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Historical Marine Fisheries Data for Belgium

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Data sources, data management and data integration related to the reconstruction of historical time-series of marine fisheries landings for Belgium

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With foreword by

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FOREWORD

Good quality data are instrumental for improving our understanding of the effects of fishing on marine ecosystems, which is the main focus of the *Sea Around Us* project at the University of British Columbia Fisheries Centre (www.seaaroundus.org). The foundation of any useful evaluation of fisheries' interactions with ecosystems is knowledge on what has been taken out of the ecosystem by the activity of fishing, namely fisheries catches. The only global database on fisheries catches, maintained by the United Nations Food and Agriculture Organization, relies for all its data on annual reports from each member country. Thus, global data are only as good as their underlying national data. As has been shown by our catch reconstruction work for many countries of the world [1-5], most national data collections are incomplete, as they focus predominantly on commercial fisheries landings, hence they under-estimate or even ignore non-commercial (e.g., recreational) and small-scale catches (subsistence and artisanal), as well as discards. Given the long history and importance of fisheries on the European continent (think of the Hanseatic League in the 13th-17th centuries, whose power and influence was in part build on the trade of herring), European countries have a long data collection history. Furthermore, given the strong administrative traditions of European countries, one could be lead to believe that fisheries catches are comprehensively accounted for in this part of the world. Yet, sadly, as we have recently demonstrated for Baltic Sea countries [4], this is not the case. Given this background, we were delighted to be collaborating with Ann-Katrien Lescrauwaet and her colleagues at the Flanders Marine Institute (VLIZ) in Belgium on their endeavour to reconstruct a total catch history for Belgium. As the first step in this massive undertaking, Ann-Katrien and her colleagues undertook a data quality validation exercise for the existing historical time-series data on marine fisheries landings for Belgium, which date back to 1929. This work, whose technical details are documented in the present working paper, laid the foundation for the publication in *Marine Policy* entitled "*Fishing in the past: Historical data on sea fisheries landings in Belgium*" [6], which summarizes the process and results of integrating these time-series data, based on fragmented and dispersed data sources for the period 1929-1999. The present working paper and associated publication will contribute to the complete catch reconstruction for Belgium, similar to the work we have done for Baltic Sea countries [4].

Dirk Zeller
December, 2010

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3 Jacquet, J. L., Fox, H., Motta, H., Ngusaru, A. & Zeller, D. (2010) Few data but many fish: Marine small-scale fisheries catches for Mozambique and Tanzania. *African Journal of Marine Science* **32**, 197-206.
4 Zeller, D., Rossing, P., Harper, S., Persson, L., Booth, S. & Pauly, D. (in press) The Baltic Sea: estimates of total fisheries removals 1950-2007. *Fisheries Research*.
5 Zeller, D., Booth, S., Pakhomov, E., Swartz, W. & Pauly, D. (in press) Arctic fisheries catches in Russia, USA and Canada: Baselines for neglected ecosystems. *Polar Biology*.
6 Lescrauwaet, A.-K., Debergh, H., Vincx, M. & Mees, J. (2010) Fishing in the past: Historical data on sea fisheries landings in Belgium. *Marine Policy* **34**, 1279-1289.

Abstract

Time series on landings of marine fisheries in Flanders were reported as early as 1767 (1767-1780; 1836-1906) for herring, salted cod and 'fresh fish' (unidentified species). Our literature screening for time-series on landings and the economic value of these landings indicated that structurally embedded reporting in Belgium (Flanders) started in 1929 with an acceptable degree of consistency and continuity ever since. The final target of the present exercise will be to reconstruct time series at the lowest taxonomic level and spatial scale, based on the available systematic and consistent reporting. Thus, the present study details the data-structure and data integration for the final reconstruction exercise. The beginning of structural reporting on fisheries and landings coincided with the period where most states in Europe developed a statistical approach to underpin policy development. Historical data on (value of) landings before 1998 were only available in printed hard copy and none of the data or time-series contained in the reports were available electronically in the public domain. No legal or other data policy restrictions were indicated or applicable. The present exercise demonstrates the feasibility of constructing a standardized and integrated database. By means of this standardization and integration, time series for the period 1929-1999 were covered on a detailed level by species (n = 41), by port of landing (four in Belgium, two in France, and one 'foreign port'), by fishing area of origin (n = 31). Detailed landings in foreign ports covered the period 1950-1999. The total amount of reported landings covered by the integrated historical fisheries database ('HiFiDatabase') over the period 1929-1999 amounts to 3,107,638 metric tonnes, of which 2,830,815 tonnes (91%) were landed in Belgian ports and 256,566 tonnes in 'foreign ports', with an additional 20,256 tonnes in *Dunkerque* and *Gravelines* (France) during World War II. The total value of these landings amounts to €2,277,999,993 which recalculated to account for inflation represents €6,075,090,365 in 2007 Euro. The most important species in terms of landings were cod and herring (respectively 17% and 16% of total landings). In terms of indexed value, sole (31%) and cod (15%) were the most valuable species. Close to 73% of all landed species originated from five fishing areas: Coastal waters (shallow waters off Belgium, northern France and the Netherlands), the southern North Sea, the areas around Iceland, and the central North Sea. Twenty percent of all landed species originated from the shallow coastal waters. The southern North Sea and the Icelandic waters follow closely with 17% and 16%, respectively. The coastal waters contributed nearly 60% of all landed pelagic species and 55% of all landed molluscs and crustaceans reported for the period 1929-1999. The integrated database allows broadening our historical view of fisheries. It underlines the strong decline in landings since reporting started in Belgium, and allows further analysis by particular species and fishing grounds. The integration of the data also allowed additional quality control, based on visual analysis. The amount of time and effort needed to construct exchangeable formats and quality controlled, integrated time-series based on the currently available sources, provided an indication of why the historical component of marine fisheries is practically absent in ecological science and fisheries management.

Introduction

Marine Fisheries in Belgium: a historical perspective

Belgium covers a land area of 30,528 km² and has a population of approximately 10.7 million. Historically, the area known as Belgium, the Netherlands and Luxembourg was called the 'Low Countries'. From the 16th century until the Belgian revolution (1830), the area of Belgium was occupied and ruled by Spain (1549-1713) as the 'Spanish Netherlands', by Austria (1713-1794) as the 'Austrian Netherlands', and annexed by the French First Republic (1794-1815). The 'Low Countries' were joined as the 'United Kingdom of the Netherlands' under the House of Orange in 1815. After the Belgian revolution of 1830 it became the independent state of Belgium (Kingdom). Belgium has three regions: Flanders (Dutch-speaking) in the north, Wallonia (French-speaking) in the south, and the Capital region of Brussels (officially bilingual; Figure 1). A slight majority of the population (59%) lives in Flanders.

Figure 1: Map of the geography and administrative structure of Belgium. Shown also is the EEZ boundary. A century of Sea Fisheries in Belgium (VLIZ 2009). *Map created by Flanders Marine Institute (VLIZ).*

The Belgian coast is approximately 67 km long and located in the province of West-Flanders (Flanders, Belgium). The Belgian part of the North Sea is 3,500 km² (0.5% of the North Sea area). Belgium has 4 coastal ports (*Nieuwpoort*, *Oostende*, *Zeebrugge* and *Blankenberge*), and fish auctions are located in *Oostende, Zeebrugge* and *Nieuwpoort* (Figure 2). Belgian marine fisheries represent 0.04% of the national Gross Domestic Product (Anon., 2008). In January 2009, the Belgian fisheries fleet consisted of 100 vessels, with a total capacity of 60,620 kW and 19,007 GT (Flanders Sea

Fisheries Service, http://lv.vlaanderen.be [accessed May 2009]), consulted in May 2009). In 2008, the Belgian fleet landed 17,307 tonnes while the total landings in Belgian and in foreign ports amounted to 20,012 tonnes. These landings represented a value of €76.3 million, 14% of which was marketed in foreign ports. The present-day Belgian fleet is highly specialized: more than 95% of the total landings are achieved by beam trawlers, focusing primarily on flatfish species such as plaice (*Pleuronectes platessa*) and sole (*Solea solea*). Sole represents 48% of the total value of fisheries in Belgium (Anon., 2008; Mees, 2001). There are no dispersed landing points along the short stretch of coastline. Although historically the port and auction of *Oostende* was the most important, today the auctions of *Zeebrugge* (53%) and *Oostende* (45%) receive the largest landings share of Belgian fisheries in Belgian ports. Traditionally an important local source of employment – a survey in 1905 revealed a direct work force of 2.336 fishers (von Schoen 1912) - fisheries today represent an estimated direct work force of only around 500 fishers (full time equivalents) (GOM/NIS 2002) and another 1,370 indirectly employed in the processing sector. Ninety-eight percent of this direct employment is absorbed by people living in the coastal municipalities. The coastal area was included in the 'EU Objective II programme 2000-2008', for less developed socio-economic regions, due to the decline in fisheries. The sector receives significant public and political support in the context of Flemish and EU Fisheries Funds.

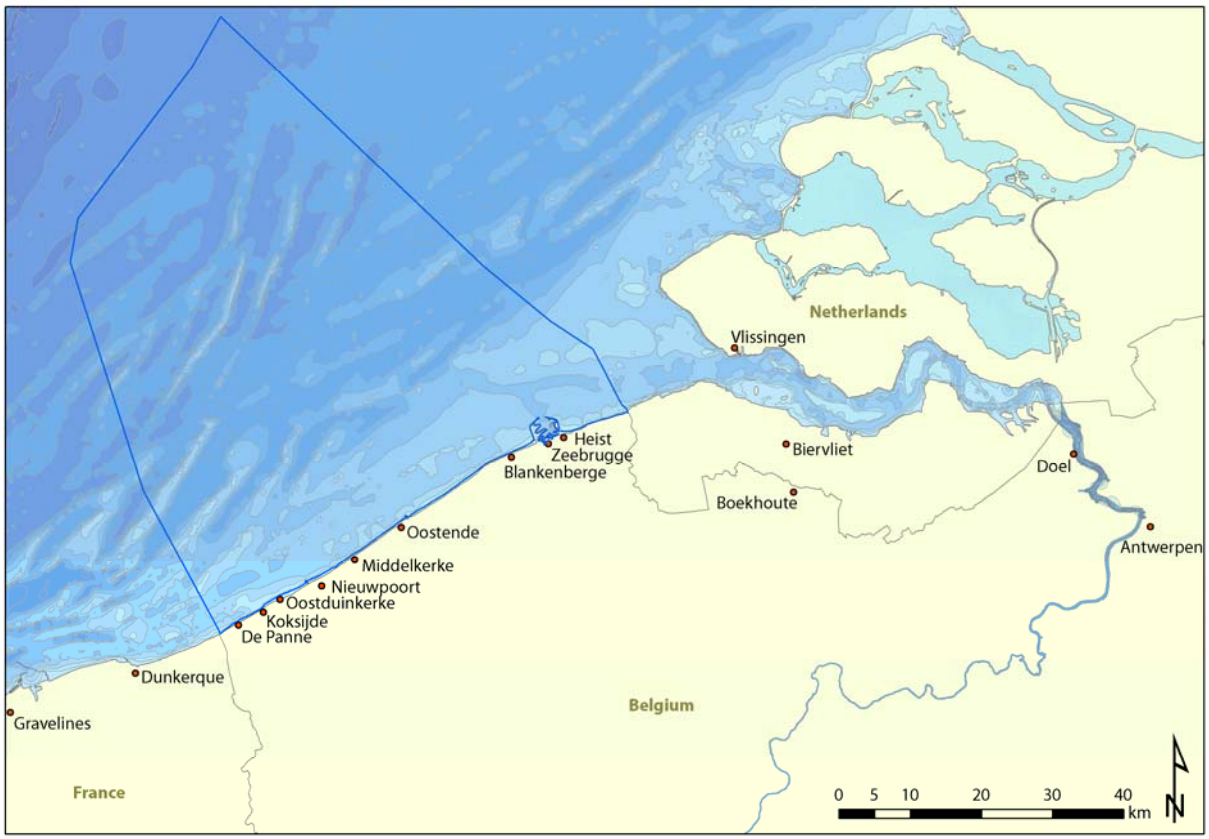


Figure 2: Map of the Belgian coast with the fishing ports, including historic fishers' settlements in Flanders, and the ports of Gravelines and Dunkerque in France. The blue line indicates the EEZ boundaries of the Belgian part of the North Sea. Source: A century of Sea Fisheries in Belgium (VLIZ 2009). *Map created by Flanders Marine Institute (VLIZ)*

It is generally assumed that historically fisheries occupied a more important role in terms of economic, employment and socio-cultural values, particularly along the coast. Yet, what exactly did the landings of Flemish fishers look like 50 or even 100 years ago, and which fishing grounds did most of the landings come from? Recovering the historical context of our fisheries is necessary to

document the cultural heritage of our coastal society and to tackle the issue of 'shifting baselines' (Pauly 1995, Pauly *et al.* 1998, Roberts 2007). To address these questions, an integrative approach is needed and a thorough data extraction based on the best available historical data and information is required.

Collective Memory Disorder?

We searched the Internet for references using the keywords; 'landings', 'fisheries' and 'evolution' on Belgian web pages. Of the first 100 references (from a total 692 returns) only 20% contained a reference to landings by Belgian fisheries (www.google.be/search?hl=nl&q=evolutie%2Baanvoer%2Bzeevisserij&btnG=Zoeken&meta=cr%3DcountryBE, consulted on 07/Jan/2009).

- Nearly half of these references compare the current situation with the previous year or provide one overall figure for the total landings of Belgian fisheries for the year in review.
- 10 references contain annual time series on the evolution of total landings, starting in 1990 (4 references), or 1984 (1 reference) at the earliest.
- The annual reports entitled 'Landings and value of landings' published by the 'Dienst Zeevisserij' (Sea Fisheries Service, Flemish Government) summarize the evolution of landings from 1950 onwards in a table with one general value for total landings every 5 years between 1950 and 1975 and annual values from 1975 to date. These documents represent the formal fisheries statistics reports of Flanders (Belgium). http://www2.vlaanderen.be/landbouw/downloads/vis/aanvoer_besomming_2007.pdf

A search effort in the *Integrated Marine Information System* IMIS (specialized marine information database of Flanders Marine Institute (VLIZ), consulted on 12/Jan/2009) based on the keywords 'landings' and 'fisheries' yielded 27 returns. Of these, 7 are the formal annual government reports on 'Landings and value of landings' containing time series that go back to 1984; another 4 refer to landings in 2004; 1990; 1997; 1990 and one paper on marine archaeology refers to landings of herring and cod in the 18th century, probably based on data reported in Cloquet (1842) and De Zuttere (1909). A PhD thesis (Polet 2004) on shrimp fisheries, reports total annual landings of the Belgian sea fisheries from 1970 onwards. Although the IMIS collection is not exhaustive in all disciplines, it contains the largest collection of publications and documents on marine and coastal sciences in Flanders and Belgium. The overall number of references in IMIS returned with the keywords 'fishery' (966) and 'fish*' (1,000), gives an indication of the relative representation of fisheries (1%) as research discipline in the Flemish/Belgian specialist literature publications.

We conducted a similar literature search in Google scholar (http://scholar.google.com/advanced_scholar_search) and the Web of Knowledge (http://www.isiknowledge.com/), with no returns that contain references to the amount (tonnes), composition and/or value (Belgian francs or Euros) of Belgian marine fisheries.

We reviewed policy documents, including the 'Assessment of marine degradation in the North Sea and proposals for a sustainable management' (Maes 2003), commissioned by a Ministerial resolution. This study conducts a thorough socio-economic analysis of Belgian sea fisheries in North Sea waters. The information on landings and their values is contained in one graph for the total production of Belgian fisheries, at 5 year intervals starting in 1960. In addition, graphs with annual landings covering the time period 1990-2000 are included for the four commercially important species cod (*Gadus morhua)*, plaice (*Pleuronectes platessa),* sole (*Solea solea)* and brown shrimp *(Crangon crangon*). The historical context for landings covered in recent policy documents (e.g., National Operational Programme) to underpin strategies for (sustainable) marine fisheries in Belgium surprisingly only go back to 1990 (ILVO 2008, Anon. 2008).

We concluded that our current collective memory (*i.e. publicly available data and information*) related to marine fisheries does not surpass 30 years. We could think of at least five possible reasons to explain the absence or incompleteness of data on marine fisheries before 1980:

- data were not collected/never existed;
- data exist/existed, but are not available (anymore) in the public domain;
- data exist and are publicly available, but data policy restrictions apply;
- data exist and are freely accessible, but not available in the appropriate format;
- data exist and are freely accessible, in appropriate format, but of insufficient reliability.

Objectives

The objectives of the present exercise were to identify, describe, verify quality, and, permanently store and safeguard historical data of Belgian marine fisheries, to integrate these data into a standardized database, and to make time series available to end-users. The scope of this paper is on the efforts of the Belgian fleet. It therefore contains data on landings by Belgian fishers, as recorded in the fish auctions. These records cover landings in Belgian ports and in foreign ports and exclude landings from foreign countries in Belgian ports. The data on the extent and capacity of the fleet and on the social and economic parameters of the Belgian fisheries sector will be the subject of another review exercise.

Gaps and inconsistencies in sources and content are documented. The process of quality control provides an assessment of data reliability to the user. In this paper we describe a stepwise process in which we inventory, describe, collect, and critically assess quality of the data on Belgian marine fisheries. The results and main findings are annotated and discussed: they serve as evidence and arguments to answer the above questions.

Materials and Methods

Question 1: Do data exist, were data collected?

Searching for literature on Belgian fisheries proved to be quite a successful venture, unless the search was specific for data and time-series. In particular historical data before the 1980s on landings and catch rates at the lowest taxonomic level (by species) were scarce. Main sources and search engines were queried for literature and screened for local data sources.

Starting points were well structured databases that allowed advanced querying on the basis of specific search terms. These databases were screened for publications, documents (including grey literature) and data on fisheries in Flanders/Belgium. Search terms included 'fishery', 'fisheries', 'fishing', 'landings', and when possible wildcards were used (e.g. 'fish*').

- Specialized libraries and databases with digitally accessible collections (on-line index/query possibilities):
    - The Integrated Marine Information System IMIS (Flanders Marine Institute - VLIZ) (http://www.vliz.be/imis) and its 'Open Marine Archive' (OMA) with full-text digital documents. Screened for data and information (modules 'publications' and 'datasets') during October 2007-February 2008;
    - The Belgian Marine Data Centre BMDC of the Management Unit for the Mathematical Model of the North Sea – MUMM (http://www.mumm.ac.be);
    - The Food and Agricultural Organization of the United Nations (FAO) and the International Council for the Exploration of the Sea (ICES); and
    - Fishbase (www.fishbase.org/) and the *Sea Around Us* Project (www.seaaroundus.org/).
- Specialized libraries: physical collections:

- The library of the Flanders Marine Institute (VLIZ) (*Oostende*, Belgium);
- The library of the Sea Fisheries Service (*Oostende*, Belgium); and
- The library and archives of the Institute of Agriculture and Fisheries Research – ILVO (*Oostende*, Belgium). This collection was stored in the archives of VLIZ to be disclosed, documented and partly digitized. (e.g. 'Fishery atlases' and 'stock assessments for herring').

- Catalogues, literature databases and internet 'harvesters': JSTOR, Web of Knowledge, Aquatic Sciences and Fisheries Abstracts, Google Scholar, Avano, Antilope and CCB (for completing reference titles).
- Historical collections: an additional search effort was conducted in the physical collections of historical archives and documentation centers in Belgium:
  - Archives of the National Institute of Statistics, Belgium (NIS), kept in the collections of the State Archives (*Rijksarchief*) of Belgium in Brussels;
  - State Archives (*Rijksarchief*) of Belgium in Brussels and Bruges: contain physical collections and inventories of historical documents of the archives of the Province of West-Flanders (1795-1814, 1830-1875), the Chambers of Commerce of *Oostende* and *Brugge*, Municipal archives of *Nieuwpoort, Blankenberge, Brugge, Heist*. The collection includes *'Bestuursmemorialen'* and *'Rapport sur l'état de l'administration de la province de Flandre Occidentale'* (Annual reports on the state of the provincial administrations) as well as *'Placcaeten van Vlaanderen'* (De Wulf 1766), which collects ancient laws and prescriptions from the local governments;
  - Provincial Archives in Bruges, which contain the inventories and physical collection of the archives of the Province of West-Flanders (1815-1830, 1875-present); and
  - City Archives of Antwerp (*ErfgoedBibliotheek Hendrik Conscience, Antwerpen*). Contain one of the most complete series of '*Landbouwstatistieken'* (Agriculture and Fisheries statistics of Belgium).

The methodology applied for screening and searching depended on the type and nature of the document or the series. As a general approach, the archivist was contacted previously and assisted in the search. Most 'promising' inventories were screened based on titles (geographic and thematic). A list of inventories and documents consulted is available from the authors.

Question 1: Findings

Table 1 gives an overview of formal sources that contain data on landings and/or value of landings by Belgian fishers in Belgian and foreign ports from 1700 to 2007 with an indication of the temporal resolution (period and frequency of data sampling), taxonomic resolution (level of aggregation), and spatial resolution (by area of origin or port of landing). The political-administrative situation is indicated, as well as reference to some noteworthy events in fisheries at that time. Only sources that contain time-series (>5 consecutive years) are listed in the table, thus this list is not meant to be exhaustive. The sharp decrease in references going back in time may, in part, reflect the decreased availability and inevitable loss of older documents. The findings of this search were broadly divided into three categories or time intervals for the purpose of this paper: 1) recent history (1900-2000); 2) the Dutch (1815-1830), early Belgian (1830-1900) and Austrian and French periods (1700-1815); and 3) the Middle Ages.

A complete list of historical and current sources consulted in this study is available at: http://dev.vliz.be/EN/Figures_Policy/Figures_Policy_Belgian_Sea_Fisheries (click on 'Collection of publications and other sources') and from the bibliography section in the present paper.

Recent history: 1900-2000

Detailed digital sources of annual landings and their values were available from 1998 onwards. This time series of official annual reporting is available in paper format since 1973. However, the predecessors of this series date back to the early 20th century (1912). Fragments of these can be found in hard copy; in some city and province archives scattered throughout Flanders.

An overview of the marine fisheries of Belgium in 1909-1910 (von Schoen 1912) provided information on the number of vessels and fishers, their production and fishing areas, ports and auctions, and import and export data, at that time. However, it does not refer to or contain a time series of landings data.

Our literature screening for time-series on landings and the economic value of these landings indicated that structurally embedded reporting in Flanders/Belgium started in 1929 with an acceptable degree of consistency and continuity ever since, except during the war period (World War II: 1940-1945). The reports have been subject to a number of changes over time (e.g., responsible authority and editor, title and format of the publication). These were either published as independent reports, or as inserted chapters in agriculture statistics reports.

The achievement of standardized and structural reporting was the work of many: the need for these data has long been recognized, i.e. by the government commission in charge of surveying this sector (Du Bus and Van Beneden 1866). The work of De Zuttere (1909) was also crucial in consolidating this structural reporting on fisheries statistics. Finally, the beginning of this structural reporting on fisheries and landings in Belgium coincided with the period where most states in Europe developed a statistical approach to underpin policy development (de Reiffenberg 1932a, 1932b, Julin 1918, Leti 2000, François and Bracke 2006).

Austrian, French and Dutch period, and the early decades of the Kingdom of Belgium: 1700-1900

Data on fisheries in Flanders were reported much earlier. Cloquet (1842) and De Zuttere (1909) reported on landings of herring and cod in the ports of *Oostende* and *Nieuwpoort* from 1767-1780 during the 'Austrian Habsburgs' (1713-1794) and French period (1794-1815). The data on 18th century landings reported by Cloquet (1842) were largely based on detailed records (the remainders of which were checked in State Archives) which were presumably still intact at that time. De Zuttere reported on landings for the period 1836-1907 for herring, salted cod and for 'fresh fish' (aggregate of unidentified species). Although the author probably consulted a wider range of original documents directly obtained from fish auction authorities or Chambers of Commerce, presumably lost at present, he referred to the annual state of administration of the province of West-Flanders (*Rapport sur l'état de l'administration dans la Flandre occidentale fait par la Députation permanente au Conseil provincial*) and the cantons (*Rapports faits par messieurs les commissaires d'arrondissement*). These sources were checked, and found to coincide with the data in De Zuttere (1909) except for some minor errors which were probably due to transcription. Some of the data and tables reported by De Zuttere (1909) were also found as draft documents while screening for historical sources (with no metadata or identification whatsoever of author and context) in the State Archives at Brussels (inventory of Vleeshouwers 1979).

