Dutch herring

An environmental history, c. 1600-1860

Poulsen, Bo

Publication date:
2008

Document Version
Accepted author manuscript, peer reviewed version

Dutch herring

Dutch herring

An environmental history,
c. 1600-1860

Bo Poulsen

Aksant
Amsterdam
2008

This publication has been made possible by:
The Royal Netherlands Embassy, Copenhagen
Oostersche Handel en Reederijen

ISBN 978.90.5260.304.9

nog niet
aangepast

Lay-out and cover design: Ruparo, Amsterdam
Cover:

Aksant Academic Publishers,
P.O. Box 2169,
1000 CD Amsterdam,
The Netherlands
www.aksant.nl

Contents

nummering wordt op t laatst aangepast

List of Figures

List of Tables

Acknowledgements

This book is a revised edition of my Ph.D.-thesis, which was awarded the Ph.D.-degree following a public defence at the University of Southern Denmark, Esbjerg on 2 February 2006. This three-and-a-half-hour public examination – in addition to the written comments of my three examiners, Professor Konstantinos Stergiou, Aristotle University of Thessaloniki, Dr. Paul Warde, University of Cambridge and Professor Per Boje, University of Southern Denmark – provided some highly valuable input, which has been incorporated in this book version of my thesis.

From 1 July 2002 – 30 September 2005, I was employed as a Ph.D.-research fellow at the Centre for Maritime and Regional Studies, University of Southern Denmark. I gratefully acknowledge the financial support I received for this project from the History of Marine Animal Populations (HMAP) project for the Census of Marine Life (CoML), A. P. Sloan Foundation, Danish Network for Fisheries and Aquaculture Research (Fishnet.dk), Forskeruddannelsesrådet, (FUR), Consequences of weather and climate changes for marine and freshwater ecosystems (CONWOY) and Maritime History and Marine Environmental Research School (MARINERS), Centre for Maritime and Regional Studies.

The field of research for my Ph.D.-project was pre-determined insofar as it dealt with the exploitation of marine resources in the North Sea, approx. 1600-1850, as a part of the North Sea component of the global research programme, History of Marine Animal Populations, (HMAP). Within this framework, I worked with Poul Holm to draw up a research plan for this dissertation, addressing issues relative to the exploitation of North Sea herring in the period from approx. 1600-1850. Due to the nature of the source material, part of the study was later extended to approx. 1860.

The book bears my name, and I bear sole responsibility for its content, including any flaws and errors. However, I could not have submitted this work without the assistance of the following experts in the field of the North Sea.

In 1998, professor Poul Holm introduced me to the field of maritime history, and later to the emerging field of marine environmental history, which was the area of research of my MA-thesis and Ph.D.-thesis. Poul always provided me with scholarly guidance, marked by high demands, deep insights, encouraging confidence and great enthusiasm. For all this, I am extremely grateful.

Marine environmental history is an interdisciplinary approach, and I have

been very fortunate in having marine scientist, Dr. Brian R. MacKenzie of the Danish Fisheries Institute as my co-supervisor. He has been very patient in instructing me on the field of historical ecology, in which I have no formal training, and it has been a stimulating and undivided pleasure to discuss the ecological potential of my archival findings with Brian.

I would like to thank all my colleagues at the Centre for Maritime and Regional Studies, at SDU and the Fisheries and Maritime Museum, Esbjerg as well as the Institute of History and Civilization. They have all provided me with excellent working conditions, while the seminars at the MARINERS research school provided the basis for many fruitful discussions.

From 2001-2006 René Taudal Poulsen was my closest day-to-day teammate, as we both worked in the field of marine environmental history. His friendship and critical comments on all of the following chapters were extremely beneficial to the results of the thesis. Special thanks also go out to Anne Lif Jakobsen for her assistance in the area of database construction, Dr. Bo Ejstrud for teaching me basic GIS and statistical analysis skills, Dr. Lawrence Mott for advice on calculating navigation points, Erika Washburn for correcting my English and Maibritt Bager and Anne Husum Marboe who both provided a critical read through of the main chapters. Further assistance was provided by Arne Langhelle, Dr. Niels Christian Nielsen, Helle Kildebæk Raun and Dr. Habil. Martin Rheinheimer. Thanks also to the university library, which provided superb service.

Anne Dorthe Holm was a great help in the process of editing the final text.

In order to fulfil the objectives of the project I had to learn Dutch, and Kirsten Verkooijen at the Department of Public Health, University of Southern Denmark was a diligent and patient teacher of her native language.

In approaching the historical exploitation of North Sea herring, it soon became clear that the largest and most promising sets of archival material on the North Sea region would stem from the Dutch North Sea herring fisheries. During my research in the Netherlands, I was overwhelmed by the amount of friendly and helpful advice I received from a number of Dutch scholars.

