. Consumer expenditure per household. http://www.statcan.gc.ca/pub/75-001-x/2007109/t/4096899-eng.htm. Accessed Novembe 2009.	3
US	Ashman H, Beckley J. 2007. Chips on the Fish. Fooc Processing-Chicago. May 68(5), 23-24	6
	IBISWorld. 2009. Fish & Seafood Aquaculture in th US. Aquaculture. Industry Report 1252 2009;(March):1-44.	5 6
	Anonymous. US seafood consumption reaches record levels. Grocer's review. February 21(2),34-35.	4
	Seafish Marketing. 2008. Seafood Export profiles-USA. 17p. www.seafood.org	2
	National Marine Fisheries service. US production of processed fishery products. Fisheries statistical servic	

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
US	. http://www.st.nmfs.noaa.gov/st1 / Visited November 2010.	5
	Market Research. 2005. The US Market for Seafood. Report 2696. 200p.	5 1
	Fairfield CP, Maze-foley K, Belden D, *et al.*, Trends in Selected Northeast Region Marine Industries. Fisheries Science. 2008;(July).	1 11
	Leek S, Maddock S, Foxall G, Food B, Bradford J. Situational determinants of fish consumption. Text. 2010;102:1-12.	5 5
	Glitnir. 2007. US Seafood Industry Report. Glitnir Seafood Team March, 44p.	2 2
	NOAA. 2007. Fisheries of the United States 2006. Fisheries Statistics division. 192p.	3 3
	Bureau of labour statistics. Consumer Expenditure Survey.http://www.bls.gov/cex/. Accessed March 2009.	2 2
	Chao, E. Hall, K. 2008. Consumer Expenditure 2004-2005. US Department of labour and US Bureau of Labour Statistics. October 2008. Report 1008.	

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
Central and South America		
Argentina	Infopesca. Pecado congelado. Enero 20 2007 N1. http://www.infopesca.org/libres/info012007/CONGELADO.PDF	2
	Glitnir. 2007. Latin America Seafood Industry Report. Glitnir Seafood Team (November), 54p.	5
	Euromonitor. (2005).Argentina-Fresh Food-Fish and seafood. http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal. Last accessed Nov. 2010.	5
Brazil	Instituto Brasileiro de Geografia e Estadistica. 2010. Gastos per capita con alimentos en el hogar-Brasil y Grandes Regiones. Comunicacion social. http://www.ibge.gov.br/espanhol/presidencia/noticias/noticia_impressao.php?id_noticia=1788	3
	Euromonitor. (2005).Brazil-Fresh Food-Fish and seafood. http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal . Last accessed Nov 2010.	5
	Glitnir. 2007. Latin America Seafood Industry Report. Glitnir Seafood Team (November), 54p.	5

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
Chile	Mendoza, C. Pinheiro, C. Amigo, H. 2007. Evolucion de la situacion alimentaria en Chile. Rev. chil. Nutr. 34(1): 62-70. http://www.scielo.cl/scielo.php?script=sci_arttext&pid=S0717-75182007000100007&lng=es Accessed in Nov 2010.	1
Chile	Euromonitor. (2005). Chile-Fresh Food-Fish and seafood. http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal Last accessed Nov 2010.	5
	Glitnir. 2007. Latin America Seafood Industry Report. Glitnir Seafood Team (November), 54 p.	5
Colombia		
	Herrera C. 2005. La dinamica del consumo en Colombia desde 1999 y sus proyecciones para 2005. Documento de Investigacion del Centro de estudios Culturales.198 p.	1
	Euromonitor. (2005).Colombia-Fresh Food-Fish and seafood. http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/PortalLast accessed Nov 2010.	5
		3

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
Mexico	Instituto nacional de estadistica y geografia. 2005. Encuesta Nacional de Ingresos y Gastos de los Hogares. http://w4.siap.gob.mx/sispro/portales/pesqueros/tilapia/consumidor/gastohogares.pdf	
	Euromonitor. (2005).Mexico-Fresh Food-Fish and seafood.http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal. Last accessed Nov 2010.	5
Peru	Glitnir. 2007. Latin America Seafood Industry Report. Glitnir Seafood Team (November), 54p.	5
Venezuela	Anido, D. Orlandoni, G. Quintero, M. Estudio del consumo a partir de las encuestas de presupuestos familiares, 1967-2005. El Caso De La Ciudad De Mérida (Venezuela)[1]. Agroalim, ene. 2005, vol.10, no.20, p.15-41.	1
	Euromonitor. (2005).Venezuela-Fresh Food-Fish and seafood. http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal. Last accessed Nov 2010.	5
Asia		
China	Seafish Marketing. 2008. Seafood Export profiles-China. 17p. www.seafood.org	2