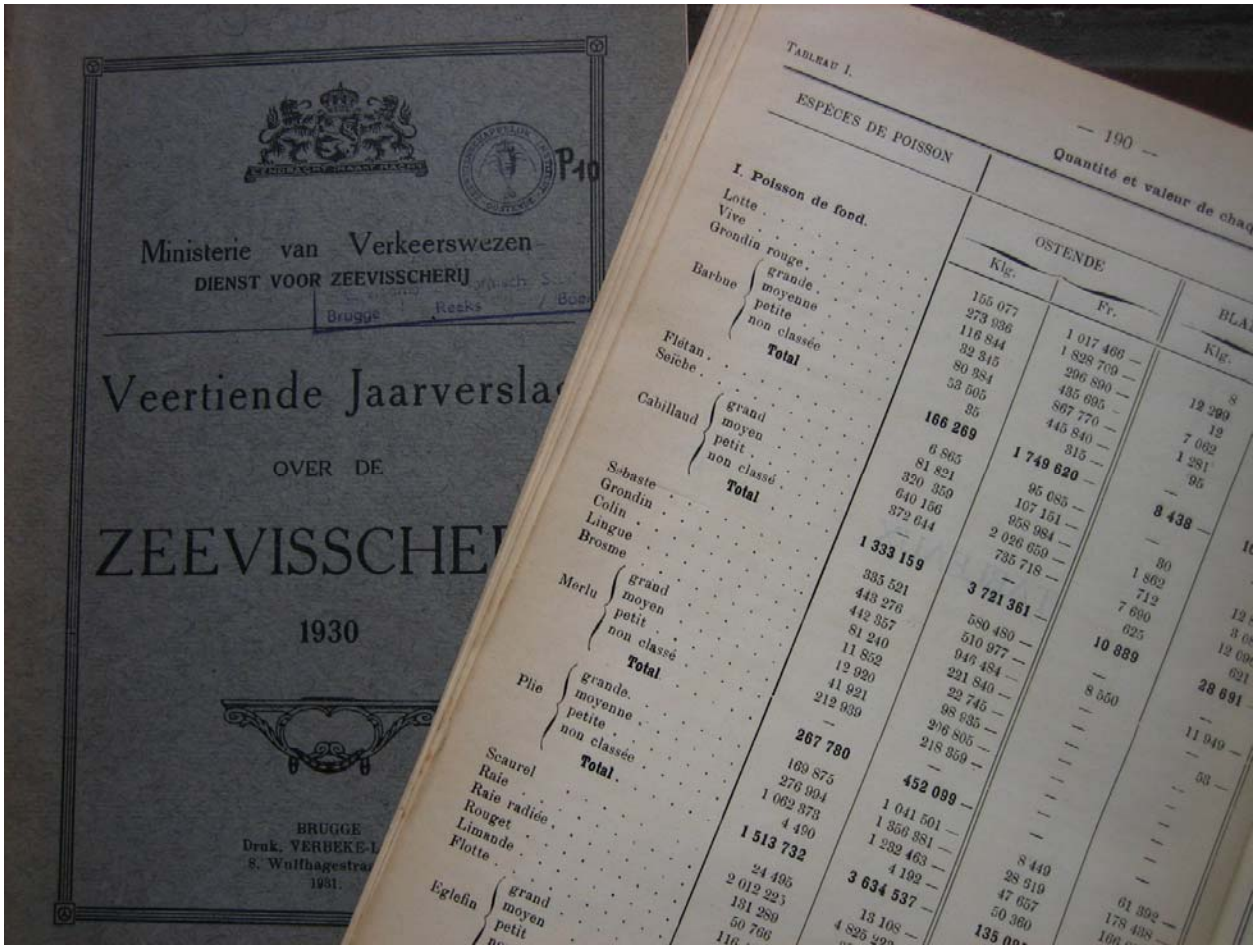


Figure 3: Image of the original tables and fisheries reports in the Series 'Jaarverslag over de zeevisscherij', Dienst voor Zeevisscherij/ Bestuur van het Zeewezen, 1930. Scanned images available from http://www.vliz.be/EN/Figures_Policy/Figures_Policy_Belgian_Sea_Fisheries. Source: A century of Sea Fisheries in Belgium (VLIZ 2009)

In spite of the level of detail provided by Cloquet (1842) for the time periods 1767-1780 and 1783-1789, and by De Zuttere (1909) for the same intervals and for 1836-1907, neither of the authors included data or references for the 45 year time period 1790-1835. This period largely coincides with the 20 years of the first French Republic (1795-1804) and the French Empire (1804-1815), and with the 15 years of the Kingdom of the Netherlands (1815-1830). During the Dutch administration, official statistics were coordinated by the 'Bureau of Statistics' (later the 'Royal Commission for Statistics'), established in 1826 by Interior Affairs in The Hague. The founder of Belgian statistics, Adolph Quetelet (1796-1874) was a member of one of the provincial commissions. In their overviews of early official statistical publications (including the French period), Heuschling (1843) and Julin (1918) commented briefly on the difficulties with marine fisheries statistics. The absence of references and data during the French and Dutch period may be due to the fact that these were non-existent or simply not disclosed in foreign archives or brought into the public domain. During our search in the State Archives, documents of correspondence with the fisheries administration in The Hague dating from the Dutch period were encountered, but no fisheries statistics or reference to the existence thereof were found. Further efforts are under way to expand this search effort to foreign archives and working groups that focus on historical fishery statistics abroad.

Table 1: Sources containing historical time-series (>5 consecutive years) on landings by Belgian fisheries from 1700 to 2007 with an indication of temporal, taxonomic and spatial resolution.

	Interval	Fishery-related events	Source	Period	Frequency	Taxonomic resolution	Spatial resolution	Physical location	Digitally available in VLIZ: Data set (D) Full publication (F)
1	**MODERN TIMES**	EU Common Fishery Policy 1972 and 1975:	Series 'De Belgische zeevisserij. Aanvoer en besomming'. Dienst Zeevisserij.*	1973-2007	Annual	By species, subtotals, general total	By port and by fishing area	DVZ	Available in paper format: 1973-1997 D: 1998-2006
2		'Cod Wars' in Iceland waters	Series 'De Belgische zeevisserij'. *Landbouwstatistieken*. Nationaal Instituut voor de Statistiek.	1969–1999	Annual	By species, subtotals, general total	By port and by fishing area	HC-Antwerpen	D
3			Collection 'Monthly landings'. Archief van dr. Frank Redant, ILVO.	1967–1980	Annual	By species, subtotals, general total	By port	ILVO and VLIZ libraries	Available in paper format
4		1958: first 'Cod war', Iceland	Series 'Statistiek van de zeevisserij' *Statistisch tijdschrift*. Nationaal Instituut voor de Statistiek.	1957–1968	Annual	By species, subtotals, general total	By port and by fishing area	HC-Antwerpen	D
5		World War II (1940-1945)	Series 'Statistiek van de zeevisserij' *Statistisch bulletin*. Nationaal Instituut voor de Statistiek.	1934–1956	Annual, no data in 1941, no data by fishing area in WWII	By species, subtotals, general total	By port and by fishing area	Erfgoed-bibliotheek Hendrik Conscience Antwerpen	D
6			Series 'Bestuurlijk Jaarverslag over de Zeevisscherij'. Bestuur van het Zeewezen.	1934-1939	Annual, no publication in 1941	By species, subtotals, general total	By port	VLIZ, DVZ	Available in paper format (1934–1936) F (1937–1939)
7			Series 'Jaarverslag over de zeevisscherij', Dienst voor Zeevisscherij/ Bestuur van het Zeewezen.	1927–1933	Annual	By species (from 1929), subtotals, general total	By port and by fishing area (from 1929)	VLIZ library, library Province West-Flanders,	F (1927–1931) Available in paper format (1932–1933)
8		**1914-1918**: World War I **1914**: natural ice replaced by artificial ice for preservation	Series 'Jaarverslag der commissie voor zeevisscherij', Provincie West-Vlaanderen.	1912–1926	Annual; no publication in WWI (1914-1918)	Subtotals, general total	By port	VLIZ library, library Province West-Flanders,	F

9	BELGIUM early decades (from 1830)	**1909**: the end of 'salted cod' fisheries in Belgium	De Zuttere (1909). Enquête sur la pêche maritime en Belgique.	1836-1907	Annual+ summer/winter landings for cod	Salted cod, herring and 'fresh caught fish'	By port	Archives and VLIZ library	F
10		**1862**: end of state subsidies in herring fisheries, Belgium **1866**: survey on sea fisheries sector, Belgium	Rapport sur l'état de l'administration dans la Flandre occidentale fait par la Députation permanente au Conseil provincial	1836-1869	Annual	Cod, herring and 'fresh caught fish'	By port	State and Provincial archives	D
11		**1884**: arrival of the first steam trawler in Belgium (Oostende)	Memoriael Administratif der Provincie West-Vlaenderen. Bestuursmemoriaal van de provincie West-Vlaanderen-Section 'Pêche maritime'	1837-1875	Annual (not all volumes contain landing statistics)	Cod, herring and 'fresh caught fish'	By port	State archives	D
	United Kingdom The Netherlands	1815-1830	Data gap						
	French Republic /Empire	French Republic 1795-1804 And French Empire 1804-1815	Data gap						
12	**Austrian Netherlands (1713-1794)**	Oostende Compagnie (1723-1731) for stimulating Flemish trade and fisheries	Cloquet (1842). Études sur l'industrie, le commerce, la marine et la pêche nationale	1767-1780, 1783-1789		'Salted cod' and herring		UA Bibliotheek Stadscampus	F

13	**Spanish Netherlands (1549-1713)**	**Ca. 1475**: start of Flanders *'Doggevaert'* or cod fisheries on the Doggerbank in the North sea **1547**: Flemish fleet consists of 200 vessels	Vlietinck, (1975). Het oude Oostende en zijne driejarige belegering (1601-1604)	1492-1580	VLIZ library	Available in paper format
14	**Burgundian Netherlands (1384-1530)**	**1396:** Flemish invent a technique for conservation of *herring: 'kaken'*	Degryse & Mus (1966-1967). De laatmiddeleeuwse haringvisserij	1398-1427	VLIZ library	Available in paper format

*Note: Format: all sources are in paper format except * from 1998 onwards (data 1997)*
HC: Erfgoedbibliotheek Hendrik Conscience, Antwerpen – Heritage Library Hendrik Conscience, Antwerp

The State Archives in Bruges keep original documents and records on landings of cod from the Company for trade and fishing to Iceland '*De Groote Nationale Compagnie voor zeevaart en vischvangst op Ijsland (1727-1780)*' (Inventory of the old regime of the City of *Nieuwpoort* - INV80 - 4184). In 1866, a government commission was charged with the investigation into the marine fisheries of Belgium. The report from this commission contains valuable information on marine fisheries drawn from a survey (Du Bus and Van Beneden 1866).

The landings data reported for this period were also collected and digitized in the context of this project. Although not consistently or systematically collected over the period, they provide a good idea of the fisheries during that era. Today, only fragments remain since the largest part of the archives was destroyed during World War I (1914 - 1918) and World War II (1940 - 1945). The data demonstrate the importance of subsidies in the observed trends, as was the case for the period 1842-1868. The rise and fall of cod fisheries in the 19th century could in part be explained by the existence of these subsidies. On the other hand, it was mainly the administrative support and control associated with granting subsidies that acted as the driver for the collection of the early fisheries statistics.

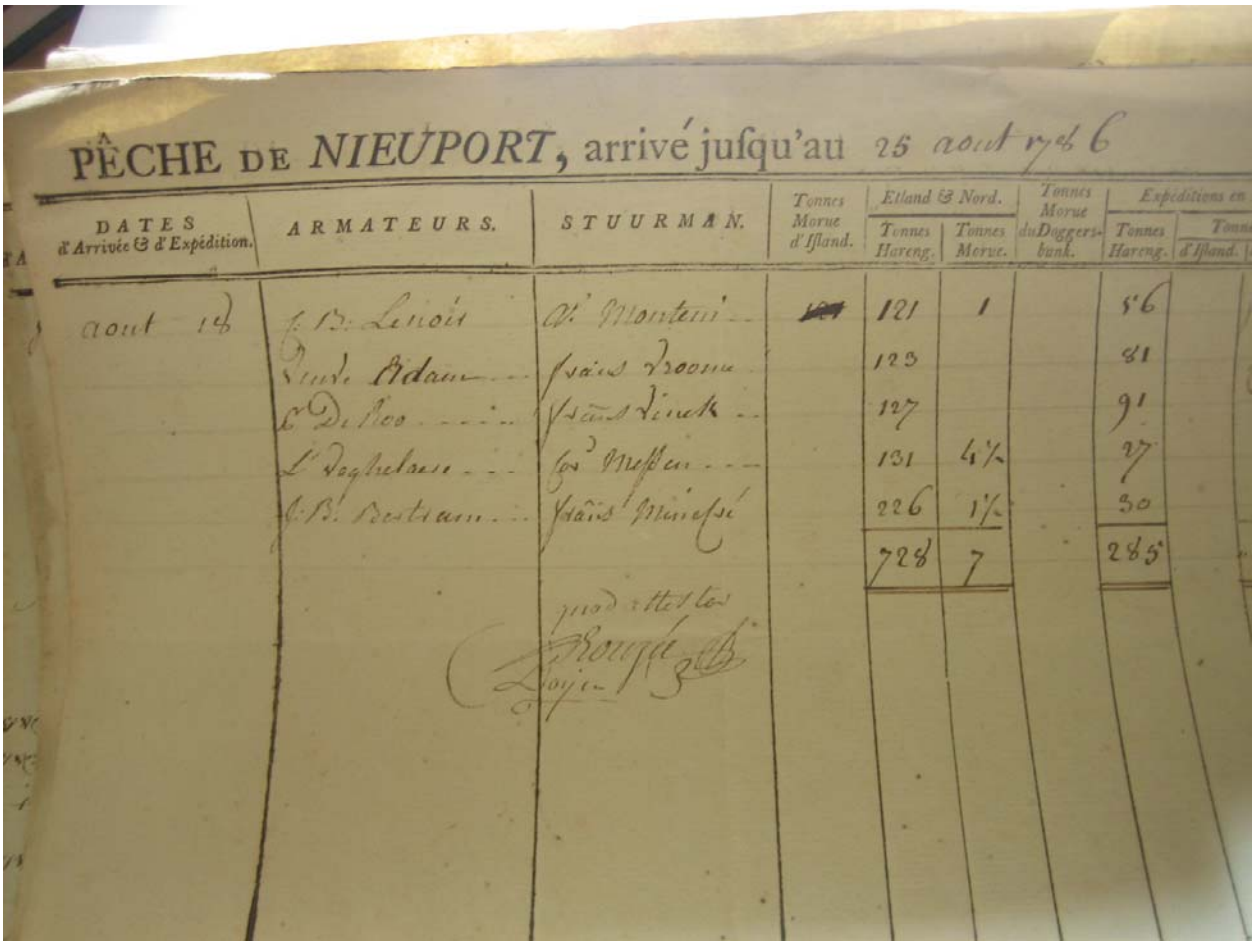
Middle Ages to 1700

Historical documents such as charters and local laws shed light on the importance of fisheries in Flanders during the Middle Ages and the Early Modern Period. The ports of *Oostende* and *Nieuwpoort* enjoyed periods of wealth and independent status for trade and fisheries. Detailed records were kept on landings, due to the tax levies on salt and particularly during years in which subsidies were granted to the herring and cod fisheries. Early documented evidence of the extent of fish trade in Flanders can be derived from taxes levied in coastal ports at the beginning of the 11th century (Degryse, 1944). Early published reports of landings in Flanders refer to herring in the port of *Biervliet* in 1398-1427 (Degryse and Mus, 1966-1967) and to *Oostende* in 1492-1580 (Vlietinck 1897). The State Archives at Bruges contain valuable documents on the history of fisheries and associated trade in *Nieuwpoort* such as the '*Keure van Nieuwpoort*' (city charter of Nieuwpoort) from 1163 which summarizes the species of fish caught, traded and taxed; a Charter of 1574 in which the king granted the city the right to exploit salt (Archive INV80 – 376); and the '*Placaetboeken van Vlaanderen*' (De Wulf, 1766) with reference to local laws and charters.

State Archives and statistics

Belgian Law on State Archives (*Rijksarchieven-RA*) stipulates that all governmental documents and administration archives older than 100 years need to be transferred to the State Archives. In practice, RA strives to collect archives as soon as they are freed from legal value (30 years and older). Recent documents (after 1980) on marine fisheries are generally kept at the Sea Fisheries Service (DVZ). Older documents were transferred from the respective fisheries authorities to the State Archives, and it was not clear in what conditions these transfers were conducted or how complete these archives are (M. Preneel, National Institute of Statistics, Belgium, pers. comm.).

The responsibility for marine fisheries has changed between ministries since the creation of the Kingdom of Belgium in 1830, e.g., the 'Ministry of Mobility and Infrastructure' created in 1884, 'Ministry of Mobility, Post, Telegraphy and Telephones', the 'Ministry of Labour and Industry', and the Ministries responsible for Agriculture in the Belgian government. With the regionalization of Belgium, the Flemish government was created in 1981. The Lambermont agreements, signed in 2000, finally transferred Sea fisheries from the federal level to the domain of agriculture of the Flemish Government.



PÊCHE DE *NIEUPORT*, arrivé jusqu'au 25 aout 1786

DATES d'Arrivée & d'Expédition.	ARMATEURS.	STUURMAN.	Tonnes Morue d'Island.	Etland & Nord. Tonnes Hareng.	Etland & Nord. Tonnes Morue.	Tonnes Morue du Doggersbank.	Expéditions en Tonnes Hareng.	Expéditions en Tonnes d'Island.
aout 18	C. B. Lenoir	Al. Montens		121	1		56	
	Pieter Adam	Jacques Broome		123			81	
	Cr. De Roo	Jacques Dinek		127			91	
	L'Doghetaer	Cos. Messen		131	4½		27	
	C. B. Bestiaen	Jacques Minesse		226	1½		30	
				728	7		285	
		pour attester la Bourse de Dayen						

Figure 4: Picture from the archives of the ancient regime of *Nieuwpoort* (INV 80 4184): fish landings register from August 25, 1786 in the fishing port of *Nieuwpoort*. Source: A century of Sea Fisheries in Belgium (VLIZ 2009).

We also looked at the history and development of statistics in Belgium and checked the list of official statistical publications in Belgium from 1830 to 1914 to check for additional references to older publications and data sources. Julin (1918) and de Reiffenberg (1932) provide good overviews of the history of the early statistics in Belgium and the difficulties in setting up methodologically sound census and data collecting systems to underpin state policies, in particular for marine fisheries. The need to standardize the collection of fisheries data was already underlined much earlier by De Zuttere (1909) and in the early volumes of the series '*Jaarverslag der commissie voor zeevisscherij*', Provincie West-Vlaanderen (*Table 1*).

Question 1: Conclusions

Time series on landings of marine fisheries in Flanders are reported as early as 1767 (1767-1780; 1836-1906) for herring, salted cod and for 'fresh fish' (aggregate of unidentified species). These fragmentary data are valuable when attempting to reconstruct parameters such as landings per unit of effort (LPUE), socio-economic importance, etc. in combination with other datasets. The absence of references and data for the 20 years during the first French Republic (1795-1804) and the French Empire (1804-1815), and the 15 years of the United Kingdom of the Netherlands (1815-1830) may be due to the fact that these were not yet discovered in foreign archives. Our literature screening for time-series on landings and the economic value of these landings indicated that structurally embedded reporting in Flanders (Belgium) started in 1929 with an acceptable degree of consistency and continuity ever since, except during the war period (1940-45). The focus of the present exercise is to reconstruct the time-series at the lowest taxonomic level, based on this systematic and consistent reporting. The beginning of structural reporting on fisheries and landings coincided with the period where most States in Europe developed a statistic approach to underpin policy development.

Question 2: Are data (still) publicly available and if yes, what data policy restrictions apply?

Significant effort was expended to collect and describe the original hard copies of the sources identified above, and make them electronically available in the public domain through the digital library 'Open Marine Archive' (http://www.vliz.be/EN/Marine_Library/Library_OMA) or in the physical collection of the library of the Flanders Marine Institute.

Table 1 indicates format (digital/paper/scans) and availability (data owner/physical location) of the 'paper' sources with time-series of landings. A number of data sources were publicly accessible in the archives of the *Rijksarchief* (State Archives) or in municipal/provincial archives, access to which was granted upon formal request. Some sources report on fisheries as part of a larger scope of reporting (e.g., agriculture statistics). Given the focus of the present exercise, priority was given to collecting and digitizing only the time-series on fisheries landings contained within these sources (not the entire reports).

Question 2: Findings

Historical sources were only available in hard copy, except for annual reports (Table 1) which are in electronic format (pdf) from 1998 onwards. None of the time-series contained in the pre-1998 reports identified in Table 1 were available electronically in the public domain. Our search for historical data and analysis of scientific and policy documents (see 'Collective Memory Disorder?' and 'Question 1: Do data exist, were data collected?') provided further evidence that these historical data were not available in the public domain or for research purposes.

Through the present exercise, the collection of data sources was stored and described, and data were digitized from the earliest year of consistent time-series (1929). All data are now public and no restriction other than the acknowledgement of sources and authors is required. A detailed list and description of digitized sources of data on landings (and their value) is available from: http://www.vliz.be/cijfers_beleid/zeevisserij/pub_bijdrage.php.

- A large portion of the original and prime data sources, such as logbooks and monthly statistics that were once recorded by the fisheries authorities or archives may have been lost and are only accessible through secondary references (e.g., Cloquet 1842, Vlietinck 1897, De Zuttere 1909);
- Part of these 'secondary' publications and annual reports from the second half of the 19th century were accessible in public archives: state (Belgium), provincial (West-Vlaanderen) or city (*Antwerpen, Brugge, Oostende*) and universities;
- Paper sources were generally of acceptable quality for subsequent digitizing; and
- Restrictions in digitization: Resources available restricted digitization of large volumes, as did quality of hard copies. Legal or policy aspects did influence digitization.

Question 2: Conclusion

Historical data on landings before 1998 were only available in hard copy and none of the data or time-series were available electronically in the public domain. No legal or other data policy restrictions were indicated or applicable. A detailed list of digitized data sources of landings is available at: http://www.vliz.be/cijfers_beleid/zeevisserij/pub_bijdrage.php.

Question 3: Data exist and are publicly and freely available, but are not in the appropriate format

As mentioned above, none of the actual data from the tables contained in the above reports were available electronically. Thus, digitalization and integration of data was never conducted and data were therefore not available for overviews or research analysis. The objective of this project was to integrate and store data from different sources into one database. This is a stepwise process, involving basic aspects of data management such as standardization and quality control (QC). Quality control, in all its dimensions, is an essential aspect in the recovery and integration of (historical) data. The different steps of converting and integrating data are documented in the following section.

- Conversion from digitized paper copies: converting the tables as published in the original annual sources, to MS Excel format tables;
- Quality control of the conversion process: QC on the created MS Excel tables;
- Quality control of data: QC of data in MS Excel tables and correction of errors;
- Standardization of MS Excel files (species, fishing grounds, ports);
- Integration of MS Excel files into a standardized and integrated pivot table (database);
- Quality control of integrated pivot table (database); and
- Graphical analysis, based on the integrated database.

Conversion from digitized original tables to MS Excel table format

The digitized sources (original paper copies) with the composition and value of landings required intermediate handling in order to be exported to MS Excel. The data from digitized sources (e.g., Figure 5) were extracted by means of image/pdf reading software (ABBYY FineReader v.9.0) and converted to MS Excel format. The effort of conversion was greatly optimized through this software (Figure 6). Tables and table structures were analyzed by the software before reading. The information was then copied and pasted in Excel tables.

FineReader conversion process (QC on Excel copies of original documents)

However, a number of anomalies (dots, spots, etc) in the printing and/or artifacts due to paper quality, storage and handling of the documents over the years, needed careful attention during the conversion process. A first visual control ensured that tables and table structure were correctly interpreted by the software and missing numbers and digits were identified. Anomalies that were misinterpreted by the software such as numbers or commas needed correction.

Quality control of data (MS Excel files) and correction of errors

A second quality control focused on the quality of the data (Figure 7). The data tables list species names in the first column and names of ports (or fishing grounds) in the first row, for any given year 'x'. Each field in the table for year 'x' therefore corresponds with the landings of a given species in a given port (or from a given fishing ground) for that year. Column subtotals should represent the sum of all landings for a given species for all ports (or fishing grounds) in year 'x'. Row subtotals should sum landings of all species by the categories of (1) demersal species, (2) pelagic species and (3) molluscs and crustaceans, by port (or by fishing ground) for year 'x'. Finally, subtotals add up to 'Global totals' in the last row. These annual row and column subtotals and totals were presumably calculated in the original files by the staff of the fisheries authority upon collecting the daily information in the fish auctions. These calculated (sub) totals were also copied in the conversion process. By calculating row and column subtotals in MS Excel, and cross-checking them with the subtotals and totals as published in the original document, two types of errors could be detected:

- A number in a column or row was wrongly copied; or
- The original (sub) total was incorrect (error in the original summation).

In these two cases, the error could be located by checking the rows or columns in the original and copied document (Figure 8). A third type of error may have occurred at the level of each field entry: i.e., errors in draft versions of the original table, before the subtotals and totals were calculated. These errors could not be traced.

The consecutive steps of the FineReader conversion, the quality control on the conversion process and the first data quality control on each of these sets of converted tables (Figures 5-8) resulted in a total of 185 MS Excel 'corrected files'. Each file represents a given dataset for a given year. Visible errors in copying and/or calculations were amended in these corrected files. Each of these errors was described and the corresponding amended figures were documented in the 'metadata' worksheets of the 'corrected files'. Many of the errors in the source documents were explained by:

- Mistakes made by the officer in charge, at the moment of reading and copying numbers, figures and locations from original notes (e.g., logbooks from the auction, or monthly overview tables) to the final overview table;
- Errors made by the officer in adding up (sub) totals during the process of completing the tables; and
- A combination of any of the previous.

Although much effort was assigned to this second QC, it is possible that some errors were not traced or accounted for. Depending on the number of intermediate steps that led to the definitive annual summary table and the procedures that were followed by the officer in drawing these annual summaries, different levels and types of errors may have occurred. Some of these errors were checked through visual quality control of the final results (see below), where we looked for outliers and 'suspicious' peaks or values.