As a part of the Dutch-Danish research project, Close encounters with the Dutch, headed by Professor Lex Heerma van Voss of the International Institute of Social History (IISG) and Poul Holm, I had the good fortune to spend six months as a visiting fellow of the IISG in Amsterdam in 2004. It would be difficult to exaggerate the hospitality with which I was received at the IISG where I benefited both as a scholar and gained new friends through my cooperation with Lex, Christiaan van Bochove, Jelle van Lottum and Kariin Sundsback. I also had a fruitful exchange of information on the Dutch herring fisheries with Christiaan and Professor Jan Luiten van Zanden – also

of the IISG, and I owe a special debt of gratitude to Christiaan for his critical read-through of all the main chapters in this thesis. While working at the IISG, I enjoyed the highly efficient and friendly service of the IISG library and Jack Hofman at the IISG archives.

Dr. Adri P. van Vliet, Institute for Maritime History, gave advice on where to find commercial catch records. Professor Jaap R. Bruijn, Universiteit Leiden, gave me the initial idea to use historic logbooks as a proxy for the movement of fishing vessels, and Dr. Jan P. van de Voort, Visserijmuseum Vlaardingen, pointed me to specific ship journals. Alex Poldervaart of the same institution kindly helped me to find contemporary illustrations of the early modern Dutch herring fisheries. At the Dutch fisheries institute, RIVO, I had a fruitful interview with Dr. Ad Corten. At the Royal Dutch Meteorological Institute (KNMI) Dr. Frits Koek helped me uncover a virtual goldmine of logbooks from herring vessels from the KNMI archive.

Thanks also to Jenny Mulder and Joep Surie who were both very helpful at the Museum op 't Houten Huijs, De Rijp, and Jasmijn van den Berg who provided a thorough introduction on how to use the Nationaal Archief in The Hague. I also benefited from the assistance of Frits Loomeijer, Maritiem Museum, Rotterdam, Laurens Priester, Gemeentearchief Schiedam, Dr. Hendrik M. van Aken at the Royal Netherlands Institute for Sea Research, Den Helder, Dr. Ingo Heidbrink, Deutsches Schiffartsmuseum, Bremerhaven, and from Dr. Jörg Luterbacher, National Center of Competence in Research (NCCR) Climate, University of Bern for sharing his data.

During the past four years I have taken part in seven HMAP workshops and summer schools, which provided numerous fruitful discussions, new insights and great fun, and I am particularly thankful for the advice I received from Dr. Tim Smith of NOAA, Northeast Fisheries Science Center, Woods Hole. It has also been highly beneficial to take part in workshops and seminars held by the research projects CONWOY and 'Dynamics of Economic Culture in the North Sea- and Baltic Region, approx. 1200-1700', as well as the seminars of the Fishnet.dk programme.

1 | Introduction

Motivation

Today, climate change is considered a prime concern when it comes to the future management of the World's fisheries resources. In the 2005 review of global fisheries resources from the Food and Agriculture Organization of the United Nation (FAO) climate variability and its potential impact on fisheries received special attention.[1] In modern fisheries, the climate is seen as a highly important factor influencing the overall fluctuations of many fish stocks. One of the problems facing fisheries managers is the task of distinguishing between the pressure caused by fishing and climatic variability, when analysing changes in modern fish stocks. Moreover, with the pressing issue of possible global warming, knowledge of the past effects of climate change may provide information for the management of future fish stocks. As worded in another recent publication from FAO; 'The dilemma is how to cope with the uncertainty of future climate changes. Lessons from the past seem a good place to start'.[2] Even if managers cannot simply project past trajectories into the future, lessons from the past still seem one way of informing us about the future of ecosystems.

This book presents an investigation of how natural variability in the North Atlantic area, and more specifically in the North Sea, may have affected the productivity of North Sea herring stocks and the recruitment of fish egs and larvae into these. An assessment of this factor is made possible through in-depth studies of the temporal and spatial variations in North Sea herring fluctuations from the pre-statistical era, when marine science was still in its embryonic stages.

We also need to look to the past to increase our understanding of society's interaction with the environment. In current debates on environmental is-

1 Csirke and Vasconcellos, *Marine fishery resources.*

2 Sharp, *Future climate change.*

sues, the starting point or baseline for scientifically-based arguments is often the time when a specific method or instrumental signal was first recorded. In the area of fisheries, the baseline for modern research is often no more than a generation, thus leaving the more distant past shrouded in darkness. This book proposes that marine environmental history is a means of shifting the baseline further back in time, shedding light onto past marine ecosystems in order to gain a better perspective on present ecosystems. This is also a way of eliminating unsubstantiated claims that everything was better in the past. One such urban legend originates from 12th century Danish chronicler Saxo Grammaticus, who stated that there were so many herring in The Sound that the fishing vessels would get stuck and that the herring could be fished with bare hands.[3]

As this study will demonstrate, we may also stand to increase our understanding of human interchange and collaboration in a seemingly cutthroat competitive industry like the fisheries. Quite unlike modern fisheries management, collaboration in the early modern Dutch herring fishery abided virtually the same fishery laws for three centuries. Working on the basis of these regulations, the fishers cooperated within a highly sophisticated information sharing system.