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
China	A, Reardon T. 2007. Asian food market transformation: challenges to promote competitiveness with iveness.Policy forum "Agricultural and Rural Development ducing Poverty and Hunger in Asia: In Pursuit of Inclusive ıstainable Growth". Manilla, Phillipines August 7-10 2007.	
India	Euromonitor. (2005).India-Fresh Food-Fish and seafood. http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal Last accessed Nov 2010.	5
India	Datamonitor. 2006. Meat, Fish and Poultry in Indonesia to 2013. Market Research report.169p.	5
Indonesia	Euromonitor. (2009).Indonesia-Fresh Food-Fish and seafood. http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal Last accessed Nov 2010.	5
	Seafish Marketing. 2008. Seafood Export profiles-Japan. 17p. www.seafood.org	4
Japan	Euromonitor. (2009).Japan-Fresh Food-Fish and seafood. http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal Last accessed Nov 2010.	5
	Ministry of Internal Affairs and Communications, Japan. Statistics Bureau. Annual Report on the Family Income and Expenditure Survey 2005: Statistical Tables. 2005.	2

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
	Accessed from www.stat.go.jp/English/data/kakei/156npt.htm on November 22, 2006.	
	Monthly Statistics of Agriculture, Forestry & Fisheries: December 2006.December 2006. Accessed from www.maff.go.jp/toukei/geppo/geppo-e.html on November 22, 2006.	3
Japan	Monthly Statistics of Agriculture, Forestry & Fisheries: December 2006. December 2006. Accessed from www.maff.go.jp/toukei/geppo/geppo-e.html on November 22, 2006.	3
	Seafish Marketing. 2008. Seafood Export profiles-Japan. 17p. www.seafood.org	4
	Tan, A. Lee,H. 2005. Determinants of Malaysian household expenditures on fresh-fish, shellfish and processed fish. 5th	1
	International Conference of Asian Society of agricultural Economists. Zahedran, Iran. August 2005.	
Malaysia	Datamonitor. 2006. Meat, Fish and Poultry in Malaysia	5

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
	to 2010. Market Research report.170p.	
	Euromonitor. (2008).Argentina-Fresh Food-Fish and seafood. http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal Last accessed Nov 2010.	5
	Anonymous. 2005. Fish and Seafood Market in Philippines: Business Report 2010. Merchant Research & Consulting Business Report. 54p.	5
Phillipines	Euromonitor. 2009.Phillipines-Fresh Food-Fish and seafood. http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal. Last accessed Nov 2010.	5
	Singapore department of statistics. Yearbook of Statistics 2006. 310p.	5
Singapore	Euromonitor. 2008.Singapore-Fresh Food-Fish and seafood. http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal Last accessed Nov 2010.	5
Singapore	Euromonitor. (2009).South Korea-Fresh Food-Fish and seafood.http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal. Last accessed Nov 2010.	5

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
South Korea	National Office Statistics Thailand. 2006. Household Socio-economic Survey. http://web.nso.go.th/en/survey/house_seco/socio.htm Accessed in May 2010.	3
Thailand	Euromonitor. (2005).Argentina-Fresh Food-Fish and seafood. http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal Last accessed Nov 2010.	
	Euromonitor. (2005). Vietnam-Fresh Food-Fish and seafood. http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal. Last accessed Nov 2010.	5
Vietnam	Australian Bureau of statistics. 2004. Household expenditure on goods and services. http://www.abs.gov.au/AUSSTATS/abs@.nsf/mf/6535.0 Accessed in July 2010.	3
Oceania		
Australia	Seafish Marketing. 2008. Seafood Export profiles-Australia. 17p. www.seafood.org	4
		5
Australia	Euromonitor. (2005).Vietnam-Fresh Food-Fish and seafood. http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal . Last accessed Nov 2010.	