— 16 —

QUANTITÉ ET VALEUR DU POISSON DÉBARQUÉ DANS LES DIFFÉRENTS PORTS DE PÊCHE DE BELGIQUE
HOEVEELHEID EN WAARDE ELKER SOORT VISCH GELOST IN DE VERSCHILLENDE VISSCHERIJHAVENS VAN BELGIË

(Source : Administration de la Marine) *(Bron : Beheer van het Zeewezen)*

ESPÈCES DE POISSONS	PORTS — HAVENS								TOTAL - TOTAAL		*VISCHSOORTEN*
	OOSTENDE OSTENDE		BLANKENBERGHE		ZEEBRUGGE		NIEUWPOORT NIEUPORT		Quantité *Hoeveelh.*	Valeur *Waarde*	
	Kg.	Fr.	Kg.	Fr.	Kg.	Fr.	Kg.	Fr.	Kg.	Fr.	
I. Poissons de fond.	A. — PÊCHE BELGE. — *BELGISCHE VANGST*										**I. Diepzwemmende visch**
Lotte	301.536	1.941.883	—	—	—	—	60	658	301.596	1.942.541	*Aalrups*
Vive	22.918	236.032	5.507	41.883	94.631	761.802	3.027	29.808	126.083	1.069.525	*Arend*
Grondin rouge	287.625	505.700	—	—	—	—	—	—	287.625	505.700	*Engelsche soldaat*
Barbue	352.469	2.427.787	8.388	62.759	24.277	236.985	8.710	78.486	393.844	2.806.017	*Griet*
Latour	18.652	55.434	—	—	—	—	—	—	18.652	55.434	*Haringshaai*
Elibot	19.064	216.910	—	—	—	—	—	—	19.064	216.910	*Heilbot*
Berger	4.063	60.358	—	—	—	—	—	—	4.063	60.358	*Herder*
Cabillaud	3.106.305	9.437.053	6.817	13.744	7.880	29.323	22.613	47.275	3.143.615	9.527.395	*Kabeljauw*
Sébaste	298.785	626.307	—	—	—	—	—	—	298.785	626.307	*Klipvisch*
Grondin	715.890	667.860	2.924	4.218	55.347	60.745	12.802	23.040	766.963	755.863	*Knorhaan*
Surmulet	18.848	51.257	—	—	—	—	—	—	18.848	51.257	*Koningsvisch*
Colin	964.677	1.507.936	—	—	275	350	10	23	964.962	1.508.309	*Koolvisch*
Lingue	256.011	597.242	—	—	—	—	—	—	256.011	597.242	*Leng*
Brosme	27.365	41.900	—	—	—	—	—	—	27.365	41.900	*Lom*
Merlu	709.212	2.167.520	—	—	—	—	—	—	709.212	2.167.520	*Mooiemeid*
Plie	2.346.714	6.160.253	97.381	333.504	555.968	2.354.354	258.649	724.238	3.258.712	9.572.349	*Pladijs*
Scaurel	37.070	30.813	4.270	2.276	—	—	2.103	2.491	43.443	35.580	*Poor*
Raie	2.548.303	6.244.198	30.523	106.280	343.543	778.534	89.841	267.386	3.012.215	7.396.398	*Rog*
Raie radiée	552.964	1.706.141	15	54	—	—	—	—	552.979	1.706.195	*Rog (Keel)*
Rouget	208.320	658.034	100	393	5.019	21.491	543	2.233	213.982	682.151	*Roodbaard*
Limande	129.667	437.225	16.291	71.038	65.097	294.150	40.555	194.440	251.610	996.853	*Schar*
Flotte	340.898	923.115	—	—	—	—	—	—	340.898	923.115	*Schaat*
Eglefin	966.070	3.216.431	—	—	—	—	—	—	966.070	3.216.431	*Schelvisch*
Sole d'Ecosse	665.294	2.196.681	—	—	—	—	—	—	665.294	2.196.681	*Schol (Schotsche)*
Sole limande	255.434	1.259.048	35	74	29	228	4	38	255.502	1.259.388	*Schol (Steen)*
Tacaud	324.760	537.589	325	246	850	2.260	4.177	4.662	330.112	544.757	*Steenpost*
Esturgeon	4.502	75.648	—	—	—	—	—	—	4.502	75.648	*Steur*
Turbot	553.053	4.921.506	6.287	83.391	144.343	1.601.281	17.505	203.644	721.188	6.809.822	*Tarbot*
Sole	1.608.859	23.526.084	30.375	409.942	379.170	5.622.587	58.078	804.252	2.076.482	30.362.865	*Tong*
Merlan jaune	146.464	378.820	—	—	—	—	12	24	146.476	378.844	*Vlaswitting*
Merlan	1.719.991	2.917.647	106.000	139.411	406.114	578.806	137.883	177.312	2.370.068	3.813.176	*Witting*
Bar	63.620	69.794	—	—	—	—	—	—	63.620	69.794	*Zeebars*
Squale pélerin	433.376	370.109	210	286	54.240	46.566	627	612	488.453	417.573	*Zeehaai*
Petite roussette	268.112	244.764	3.110	4.189	1.275	1.880	16.520	19.866	289.017	270.699	*Zeehond*
Congre	156.773	395.516	125	181	—	—	144	856	157.042	396.553	*Zeepaling*
Loup de mer	37.780	74.673	—	—	—	—	—	—	37.780	74.673	*Zeewolf*
Dorée	86.655	315.939	30	89	70	235	20	66	86.775	316.329	*Zonnevisch*
Autres espèces	57.391	69.752	12.905	54.574	200	365	2.248	4.685	72.744	129.376	*Andere soorten*
Total I.	20.615.495	77.270.959	331.698	1.328.532	2.138.328	12.391.942	676.131	2.586.095	23.761.652	93.577.528	*Totaal I*
II. Poissons pélagiques.											**II. Pelagische visch**
Hareng	10.554.361	9.119.564	15	22	3.250	3.144	82.237	99.649	10.639.863	9.222.379	*Haring*
Maquereau	702.315	1.123.014	—	—	—	—	—	—	702.315	1.123.014	*Makreel*
Esprot	1.075.488	795.905	—	—	34.470	13.420	310.090	329.834	1.420.048	1.139.159	*Sprot*
Total II.	12.332.164	11.038.483	15	22	37.720	16.564	392.327	429.483	12.762.226	11.484.552	*Totaal II*
III. Crustac. et mollusq.											**III Schaal- en weekdieren**
Seiche	7.500	2.785	—	—	—	—	—	—	7.500	2.785	*Inktvisch*
Buccins	28.847	50.093	—	—	—	—	—	—	28.847	50.093	*Kinkhorens*
Crabes	43.565	17.813	—	—	15	306	606	1.155	44.185	19.274	*Krabben*
Homards	4.065	69.569	99	3.172	155	2.301	816	16.310	5.135	91.352	*Kreeften*
Petits homards	247.979	686.585	—	—	—	—	—	—	247.979	686.585	*Kreeftjes*
Crevettes et aut. esp.	1.115.766	4.350.762	114.332	550.745	2.000.123	8.412.912	286.197	999.670	3.516.418	14.314.089	*Garnalen en and. soort.*
Total III.	1.447.722	5.177.607	114.431	553.917	2.000.293	8.415.519	287.619	1.017.135	3.850.065	15.164.178	*Totaal III.*
Total général (Pêche belge.)	34.395.381	93.487.049	446.144	1.882.471	4.176.341	20.824.025	1.356.077	4.032.713	40.373.943	120.226.258	**Algemeen totaal** (*Belgische vangst*)
	B. — PÊCHE ÉTRANGÈRE. — *VREEMDE VANGST*										
Poissons de fond	5.927	24.997	—	—	—	—	—	—	5.927	24.997	*Diepzwemmende visch*
Poissons pélagiques	525	520	—	—	—	—	—	—	525	520	*Pelagische visch*
Total	6.452 (1)	25.517	—	—	—	—	—	—	6.452	25.517	*Totaal*
	C. — TOTAL : PÊCHE BELGE ET ÉTRANGÈRE. — *TOTAAL : BELGISCHE EN VREEMDE VANGST.*										
	34.401.833	93.512.566	446.144	1.882.471	4.176.341	20.824.025	1.356.077	4.032.713	40.380.395 (2)	120.251.775 (2)	

(1) Pays d'origine : France. (1) *Land van herkomst : Frankrijk.*
(2) Non compris 91,627 kg. de poisson de fond, d'une valeur de 302,037 fr., débarqué à Anvers.
(2) *Niet inbegrepen 91,627 kg. diepzwemmende visch ter waarde van 302,037 frank gelost te Antwerpen.*

Figure 5: Example of digitized original source (1936, from 'Statistisch Bulletin, 1937')

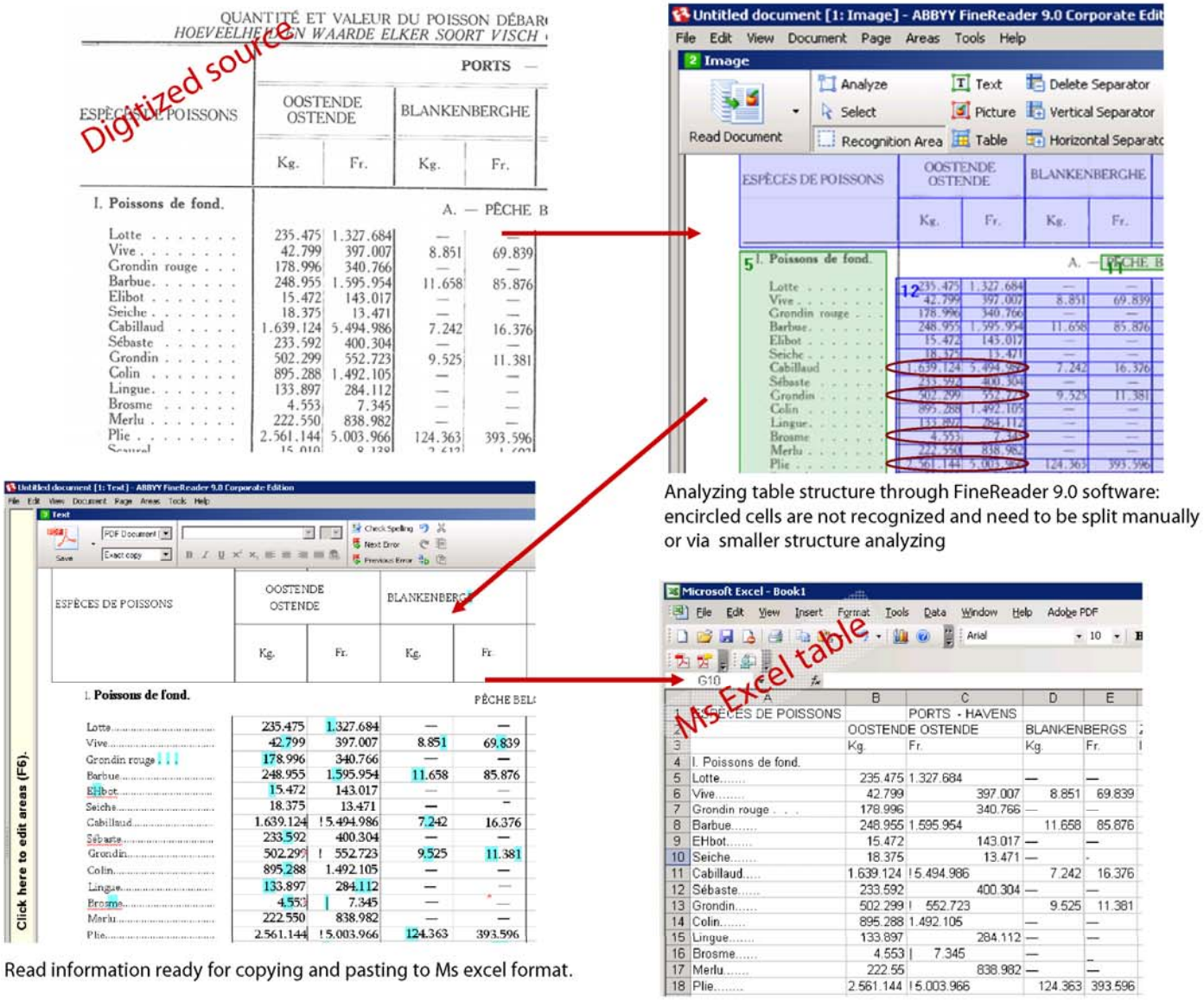
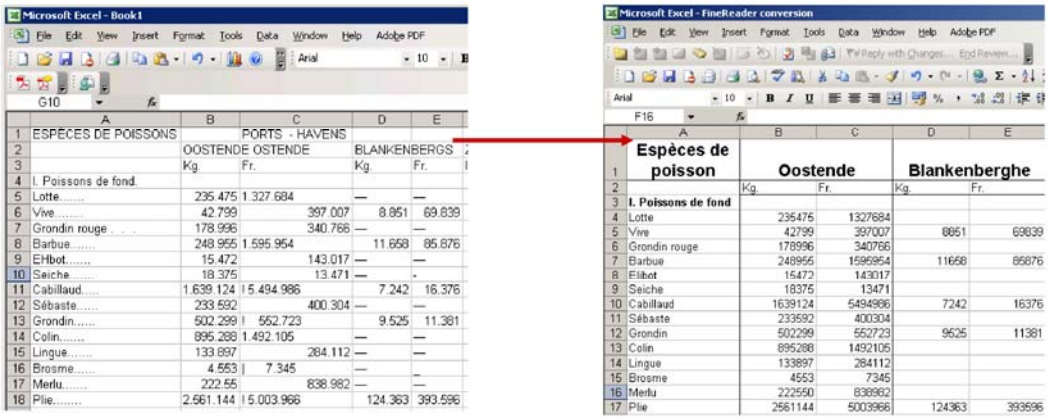


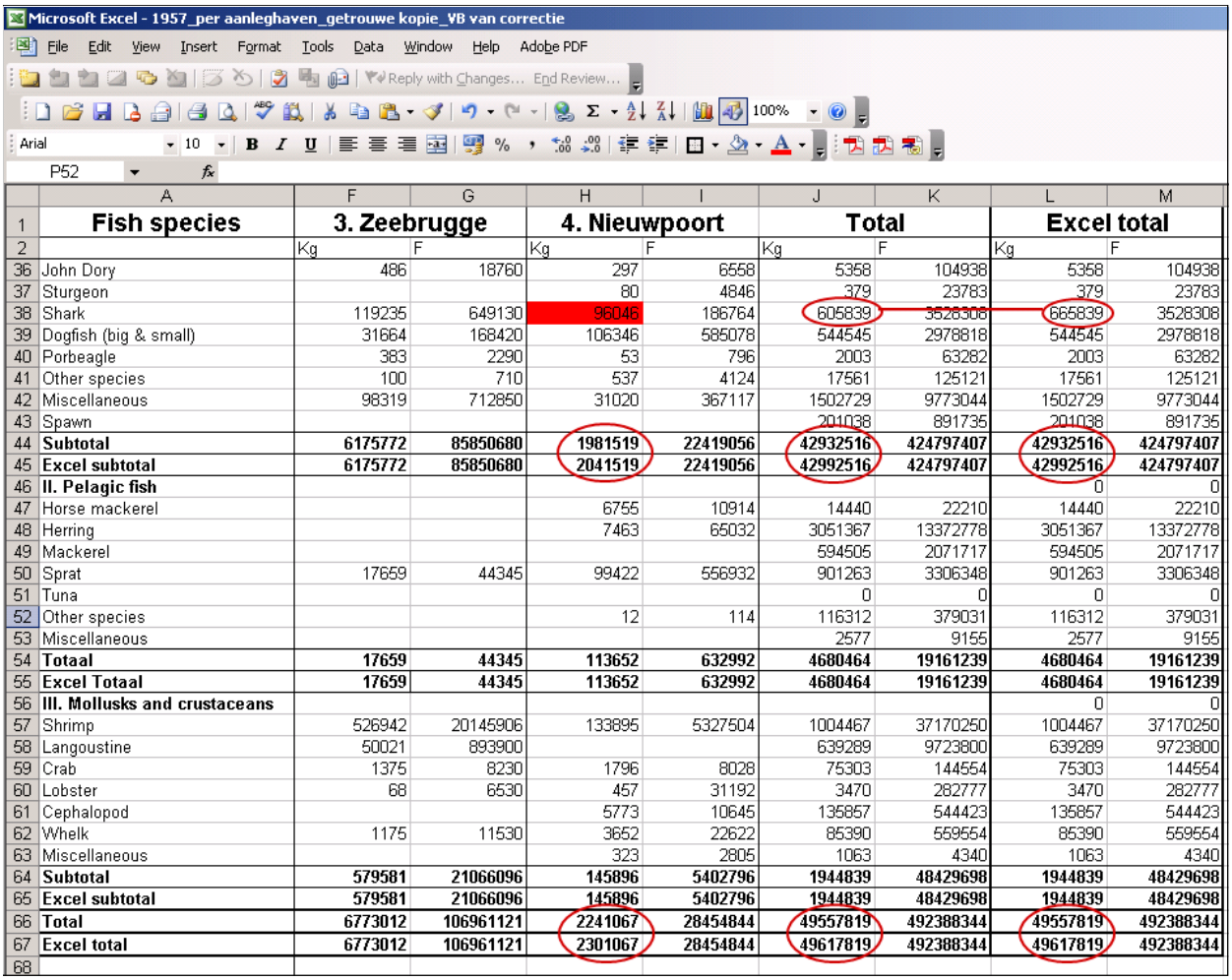
Figure 6: Example of FineReader 9.0 stepwise conversion process.



	A	B	C	D	E
1	ESPECES DE POISSONS		PORTS - HAVENS		
2		OOSTENDE	OSTENDE	BLANKENBERGS	
3		Kg.	Fr.	Kg.	Fr.
4	I. Poissons de fond.				
5	Lotte.....	235.475	1.327.684	—	—
6	Vive.....	42.799	397.007	8.851	69.839
7	Grondin rouge . . .	178.996	340.766	—	—
8	Barbue.....	248.955	1.595.954	11.658	85.876
9	EHbot.....	15.472	143.017	—	—
10	Seiche.....	18.375	13.471	—	-
11	Cabillaud.....	1.639.124	5.494.986	7.242	16.376
12	Sébaste.....	233.592	400.304	—	—
13	Grondin.....	502.299	552.723	9.525	11.381
14	Colin.....	895.288	1.492.105	—	—
15	Lingue.....	133.897	284.112	—	—
16	Brosme.....	4.553	7.345	—	—
17	Merlu.....	222.55	838.982	—	—
18	Plie.....	2.561.144	5.003.966	124.363	393.596

	A	B	C	D	E
1	Espèces de poisson	Oostende		Blankenberghe	
2		Kg.	Fr.	Kg.	Fr.
3	I. Poissons de fond				
4	Lotte	235475	1327684		
5	Vive	42799	397007	8851	69839
6	Grondin rouge	178996	340766		
7	Barbue	248955	1595954	11658	85876
8	Elibot	15472	143017		
9	Seiche	18375	13471		
10	Cabillaud	1639124	5494986	7242	16376
11	Sébaste	233592	400304		
12	Grondin	502299	552723	9525	11381
13	Colin	895288	1492105		
14	Lingue	133897	284112		
15	Brosme	4553	7345		
16	Merlu	222550	838982		
17	Plie	2561144	5003966	124363	393596

Figure 7: Quality control of the FineReader conversion resulting in “clean” MS Excel files.



	A	F	G	H	I	J	K	L	M
1	Fish species	3. Zeebrugge		4. Nieuwpoort		Total		Excel total	
2		Kg	F	Kg	F	Kg	F	Kg	F
36	John Dory	486	18760	297	6558	5358	104938	5358	104938
37	Sturgeon			80	4846	379	23783	379	23783
38	Shark	119235	649130	96046	186764	605839	3528308	665839	3528308
39	Dogfish (big & small)	31664	168420	106346	585078	544545	2978818	544545	2978818
40	Porbeagle	383	2290	53	796	2003	63282	2003	63282
41	Other species	100	710	537	4124	17561	125121	17561	125121
42	Miscellaneous	98319	712850	31020	367117	1502729	9773044	1502729	9773044
43	Spawn					201038	891735	201038	891735
44	**Subtotal**	**6175772**	**85850680**	**1981519**	**22419056**	**42932516**	**424797407**	**42932516**	**424797407**
45	**Excel subtotal**	**6175772**	**85850680**	**2041519**	**22419056**	**42992516**	**424797407**	**42992516**	**424797407**
46	**II. Pelagic fish**							0	0
47	Horse mackerel			6755	10914	14440	22210	14440	22210
48	Herring			7463	65032	3051367	13372778	3051367	13372778
49	Mackerel					594505	2071717	594505	2071717
50	Sprat	17659	44345	99422	556932	901263	3306348	901263	3306348
51	Tuna					0	0	0	0
52	Other species			12	114	116312	379031	116312	379031
53	Miscellaneous					2577	9155	2577	9155
54	**Totaal**	**17659**	**44345**	**113652**	**632992**	**4680464**	**19161239**	**4680464**	**19161239**
55	**Excel Totaal**	**17659**	**44345**	**113652**	**632992**	**4680464**	**19161239**	**4680464**	**19161239**
56	**III. Mollusks and crustaceans**							0	0
57	Shrimp	526942	20145906	133895	5327504	1004467	37170250	1004467	37170250
58	Langoustine	50021	893900			639289	9723800	639289	9723800
59	Crab	1375	8230	1796	8028	75303	144554	75303	144554
60	Lobster	68	6530	457	31192	3470	282777	3470	282777
61	Cephalopod			5773	10645	135857	544423	135857	544423
62	Whelk	1175	11530	3652	22622	85390	559554	85390	559554
63	Miscellaneous			323	2805	1063	4340	1063	4340
64	**Subtotal**	**579581**	**21066096**	**145896**	**5402796**	**1944839**	**48429698**	**1944839**	**48429698**
65	**Excel subtotal**	**579581**	**21066096**	**145896**	**5402796**	**1944839**	**48429698**	**1944839**	**48429698**
66	**Total**	**6773012**	**106961121**	**2241067**	**28454844**	**49557819**	**492388344**	**49557819**	**492388344**
67	**Excel total**	**6773012**	**106961121**	**2301067**	**28454844**	**49617819**	**492388344**	**49617819**	**492388344**
68									

Figure 8: Example of a case in which a figure for landings of ‘shark’ in *Nieuwpoort* was wrongly copied in the final source document: the error is reflected in the quality control calculated row and column subtotals. By replacing the ‘96046’ by ‘90046’ the original subtotals matched.

Standardization (taxonomy and geography)

Standardizing is a requisite for functional databases. Therefore an analysis was conducted of the different parameters included in the time-series, with standardizations applied where necessary. Standardization was required and applied at five different levels:

- **Reporting units of landed species:** most reporting units were at the species level (e.g., herring), while others were aggregates ('lobsters' or 'pelagic species not identified elsewhere' which were reported as 'other pelagic species'), or because the species was locally known under a generic name (e.g., 'shells' probably refers to clams *Pecten jacobaeus*). Other aggregates refer to functional groups, e.g., 'total pelagic species' reported as the sum of all species reported as 'pelagic'. Some units were reported over the entire period (1929-1999) while others appeared only for a few years. Aggregations were applied in the data for those reporting units at the species level for which some doubts were raised on the accuracy of the taxonomic identification, as species identification in the field is not always straightforward (e.g., 'rays' and 'sharks'). The overall number of different reported taxonomic 'units' for all files was 113 (including different naming and spelling). After standardization this number was reduced to 56 (including all aggregates).
- **Taxonomic units:** most reporting units were at unique species level. Taxonomy was checked by means of the World Register of Marine Species (WoRMS, http://www.marinespecies.org) and (vernacular) names linked to officially acknowledged taxa (Aphia ID codes, see right column). In some cases, additional sources were consulted (e.g., literature, Fishbase http://www.fishbase.org). In cases where taxonomic identification was uncertain, such as for sharks and rays, these taxa were aggregated in the standardized database. Finally after standardizing and aggregation, 41 units remained at the species level (**Error! Reference source not found.**).
- **Assigning species names to aggregate groups:** species or reporting units may have been erroneously assigned to aggregate groups over a particular period, as was the case for 'squid' (classified as demersal instead of molluscs) and horse mackerel (classified as demersal instead of pelagic). A standardized approach was applied for the entire period 1929-1999.
- **Ports**: assigning landings as disembarked in a particular port. A total of 6 ports were reported in the overall period: *Nieuwpoort, Oostende, Zeebrugge* and *Blankenberge* (Belgium) while during World War II (1940-1944), landings were disembarked in France (*Gravelines and Dunkerque;* Figure 2). Landings in these French ports were not included as 'Belgian ports' in the time-series because this time series covers only the four Belgian ports of *Nieuwpoort, Oostende, Blankenberge* and *Zeebrugge*. However, the data were included in the time-series in the database.
- **Fishing area**: the overall number of different fishing areas reported was 40 (including different spellings, Table 3). Standardizing fishing area names and their boundaries is not an easy task in the absence of reliable geo-referenced data sources. A detailed description of the process of standardization is available in Appendix (2). The list of fishing areas after standardization is included in Table 3). To assign these standardized names, both the ICES map of fishing areas and the VLIZ Marine Gazetteer VLIMAR (http://www.vliz.be/vmdcdata/vlimar) database were consulted. The resulting map is included as Figure 9 (global) and Figure 10 (North Sea and 'western' fishing grounds). Finally after standardizing, 31 standardized names of fishing grounds remained (Table 3).