Moreover, herring was an important natural resource for the countries surrounding the North Sea, and salted herring was one of the principal commodities in the inter-European trade in the early modern period. Yet, this study is the first to apply environmental history to the North Sea herring fisheries in the period 1600-1860. To this end, an assessment was made of how the natural availability of herring influenced the development of the various herring fisheries.

This study introduces the concept of *relative spatial potential*, to describe how the different competing shore-based and high seas fisheries were highly dependent on the spatial variability of herring, which changed greatly over the course of approx. 250 years. In some periods, spatial variability favoured various shore-based fisheries, while at other times the spatially independent Dutch method of herring fishery was in a privileged position.

Through the construction of the World's longest-spanning time-series for catch per unit effort, CPUE facilitates an assessment of the influence of catch rates on the overall development of Dutch herring fishery. In the century between approx. 1550-1650, The Dutch Republic was the most modern economy, and Europe's leading trading nation. Yet during the same period, the Dutch herring industry absorbed more capital, and employed just as many men and ships as did the merchant fleet.[4] Over the next 200 years the glory

3 Saxo, *Saxos Danmarkshistorie*, p. 17.

4 De Vries and Van der Woude, *The first modern economy*, p. 266.

of the Dutch herring industry gradually faded, and historians have sought to explain this development ever since. This is the first analysis of the role of the environment in this downfall. Moreover, this marine environmental study makes up a general assessment of the supply side of the European herring sector and presents an overview of the patterns of trade and consumption for salted herring.

A final motivation of this study is that the approach, methodology and analytic tools applied in the analyses are interdisciplinary in that they attempt to bridge the gap between the two cultures, natural science and the humanities. In an attempt to create a synthesis between the environmental and societal changes affecting the herring fisheries, chapter 11 proposes a coherent system for the exploitation[5] of herring between 1600-1860. In this system of herring exploitation, the fisheries developed within a relationship between the spatial and temporal availability of resources, but did so within a broader historical and environmental context.

This is discussed in the synthesising chapter 11, where the fusion of driving forces in the natural environment and human society leads us to address three main overarching questions of this book:

Problem; three questions

In short, the purpose of this study is to increase our understanding of the driving forces behind pre-modern resource exploitation. Within this framework, the objective is to distinguish between human and natural factors impacting the marine ecosystem, through the analysis of relevant sets of historical source material.

We can thus formulate a starting point on the basis of three overarching questions.

1. What were the main forces stimulating change in the exploitation of North Sea herring during the period between approx. 1600-1860. In other words, what were the dynamics[6] of this particular historical system?
2. Which role did the natural environment play in this regard?
3. What caused the long-term decline of the Dutch herring fisheries?

---

5 'Exploitation' is defined as the utilisation of a natural resource.

6 Dynamics are defined as 'the forces that stimulate development or change within a system or process'. *The Concise Oxford Dictionary*, (1999).

2 | Methodology

Sound science, including historical science, is issue-driven. When the issues involve interaction between natural systems and human society, we must incorporate methods from the human as well as marine sciences.

This is not unproblematic and the two types of science often lead separate lives. Some fifty years ago, physicist C.P. Snow lamented this fact, when coining the term the two cultures, the natural sciences and the humanities, operating in separate intellectual worlds.[1] Since then, the differences have most likely grown greater in many ways. In recent theoretical works on historical science, it has even been claimed that there are absolute differences between natural sciences and history. English historian Arthur Marwick stated that '...there is a fundamental difference in the subject of study: the natural sciences are concerned with the phenomena of the natural world and the physical universe, while history is concerned with human beings and human societies in the past. There is a difference in the phenomena studied, and these phenomena are very different in character.'[2]

Issues involving man's interactions with the environment transcend this 'fundamental division' of the two cultures, so how does one go about solving this problem as a historian?