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
New Zealand	Statistics New Zealand. 1998-2001. Key statistics. http://search.stats.govt.nz/search?w=consumer+expenditure+&button.x=0&button.y=0&button=Search&w_pre=consumer+expenditure+2005&af_pre= . Accessed July 2010.	3
	Statistics New Zealand. 1998-2001. Key statistics. http://search.stats.govt.nz/search?w=consumer+expenditure+&button.x=0&button.y=0&button=Search&w_pre=consumer+expenditure+2005&af_pre= . Accessed July 2010.	3
Eastern Europe		
Bulgaria		10.
	Euromonitor. (2008).Czech Republic-Fresh Food-Fish and seafood. http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal. Last accessed Nov 2010.	5
Czech Republic		
	Euromonitor. (2008).Argentina-Fresh Food-Fish and seafood http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal . Last accessed Nov 2010.	5

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
Hungary		
	Central statistical Office-Poland. 2009. Statistical Yearbook of the republic of Poland. Chapter XIX trade and catering. http://www.stat.gov.pl/cps/rde/xbcr/gus/PUBL_sy_statitical_yearbook_of_the_rep_of_poland_2009.pdf	3
Poland	Euromonitor. (2005).-Fresh Food-Fish and seafood.http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal. Last accessed Nov 2010.	5
	National Statistics of Romania. Metadata database-Households expenditure. www.insse.ro/cms/rw/pages/index.en.do. Accessed Nov 2010.	3
Romania		
	Seafish Marketing. 2008. Seafood Export profiles-Russia. 17p. www.seafood.org	4
Russia	Euromonitor. (2008).Frozen and processed Food-Russia. Euromonitor International: Country Sector briefing. November 2008.10p	5
	USDA. 2006. Russian Federation Fishery products Fish and Seafood Market update. Gain Report RS0061.3p	2
Russia		
	Statistical office of the Slovak Republic. Consumption of selected kinds of food and alcoholic beverages (per capita) in 2001-2006. http://portal.statistics.sk/showdoc.do?docid=10994http://portal.statistics.sk/showdoc.do?docid=10994	3

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
Slovakia		
Serbia	USDA.2008. Fishery Products Fish and Seafood Market Situation in Serbia. Gain Report RB8011.	2
Western Europe		
Austria		
	InWEnt. 2006. Market Study on selected Western European Fish and Seafood Markets on behalf of InWEnt – Capacity Building International, Germany – PDMGroup	5
	Statistics Austria. 2006. Final consumption expenditure. http://www.statistik.at/web_en/statistics/national_accounts/gross_domestic_product/annual_data/029255.html . Accessed July 2010	
Belgium	Willemsen, F. 2003. Report on the seafood consumption data found in the European countries of the OT-SAFE projects. http://www.ivm.vu.nl/en/Images/OT7DBA3C19-6B94-4471-BD772CB22C9544E7_tcm53-87248.pdf	2

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
Denmark	Seafish Marketing. 2008. Seafood Export profiles-Denmark. 17p. www.seafood.org	4
	Statistics Finland. 2006. Income and consumption. http://www.stat.fi/til/tul_en.html. Accessed November 2010.	3
Finland	Lossaurn C. 2008. Dossier:maree et maree LS. July August (238), 106-115p.	6
France	Monzie S. 2008. Les labels ont la peche. Point-de-Vente. January(1016),56-60(4pp)	6
France	Astruc C. 2007. Les enseignes toujours plus responsables. LSA (September)(2013)42-44pp.	6
	Anonymous. 2007. Long term sustainability depends on increased investments. LSA August 4, 24-33	6
	Seafish Marketing. 2008. Seafood Export profiles-France. 17p. www.seafood.org	4
	Anonymous. 2008. Key Figures for Fisheries and aquaculture sector in France. Les publications de l'observatoire économique de l'OFIMER. www.ofimer.fr/99_up99load/2_actudoc/1725d1_01.pdf	2

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
France		
	Lossaurn C. 2007. Pourquoi la mare peut remonter. Lineares, July-August (227)112-113p.	6
	Lossaurn C. 2006. Dossier maree LS. Lineares June (215)"104-112.	6
	Moreau J. 2007. La filiere bleue prend le vent du marche. Process- Alimentaire (March)1235:44-45.	6
	Manfort MC. 2005. Supermarkets fresh fish sales are soaring. Seafood International. July 20(7):22-23.	6
	Descamps A. 2005. Raayon maree:un rayon a fort potentiel. LSA. June(1910) 1-2	6
France		
	Glitnir Seafood industry. 2008. EU Seafood Industry Report (April) 22p.	5
	Anonymous. 2005. Les fiches especes:Sommaire. Lineaires October (207) Supplement L'indespensable Maree, 55-92	6
	National Institute of Statistics and economic studies. 2006. Consumer Price indices. http://www.bdJunem.insee.fr/bdm2/2009 Accessed June 2010.	3