Table 2: List of standardized reporting units (local names by alphabetical order in Dutch). Source: 'A century of Sea Fisheries in Belgium' (VLIZ 2009)

	English common name	Local name	Scientific name(s)	WoRMS ID
Demersal fish	**Other species**	**Andere soorten**		
	Flounder	**Bot**	*Platichthys flesus*	*127141*
	Red gurnard	**Engelse poon**	*Aspitrigla cuculus*	*150662*
	Grey gurnard	**Grauwe poon**	*Eutrigla gurnardus*	*150637*
	Brill	**Griet**	*Scophthalmus rhombus*	*127150*
	Greater weever	**Grote Pieterman**	*Trachinus draco*	*127082*
	Sharks	**Haaien**	*Squalus acanthias, Scyliorhinus canicula, Lamna nasus*	*105923 105841 105814*
	Flathead mullet	**Harder**	*Mugil cephalus*	*126983*
	Hake	**Heek**	*Merluccius merluccius*	*126484*
	Halibut	**Heilbot**	*Hippoglossus hippoglossus*	*127138*
	Cod	**Kabeljauw**	*Gadus morhua*	*126436*
	Conger eel	**Kongeraal**	*Conger conger*	*126285*
	Coal fish	**Koolvis**	*Pollachius virens*	*126441*
	Spawn (fish roe)	**Kuit**		
	Ling	**Leng**	*Molva molva*	*126461*
	Cusk	**Lom**	*Brosme brosme*	*126447*
	Red mullet	**Mul**	*Mullus surmuletus*	*126986*
	Pollack	**Pollak**	*Pollachius pollachius*	*126440*
	Tub gurnard	**Rode poon**	*Chelidonichthys lucerna*	*127262*
	Rays	**roggen**	*Bathyraja brachyurops, Raja montagui, Leucoraja circularis, Raja clavata, Amblyraja radiata, Dipturus batis, Leucoraja naevus*	*271509, 105887, 105873, 105883, 105865, 105869, 105876*
	Ocean perch	**Roodbaars**	*Sebastes marinus*	*127253*
	Dab	**Schar**	*Limanda limanda*	*127139*
	Megrim	**Scharretong**	*Lepidorhombus whiffiagonis*	*127146*
	Haddock	**Schelvis**	*Melanogrammus aeglefinus*	*126437*
	Plaice	**Schol**	*Pleuronectes platessa*	*127143*
	Bib	**Steenbolk**	*Trisopterus luscus*	*126445*
	Sturgeon	**Steur**	*Acipenser sturio*	*126279*
	Turbot	**Tarbot**	*Psetta maxima*	*154473*
	Sole	**Tong**	*Solea solea*	*127160*
	Lemon sole	**Tongschar**	*Microstomus kitt*	*127140*
	Miscellaneous	**Varia**		
	Whiting	**Wijting**	*Merlangius merlangus*	*126438*
	Witch	**Witje**	*Glyptocephalus cynoglossus*	*127136*
	Bass	**Zeebaars**	*Dicentrarchus labrax*	*126975*
	Blackspot seabream	**Zeebrasem**	*Pagellus bogaraveo*	*127059*
	Angler	**Zeeduivel**	*Lophius piscatorius*	*126555*
	Wolf-fish	**Zeewolf**	*Anarhichas lupus*	*126758*
	John dory	**Zonnevis**	*Zeus faber*	*127427*
Pelagic fish	**Other species**	**Andere soorten**		
	Herring	**Haring**	*Clupea harengus harengus*	*293567*
	Horse mackerel	**Horsmakreel**	*Trachurus trachurus*	*126822*
	Mackerel	**Makreel**	*Scomber scombrus*	*127023*

Table 2: List of standardized reporting units (local names by alphabetical order in Dutch). Source: 'A century of Sea Fisheries in Belgium' (VLIZ 2009)

	English common name		Local name	Scientific name(s)	WoRMS ID
	Sprat		**Sprot**	*Sprattus sprattus sprattus*	*236448*
	Tuna		**Tonijn**	*Thunnus thynnus*	*127029*
	Miscellaneous		**Varia**		
	Salmon		**Zalm**	*Salmo salar*	*127186*
	Other crustaceans		**Andere schaaldieren**		
	Other species		**Andere soorten**		
Crustaceans & molluscs	**Brown shrimp**	**Schaal- en weekdieren**	**Grijze garnaal**	*Crangon crangon*	*107552*
	Brown shrimp (and other species)		**Grijze garnaal (en andere soorten)**		
	Cephalopods		**Inktvis**	*Alloteuthis subulata, Loligo forbesi, Loligo vulgaris*	*153131, 140270, 140271*
	Lobsters		**Kreeften**	*Homarus gammarus, Nephrops norvegicus*	*107253 107254*
	Edible crab		**Noordzeekrab**	*Cancer pagurus*	*107276*
	Shells		**Schelpen**	probably *Pecten jacobaeus*	*394429*
	Miscellaneous		**Varia**		
	Whelk		**Wulk**	*Buccinum undatum*	*138878*

Note: Links to the World Record of Marine Species is achieved by adding the ID code number (right column) in the URL address, e.g. the page for 'flounder' (code 127141') is: www.marinespecies.org/aphia.php?p=taxdetails&id=127141

Table 3: Original names of the fishing areas as reported in original statistical sources (second column), and names as assigned after standardization (right column) in the 'A century of Sea Fisheries in Belgium' (VLIZ 2009).

	Original name of fishing ground	Standardized name	English name
1	Kustzee	Kustzee	Coastal waters
2	Noordzee-Zuid	Noordzee (zuid)	North Sea (south)
3	Noordzee-Midden	Noordzee (midden)	North Sea (central)
4	Noordzee-Midden-Oost (Witte Bank)	Noordzee (midden-oost)	North Sea (central-east)
5	Noordzee-Midden-Oost	Noordzee (midden-oost)	North Sea (central-east)
6	Witte Bank	Noordzee (midden-oost)	North Sea (central-east)
7	Noordzee-Midden-West	Noordzee (midden-west)	North Sea (central-west)
8	Noordzee-Noord	Noordzee (noord)	North Sea (north)
9	Noordzee	Noordzee	North Sea
10	IJsland	IJslandzee	Iceland Sea
11	IJslandzee	IJslandzee	Iceland Sea
12	Faroe	Faeröer / Faroe	Faroe Islandss
13	West-Schotland	West-Schotland	West Scotland
14	Rockall	Rockall	Rockall rock
15	Moray-Firth	Moray-Firth	Moray-Firth
16	Noordzee - Moray Firth	Moray-Firth	Moray-Firth
17	Fladen	Fladen	Fladen Sea
18	Noordzee - Fladen	Fladen	Fladen Sea
19	Kanaal	Engels Kanaal	English Channel
20	Engels Kanaal	Engels Kanaal	English Channel
21	Bristol Kanaal	Kanaal van Bristol	Bristol Channel
22	Kanaal van Bristol	Kanaal van Bristol	Bristol Channel
23	Zuid-Ierland	Zuid-Ierland	South Ireland
24	West-Ierland	West-Ierland	West Ireland
25	Zuid- en West-Ierland	Zuid- en West-Ierland	South- and West Ireland
26	Zuid- en West-Ierland (Mine Head)	Zuid- en West-Ierland	South- and West Ireland
27	Mine-Head	Zuid- en West-Ierland	South- and West Ireland
28	Ierse Zee	Ierse Zee	Irish Sea
29	Portugal Marokko	Portugal Marokko	Portugal Morocco
30	Spanje	Spanje	Spain
31	Portugal Marokko Spanje	Portugal Marokko Spanje	Portugal, Morocco Spain
32	Witte Zee	Witte Zee	White Sea
33	Witte Zee Beeren-eilanden	Witte Zee – Bereneiland	White Sea-Bear Island
34	Beren-eiland	Bereneiland	Bear Island
35	Frankrijk-West	Frankrijk-West	West France
36	Barentszzee	Barentszzee	Barents Sea
37	Labrador	Labrador	Labrador
38	Golf Gascogne	Golf Gascogne	Gulf of Gascogne
39	Groenland	Groenland	Greenland
40	Andere gronden	Andere gronden	Other areas

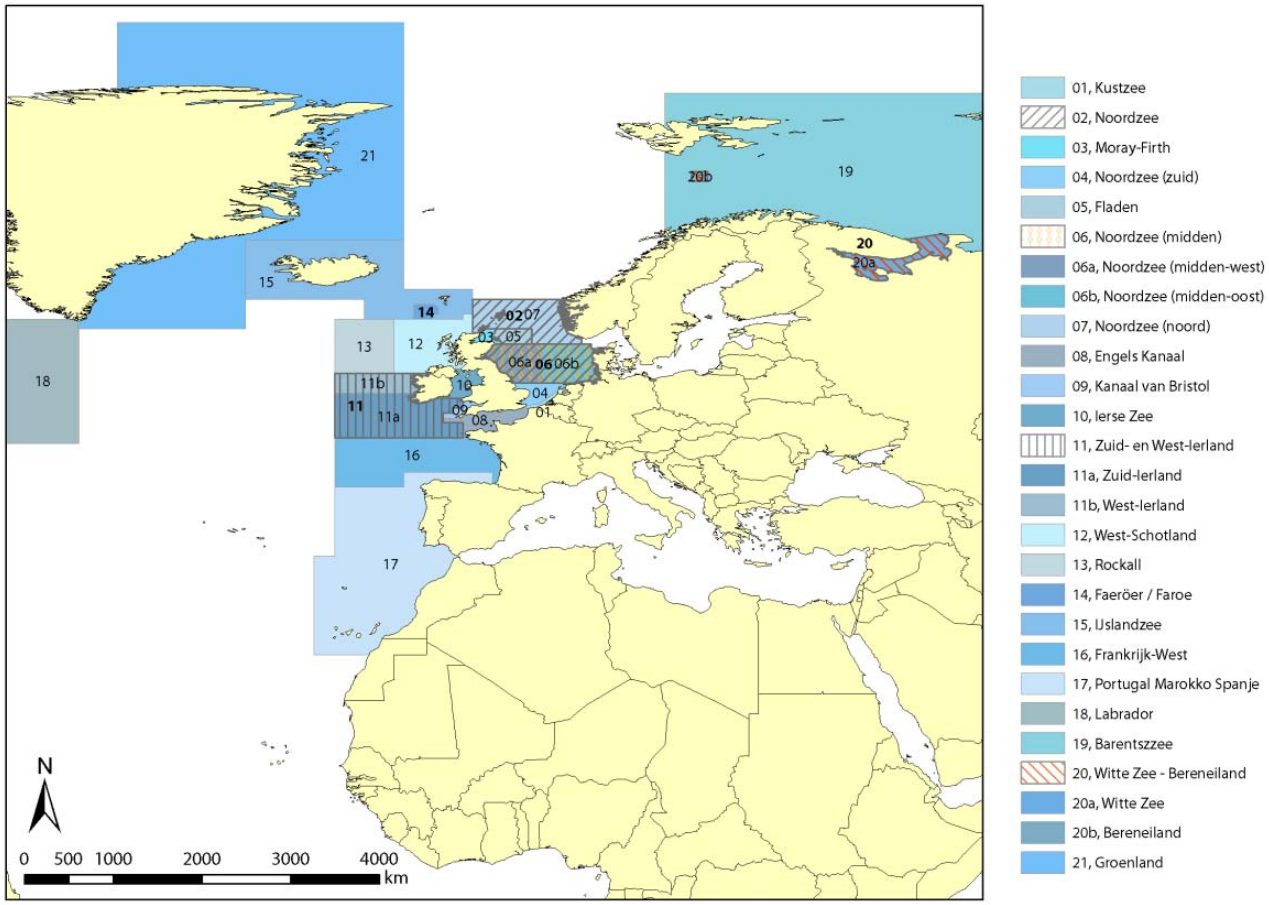


Figure 9: Boundaries and names of fishing areas as reported in local data sources (HiFiDatabase), after standardization. For English translation, see Table 3. *Source: 'A century of Sea Fisheries in Belgium' (VLIZ 2009)*

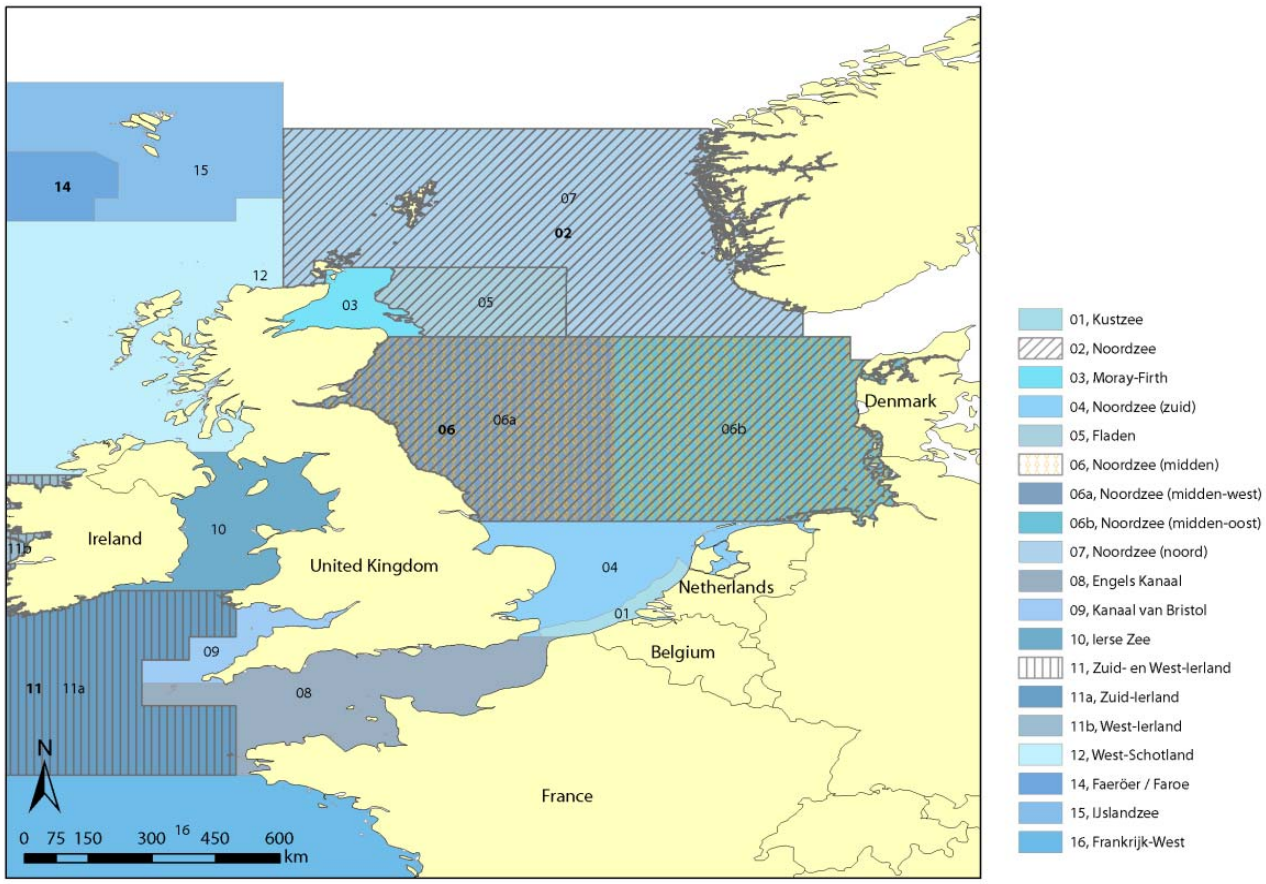


Figure 10: Boundaries and names of fishing areas around the North Sea and western fishing grounds, as reported in local data sources (HiFiDatabase) after standardization. For English translation, see Table 3. *Source: 'A century of Sea Fisheries in Belgium' (VLIZ 2009).*

Integration of single MS Excel files (one file per year) into standardized pivot tables

Pivot tables are dynamic MS Excel tables that can easily convert data for different visualization and analytical purposes, and allow simple statistical functions. Pivot tables were first constructed for three time series, which together form the integrated 'HiFiDatabase' (Figure 11):

- Landings and value of landings of Belgian marine fisheries **in Belgian ports, by species, by port**, and by year;
- Landings and value of landings of Belgian marine fisheries **in Belgian ports, by species, by fishing ground**, and by year; and
- Landings and value of landings of Belgian marine fisheries **in foreign ports, by species, by fishing ground**, and by year.

Pivot tables were based on the 'corrected files', after standardization of species names, ports and fishing grounds (see above). The three pivot tables were obtained by copying the values of the fields in the 'corrected files' to the corresponding fields in standardized formats. They represent approximately 85,000 rows of data in MS Excel.

	A	B	C	D	E	F	G	H	I	J
1	Hoeveelheid en waarde van elke vissoort van Belgische vangst van de visserijgronden ingevoerd door Belgische vaartuigen									
2										
3	Jaarta	Visgrond	Vistuig	Aandrijving	Vaartuig	Categorie vis	Vissoort	Grootteklasse	Kg	Fr
4	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Zeeduivel			
5	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Grote Pieterman		98	
6	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Engelse poon			
7	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Griet	Groot	220	
8	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Griet	Middelmatig	298	
9	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Griet	Klein	114	
10	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Griet	Ongeklasseerd		
11	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Heilbot			
12	1929	Kustzee	Trawl	Motor	Gedekt	Schaal- en weekdieren	Inktvis		183	
13	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Kabeljauw	Groot	71	
14	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Kabeljauw	Middelmatig	349	
15	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Kabeljauw	Klein	1872	
16	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Kabeljauw	Ongeklasseerd	95	
17	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Roodbaars			
18	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Grauwe poon		4475	
19	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Koolvis			
20	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Leng			
21	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Lom			
22	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Heek	Groot		
23	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Heek	Middelmatig		
24	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Heek	Klein		
25	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Heek	Ongeklasseerd		
26	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Schol	Groot	3904	
27	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Schol	Middelmatig	10142	
28	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Schol	Klein	16535	
29	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Schol	Ongeklasseerd	3730	
30	1929	Kustzee	Trawl	Motor	Gedekt	Pelagische vis	Horsmakreel			
31	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	roggen		15855	
32	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Roggen			
33	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Rode poon		242	
34	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Schar		20714	
35	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Roggen			
36	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Schelvis	Groot		
37	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Schelvis	Middelmatig		
38	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Schelvis	Klein		
39	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Schelvis	Ongeklasseerd		
40	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Scharretong			
41	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Tongschar		47	
42	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Steenbolk		370	
43	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Steur			
44	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Tarbot	Groot	205	
45	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Tarbot	Middelmatig	233	
46	1929	Kustzee	Trawl	Motor	Gedekt	bodemvissen	Tarbot	Klein	502	

Figure 11: Example of structure of the database (series II). *Source: 'HiFiDatab*ase*: A century of Sea Fisheries in Belgium' (VLIZ 2009).*

Quality control of pivot tables

Since fields were copied from the 185 'corrected files' (each corresponding to a given year within each of the three time-series) to the pivot tables (three files), a control of the accuracy of this copying process was conducted on each of the resulting pivot tables to check consistency with corrected files, by:

- checking a minimum number of randomly chosen fields for each of the categories 'demersal', 'pelagic' and 'molluscs and crustaceans' (<10% of the fields); and
- checking the subtotals and totals (rows and columns from the pivot tables with those of the corrected files.

Graphical analysis

Graphs on the changes of the value of landings over time for each of the species and aggregated units were constructed from the pivot tables, a) by port and b) by fishing ground. Visual inspection of these graphs allowed a second quality control of errors or anomalies in the data. Special attention in the graphical analysis was given to abnormally high landings for a given species from a specific fishing ground or sudden abrupt changes in observed trends. These errors were typically not detected in the first phase of quality control of numerical values, because they were not generated by simple calculation or copy errors.

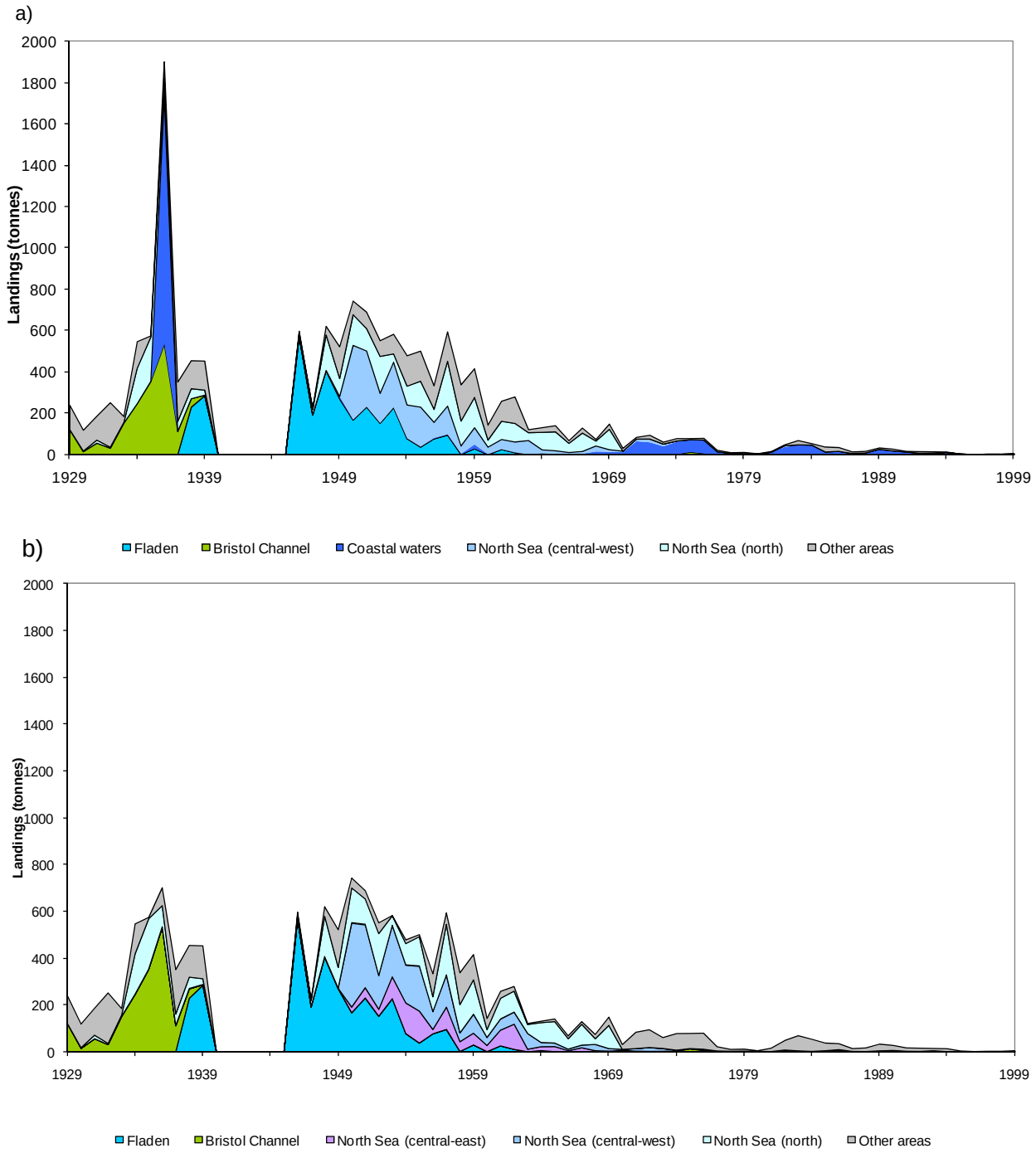


Figure 12: Example of quality control based on graphical analysis of the data (by fishing ground). a) The sudden increase in landings from 'Coastal waters' from 0 tonnes in 1935 to 1,200 tonnes in 1936, and again 0 tonnes in 1937 (all identified as mackerel) was attributed to an error. b) The corrected data after geographical analysis. Source: 'A century of Sea Fisheries in Belgium' (VLIZ 2009).

A number of problems and errors were detected through this visual control and plausible explanations were investigated using additional sources (comparing 'row totals' from one data-series with another). As an example, a sudden increase from 0 tonnes in 1935 to 1200 tonnes in 1936, followed by 0 tonnes in 1937 was reported for landings for mackerel in coastal waters ('Kustzee') (Figure 12). By checking the value of subtotals for mackerel reported in a second source (subtotals of landings by species in Belgian ports, as reported in the originals for time series III), we found a difference with a value similar to this anomaly. At the same time, the subtotal reported in this same source but for another species 'sprat' showed a difference of exactly the same value of the anomaly for mackerel. Part of the landings of sprat from coastal waters was incorrectly assigned to the reported values for mackerel.