A source is a function

First of all, we need to establish the status of history as a science. Within the continental European tradition, it is common to view history as a science, in the same way as medicine, physics, geology and biochemistry are sciences. Within the Anglo-American world though, this is more problematic. Part of the problem arises from what has been called an eccentricity of the English language, by which the term 'historical science' does not have the same con-

1 Snow, *De to kulturer.*

2 Marwick, *New Nature of History*, p. 248.

notations as for instance natural science. In Danish, and German this is not a problem, since Videnskab, or Wissenschaft, can be both historievidenskab (historical science) and naturvidenskab (natural science).[3]

A more serious aspect of the problem, which also holds sway in some corners of European continental historical science, is the view held by some historians that the practice of history bears more resemblance to literary conventions, or that it is merely a craft enabling the historian to tell stories. The study of the past is the study of something that no longer exists. This poses a logic problem, and some feel this invalidates the practice of history as a science, since there are problems with regard to subjectivity, bias and the representativity of sources, which are 'leftovers' from the past.

This view is espoused in influential writings by various sources, such as English historian Keith Jenkins.[4] It is also a central argument in two articles in a recent issue of leading Swedish historical journal, Historisk Tidskrift.[5]

In this study, the words history and historical science are both used, as the latter underlines the assertion that the study of history is just as much a science as is natural science. As the following chapters will demonstrate, marine ecology and history share the same fundamental scientific challenges such as uncertainties, error and problems of subjectivity in the methods used to select data.

Within the field of history, the challenge of overcoming these problems has been addressed by Danish historian Paludan, who states that any scientific problem should be addressed by way of a series of transparent hypotheses.[6] These hypotheses are used as guidelines when collecting and analysing data, which in the field of history normally involves written documents. However, the sources used are merely sources, or data, insofar as they serve to test the hypothesis. The data can either serve its purpose well or not, but fruitful interaction between the historian and the data will result in an interpretation that yields new knowledge. This principle, known as the *functional concept of sources*, is illustrated by figure 2.1.[7] The arrows describe the main direction of the different stages in the process of scientific investigation. In reality though, the hermeneutical or interpretative elements of any scientific undertaking mean the process will involve recurring gradual reformulation and fine-tuning during the course of the investigation.

---

3 Evans, *In defense of history*, p.45.

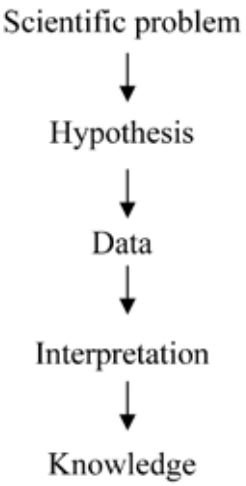
4 Jenkins, Keith, *On "What is History?"*.

5 Nilsson, 'Historia som vetskap', pp. 189-207 and Nilsson, 'källkritik och historieskrivning', pp. 233-248.

6 Paludan, 'Cairos røde Rose', pp. 29-40.

7 For this graphic representation of Paludan's line of thinking, I am indebted to Dr. Claus Møller Jørgensen, University of Aarhus.

Figure 2.1
The status of data based on the functional concept of sources



What does differentiate history from marine ecology and historical climatology is the perspective of the scientific problem being addressed by the hypothesis. If the perspective is anthropogenic or human, then the investigation falls within the realm of history, or any social science for that matter. If the perspective is ecological then the investigation will fall within the realm of a natural science discipline. Interdisciplinary questions, such as those formulated in the above section, should be addressed within the framework of an interdisciplinary science such as marine environmental history.

Environmental history

French historian Fernand Braudel was one of the first to include the natural environment as a structural background for historical analysis in his two volumes on The Mediterranean.[8] Braudel took on the task of incorporating '...the dialectic of space and time (geography and history)....'[9] Differentiating between three tempi of change, geography '...helps us to rediscover the slow unfolding of structural realities, to see things in the perspective of the very long-term.'[10] These slow moving long-term structural realities, *la longue dureé*, were the natural environment of the mountains, plains and seas of the

8 Braudel, *The Mediterranean*.
9 Braudel, *The Mediterranean*, p. 16.
10 Braudel, *The Mediterranean*, p. 23.

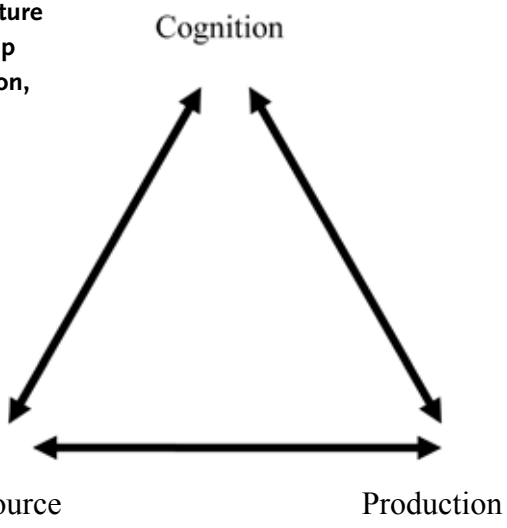
Mediterranean, as well as the trading routes and ancient towns, all factors which were elegantly laid out as fundamental to the conditions of people and their lives in the 16th century Mediterranean World. The lives of peoples, and societies also evolved amidst faster moving change, such as economic trends, the *conjunctures*. Finally, Braudel investigated what he viewed as the major political events, *l'histoire evenementielle*, which he saw as the traditional heritage of historical science. The Mediterranean is still regarded as a classic within the field of history, but critiques of the approach taken by Braudel and other structuralist historians has pointed to a lack of real integration between la longue dureé and the relevant conjunctures and events. Nonetheless, the classification and isolation of meaningful historical tempi for natural as well societal factors is also an ambition of this study.