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
Germany	Neubacher H. 2005. Quality, choice, low price-Germans demand it all. Seafood International. July 20(7):25p.	6
	Seafish Marketing. 2008. Seafood Export profiles-GERMANY. 17p. www.seafood.org	6
	Fisch-Informationszentrum e. V. 2008. Fisch wirtschaft daten und fakten. http://www.fischinfo.de/pdf/d_und_f2009.pdf	
Germany	Glitnir Seafood industry. 2008. EU Seafood Industry Report (April) 22p.	2
	Anonymous. 2004. Tiefkuhlfisch immer beliebter. November (32)11:33	5
	InWEnt. 2006. Market Study on selected Western European Fish and Seafood Markets on behalf of InWEnt – Capacity Building International, Germany – PDMGroup	6
	Statisches Bundesamt Deutschland. 2006. Household consumption expenditure on food. http://www.destatis.de/jetspeed/portal/search/results.psml . Accessed June 2009.	5

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
		3
Iceland	Anonymous. 2004. The Icelandic Fish Industry (March) ISBR Research. 28p.	
	Gislason H. 2006. Sun shines down on icelandic fisheries. Seafood-International. 21(6), 29-33.	6
	Islansbanki Research. 2005. The icelandic fish industry Report. August-2005. 23p. http://www.islandsbanki.is/english/seafood-industry/research-and-publications/	2
Ireland	Rahman S. Seafood comes out of its shell. June 33(6),64-73	6
	Moreau J. 2007. La filière bleue prend le vent du marché. Process- Alimentaire (March) 1235:44-45	6
Italy	Massi F. 2008. Dal Mare al Freezer. Italian fish market, with particular reference to frozen fish. Largo consumo (Jul-Aug), 28(7-8): 37-38	6
	Seafish Marketing. 2008. Seafood Export profiles-Italy. 17p. www.seafood.org	4
	Anonymous. 2006. Consumers eat less but pay more	6

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
	for fish in Italy. Seafood International. January 21 (1):3-6	
	Glitnir Seafood industry. 2008. EU Seafood Industry Report (April) 22p.	5
Italy	Italian National Institute of Statistics. 2006. Household consumption. http://en.istat.it/salastampa/comunicati/in_calendario/consfam/20100705_00/ Accessed June 2009.	3
	Foraboschi P. 2005. Le contrazioni dei molluschi. Largo Consumo. May 25(5):38-39.	6
Netherlands	Seafish Marketing. 2008. Seafood Export profiles-Netherlands. 17p. www.seafood.org	4
	Statistics Netherlands. 2004. Statistical Yearbook of the Netherlands 2004-Income wealth and expenditure. http://www.cbs.nl/NR/rdonlyres/3C60B3E9-09E0-491F-87F2-99B8E54936A1/0/2004a3pub.pdf	2
	InWEnt. 2006. Market Study on selected Western European Fish and Seafood Markets on behalf of InWEnt – Capacity Building International, Germany – PDMGroup	5
	GfK panel services Benelux. 2005. Samenvatting Vis, Schaal-en schelpdieren.	3

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
	http://www.pvis.nl/index.php?id=199#c574 . Accessed May, 2009.	
Netherlands	USDA. 2005. The Netherlands Fishery Products Annual 2005. Global Agriculture Information Network. Gain report NL0049.10p	2
	Williams E. 2006. Dutch fish and seafood export value up, with frozens top earner. Quick Frozen Food International. (July)1:5p.	6
Norway	Statistics Norway. 2006. Survey of consumer expenditure. http://www.ssb.no/english/10. http://www.ssb.no/locate	3
Portugal	Seafish Marketing. 2008. Seafood Export profiles-Portugal. 17p. www.seafood.org	4
	Glitnir Seafood industry. 2008. EU Seafood Industry Report (April) 22p.	5
Portugal	Instituto Nacional de Estadistica-Portugal. 2008. Anuário Estatístico de Portugal 2008. www.ine.pt . Accessed August 2010.	3