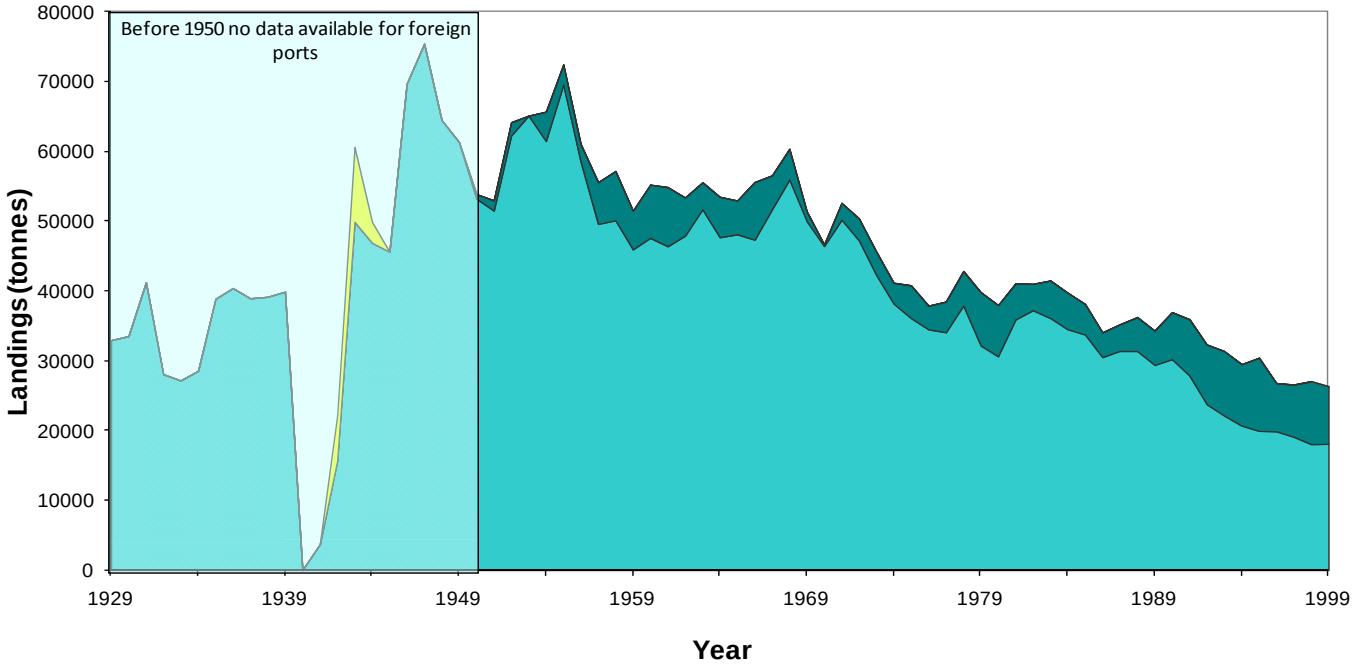


Figure 13: Landings of Belgian fisheries in Belgian (light green) and foreign (darker green) ports in the period 1929-1999, including *Dunkerque* and *Gravelines* (France). Note the continuous decline in landings in Belgian ports, in particular since the 1970s and the proportional increase of landings in foreign ports from the 90s. *Source: 'A century of Sea Fisheries in Belgium' (VLIZ, 2009).*

This error may have been due to the fact that 'sprat' and 'mackerel' were located next to each other on the reporting form tables and the values were probably copied in the wrong fields at the moment of producing the tables. This example illustrates the importance of graphical analysis and the different requirements for quality control.

Question 3: results and findings

After digitizing and converting to MS Excel files, corrected data were standardized and integrated into one database. This database, named 'HiFiDatabase' ('Historical Fisheries Database', VLIZ), contains time series with standardized species names, reporting units, fishing areas and ports of landing. The integrated database allows querying data at the species level (41 species) and another 15 aggregate categories, by year (1929-1999), by fishing area (31 subareas) and by port of landing in Belgian and foreign ports.

By querying the database, the change in landings of a particular species over time can be analyzed by port or by fishing area. Alternatively, changes in the species being unloaded in a particular port, or the shifts in species landed from a particular fishing area, can be analyzed. This method captures and documents the continuous decline in landings of many species (e.g., cod, herring, sole, turbot, rays, greater weaver, brown shrimp, etc.) as well as the stagnation or increase in landings of some species (e.g., lemon sole, dab, flounder, brill). Similar trends are documented by fishing area. Such detailed analyses will be presented in a different paper. However, some main findings are summarized here.

Total value and landings of the Belgian fisheries, in Belgian and foreign ports

The total amount of reported landings covered by the integrated HiFiDatabase over the period 1929-1999 amounts to 3,107,638 tonnes, of which 2,830,815 tonnes (91%) were landed in Belgian ports and 256,566 tonnes in 'foreign ports', with an additional 20,256 tonnes in *Dunkerque* and *Gravelines* (France) during World War II (Figure 13). Annual landings have continuously declined since a peak in 1947 (75,370 tonnes), with only one third of this amount by 1999. Since the mid 1990s, total landings have dropped below 1929 landings (Figure 13).

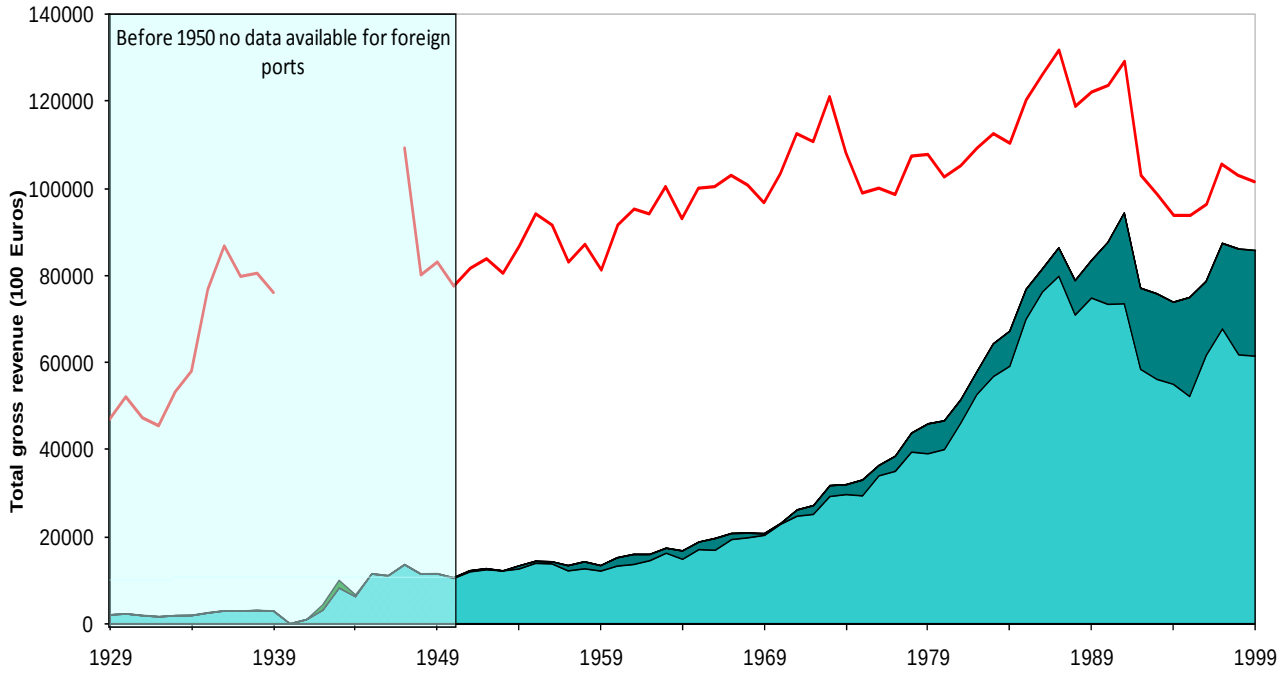


Figure 14: Value of landings (1,000 EUR) of Belgian fisheries in Belgian (light green) and foreign (dark green) ports between 1929-1999. Value of landings in Gravelines and Dunkerque during WWII are shown separately. Note the proportional increase of landings in foreign ports from the 1990s. Source: 'A century of Sea Fisheries in Belgium' (VLIZ 2009).

The total value of these landings amount to €2,277,999,993 which calculated to indexed values based on reference year 2007 represent €6,075,090,365 (Figure 14). While the peak in landings occurred in 1947, the gross income (indexed values) generated by Belgian fisheries steadily increased after 1950, peaked in 1987 and 1991 and declined afterwards (Figure 14). In spite of the decline in landings, the Belgian fisheries have maintained their gross income mainly by the increase in market value for some species, by reduced numbers of fishers, and by focusing on select and high-priced species. The increase in gross income however is not correlated to net income, in particular considering the proportional importance of fuel prices in the total fisheries production.

Demersal, pelagic, 'mollusc and crustacean' fisheries: value and landings in Belgian and foreign ports

Demersal fisheries

Since the 1950s, Belgian fisheries have mainly focused on demersal species, using beam trawlers, and targeting flatfish such as sole and plaice. Landings for demersal fisheries show a peak in 1968 with annual landings of 57,767 tonnes, of which 4,380 tonnes were landed in foreign ports (Figure 15). This was supported by rich fishing areas in Icelandic waters. From 1972 onwards, access to these fishing grounds became restricted by Iceland. As of 1975, the presence of Belgian fishers within the Icelandic 200 nm became subject to a 'phase-out'. Flatfish fisheries were forced towards other fishing grounds, with the 'western waters' (English Channel, Bristol Channel, Irish Sea, etc.) gaining importance. While demersal landings in Belgian ports steadily decreased from 1968, the landings in foreign ports increased slightly since the 1990s (Figure 15a).

The total value for demersal fisheries increased until the late 1980s, and has been gradually declining since (Figure 15b). The 2007 adjusted value for this fishery reflects a steady and slower increase in value, but otherwise the same pattern (Figure 15b).

Pelagic fisheries

During and after World War II, unusually high landings of pelagic fish were reported: up to 58,000 tonnes (mainly herring) in 1943 (Figure 16a), of which the larger part was sold in the fish auction of *Nieuwpoort*. Pelagic fisheries focused on the coastal waters, the southern North Sea and Fladen. During WWII, Belgian fishers landed an important part of the herring catches in French (border) ports: in *Gravelines* and *Dunkerque* alone, more than 10,000 tonnes of 'Flemish herring' was sold in 1943. Besides herring, sprat, mackerel and horse mackerel were targeted. Substantial landings and value (Figure 16b) of pelagic species were made in the early 1950s (21,402 tonnes in 1955), but after the last peak in the early 1980s (9,254 tonnes in 1982) pelagic fisheries in Belgium seem to have essentially disappeared.

'Mollusc and crustacean' fisheries

Since the early 20th century, Belgian fisheries for molluscs and crustaceans focused on a few target species: brown shrimp (*Crangon crangon*), whelk (*Buccinum undatum*), lobsters and cephalopods. Landing statistics show a peak of 4,343 tonnes in the annual landings for molluscs and crustaceans in 1937 (Figure 16a). Although similar (though lower) peaks were repeated in the early 1950s and 1970s, a gradual decline is visible. This decline is also reflected in the value, especially since the mid- late-1970s (Figure 16b). The largest proportion of molluscs and crustaceans originated from coastal waters. Since the 1960s the fish auction of *Zeebrugge* focused on commercializing more expensive species of crustaceans such as shrimp and lobsters.

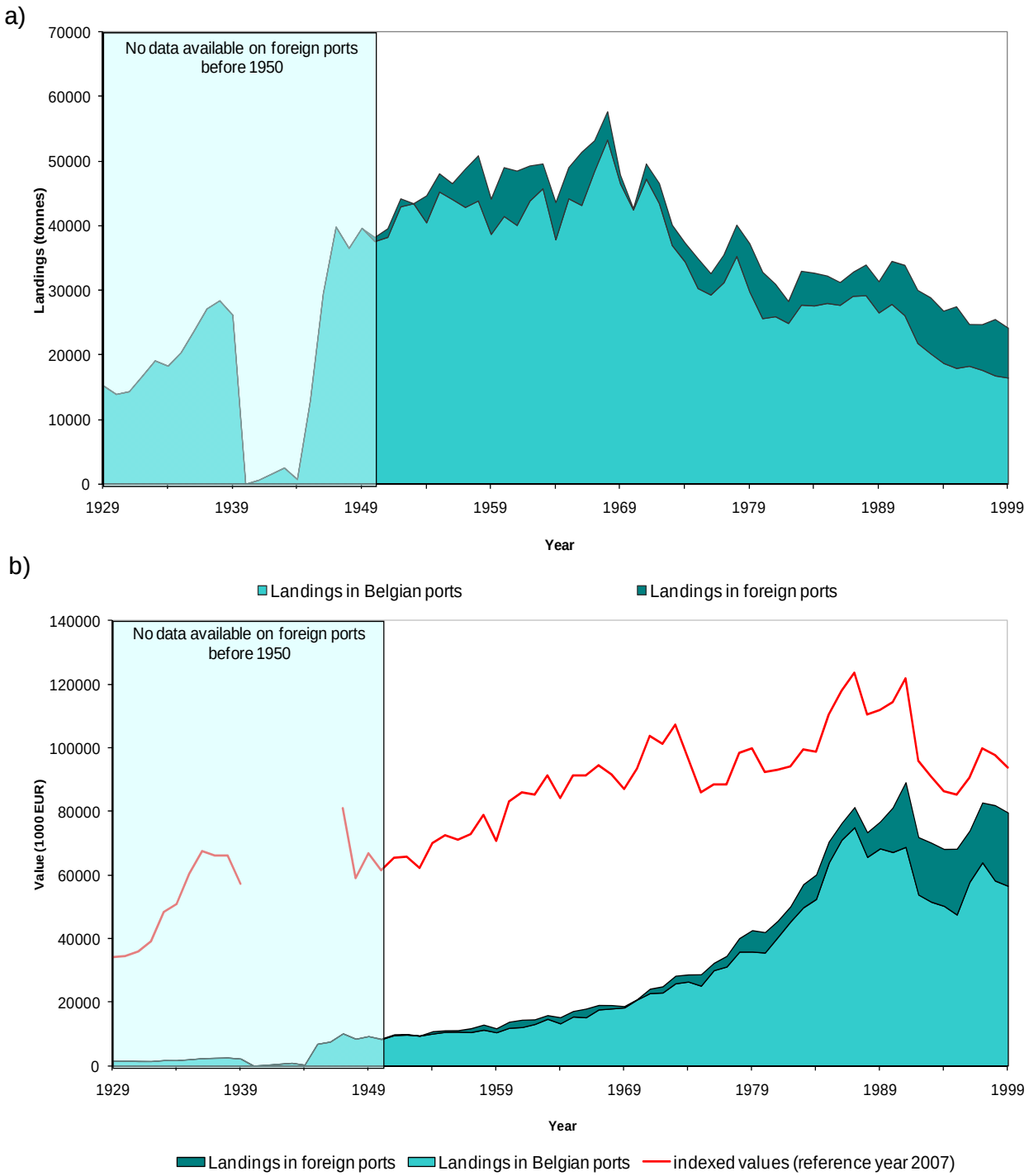


Figure 15: Demersal species, a) total landings and b) value of total landings. Source: 'A century of Sea Fisheries in Belgium' (VLIZ 2009).

Figure 16: Pelagic species, a) total landings and b) value of landings. Source: 'A century of Sea Fisheries in Belgium' (VLIZ 2009).

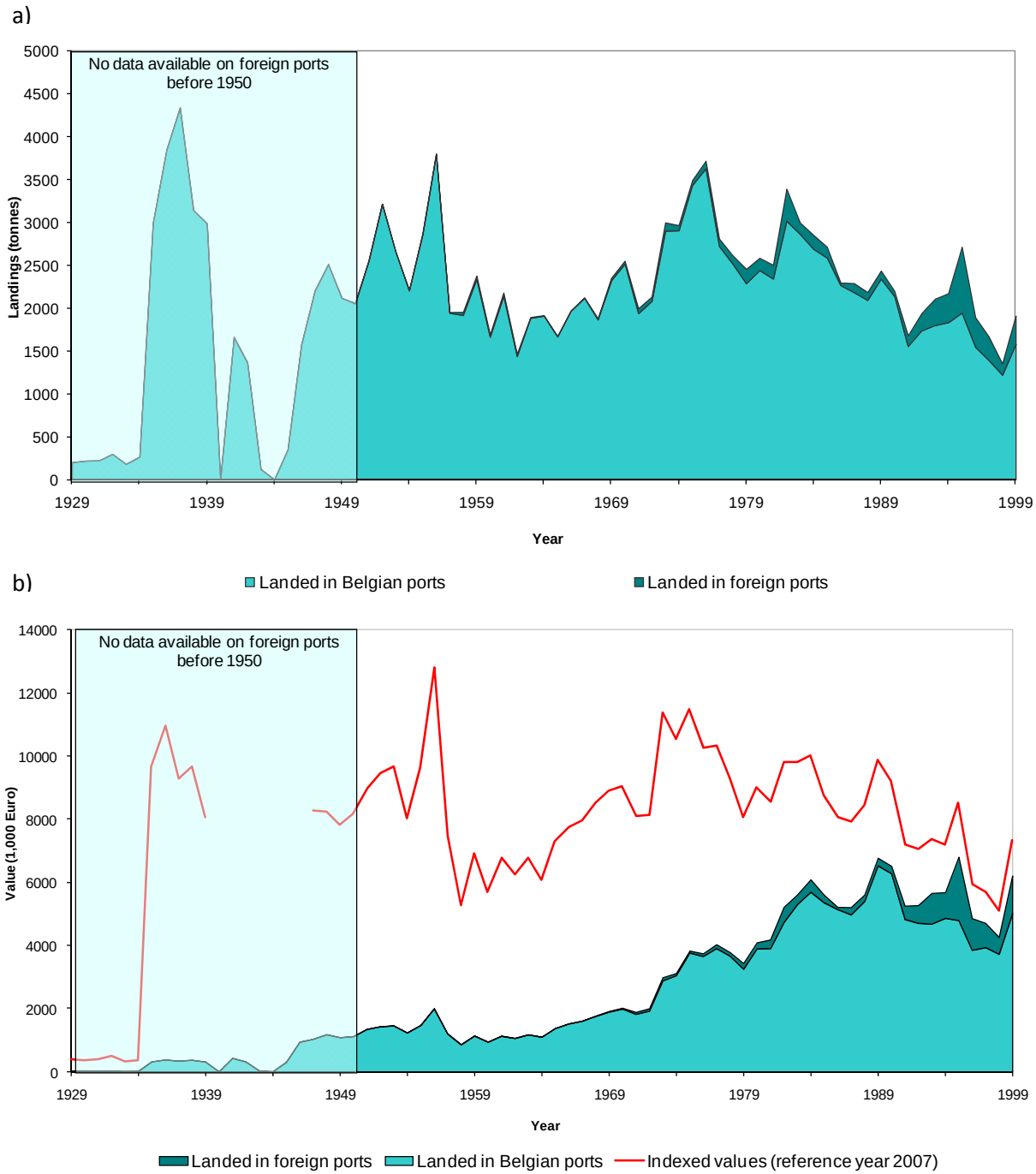


Figure 17: Molluscs and crustaceans landed in Belgian and foreign ports by Belgian fisheries, a) total landings (tonnes) and b) total value (1000 Euro).

Most important species

The database allowed scoring the most important species in Belgian marine fisheries in terms of landings (kg) and value (Euro) for the period 1929-1999, as landed in Belgian and foreign ports.

In **terms of landings**, cod and herring were the most important species. They made up 17% and 16%, respectively, of the total landings of Belgian fisheries (1929-1999), closely followed by plaice (14%), sole (8%), whiting (6%) and rays (6%). These species made up 67% of the total reported landings (3,107,638 tonnes) covered by the integrated HiFidatabase over the period 1929-1999 (Table 4 and Figure 19).

Table 4: Most important species in terms of landings of Belgian marine fisheries 1929-1999

Species	Landings (kg) in Belgian ports	Landings (kg) in foreign ports	Total landings (kg)	Percentage of total landings (%)
Cod	475,830,707	63,452,890	539,283,597	17
Herring	494,349,106	1,073,844	495,422,950	16
Plaice	340,577,079	87,748,584	428,325,663	14
Sole	225,630,204	12,057,095	237,687,299	8
Whiting	170,484,151	9,930,878	180,415,029	6
rays (aggregated)	169,506,117	8,265,576	177,771,693	6
Sum	**1,876,377,364**	**182,528,867**	**2,058,906,231**	**67**

Source: VLIZ HiFiDatabase 2009

In terms of **nominal value of landings**, sole and plaice were the most important species. However, cumulated nominal values were negatively biased for species which generated income in the earlier years only and therefore contributed lower overall nominal values. After accounting for the inflation by indexation of values, sole and cod appeared as the two most important species with 31% and 15%, respectively, of the total indexed value of Belgian fisheries (Table 5). They were closely followed by plaice (11%), brown shrimp (5%), rays (5%) and turbot (3%). These species made up 70% of the total indexed value of reported landings (6,075,090,365 Euro).

Table 5: Most important species in terms of value of landings of Belgian marine fisheries 1929-1999: nominal values and indexed values (reference year 2007)

Species	Nominal value (Euro) in Belgian ports	Nominal value (Euro) in foreign ports	Total nominal value (Euro)	Total indexed value (Euro)	Indexed value (%)
Sole	720,891,297	69,546,672	790,437,969	1,882,646,185	31
Cod	249,700,409	48,225,963	297,926,372	888,249,043	15
Plaice	234,873,098	107,266,892	342,139,990	695,269,398	11
brown shrimp	79,152,943	11,069,718	90,222,661	310,118,469	5
rays (aggregated)	70,172,223	3,207,275	73,379,498	279,556,322	5
Turbot	63,317,885	13,111,290	76,429,175	208,450,538	3
Sum	**1,418,107,855**	**252,427,810**	**1,670,535,665**	**4,264,289,955**	**70**

Source: VLIZ HiFiDatabase 2009

Most important fishing areas

The integrated data permits analysis of landings and values by species and fishing area. The most important fishing area was coastal waters (Table 6).

Table 6: Five most important fishing areas for the Belgian marine fisheries (1929-1999) in terms of landed species (kg), in order of importance.

Fishing area	Landings(kg) in Belgian ports	Landings (kg) in foreign ports	Total landings (kg)	Total landings (%)
Coastal waters	600,115,224	15,806,841	615,922,065	20
North sea (south)	515,370,304	17,381,122	532,751,426	17
Iceland Sea	462,469,753	37,893,907	500,363,660	16
North Sea (central-west)	220,023,736	77,493,755	297,517,491	10
North Sea (central-east)	206,814,279	78,356,942	285,171,221	9

Source: VLIZ HiFiDatabase 2009

Close to 73% of all landed species originated from 5 fishing areas: Coastal waters, North Sea (south), Iceland Sea, and North Sea (central-east and central-west) (Figure 18). The data underline the importance of coastal and North Sea waters to Belgian fisheries. Considering the entire period 1929-1999, 20% of all landed species originated from the coastal shallow waters. The North Sea (south) and the Iceland Sea follow closely with 17% and 16%, respectively. The eastern and western part of the central North Sea, contribute each with approximately 10% of the total landings. When early reports on the spatially aggregated fishing area 'North Sea (central)' are included, estimated landings originated from the central North Sea are 20%. Compared to the relatively large spatial extent of the central North Sea, the coastal waters have been an important source of fish products throughout the time period considered here, and despite their more limited spatial extent contributed nearly 60% of all landed pelagic species and 55% of all landed 'molluscs and crustaceans' reported during this period.

Most important fishing ports

The landings in foreign ports were reported as one aggregated value (except for the ports of *Dunkerque* and *Gravelines* during World War II). It was therefore not possible to look at trends in landings of Belgian fisheries for individual foreign ports. Over the period covered by the integrated database, the fish auctions of *Oostende* and *Zeebrugge* were the most important. Although since 1985 *Zeebrugge* has taken the lead in terms of annual landings in Belgian ports, *Oostende* was the most important port when considering overall landings reported in Belgian ports for the entire period 1929-1999: 68% of all landings were reported in *Oostende*, versus 24% in *Zeebrugge*, 8% in *Nieuwpoort* and 0.35% in *Blankenberge*.