Ecology, Production and Cognition

For actual integration between environmental and societal forces of change it is worth turning to American environmental historian, Donald Worster. Worster proposed that environmental history should be inclusive towards the methodology and perspectives of other scientific disciplines, including the natural sciences. The idea is to view interactions between man and nature as part of a triangular relationship between the concepts of Cognition, Production and Resource. This is illustrated by figure 2.2.

Figure 2.2

Interaction between man and nature as part of a triangular relationship between the concepts of Cognition, Production and Resource.



One of the common denominators of history and ecology is that they both study change and stability within a specified time and space, or, to put it in different terms, an historical system. In order to establish a coherent system of resource exploitation, one must analyse the impact of human production and cognitive aspects on the natural resource, as well as the reversed impacts.[11] Therefore, the issues can be viewed from multiple perspectives, anthropogenic as well as ecological. This is illustrated by arrows in Worster's triangle, which can take any direction in between the corners.

When it comes to the historical study of fisheries, this triangular concept was first adopted by Arthur F. McEvoy. In a study of the Californian fisheries from 1850-1980, McEvoy explains how the 'cognitive corner' has influenced the production of fish and availability of sardines through the fishery legislation imposed by the Californian government, as well as the beliefs of the individual fishers. In the 'resource corner', the availability of fish set maximum limits to the number of freshly caught fish. A clear example of this occurred in the 1950s and 1960s, when the Californian sardine fisheries witnessed one of the most spectacular and tragic crashes of any commercial fishery. Insofar as the collapse of stocks was the result of pressure from fishing, we can conclude that production influenced the resource. The resource can be said to have affected cognition, since a moratorium was subsequently introduced. To the extent that the moratorium was instrumental in bringing back the sardines, which started to emerge in greater numbers in the 1980s, cognition in the form of lawmaking affected the availability of natural resources.[12]

The Californian sardine fisheries were one of several case studies described in *Scaling Fisheries*, where American marine ecologist Tim Smith, explored the historical development of fisheries science from the mid-19th to mid-20th century.[13] Smith analyses the development of time series in the estimation of stock fluctuations, and describes how scientific contributions were, and still are, deeply imbedded in a wider social and political context, which has often overshadowed the most rational method of conducting marine science.

In an approach more similar to McEvoy's, historian Margaret Beattie Bogue wrote *Fishing the Great Lakes, An environmental history, 1783-1933*, in which she explains how the exploitation patterns established in the Great Lakes of North America seriously depleted fish stocks, and analyses the at-

---

11 Worster, 'Environmental History', pp. 289-307.

12 McEvoy, *The Fisherman's problem* and McEvoy, 'Toward an Interactive Theory', pp. 211-229. The adoption of this approach owes much to fruitful discussions of McEvoy's article at the HMAP summer school in 2001.

13 Smith, *Scaling Fisheries*.

tempts by fisheries managers to cope with changing conditions for fish and fishers.[14]

Within the field of social anthropology, there is longstanding tradition of analysing the everyday practices of fishers and fishing communities. Some studies also take into consideration the changing conditions in terms of the resources available to fisheries, and the way in which fishers adapt to these changes. For this study, the anthology *North Atlantic Fishers: Anthropological Essays on Modern Fishing* has been of inspiration.[15]

A more recent collection of papers focusing mainly on Canadian fisheries is *Fishing Places, Fishing People*, containing contributions from historians and natural scientists on what can be broadly termed as historical anthropology. The interplay between small-scale or indigenous fisheries, the availability of natural resources and the issue of fisheries management are the focal points of most papers.[16]

While all these environmental studies dealt with the three corners of the triangle, none has tried to discover and document changes in the availability of resources as a part of their analyses.

Marine environmental history

This is one area that sets marine environmental history apart and, in some ways, lends it greater ambition, by actually pairing and applying methods from history and marine science in analyses of resource availability. This however, does not mean that analyses of the production and cognitive matters are excluded.