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
Spain	Castro FJ. 2008. Ahumados de pescados. La produccion frena su crecimiento. Alimarket-Revista. October(221),227-287	6
	Duran E. 2008. Pescado congelado. Mas volumen menos margen. Alimarket-Revista. June(218)247-275	6
	Seafish Marketing. 2008. Seafood Export profiles-Spain. 17p. www.seafood.org	4
	Glitnir Seafood industry. 2008. EU Seafood Industry Report (April) 22p.	5
	InWEnt. 2006. Market Study on selected Western European Fish and Seafood Markets on behalf of InWEnt – Capacity Building International, Germany – PDMGroup	5
	CBI market information database. 2008.The Fishery products markets in Spain. CBI Market Survey. www.cbi.eu Visited September 2009.	4
	Ministerio de Medio ambiente Espania. Precios origen-destino en la alimentacion. http://www.mapa.es/es/estadistica/pags/PreciosOrigenDestino/precios.htm Visited June 2009.	5

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
Spain	Cardeno M. 2008. Demanda y gasto en pescado, demanda en el hogar y en los establecimientos de restauracion. http://www.mapa.es/ministerio/pags/biblioteca/revistas/pdf_DYC%5CDYC_2008_101_completa.pdf	2
Sweden	Seafish Marketing. 2008. Seafood Export profiles-Sweden. 17p. www.seafood.org	4
Sweden	Statistics Sweden. 2005.National accounts-Household consumption expenditure (ESA95) Quarter 2004K1-2005K3. http://www.ssd.scb.se/databaser/makro/start.asp . Accessed June 2009.	3
Switzerland	Schweizerische idgemossenschaft. 2005. Die interaktive Statistikdatenbank. http://www.pxweb.bfs.admin.ch/Dialog/statfile.asp?lang=1 . Accessed June 2009.	3
Turkey	Rad, F. Country Report:Turkey. 1988-2001. International Centre for advanced Mediterrenean Agronomic Studies. 372p.	4

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
Turkey	Akbay, C. Ismet, B. Chern W. 2007. Household food consumption in Turkey. European Review of Agricultural Economics. 34(2):209-231.	1
UK	Anonymous. 2009. In season. Grocer (January 17th)2223 (7888): 38-45	6
	Anonymous. 2008. Credit crunch boosts sales of fresh salmon. Grocer (November)231 (7881): 35-54	6
	Botha S. 2004. Retail market overview in France and the UK. Seafish A42(24):27	6
	Mintel. 2004. Fish (UK market). Marketing intelligence Food and Drink. September:85p.	5
	European Comission. 2002. Facts and figures on the CFP (Global Fish Industry). A41(9):27p.	2
	Glitnir Seafood industry. 2008. EU Seafood Industry Report (April) 22p.	5
	Roheim C, Gardiner L, Asche F. 2007. Value of brands and other attributes: Hedonic analysis of retail frozen fish in the UK. Marine resource economics (22):239-253p.	1

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
UK	Market Research. 2008. Fish and Fish Products. Market research reports Key note Publications Ltd (January) 20p.	5
	Fousekis P, Revell BJ.2005. Retail Fish Demand in Great Britain and its Fisheries Management Implications. Marine Resource Economics (19) : 495–510pp.	1
	InWEnt. 2006. Market Study on selected Western European Fish and Seafood Markets on behalf of InWEnt – Capacity Building International, Germany – PDMGroup	5
	Markets on behalf of InWEnt – Capacity Building International, Germany – PDMGroup	5
Middle East		
Egypt	Soliman, I. Fabiosa, J. Bassiony, H. 2010. A riview of agricultural policy evolution, agricultural data sources and food supply and demand studies in Egypt. Working paper 10-wp 506. Centre for agricultural and Rural development Iowa State University. 44P	2
Israel	Central Bureau of Statistics-Israel. Household expenditure Survey-2007- http://www1.cbs.gov.il/reader/?MIval=cw_usr_view_	3

Table 7. References for retail expenditure and consumption for the year 2005. In order of reliability: (1) Peer reviewed publication (2) Government agency report (3) Government agency website (4) NGO report (5) Private market report (6) Magazine article. (Continued)

Country	Source	Source type*
	SHTML&ID=748 . Accessed Nov 2009.	
Morocco	Euromonitor. (2005).Morocco-Fresh Food-Fish and seafood. http://www.portal.euromonitor.com.ezproxy.library.ubc.ca/Portal . Last accessed Nov 2010.	5
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Table 8. Detailed estimated retail revenue by country for the year 2005. Numbers in bold represent raw data.