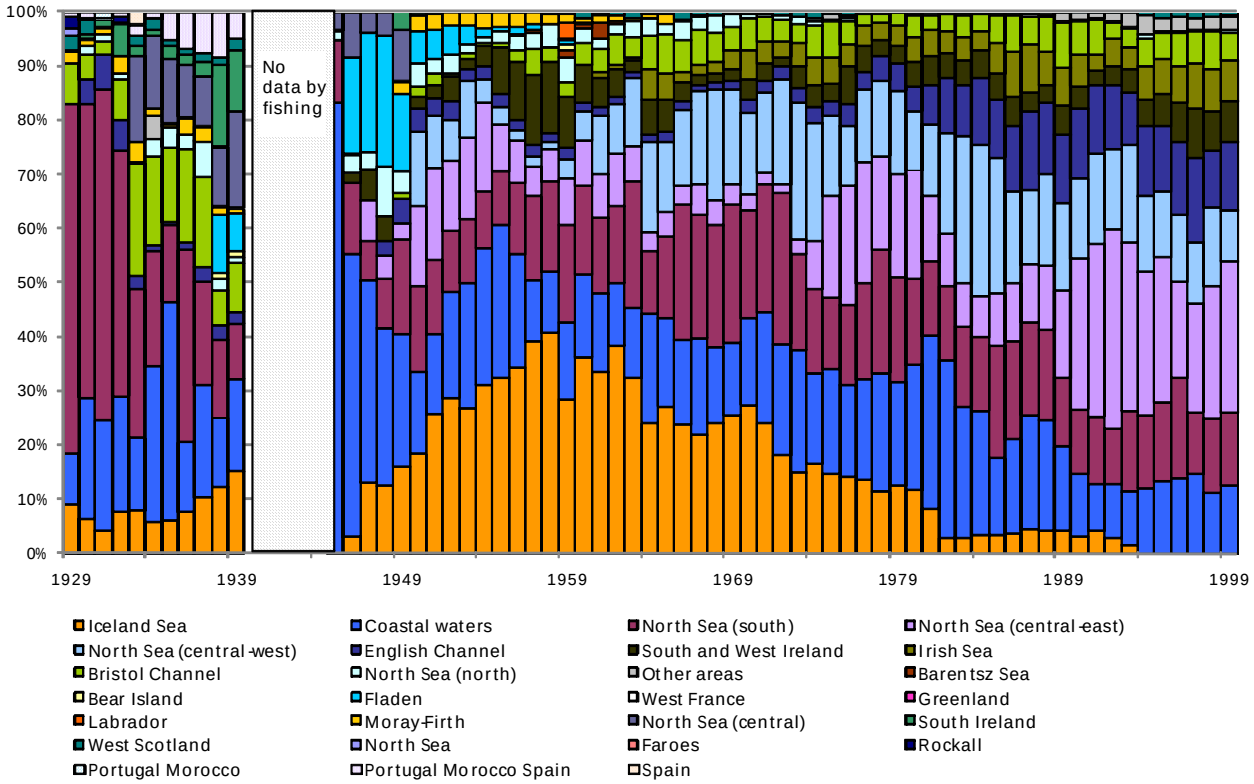


Figure 18: Percentage of annual landings by fishing ground of origin, as landed by Belgian fisheries in Belgian and in foreign ports (1929-1999). *Source VLIZ HiFiDatabase 2009*

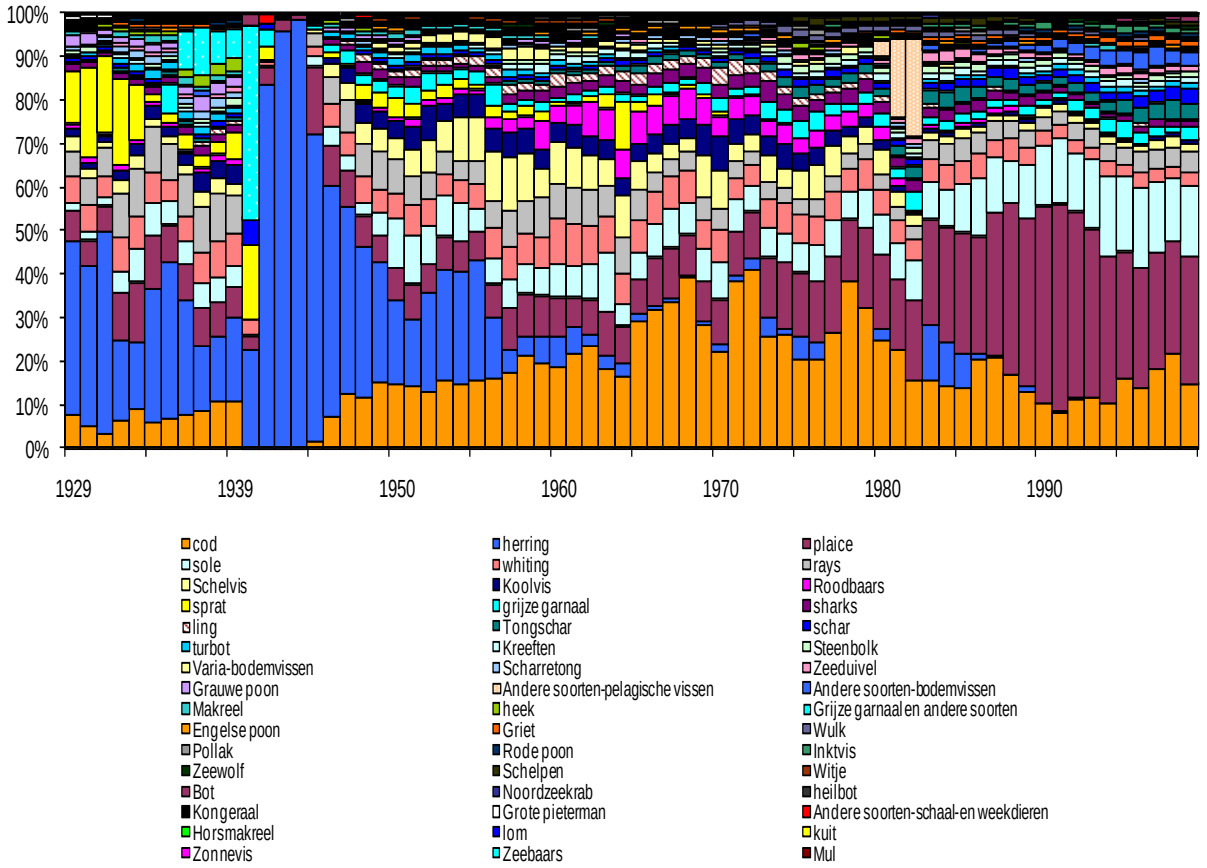


Figure 19: Percentage of annual landings by species (or aggregation of species) from Belgian fisheries, landed in Belgian and in foreign ports (1929-1999). *Source VLIZ HiFiDatabase 2009*

Question 3: Conclusion

The present exercise demonstrated the feasibility of constructing a standardized and integrated database and digitized copies of the original files in MS Excel format to redistribute historical fisheries landing statistics to end-users. By means of this standardization and integration, time series for the period 1929-1999 were derived at the level of species (41), by port of landing (4 in Belgium, 2 in France, and 1 category of 'foreign ports'), and by fishing area of origin (31). Detailed landings in foreign ports were documented for the period 1950-1999.

The total amount of reported landings presented in the integrated HiFiDatabase for the time period 1929-1999 amounted to 3,107,638 tonnes, of which 2,830,815 tonnes (91%) were landed in Belgian ports and 256,566 tonnes in 'foreign ports', with an additional 20,256 tonnes in *Dunkerque* and *Gravelines* (France) during World War II. The total value of these landings amounts to €2.28 billion, or €6.08 billion (indexed to the reference year 2007).

The most important species in terms of landings volume were cod and herring, which represented 17% and 16%, of total landings, respectively. In terms of indexed economic value, sole (31%) and cod (15%) were the most valuable species over the 1929-1999 time period. Almost 73% of all landed species originated from 5 fishing areas: coastal waters, southern North Sea, Iceland Sea, and central North Sea (east and west). An estimated 20% of all landed species originated from the shallow coastal waters. The southern North Sea and the Icelandic waters followed closely with 17% and 16%, respectively. The coastal waters contributed nearly 60% of all landed pelagic species and 55% of all landed molluscs and crustaceans reported for the period 1929-1999.

Over 500 graphs visualizing time-series of landings (tonnes), value of landings (EUR) and value (EUR/kg) for 41 species and 15 groups of species or aggregates (rays, sharks, lobsters, cuttlefish, total demersal species, etc.) were made available on-line at www.vliz.be/EN/Figures_Policy/Figures_Policy_Belgian_Sea_Fisheries. This quality-controlled and integrated database allows broadening our historical view on fisheries and underlines the strong decline in landings since Belgium started reporting, and allows further analysis by particular species and fishing grounds. The resources needed in terms of money, time and effort to construct exchangeable formats and quality controlled integrated time-series based on the currently available sources, provided a first answer to the question why the historical component of marine fisheries is practically absent in ecological science and fisheries management.

Question 4: Data exist and are freely accessible, but of insufficient reliability

Reliability of fisheries data is a complex issue that starts at the moment the nets are hauled in. A combination of the selectivity of fishing gears, management regulations and socio-economic conditions affect the proportion of mortality that actually results in 'catch' and the proportion of 'catch' that is effectively reported as 'landings'. The remaining proportion of the 'catch' is then considered either illegal, unreported or unregulated (IUU), and may be either discarded or retained as by-catch. For an overview of terminology and estimates of these factors, see Alverson *et al.* (1994), Pauly *et al.* (1998), Gray *et al.* (2004), and Zeller *et al.* (2007). An example of unreported fisheries for Belgium is the recreational line fishing for highly valued economic species (such as cod) which is estimated to be in the range of the commercial landings for this species in recent years (Anon. 2006). Unreported catches may also include fisheries with fixed nets from the beach (for flatfish), artisanal shrimp fisheries by beach trawlers (by horse, on foot), or commercial catches of shrimp that are not landed at auction points. Illegal catches include those that are landed in ports but are transferred for direct sale and consumption without passing the formal reporting procedures at the fish auctions.

Fisheries management with an ecosystem-based perspective includes measures to mitigate and reduce the by-catch, discards and mortality of non-target species, while optimizing catch of target species per unit of effort based on sustainable levels. Therefore, there is increasing interest in the reconstruction of earlier states of marine ecosystems (including fish stocks) to understand the ecological effect of fishing in the past and support the definition of sustainable management objectives (Pauly 1995, Christensen and Pauly 1998). A number of tools and data are required to achieve this, i.e., reliable data (historical, current and foreward projections) on landings but also reliable estimates of fishing mortality (including IUU) and stock assessments. Each of these statistics, estimates and assessments contain levels of uncertainty. Considerable efforts are being expended to improve the data collection in fisheries, including by-catch and discards (see EU Common Fisheries Policy [CFP] data collection regulation, CFP by-catch regulation). However, despite the uncertainties in absolute figures, it is often the trends that are most relevant.

As in many countries, the problem of incompleteness and reliability of the fisheries data in Flanders/Belgium has been persistent over time and hard to address. In fact, early publications (e.g., 'Bestuursmemoriaelen 1840-1870, De Zuttere 1909) acknowledge the fact that state subsidies were the drive for the collection of fisheries data. When subsidies in Flemish fisheries in the 19th century were abolished, data collecting stopped, as reported in *Bestuursmemoriael* (1867 in De Zuttere 1909). Still, considering the relative size of the fleet, the short coastline and the limited number of fish auctions and fishing ports, we believe that the present historical reconstruction of landing statistics in Flanders/Belgium may depict a relatively complete picture of historical landings for this time period, compared to other countries.

In the present study, which focuses on the recovery and integration of historical landing statistics, two phases of quality control (QC) were conducted on the intrinsic and relative quality of the data:

- **First phase** (see Q3):
  - the correction of obvious and traceable errors that resulted in 'correct versions': provides an indication of the quality of the data and the accuracy of the data management at the time of reporting
  - graphical analysis of integrated data (pivot tables)
- **Second phase** (this section): comparison of values between two comparable datasets that are part of the national reporting (local sources as identified in Q1), in order to trace inconsistencies and where possible correct remaining errors.

Furthermore, data from the HiFiDatabase were compared to the values as reported by ICES (Fishstat). The degree of consistency between both figures can be regarded as an indication of the reliability of the data collecting process, disregarding the intrinsic problems of reliability in fisheries data as briefly indicated above.

In a few cases, the type of error and cause or origin can be identified and corrected. But in many cases this is not possible. In order to get an idea of the scale of the problem, a matrix was drawn in which the (relative) reliability of the data was expressed for each species, by year. This relative reliability was expressed as a percentage (%) and calculated as the absolute difference (in tonnes or in Euro) between the value for a given species and given year found in time series I versus the corresponding value in time-series II, as a percentage of the value in time series I. It was not possible to make this comparison for foreign ports.

Question 4: results and findings

The product is a color coded matrix of (relative) reliability of historical data on the composition and value of Belgian marine fisheries landings in Belgian ports (Figure 20). Horizontal lines refer to species or aggregated taxa (e.g., rays) and vertical lines represent a given year of reporting. The green and yellow zones are considered to have excellent (0% difference) and good reliability (0% <

difference <1%). The latter (yellow) is mainly due to differences in rounding. Gray zones stand for 'no data', which applies to the war period, as well as selected species such as salmon, tuna, or aggregated taxa which were not reported in specific periods. Blue codes are inconsistent reporting between the first and the second time series (e.g. one time-series reports values for a given species in a given year, while the second time series does not report data on that species and year). The dark-red zones are considered as having lower reliability: e.g., the earlier years (1933-1935), and certain pelagic species (herring, sprat and horse-mackerel) in more recent years. In the latter case it may be the low amount of landings of pelagic species that may result in higher percentage.

A similar matrix was drafted for value of landings (Figure 21). Reliability as defined in the present exercise is better scored for value of landings. Differences smaller than 1% were mainly due to rounding.

The reliability of most of the time-series data are deemed excellent to good (0% and up to 1% difference), except during the pre World War II period for the intermediate aggregated levels of taxa ('miscellaneous', 'other species') and for pelagic species (herring, sprat, mackerel, horse mackerel) after 1980.

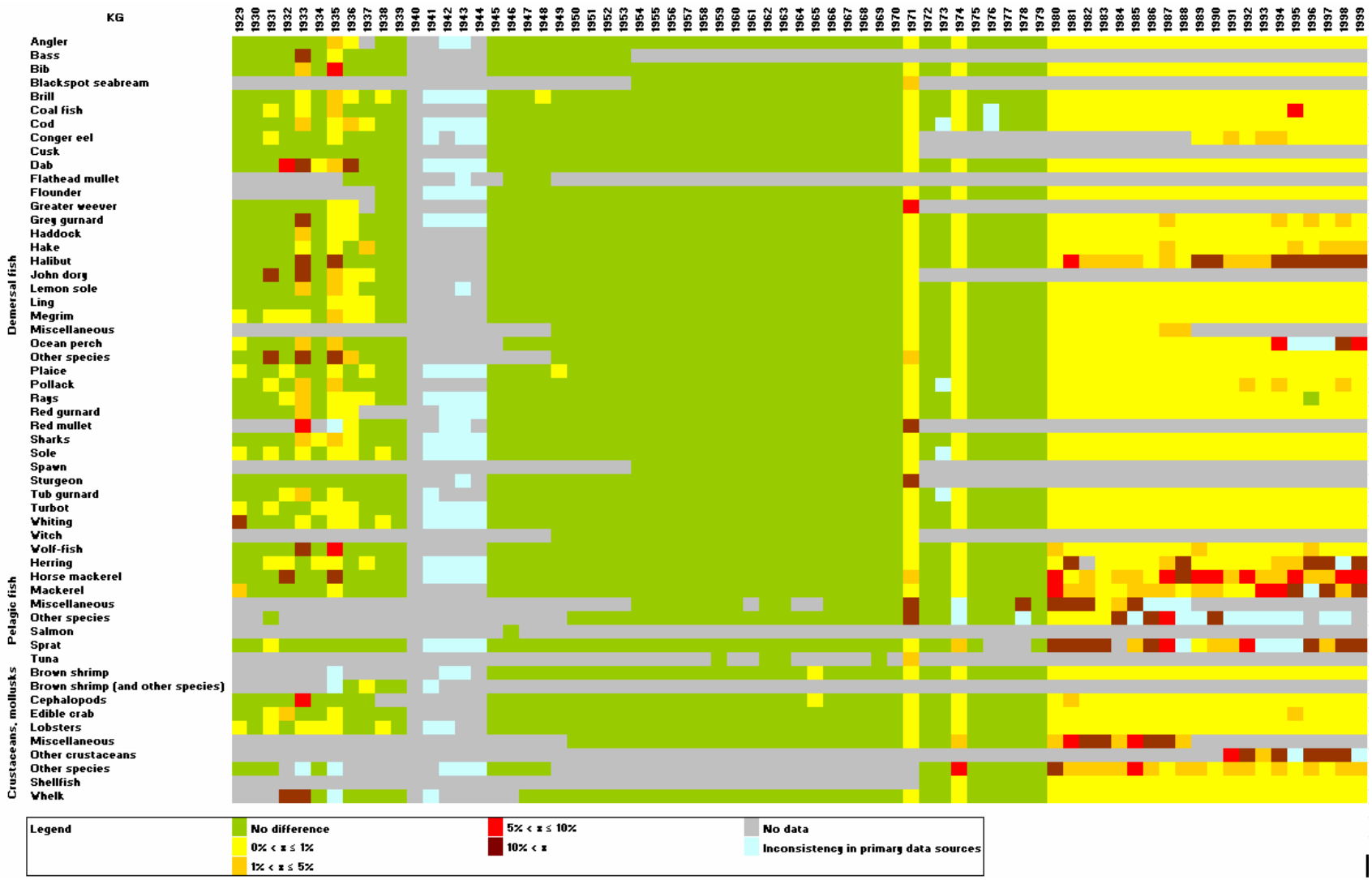


Figure 20: Reliability matrix for the landings of Belgian fisheries landed in Belgian ports. Vertical: species or aggregate taxa; horizontal: years (1929-1999). Note the clustering of inconsistent reporting for pelagic species and for certain years. Green: no difference (0%); Yellow: 0.0001% to 1% of the value in time-series; Orange: difference ranges between 1% and 5% of the value in time-series; Red: difference ranges between 5% and 10% of the value in time-series; Dark red: difference is higher than 10% of the value in time-series; Grey: 'no data' or '0'' reported in either of the time-series; Blue: inconsistent reporting: e.g., data (value) reported in time series I while time series II reports no data or '0' value. Source: 'HiFiDatabase' (VLIZ 2009).

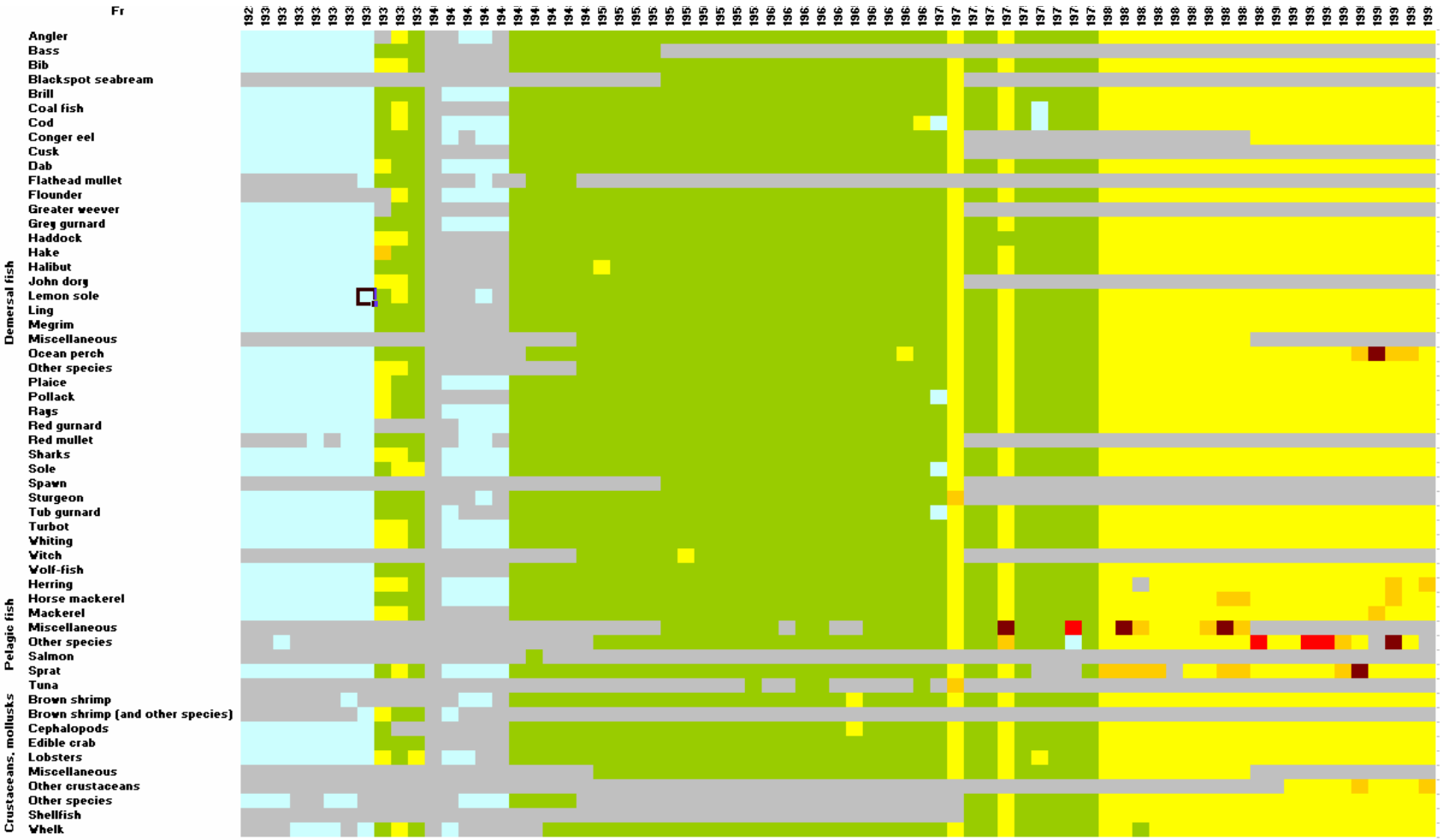


Figure 21: Reliability matrix for the value of landings of Belgian fisheries landed in Belgian ports. Vertical: species or aggregated taxa; horizontal: years (1929-1999). Note the clustering of inconsistent reporting for certain species and for certain years. Source: 'HiFiDatabase' (VLIZ 2009).

A measure of the relevance and impact of the quality control process

The results of the first quality control of the data in the 'corrected files' (see Q3 section 3) and the graphical analysis (see Q3 section 7) yielded an overall absolute correction of approximately 12,643 tonnes and €2.4 million (non-indexed). Expressed in relative terms, these corrections amount to 73% of the entire landings of Belgian fisheries in Belgian ports in 2008 (17,307 tonnes). Expressed as a proportion of the current value of landings for 2008, this would correspond to €48.6 million.

It should be noted that the impact of the corrections may increase substantially when looking at a particular species (see graphical analysis). Table 7 gives an overview of the corrected errors in the HiFiDatabase compared to the original sources.

Table 7: Magnitude of corrections on the original data after first phase of quality control.

Source (time-series)	Corrections in landings kg (%)	Corrections in value EUR (%)
Belgian ports, by port	3,920,921 (31)	1,593,798 (66)
Belgian ports by fishing area	7,656,687 (61)	39,505 (2)
Foreign ports by fishing area	971,730 (8)	503,253 (21)
Belgian and foreign ports	94,176 (1)	281,244 (12)
TOTAL corrections	**12,643,514(100)**	**2,417,800 (100)**

Source VLIZ HiFiDatabase 2009

Comparison of the 'local' dataset to ICES/FAO landing statistics

Hoek and Kyle (1905) gave an overview of Belgian fisheries, in a country overview published by the International Council for the Exploration of the Sea (ICES). Since 1903, ICES member states report national fishing statistics in order to build joint catch ('capture production') statistics by marine areas, which are published in the 'Bulletins Statistiques'. Currently, reporting of catch statistics to ICES by Belgium (Flanders) occurs bi-annually: the preliminary catches for the first half of the year and the statlant27A data by 31st may, per annum (E. Tessens, pers. comm.). These statistics are collected by the Sea Fisheries Service of the Flemish government (and its predecessors) and are based on landing statistics as reported at fish auctions (dead weight). A comparison between the ICES database and the local integrated database was conducted to look for possible inconsistencies. ICES data were obtained from Fishstat (download in June 2008), and are known to match FAO data. The landings reported by Belgium were reported as aggregated catch from the 'Northeast Atlantic' area (Statlant27), starting in 1950.

Some terms of reference were clarified as a context for this comparison:

1. The Fishstat database contains data from 1950 onwards. Therefore the comparison with the local data (HiFiDatabase) is restricted to the period 1950-1999 and data 1929-1949 were excluded.
2. The Fishstat database contains aggregated landings from Belgian marine fisheries landed both in Belgian ports and in foreign ports. This is also the case for the HiFiDatabase: landings in Belgian ports and in foreign ports can be queried separately.
3. Fishstat data on total landings are based on landings expressed in fresh weight. These 'fresh weight' values are reported by countries after conversion of 'dead weight' as recorded in the

auction, with species-specific conversion factors. The HiFiDatabase contains the original non-converted data (dead weight) as recorded at the auctions.

4. The total landings from Fishstat can not be compared to the total landings from the HiFiDatabase: Fishstat data represent the sum of the total landings by species, each converted to fresh weight by a species-specific conversion factor. Therefore, the sum of the components (species landings) of fishstat is not directly comparable to the landings in the HiFiDatabase.

Since HiFiData are based on landings as registered in the fish auction (dead weight), conversion factors were needed to calculate and convert to fresh weight. Therefore, total landings by species per annum were multiplied by the species-specific conversion factor (see appendix 2, source Mr. E. Tessens-DVZ) and compared to the corresponding value as reported by ICES/FAO (Fishstat).