Marine environmental history is exemplified in the project The History of Marine Animal Populations (HMAP). The purpose of HMAP is to deepen our understanding of the dynamics of marine ecosystems and the interaction between human society and marine resources.[17] This research project is being conducted against the backdrop of an increasing awareness within the natural sciences of the value of a more temporal dimension in explaining and solving the problems of the present. Examples of this can be found in the volume *The Exploited Seas: New Directions for Marine Environmental History*.[18] One article, co-written by historian Cadigan and marine ecologist Hutchings explores the spatial expansion of cod fisheries off Newfoundland

14 Beattie Bogue, *Fishing the Great Lakes*.

15 Andersen and Wadel, *North Atlantic Fishermen*.

16 Newell and Ommer, *Fishing Places*.

17 http://www.coml.org; Holm, et al. http://www.cmrh.dk/hmapii.pdf; and Poul Holm et al. *The Exploited Seas*.

18 Holm, *et al. The Exploited Seas*.

in the 19th century arguing that the fishers dealt with declining catch rates in the inshore waters by gradually fishing further and further away from their home area, with the labour situation also playing a role in this spatial shift of fishing.[19]

For a European example, we can look to Ph.D.-thesis An environmental history of North Sea ling and cod fisheries, 1840-1914 by historian René Taudal Poulsen. In this thesis, Poulsen applies theories on the spatial depletion of fish stock to the 19th century fisheries on the Swedish west coast. He finds that fisheries were able to affect the stock of ling, while the changes observed in the fisheries affected the way in which the industry was organised and the economic performance of the fisheries.[20]

Shifting baselines

The implementation of longer time scales in natural science has highlighted a phenomenon termed the *shifting baseline syndrome*.

Recently, American biologist Jeremy Jackson called for the baseline of scientific investigation to be pushed back centuries, in order to better understand the interplay between man and the sea. As an example of this, Jackson successfully argued that the reason for the recent deterioration of coral reefs is to be found in the Caribbean fisheries of the sixteenth and seventeenth centuries.[21] Thus, human interventions four centuries ago are still affecting an important marine ecosystem.

With regards to the waters of Northern Europe, a joint article by marine ecologists and historians listed a number of important hypotheses that can further our understanding of historic ecosystems in the North Sea and Baltic Sea.[22] From a marine ecology perspective, it is of great interest to know how marine ecosystems functioned in an era before intensive fishing affected fish stocks and indirectly influenced other trophic levels in ecosystems. Many more studies of historic marine ecology are currently being investigated as a part of the HMAP research programme.

Within the research field of historical ecology, studies have proposed a baseline shift with regards to scientific fisheries studies. However, the study of North Sea herring populations has seen a marked interest in long time series spanning the past 125 years of scientific investigation.

---

19 Cadigan and Hutchings, 'Newfoundland Fishery for Atlantic Cod', pp. 31-65.

20 Poulsen, 'North Sea ling and cod fisheries'.

21 Jackson et al., 'Historical overfishing', pp. 629-637 and Jackson, 'Reefs since Columbus', pp. 23-32.

22 MacKenzie et al., 'hypothesis for a historical reconstruction', pp. 173-190.

When it comes to European fisheries, the timing of and causes for the Bohuslen herring periods are probably the oldest topic of scientific debate in this area. Approximately once every century since the Viking Age, 30-60 year periods of extremely prolific herring fisheries at Bohuslen have been recorded. The causes of these Bohuslen periods have been subject to speculation since – at least – the late 16th century.[23] The first study to assess whether the phenomenon was caused by climate-related factors was conducted as early as 1879. A Scandinavian audience of fisheries scientists heard A.V. Ljungman set out his hypothesis that the occurrence of herring was influenced by changes in the frequency of sunspots.[24]

Both the origin of the herring and the causes for their sudden emergence and later disappearance have been the focus of much debate. In the 1950s and 1960s, Norwegian scientist Devold put forward the hypothesis that the herring at Bohuslen belonged to the Atlanto-Scandian herring stock, which appeared in Skagerack during certain periods, switching to the Norwegian west coast in others. In the 1960s however, Swedish scientist Höglund analysed fish bones excavated from 18th century production sites for train oil, concluding that the Bohuslen herring originated from the North Sea, and was actually spent herring from the Buchan Herring subpopulation.[25] Höglund's theory still holds sway today.[26] Nonetheless, the causes for these periodic changes in the annual migration patterns of North Sea herring are still much debated, and serve as topic for discussion in their own right.

At the other end of the North Sea, the English Channel has also been the focus of investigations into climate-related issues during the last 20 years. In 1988, Southward et al. presented an analysis of sardine and herring fisheries in the English Channel based from the South English counties of Devon and Cornwall between the late 16th century until the present day. They compared climate-related factors such as sunspots and temperature changes with various sources of evidence for fishing activity, concluding that periods of warmer weather favoured the sardine fisheries, while a colder climate was more beneficial to the herring fisheries. However, historical fisheries data from before approx. 1900 was mainly of a qualitative nature. For most of the time span, the analysis is thus based on scarce reports from visiting travel writers and reports in old local newspaper on the relative success of the various fisheries.[27] This means the quality of the historical source material is dependent on highly heterogeneous and subjective origins.