Country	Total Seafood (thousand t)	Retail revenue from marine seafood (thousand US$)
Western Europe	**5,631**	**34,256,638**
Austria	**108**	**336,262**
Belgium	**199**	**748,539**
Denmark	**62**	**620,947**
Finland	**118**	**336,270**
France	**442**	**5,072,331**
Germany	**545**	**2,947,421**
Greece	**228**	**375,115**
Ireland	**57**	**337,873**
Italy	**580**	**4,691,480**
Netherlands	**287**	**712,601**
Norway	**163**	**848,665**
Portugal	**699**	**342,682**
Spain	**953**	**9,805,377**
Sweden	**180**	**770,484**
Switzerland	**117**	**677,859**
United Kingdom	**892**	**5,632,732**
Asia	**37,232**	**93,955,346**
China	**19,677**	**32,474,200**
India	**1,371**	**16,514,000**
Japan	**5,786**	**30,767,184**
Malaysia	**1,455**	**2,117,680**
Philippines	**2,608**	**5,503,360**
Singapore	**269**	**1,164,670**
South Korea	**2,529**	**231,000**
Thailand	**1,994**	**2,943,251**
Vietnam	**1,544**	**2,240,000**
Africa	**4,897**	**11,263,234**
Chad	49	48,481
Congo	57	100,259
Cote d'ivoire	**224**	**393,491**
Dijbouti	1	1,215
Ethiopia	8	42,923
Gambia	28	150,568
Ghana	484	2,568,089

Table 8. Detailed estimated retail revenue by country for the year 2005. Numbers in bold represent raw data. (Continued).

Country	Total Seafood (thousand t)	Retail revenue from marine seafood (thousand US$)
Liberia	**13**	**68,092**
Morocco	**260**	**1,382,000**
Mozambique	39	208,685
Namibia	25	130,448
Senegal	249	1,321,553
Seychelles	4	22,656
Sudan	47	248,472
Swaziland	6	31,957
Tanzania, United Republic of	212	1,123,957
Togo	40	213,573
South Africa	**2,005**	**263**
Uganda	267	1,418,238
Zambia	63	335,759
Mauritania	201	283,079
Somalia	30	42,251
Eastern Europe	**2,884**	**12,088,426**
Albania	27	115,987
Bulgaria	**22**	**112,827**
Belarus	129	388,462
Bosnia	24	72,023
Czech Republic	**129**	**456,713**
Hungary	**32**	**70,294**
Poland	**324**	**889,939**
Romania	**55**	**109,750**
Russia	**1,806**	**7,952,962**
Slovakia	**32**	**166,213**
Slovania		**481,171**
Ukraine	**482**	**2,329,728**
Middle East	**2,537**	**6,990,231**
Algeria	150	210,882
Egypt	**1,168**	**5,918,101**
Israel	**94**	**98,001**
Tunisia	131	557,667
Turkey	**586**	**62,513**
Kuwait	4	5,633

Table 8. Detailed estimated retail revenue by country for the year 2005. Numbers in bold represent raw data. (Continued).

Country	Total Seafood (thousand t)	Retail revenue from marine seafood (thousand US$)
Karzakhstan	44	83,910
Kygystan	3	4,225
Tajikistan	5	7,042
Palestine	2	2,817
Qatar	11	15,498
Syria	17	23,942
Latin America	**3,430**	**9,594,292**
Cuba	78	131,506
Dominican Republic	77	159,445
Ecuador	47	80,591
El Salvador	35	60,546
Gautemala	32	67,055
Honduras	17	29,907
Jamaica	58	99,696
Panama	33	67,344
Peru	442	758,685
Paraguay	20	33,529
Uruguay	31	107,593
Brazil	**905**	**1,923,623**
Argentina	**373**	**1,029,374**
Chile	**183**	**1,182,493**
Colombia	**168**	**525,960**
Mexico	**1,008**	**2,989,000**
Venezuela	**297**	**1,377,319**
Oceania	494	1,219,309
Australia	**376**	**1,142,078**
New Z	**118**	**77,231**
North America	**2,443**	**32,691,632**
Canada	**585**	**3,193,517**
USA	**3,155**	**29,498,115**
Total	**59,549**	**202,059,108**

Table 9. Restaurants and seafood restaurants revenue by country. *GDP from hotels and restaurants extracted from Euromonitor ® 2010; ** Estimated values.