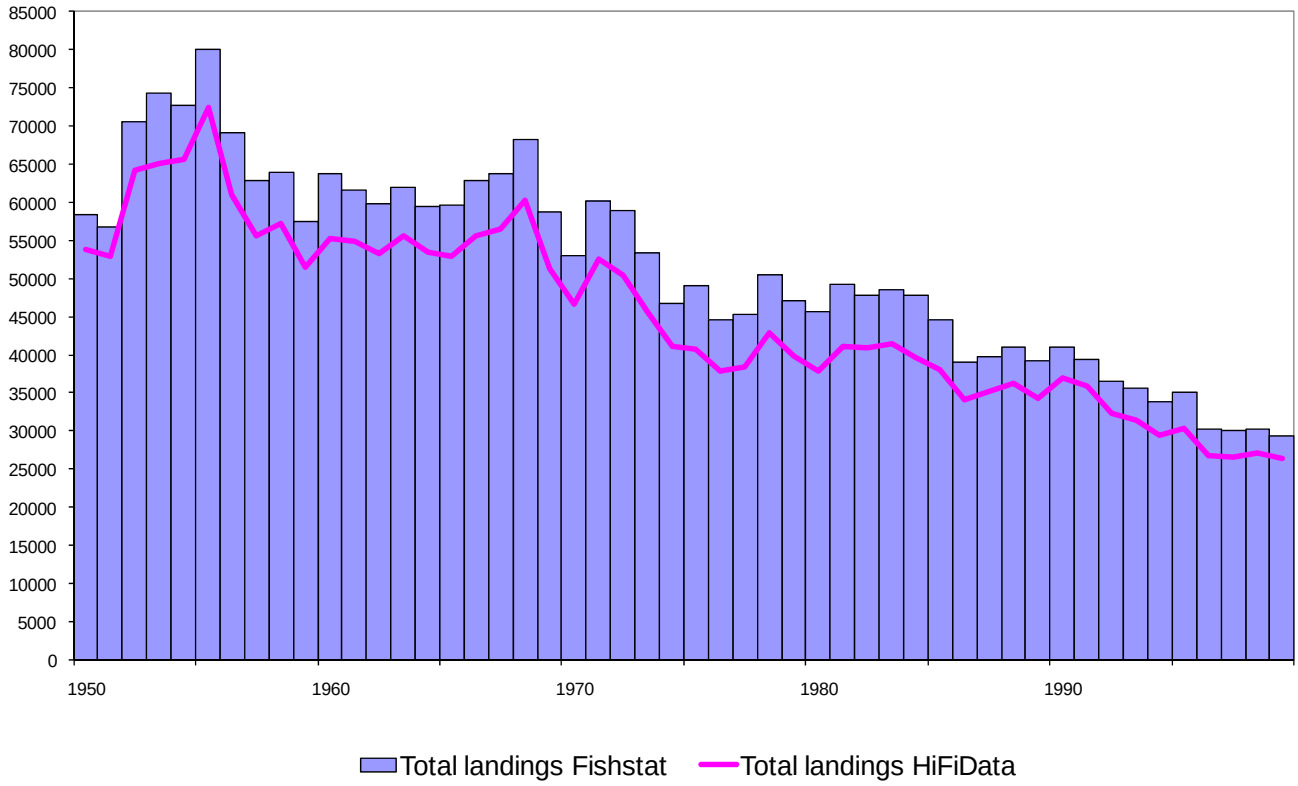


Figure 22: Total annual landings (tonnes fresh weight) as reported by ICES/FAO (Fishstat) compared to total landings (tonnes dead weight) as collected and integrated in the HiFiDatabase for Belgian marine fisheries 1950-1999. *Source: HiFiDatabase (VLIZ 2009) and Fishstat download in June 2008.*

Findings of comparison between ICES and HiFiDatabase

The total landings from the Fishstat and HiFiDatabase match each other fairly well (Figure 22). As expected, the values from HiFiData (pink line) are consistently lower than Fishstat landings (blue bars) over the entire period due to the difference between dead and fresh weight.

Apparently not all species were subject to reporting, or the reported aggregations of species do not fully coincide between the two databases. Therefore, it was not feasible to conduct the conversion from HiFiData to Fishstat for the overall landings by simply adding up the converted values by single species. Subtotals (dead weight) by individual species from the HiFiDatabase were converted to fresh

weight equivalents by multiplying with the corresponding species-specific conversion factor, where applicable. An example is provided for Atlantic cod (*Gadus morhua*) in Figure 23.

Annual landings for this species as provided by the HiFiDatabase (pink line), were multiplied by a conversion factor of 1.18. The product is 'HiFiData converted' (green line). The overall landings for the period were reported as 581,725 tonnes (Fishstat), 478,330 tonnes (HiFiData) and 564,430 tonnes (HiFiData converted). Therefore a discrepancy of 17,295 tonnes (3%) was detected for cod, in favour of the Fishstat data. Most of these discrepancies are due to the earlier years (1950s).

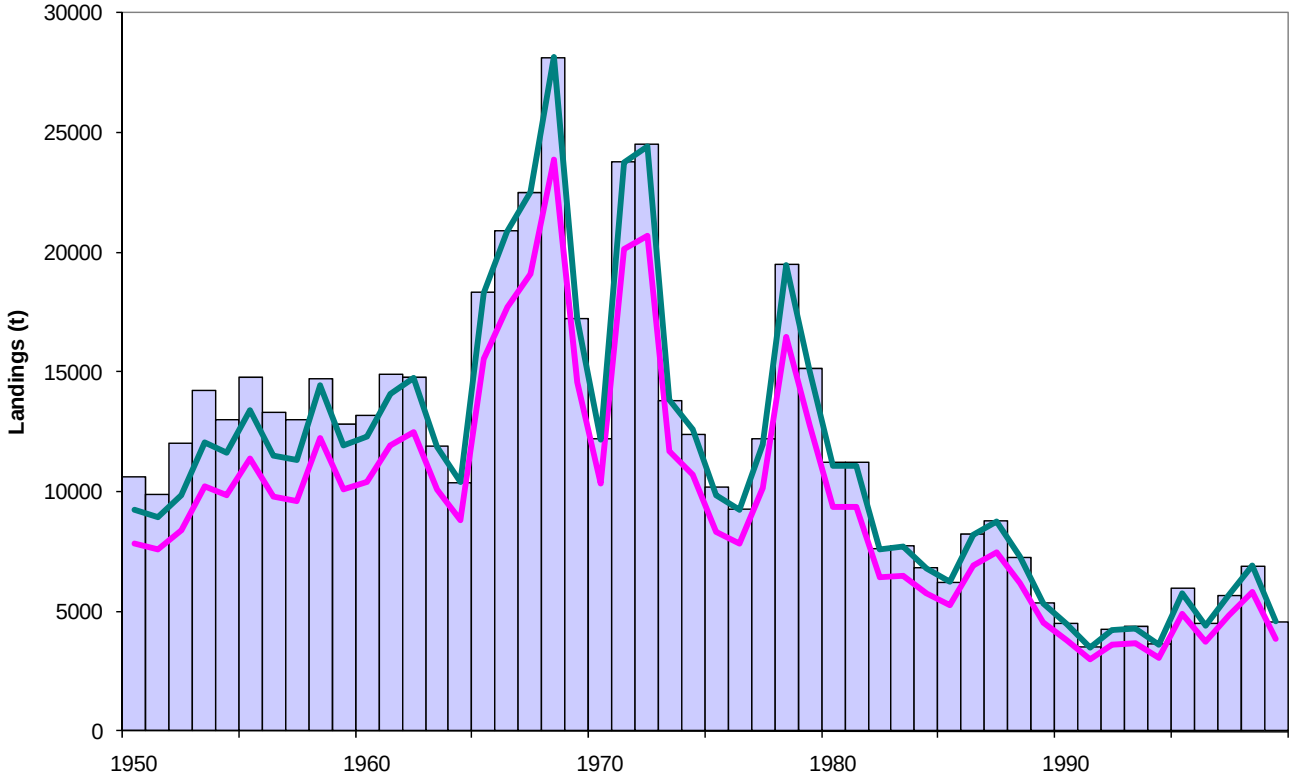


Figure 23: Conversion for Atlantic cod (*Gadus morhua*) from HiFiData (dead weight) to fresh weight ('HiFiData converted') by conversion factor 1.18. Blue bars represent ICES data from Fishstat. S*ource: HiFiDatabase (VLIZ 2009) and Fishstat download in June 2008*

Similar conclusions were drawn for Common sole (*Solea solea*, Figure 24): inconsistencies between both databases on a *per annum* basis for this species were noted particularly between 1950 and 1960 (up to 30%). The overall discrepancy for sole over the period 1950-1999 is 15,877 tonnes (7%).

The differences may be due to changes in the conversion rates compared to earlier reporting years. However, the over- or underreporting was not systematic nor was it associated with the first decades of reporting as was clearly shown by the case of Megrim (*Lepidorhombus whiffiagonis*) for which over- and underreporting could be detected even between years (Figure 25).

For some species (Atlantic horse mackerel, Atlantic wolffish, Common shrimp, European sea bass, European hake, Surmullet, Pouting, etc.), the local HiFiDatabase reported higher landings than the Fishstat data after conversion to fresh weight. For others (Atlantic herring, European plaice, European sole, Atlantic cod, European flounder, European conger, etc.) the Fishstat reports were higher (Figure 26). This points to some disconnect between these two data sources.

For some species, the total landings (x1000kg) over the period 1950-1999 reported in Fishstat were higher, for other species the local database contained higher values. Also, the Fishstat database was not necessarily consistent in reporting higher values (or lower values in some cases) for a particular species throughout the time period 1950-1999, compared to the HiFiData. The data in Fishstat seemed to have been subject to rounding, at least in the earlier decades of reporting, and landings below 50 kg were not included. However, the rounded figures do not match with converted HifiData. Also, certain species (e.g. pouting, surmullet) were not reported in the earlier years. Furthermore, the Fishstat database contained aggregations for certain groups of species, hence it was impossible to conduct a comparison at the species level. Even after the conversion process and despite the unreported species and the landings that were not accounted for, the Fishstat database seemed to report a higher total amount of landings, especially for the more abundant group of demersal fishes. Our calculations indicated that, for demersal species which were included both in HiFiData and Fishstat, the sum of the HiFiData landings by species converted to live weight, was still approximately 288,000 tonnes lower than those reported in Fishstat.

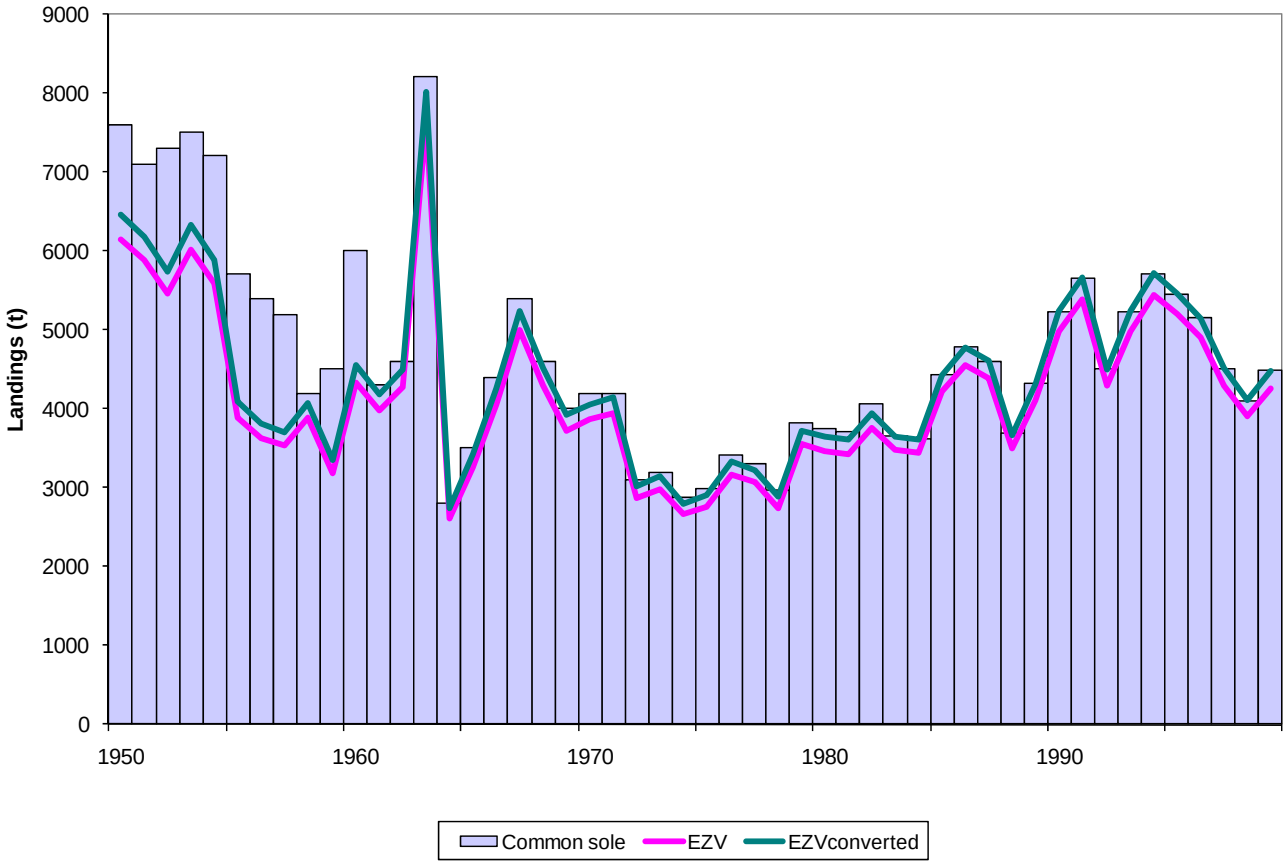


Figure 24: Conversion for Common sole (*Solea solea*) from HiFiData (dead weight) to fresh weight ('HiFiData converter') by conversion factor 1.05. Blue bars represent ICES data from Fishstat. Source: *HiFiDatabase (VLIZ 2009) and Fishstat download in June 2008.*

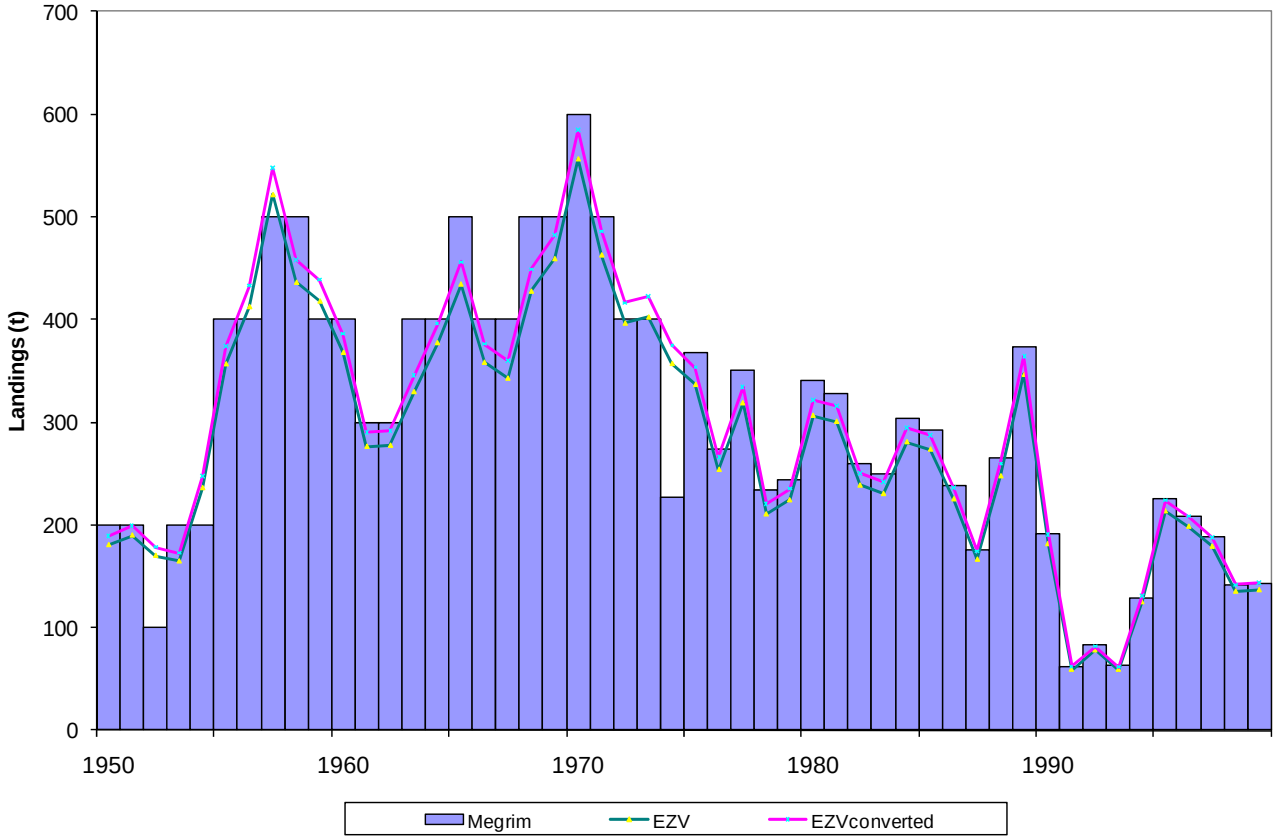


Figure 25: Conversion for Megrim (*Lepidorhombus whiffiagonis*) from HiFiData (dead weight) to fresh weight ('HiFiData converted') by conversion factor 1.05. Blue bars represent ICES data from Fishstat. *Source: HiFiDatabse (VLIZ 2009) and Fishstat downlead in June 2008.*

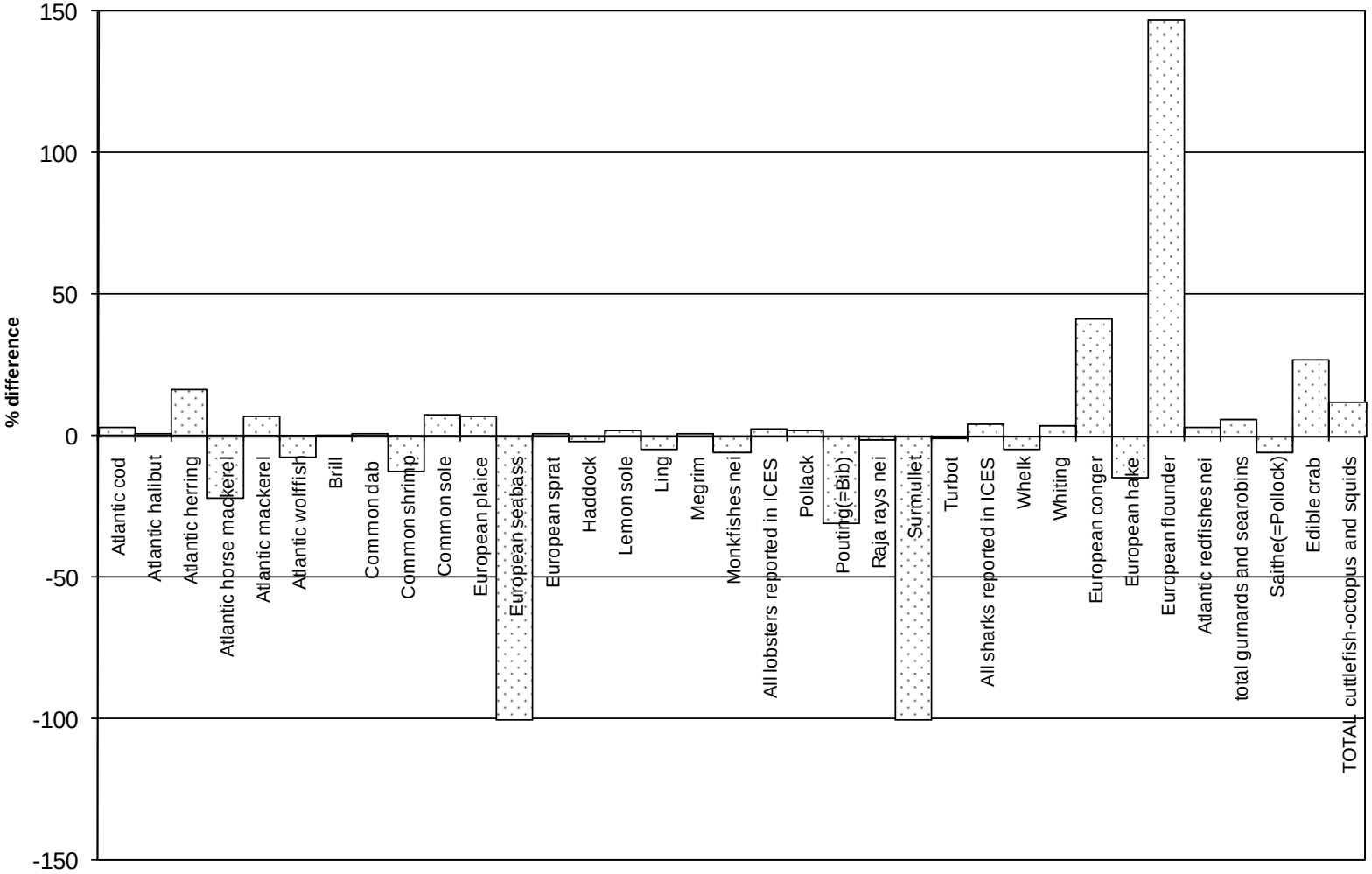


Figure 26: Discrepancy (%) between reported landings (x1000kg) in HiFiData and Fishstat, by species or aggregated groups of species (1950-1999). Positive values indicate higher reported landings in Fishstat, while negative values mean that the local HiFiDatabase (after conversion for fresh weight) reported higher landings. *Source: HiFIDatabase (VLIZ 2009) and Fishstat download in June 2008.*

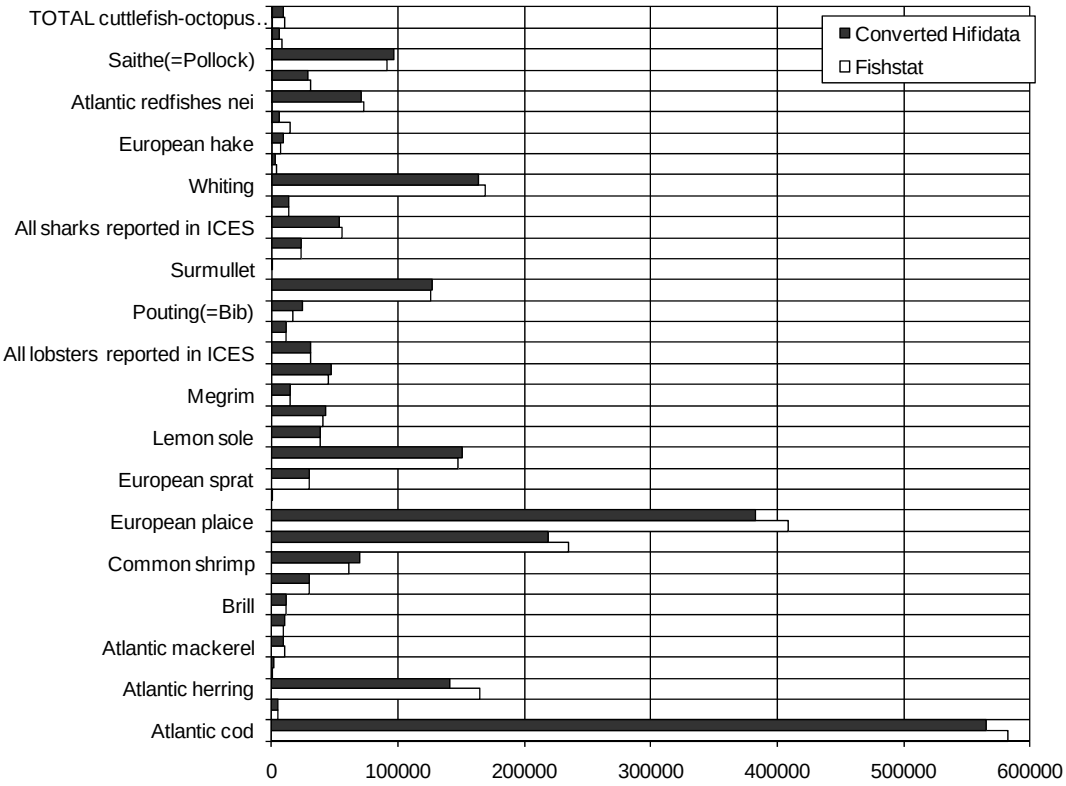


Figure 27: Total reported landings (x1000kg) in HiFiData (1950-1999) after conversion factors were applied, to convert to fresh weight (dark bars), compared with Fishstat data (white bars). *Source: HiFiDatabase (VLIZ 2009) and Fishstat download in June 2008*

Question 4: conclusion

The issue of reliability and completeness of fisheries data in Flanders/Belgium has been a persistent problem, as in many other fishing countries. Two phases of quality control (QC) were conducted (see also Question 3). Furthermore, data from the HiFiDatabase were compared to the values as reported by ICES (Fishstat).

The integration of the data allowed a level of quality control that increased the accuracy of the data by approximately 12,643 tonnes and €2.4 million (non-indexed value). Expressed in relative terms, these corrections amount to 73% of the entire landings of Belgian fisheries in Belgian ports in 2008 (17,307 tonnes). Expressed as a proportion of the current value of landings for 2008, this would amount to €48.6 million.

The reliability of the data was evaluated as 'excellent' to 'good', except during the war period for the intermediate aggregated taxa ('miscellaneous', 'other species') and for pelagic species (herring, sprat, mackerel, horse mackerel) after 1980.

Overall, the Fishstat database (ICES) reported a higher amount of landings for Belgian fisheries 1950-1999 compared to the HiFiDatabase (dead weight), which could only in part be explained by the conversion to live weight equivalents, as reported in Fishstat. The comparison between Fishstat and HiFiData was not straightforward and had to be done at species level, after conversion to fresh weight equivalents. The currently applied species-specific conversion factors were used throughout. For some species the total landings over the period 1950-1999 reported in Fishstat were higher, for others the converted HiFiDatabase contained higher values. Still, even after the conversion process and in spite of the unreported species and landings, the Fishstat database seemed to report a higher total amount of landings, especially for the more abundant group of demersal fishes. Our calculations indicated that, for demersal species which were included both in HiFiData and Fishstat, the sum of the HiFiData landings by species converted to live weight, was still approximately 288,000 tonnes lower than those reported in Fishstat.

Discussion and conclusion

The present discussion paper reports on the process of inventory, data capture, data integration and quality control of historical marine fisheries data for Belgium. It gives an overview of the process, the methodologies applied and the metadata required for correct interpretation of the data integration. The results can be summarized in three main areas:

- **Digitized inventory (IMIS) and annotated bibliography**
  The results of literature screening and inventory are available from the bibliography. All data and literature (context) sources were digitized, linked to context ('Historical Fisheries Data - *HiFiData*') and are now available in the public domain. They can be queried (by author, by keyword(s), by year of publication, etc.) through the modular *Integrated Marine Information System IMIS* managed by Flanders Marine Institute VLIZ.