---

23 Poulsen, *The renaissance Sea*, pp. 284-292.
24 Ljungman, 'sillfiskenas sekulära periodicitet', pp. 257-268.
25 Höglund, *On the Bohuslän herring*.
26 Corten, 'mechanism for the Bohuslän herring', p. 209.
27 Southward et al., 'Fluctuations in the herring and pilchard', pp. 423-445.

On the French side of the Channel, Binet had reached a similar conclusion two years earlier, also based on mainly qualitative evidence. Going back to approx. 1700, Binet constructed an ordinal scale for the French herring and sardine fisheries, in which each year was rated either "poor", "medium" or "good".[28]

In an article presenting an overview of European herring, Alheit and Hagen proposed that long-term developments in terms of temperature affect both the abundance and spatial distribution of herring, sardines and anchovy in Northern European fishing waters. They compared different testimonies on a number of shore-based historical fisheries, and found similar periodical patterns with regards to the abundance of herring and sardines in different areas of Europe. Alheit and Hagen proposed that the herring fisheries in the Biscay, the English Channel, Devon and Cornwall and Bohuslen in Sweden all showed similarities during the bountiful fishing periods, when the sea surface temperature and air temperatures were low. Contrary to this finding, the spring herring fisheries of western Norway and sardine fisheries of Devon and Cornwall and off the coast of North Brittany seemed to benefit from the opposite climatic conditions.[29] This conclusion is supported by a study on the abundance of Norwegian spring spawning herring in the 20th century. Here, scientists Toresen and Østvedt, conclude that the recruitment of this stock of herring is positively correlated with average temperatures in the northeast Atlantic region during the winter season. They attribute this to environmental factors governing the major fluctuations.[30]

When it comes to the long-term historical abundance and distribution of North Sea herring, however, no evidence has been available as of yet. Nor is there any data from before approx. 1920 that would allow us to make comparisons with the general fluctuation pattern of European herring.

Dutch herring historiography

As the first marine environmental history of the North Sea herring fisheries, this study offers new insights, focusing primarily on the Dutch North Sea herring fishery.

The Dutch high seas herring fishery, *De Grote Visserij*, was the largest and most organized fishery in pre-modern Europe. In short, it was of great economic importance to the Dutch Republic, and there is an ongoing debate in Dutch historiography as to why the Dutch herring fisheries – with their

28 Binet, 'French sardine and herring', pp. 253-272.

29 Alheit and Hagen, 'Long-term climate forcing', pp. 130-139.

30 Toresen and Østvedt, 'abundance of Norwegian spring-spawning herring', pp. 231-256.

dominance of the North Sea market during the 17th century – came to deteriorate over the following centuries, losing out primarily to Swedish, Scottish and Norwegian herring producers. The downfall of the great Dutch herring fishery has attracted the attention of a number of historians, resulting in five different theories as to the main causes of decline.

1) The North Sea was a frequent theatre of war in the Early Modern period. The possible negative impact on the Dutch herring industry has been a topic for debate since – at least – the late 19th century, when Dutch historian Beaujon published a political history of the Dutch fisheries. By the time of the Peace of Utrecht in 1713, Beaujon found, the Dutch herring fisheries had been hampered and broken down by the combined effects of a century of war and piracy.[31] Canadian historian Unger also proposed that the wars of the 17th century dealt decisive blows to the Dutch herring industry.[32] Recent historical research has attempted to quantify the effects of piracy. Dutch historian Adri van Vliet has made special efforts to investigate piracy from Dunkerque in present-day northern France, and its impact on these fisheries during the 80 years War, (1568-1648).[33]

2) As a second explanation, Unger analysed the position of the Dutch on the North European herring market. He attributes the success of Dutch herring fishery to its superior technology, organisation and institutional framework in the 16th century. In the following century, the fisheries declined as the organisation was struck by inertia and failed to develop.[34]
However, Dutch historian Johan de Vries did not feel this was significant in terms of technological innovation, as the Dutch remained leaders in terms of fishing technology throughout the period.[35]

3) British and Dutch experts have suggested that competition from Scotland was a third important factor in the decline of the Dutch herring fisheries.[36] The relatively high prices of prime quality Dutch herring were potentially bad for competition. Equally bad for business was a possible change of diet in the home market and decreasing overall demand.