Country	GDP from Hotels and Restaurants in 2005 USD$ mn**	Revenue from Restaurants in 2005 USD$ mn**	Revenue from Seafood Restaurants in 2005 USD$ mn**
Asia	**340,895**	**146,585**	**36,646**
China	106,000	45,580	11,395
Hong Kong, China	4,694	2,019	505
India	12,181	5,238	1,309
Indonesia	9,390	4,038	1,009
Japan	234,000	100,620	25,155
Kazakhstan	501	215	54
Malaysia	2,871	1,234	309
Philippines	1,622	697	174
Singapore	2,271	977	244
South Korea	17,845	7,674	1,918
Taiwan	7,134	3,068	767
Thailand	7,701	3,312	828
Vietnam	1,435	617	154
Rest of Asia	39,250		25,000
Oceania	**23,758**	**10,216**	**2,554**
Australia	21,739	9,348	2,337
New Zealand	2,019	868	217
Eastern Europe	**20,603**	**8,859**	**2,215**
Bosnia-Herzegovina	263	113	28
Bulgaria	617	265	66
Croatia	1,632	702	175
Czech Republic	2,206	948	237
Estonia	214	92	23
Georgia	180	77	19
Hungary	1,519	653	163
Lithuania	329	141	35
Macedonia	84	36	9
Montenegro	67	29	7

Table 9. Restaurants and seafood restaurants revenue by country. *GDP from hotels and restaurants extracted from Euromonitor ® 2010; ** Estimated values. (continued)

Country	GDP from Hotels and Restaurants in 2005 USD$ mn**	Revenue from Restaurants in 2005 USD$ mn**	Revenue from Seafood Restaurants in 2005 USD$ mn**
Poland	3,304	1,421	355
Romania	1,747	751	188
Russia	5,932	2,551	638
Serbia	260	112	28
Slovakia	864	372	93
Slovenia	689	296	74
Ukraine	454	195	49
Latin America	**54,707**	**24834**	**6,209**
Argentina	4,299	1,848	462
Bolivia	254	109	27
Brazil	12,323	5,299	1,325
Chile	3,048	1,311	328
Colombia	2,108	906	227
Dominican Republic	3,769	1,620	405
Ecuador	593	255	64
Guatemala	802	345	86
Mexico	21,624	9,298	2,325
Peru	2,974	1,279	320
Venezuela	5,962	2,564	641
Middle East and Africa	**16,524**	**10663**	**1776**
Algeria	948	408	102
Bahrain	258	111	28
Cameroon	368	158	40
Egypt	2,581	1,110	277

Table 9. Restaurants and seafood restaurants revenue by country. *GDP from hotels and restaurants extracted from Euromonitor ® 2010; ** Estimated values. (Continued)

Country	GDP from Hotels and Restaurants in 2005 USD$ mn**	Revenue from Restaurants in 2005 USD$ mn**	Revenue from Seafood Restaurants in 2005 USD$ mn**
Israel	2,261	972	243
Jordan	192	82	21
Kenya	259	111	28
Kuwait	551	237	59
Morocco	1,394	599	150
Nigeria	351	151	38
Qatar	341	147	37
South Africa	2,205	948	237
Tunisia	1,630	701	175
United Arab Emirates	2,337	1,005	251
North America	**362,380**	**201291**	**52,500**
Canada	23,254	9,999	2,500
USA	339,126	191,292	50,000
Western Europe	**430,159**	**184,968**	**49,243**
Austria	12,451	5,354	1,338
Belgium	5,411	2,327	582
Denmark	3,147	1,353	338
Finland	2,823	1,214	303
France	45,663	19,635	7909
Germany	41,138	17,689	4,422
Greece	15,139	6,510	1,627
Ireland	4,138	1,779	445
Italy	59,987	25,794	6,449
Netherlands	10,527	4,527	1,132
Norway	3,455	1,486	371

Table 9. Restaurants and seafood restaurants revenue by country. *GDP from hotels and restaurants extracted from Euromonitor ® 2010; ** Estimated values.(Continued).

Country	GDP from Hotels and Restaurants in 2005 USD$ mn**	Revenue from Restaurants in 2005 USD$ mn**	Revenue from Seafood Restaurants in 2005 USD$ mn**
Spain	75,802	32,595	8,149
Sweden	4,528	1,947	487
Switzerland	8,238	3,542	886
Turkey	10,620	4,566	1,142
United Kingdom	59,820	25,723	6,431
ROW	60,000	25,800	6,450
Total	**1,249,026**	**587,416**	**151,143**