- **Integrated database**
  Datasets from single paper sources (different tables from single annual reports) were digitized (to MS Excel), standardized, quality controlled and integrated into one 'HiFiDatabase'. This database was stored according to professional data management standards and is available for further research purposes. The efforts of data mining have yielded a significant increase in readily available and high resolution data (by species, by fishing area, per annum). In practical terms this means that a continuous time series is

available in digital format since the first year of detailed and systematic reporting (1929) until 1999 (and can be extended up to current year). It improves the availability of digital information by around 60 years (from 1989 back to 1929). To our knowledge, the present data rescue and integration of historical fisheries data is the first attempt in Belgium to collect, archive and integrate the available historical marine fisheries statistics.

Finally, the data collection and integration disclosed data on the early 20th century that can be further used for basic research on fisheries and historical ecology of the (southern) North Sea. A time-series was constructed from the data found in older sources for the period 1836-1907 (De Zuttere 1909, Cloquet 1842) for herring, salted cod and 'fresh fish' (aggregated taxa). The original sources for these older data were identified and the data quality controlled. Although this dataset cannot be fully integrated with the HiFiDatabase, the first provides a good insight into the importance of fisheries in the 19th century since associated data on the extent of the fleet is available for that period. The figures (graphs) in appendix 3 illustrate the results of this 19th century historical sea fish landings data.

- **Accessible results for policy, science and the interested public**
  Data accuracy was improved as much as possible. Reliability maps provide users with an indication of the relative reliability of the data. The data rescue process and metadata standards, methods, etc. are described in an on-line 'Users Guide'.

Potential and limitations of the HiFiDatabase

There is an increasing need for historical baselines on marine ecosystems, especially fish stocks and fisheries, to evaluate impacts and set goals for sustainable management (Pinnegar and Engelhard 2008). However this requires a historical perspective, at least to times before the onset of industrial or large-scale intensive fishing practices, and ideally estimates of historical biomass and fishing mortality (Pauly 1995, Rijnsdorp et al. 1996, Roberts 2007, Cardinale et al. 2009). Historical time series are scarce and available time series typically start after the beginning of intensive exploitation. Hence the baselines for rebuilding depleted fish stocks typically refer to strongly exploited situations (Pitcher 2001).

In the absence of catch statistics, data on landings have been used in a number of applications and models as a proxy for fishing mortality (Daan et al. 1994, Walker and Heessen 1996, Zeller and Pauly 2007, Eero et al. 2008). Landing statistics can serve as basis for estimation of total catch by considering a diversity of sources and data (surveys, oral history and interviews, historical population data, consumption data etc.). The HiFiDatabase can serve as such a basis for further analysis.

However, some limitations apply to the HiFidatabase, in addition to those described above:

- Unlike with current data, it is difficult to validate the taxonomic identity of landed species for earlier years. This is a limiting factor for interpretation of species that may not be easy to determine in the field (e.g., rays);
- It is not known if or what proportion of the catch was actually landed informally at other sites along the coast;
- No data were found on landings in foreign ports before 1950. Therefore, data before 1950 may provide an incomplete picture;
- In some years and some sources, landings were rounded to the nearest thousand kg ;
- The spatial units of reporting, although more detailed than the Fishstat data, remain coarse;
- Historical landing statistics were reported on a calendar year basis (January-December). This restricts interpretation of fisheries which were held during winter season; and
- Uncertainty remains concerning the discrepancy between HiFiData and Fishstat which could not be fully explained by converting to fresh weight equivalent.

Future research

To achieve the present historic reconstruction and data integration, a thorough literature search was conducted in archives and physical collections. Though not all-encompassing, this exhaustive search disclosed data that were previously not known or accessible to the public. The current effort of data rescue and data integration will include these sources and be complemented with:

- Repeat the present exercise with respect to historical data on the fishing capacity of marine fisheries in Belgium: fleet (number of vessels, tonnage, engine power), type of fishing gear, number of sea days and fishing days, technological creep, etc.;
- Conduct a detailed trend analysis of the HiFiData, by species and by fishing area of origin;
- Collect, describe, store, quality control and integrate historical data on the monthly distribution of landings and length categories for 7 demersal and 1 pelagic species;
- Collect data and information that allow for a calculation of indices of Catch Per Unit of Effort (CPUE) or Landings Per Unit of Effort/Power (LPUE/LPUP) and trends herein over time;
- Collect evidence that allow for an estimation of Illegal, Unreported and Unregulated catch (IUU) by Belgian marine fisheries, to complement the current landing statistics;
- Explore the relevance of collected data for policy development:
    - for the description of historical baselines for the Belgian part of the North Sea and the wider North Sea area;
    - for inferences related to trophic level of marine fisheries, and the concept of fishing down the food web (Pauly et al. 1998); and
- Explore with neighbouring countries (The Netherlands, UK, France), the feasibility of reconstructing historical marine fisheries by spatially defined areas, in particular for the coastal waters (spatial unit which is not reported in the ICES database).

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Appendices

Appendix 1: Overview of fishing areas and their occurrence in reporting over time and the standardization process.

Appendix 2: Table with conversion factors to calculate fresh weight from reported (deadweight) landings.

Appendix 3: graphs with historical landings of marine fisheries (1836-1909).

Appendix 1:

Overview of fishing areas and their occurrence in reporting over time and the standardization process. The full text manual is available at: **http://www.vliz.be/cijfers_beleid/zeevisserij/manual/manual_fishing_areas.pdf**

Table 1: List of the names of fishing grounds as reported in historical sources of Belgian sea fisheries statistics in the period 1929-1999.

	Original name of fishing ground
1	Kustzee
2	Noordzee-Zuid
3	Noordzee-Midden
4	Noordzee-Midden-Oost (Witte Bank)
5	Noordzee-Midden-Oost
6	Witte Bank
7	Noordzee-Midden-West
8	Noordzee-Noord
9	Noordzee
10	IJsland
11	IJslandzee
12	Faroe
13	West-Schotland
14	Rockall
15	Moray-Firth
16	Noordzee - Moray Firth
17	Fladen
18	Noordzee - Fladen
19	Kanaal
20	Engels Kanaal
21	Bristol Kanaal
22	Kanaal van Bristol
23	Zuid-Ierland
24	West-Ierland
25	Zuid- en West-Ierland
26	Zuid- en West-Ierland (Mine Head)
27	Mine-Head
28	Ierse Zee
29	Portugal Marokko
30	Spanje
31	Portugal Marokko Spanje
32	Witte Zee
33	Witte Zee Beeren-eilanden
34	Beren-eiland
35	Frankrijk-West
36	Barentszzee
37	Labrador
38	Golf Gascogne
39	Groenland
40	Andere gronden

Table 2: An annual overview of the historical names of fishing grounds as reported in original sources 1929-1999.

Fishing ground (original sources)	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Kustzee	x	x	x	x	x	x	x	x	x	x	x						x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Noordzee-Zuid	x	x	x	x	x	x	x	x	x	x	x						x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Noordzee-Midden		x		x	x	x	x	x	x	x	x						x	x	x	x	x	x																																																				
Noordzee-Midden-Oost (Witte Bank)																						x				x	x																										x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Noordzee-Midden-Oost																												x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x																			
Witte Bank																			x	x	x	x	x	x	x																																															
Noordzee-Midden-West																						x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Noordzee-Noord		x	x	x	x	x	x	x	x	x	x						x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Noordzee	x																																																																					
IJsland	x	x	x	x	x	x	x	x	x	x	x							x	x	x	x		x	x		x	x				x	x																																						
IJslandzee																						x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Faroe	x					x																																																															
West-Schotland	x	x	x	x	x	x	x	x	x	x	x											x						x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Rockall	x	x	x	x	x		x																																																														
Moray-Firth	x	x	x	x	x	x	x	x	x	x	x										x	x	x	x	x	x	x	x	x	x																										x															
Noordzee - Moray Firth																															x	x	x	x	x	x	x		x																																	
Fladen																		x	x	x		x	x	x	x	x	x	x	x	x											x		x				x	x	x					x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Noordzee - Fladen										x	x						x				x										x	x	x	x	x	x	x	x	x																																	
Kanaal		x	x	x	x	x	x	x	x	x	x																																																											
Engels Kanaal																	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Bristol Kanaal																	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Kanaal van Bristol	x	x	x	x	x	x	x	x	x	x	x																																																												
Zuid-Ierland	x	x	x	x	x	x	x	x	x	x	x										x	x	x			x																																												
West-Ierland			x	x		x																																																																	
Zuid- en West- Ierland																						x	x			x	x	x	x	x	x	x	x	x	x	x	x											x									x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Zuid- en West-Ierland (Mine Head)																															x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Mine-Head																		x	x	x				x	x																																																
Ierse Zee																																	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Portugal Marokko			x																																																																			
Spanje					x													x																																																							
Portugal Marokko Spanje	x	x		x	x	x	x	x	x	x	x																																																													
Witte Zee																		x																																																							
Witte Zee Beeren-eilanden										x	x																																																														
Beren-eiland																															x																																											
Frankrijk-West																											x	x																																														
Barentszzee				x																								x	x		x	x	x	x																																							
Labrador																															x	x																																										
Golf Gascogne	x	x																																																																				
Groenland																																																																						
Andere gronden	x	x	x	x	x	x																																						x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Table 3: List of the names of fishing grounds as reported in historical sources of Belgian sea fisheries statistics (in the period 1929-1999) with identification of standardized names and decision rules.

	Original name of fishing ground	Standardized name	Decision rule
1	Kustzee	Kustzee	A
2	Noordzee-Zuid	Noordzee (zuid)	A
3	Noordzee-Midden	Noordzee (midden)	A
4	Noordzee-Midden-Oost (Witte Bank)	Noordzee (midden-oost)	C
5	Noordzee-Midden-Oost	Noordzee (midden-oost)	C
6	Witte Bank	Noordzee (midden-oost)	C
7	Noordzee-Midden-West	Noordzee (midden-west)	A
8	Noordzee-Noord	Noordzee (noord)	A
9	Noordzee	Noordzee	A
10	IJsland	IJslandzee	B
11	IJslandzee	IJslandzee	B
12	Faroe	Faeröer / Faroe	A
13	West-Schotland	West-Schotland	A
14	Rockall	Rockall	A
15	Moray-Firth	Moray-Firth	B
16	Noordzee - Moray Firth	Moray-Firth	B
17	Fladen	Fladen	B
18	Noordzee - Fladen	Fladen	B
19	Kanaal	Engels Kanaal	B
20	Engels Kanaal	Engels Kanaal	B
21	Bristol Kanaal	Kanaal van Bristol	B
22	Kanaal van Bristol	Kanaal van Bristol	B
23	Zuid-Ierland	Zuid-Ierland	A
24	West-Ierland	West-Ierland	A
25	Zuid- en West-Ierland	Zuid- en West-Ierland	C
26	Zuid- en West-Ierland (Mine Head)	Zuid- en West-Ierland	C
27	Mine-Head	Zuid- en West-Ierland	C
28	Ierse Zee	Ierse Zee	A
29	Portugal Marokko	Portugal Marokko	A
30	Spanje	Spanje	A
31	Portugal Marokko Spanje	Portugal Marokko Spanje	A
32	Witte Zee	Witte Zee	A
33	Witte Zee Beeren-eilanden	Witte Zee – Bereneiland	A
34	Beren-eiland	Bereneiland	A
35	Frankrijk-West	Frankrijk-West	A
36	Barentszzee	Barentszzee	A
37	Labrador	Labrador	A
38	Golf Gascogne	Golf Gascogne	A
39	Groenland	Groenland	A
40	Andere gronden	Andere gronden	A

Table 4: An annual overview of the standardized names of fishing areas as used in the integrated database

Fishing ground (standardized names)	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Kustzee	X	X	X	X	X	X	X	X	X	X	X						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Noordzee (zuid)	X	X	X	X	X	X	X	X	X	X	X						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Noordzee (midden)		X		X	X	X	X	X	X	X	X						X	X	X	X	X	X																																																	
Noordzee (midden-oost)																			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Noordzee (midden-west)																						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Noordzee (noord)		X	X	X	X	X	X	X	X	X	X						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Noordzee	X																																																																						
IJslandzee	X	X	X	X	X	X	X	X	X	X	X							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Faeröer / Faroe	X					X																																																																	
West-Schotland	X	X	X	X	X	X	X	X	X	X	X											X						X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Rockall	X	X	X	X	X		X																																																																
Moray-Firth	X	X	X	X	X	X	X	X	X	X	X										X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X																X																
Fladen										X	X						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X				X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Engels Kanaal		X	X	X	X	X	X	X	X	X	X						X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Kanaal van Bristol	X	X	X	X	X	X	X	X	X	X	X						X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Zuid-Ierland	X	X	X	X	X	X	X	X	X	X	X										X	X	X			X																																													
West-Ierland			X	X		X																																																																	
Zuid- en West-Ierland																		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ierse Zee																																	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Spanje					X													X																																																					
Portugal Marokko Spanje	X	X		X	X	X	X	X	X	X	X																																																												
Portugal Marokko			X																																																																				
Witte Zee																		X																																																					
Witte Zee - Bereneiland										X	X																																																												
Bereneiland																															X																																								
Frankrijk-West																											X	X																																											
Barentszzee				X																								X	X	X	X	X	X	X																																					
Labrador																															X	X																																							
Golf Gascogne	X	X																																																																					
Groenland																																																																							
Andere gronden	X	X	X	X	X	X																																								X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Appendix 2:

Appendix Table 2. Conversion factors used to convert reported (deadweight) to wet (fresh weight) for landings (Source: Sea Fisheries Service, Department of Agriculture and Fisheries, Flemish Government).

ALFA_3	Scientific name	Name	Presentation	Commercialized	FACTOR
ANF	Lophiidae	ANGLER	FRESH	ENTIRE	1.18
ANF	Lophiidae	ANGLER	FRESH	No head	3.00
BIB	*Trisopterus luscus*	BIB	FRESH	STRIPPED	1.18
BLL	*Scophthalmus rhombus*	BRILL	FRESH	STRIPPED	1.05
BSS	*Dicentrarchus labrax*	SEA BASS	FRESH	STRIPPED	1.18
CAA	*Anarhichas lupus*	WOLFFISH	FRESH	STRIPPED	1.18
CNZ	*Crangon* spp.	SHRIMP	FRESH	ENTIRE	1.25
COD	*Gadus morhua*	COD	FRESH	STRIPPED	1.18
COE	*Conger conger*	CONGER EEL	FRESH	ENTIRE	1.00
CRE	*Cancer pangurus*	EDIBLE CRAB (legs)	FRESH	ENTIRE	1.00
CRE	*Cancer pangurus*	EDIBLE CRAB	FRESH	ENTIRE	1.00
CRU	Crustacea	OTHER CRUSTACEANS	FRESH	ENTIRE	1.00
CTC	*Sepia officinalis*	(CEPHALOPODS)	FRESH	ENTIRE	1.00
DAB	*Limanda limanda*	DAB	FRESH	STRIPPED	1.05
DGS	*Squalus acanthias*	(SHARKS)	FRESH	ENTIRE	1.00
DGZ	*Squalus* spp.	(SHARKS)	FRESH	ENTIRE	1.00
DPX	Perciformes	OTHER DEMERSAL	FRESH	STRIPPED	1.11
FLE	*Plathichthys flesus*	FLOUNDER	FRESH	ENTIRE	1.05
GUG	*Eutrigla gurnardus*	GREY GURNARD	FRESH	ENTIRE	1.00
GUR	*Chelidonichthys cuculus*	RED GURNARD	FRESH	ENTIRE	1.00
GUU	*Chelidonichthys lucerna*	TUB GURNARD	FRESH	ENTIRE	1.00
HAD	*Melanogrammus aeglefinus*	HADDOCK	FRESH	STRIPPED	1.18
HAL	*Hippoglossus hippoglossus*	HALIBUT	FRESH	STRIPPED	1.05
HER	*Clupea harengus*	HERRING	FRESH	ENTIRE	1.00
HKE	*Merluccius merluccius*	HAKE	FRESH	ENTIRE	1.18
JAX	*Trachurus* spp.	HORSE MACKEREL	FRESH	ENTIRE	1.00
LBE	*Homarus gammarus*	(LOBSTERS)	FRESH	ENTIRE	1.00
LEM	*Microstomus kitt*	LEMON SOLE	FRESH	STRIPPED	1.05
LEZ	*Lepidorhombus* spp.	MEGRIM	FRESH	STRIPPED	1.05
LIN	*Molva molva*	LING	FRESH	STRIPPED	1.18
MAC	*Scomber scrombus*	MACKEREL	FRESH	ENTIRE	1.00
MOL	Mollusca	OTHER MOLLUSCS	FRESH	ENTIRE	1.00
MUR	*Mullus surmuletus*	RED MULLET	FRESH	ENTIRE	1.04
NEP	*Nephrops norvegicus*	(LOBSTERS) (parts)	FRESH	ENTIRE	3.30
NEP	*Nephrops norvegicus*	(LOBSTERS) (entire)	FRESH	ENTIRE	1.00
OCZ	*Octopus* spp.	(CEPHALOPODS)	FRESH	ENTIRE	1.00

Appendix Table 2. Conversion factors used to convert reported (deadweight) to wet (fresh weight) for landings (Source: Sea Fisheries Service, Department of Agriculture and Fisheries, Flemish Government).

ALFA_3	Scientific name	Name	Presentation	Commercialized	FACTOR
PLE	*Pleuronectes platessa*	PLAICE	FRESH	STRIPPED	1.05
POK	*Pollachius virens*	COALFISH	FRESH	STRIPPED	1.18
POL	*Pollachius pollachius*	POLLACK	FRESH	STRIPPED	1.18
PPX	Perciformes	OTHER PELAGIC	FRESH	STRIPPED	1.00
RED	*Sebastes* spp.	OCEAN PERCH	FRESH	ENTIRE	1.00
SCE	*Pecten maximus*	SCALLOPS (SHELLS)	FRESH	ENTIRE	1.00
SKA	*Raja* spp.	RAYS	FRESH	ENTIRE	1.05
SKH	Selachimorpha	(SHARKS)	FRESH	ENTIRE	1.00
SOL	*Solea solea*	SOLE	FRESH	STRIPPED	1.05
SPR	*Sprattus sprattus*	SPRAT	FRESH	ENTIRE	1.00
SQC	*Loligo* spp.	(CEPHALOPODS)	FRESH	ENTIRE	1.00
TUR	*Psetta maxima*	TURBOT	FRESH	STRIPPED	1.05
USK	*Brosme brosme*	CUSK	FRESH	STRIPPED	1.18
WHE	*Buccinum undatum*	WHELK	FRESH	ENTIRE	1.00
WHG	*Merlangius merlangus*	WHITING	FRESH	STRIPPED	1.18

Appendix 3:

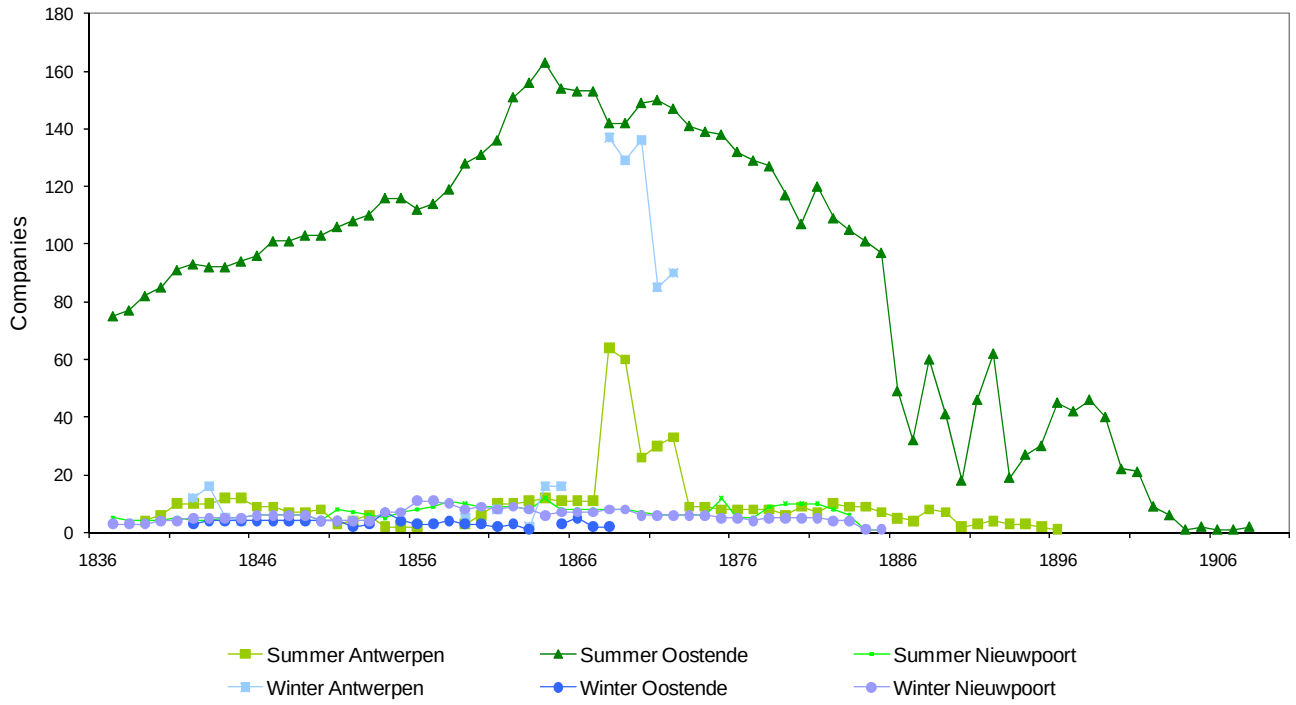

Figure Appendix 3.1: Number of ship owners dedicated to cod fisheries in the summer and winter period in the ports of Antwerpen, Oostende and Nieuwpoort 1836-1908. Collected from the Administrative Reports of the province of West-Flanders (1838-1860) and De Zuttere (1909) by VLIZ (VLIZ 2009).

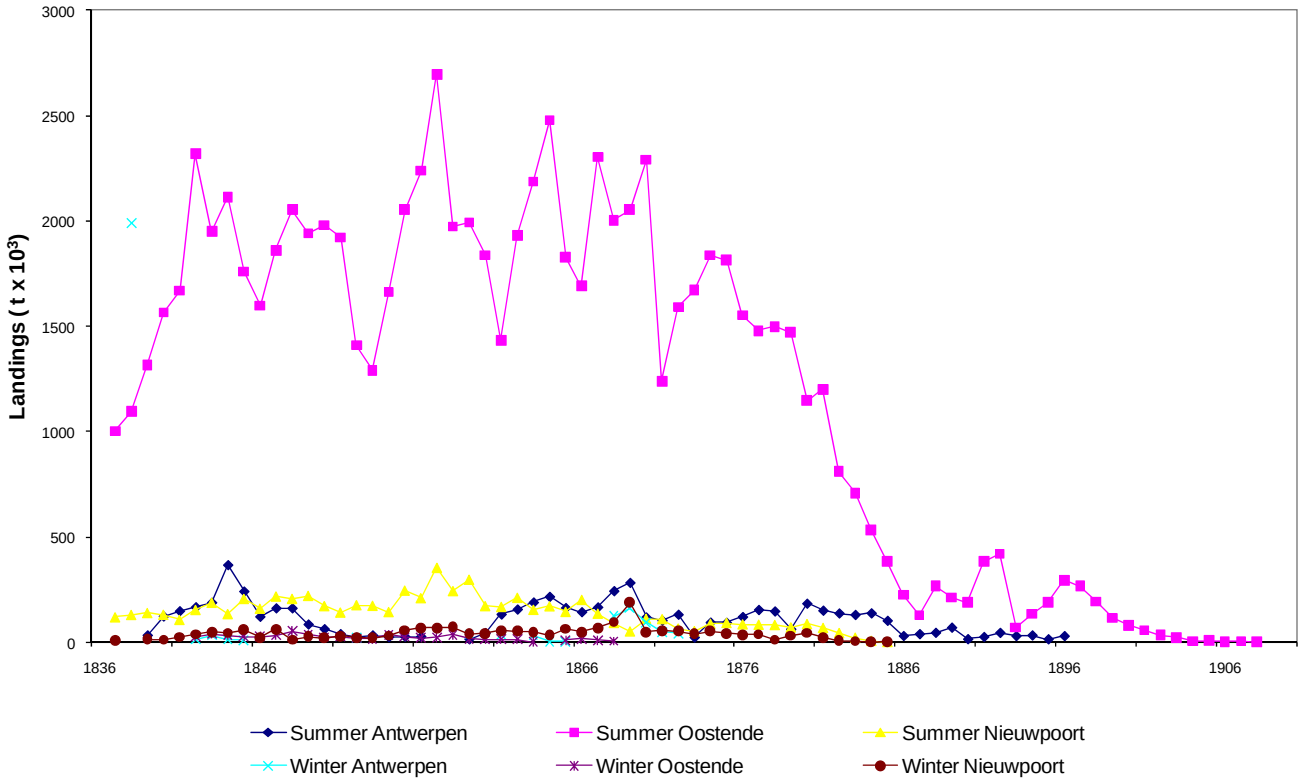

Figure Appendix 3.2: Landings of cod fisheries in the summer and winter period in the ports of Antwerpen, Oostende and Nieuwpoort 1836-1908. Collected from the Administrative Reports of the province of West-Flanders (1838-1860) and De Zuttere (1909) by VLIZ (VLIZ 2009).