---

31 Beaujon, *Nederlandsche Zeevisscherijen*, p. 80.
32 Unger, 'Dutch Herring, Technology', p. 279.
33 Van Vliet, *Vissers en Kapers*, 'Het einde van een bedrijfstak' and *Vissers in Oorlogstijd*.
34 Unger, 'Dutch Herring, Technology'.
35 Vries, *De economische achteruitgang*, p. 143.
36 Michell, 'European Fisheries' and De Vries and Van der Woude, *The first modern economy*, pp. 252-253.

4) Some have taken a more neo-classical approach to the question, suggesting that more lucrative investment opportunities in other sectors made investors lose interest in the fisheries. Mercantilist trading policies of North European states added to the slump in demand with high taxes being levied on imported goods and the favouring of local industries.[37]

5) Declining catch rates always were a black box for historians trying to explain the downfall of the great Dutch herring industry. This explanation was first suggested by Dutch historian Kranenburg more than half a century ago, and a number of subsequent authors have commented on environmental changes.[38] This study, however, is the first to present an in-depth analysis of this problem from both a temporal and spatial perspective.

37 Vries, Jan de and Ad van der Woude, *The first modern economy*.

38 Kranenburg, *De zeevisscherij*, pp. 43-44, Michell, 'European Fisheries', Willemsen, *Enkhuizen*, van Bochove, 'De Hollandse haringvisserij', pp. 15-16, De Vries and Van der Woude, *The first modern economy*, pp. 251-253, and De Vries, *De economische achteruitgang*, p. 144.

3 | Hypotheses and questions

This study attempts to present analyses covering all three corners of Worster's triangle. This is achieved by applying multiple perspectives on the interaction between North Sea herring populations and the human fisheries systems and societal factors impacting the fisheries.

The individual analyses in chapters 4-11 each address at least two corners of the triangle. The synthesising chapter 11, however, is intended to present a system of herring exploitation in the North Sea, approx. 1600-1850 as well as analyses spanning all three 'corners'.

The next step is to apply the above theories on interaction between man and nature to the empirical past of the North Sea ecosystem and North Sea history as observed in the exploitation of herring, between approx. 1600-1850. In order to construct relevant sets of observations, a number of hypotheses must be defined and tested. The main hypotheses examined in this study are the following, listed here according to their primary perspective on each particular issue:

Methodological:

- A uniform set of historical data will allow for the reconstruction of lengthy time series with regards to fishing effort and catch rates.
- Historical research will allow for reconstruction of the spatial dimensions of the North Sea herring exploration pattern.
- The above two hypotheses allow us to differentiate between natural and human impacts on a former ecosystem.
- Theories from modern marine ecology can provide new insights into the history of the North Sea herring fisheries

Mainly ecological:

- The total extraction of North Sea herring can be measured over a period of

several centuries
- Did fisheries have a significant impact on the abundance of North Sea herring, or not?
- How did the population of North Sea herring fluctuate during the defined time period?
- How did the stock of North Sea herring migrate, both seasonally and over decades?

Mainly anthropogenic:
- What was the total production of salted herring in the North Sea area?
- Who were the main producers of herring during this period?
- How did the main producers differ in terms of their mode of production?
- Which factors characterised the development of European herring consumption?
- How was the European salted herring market integrated?
- How did the organisation of Dutch herring fisheries influence fishing strategy
- How can the cooperative behaviour of the Dutch fishers be addressed with modern theories on information sharing systems?
- To what extent were fishing strategies adaptive to the challenges of a species with severe temporal and spatial fluctuations?
- How did external historical developments impact the fisheries?

Synthesising:
- Can one distinguish between the influential factors underlying the observed environmental and anthropogenic developments, or even establish a hierarchy of causations?
- What role did the environment play in the development of historical herring fisheries?
- What was the main dynamic behind pre-industrial resource exploitation?
- How can knowledge of this former ecosystem contribute to today's understanding of and management of marine resources?

These three types of analyses focusing on the herring fisheries are situated within a context of external forces. These are: 1) environmental forcing, 2) the probability of fishing mortality in chapter 5 and 3) their historical context, described mainly in chapters 4, and 6 and partly in chapters 7 and 9. This contextualisation serves to address the starting point of the three main questions in synthesising chapter 11.

First of all though, it is essential to measure how much herring was extracted from the North Sea in the period chosen for analysis, between approx. 1600-

1860. This is examined in chapter 4, which also provides a historical context to the main producers and production methods in the herring industries around the North Sea. In chapter 5, the total extraction of herring is weighed against current knowledge on how much herring can be extracted from the North Sea without affecting the abundance of the herring stock. The chapter concludes that fishing pressure in the period 1600-1860 is not likely to have affected the fish stock.

Testing the above hypotheses will require the use of three different types of analytical tools. These are 1) Catch per unit effort analyses of the Dutch herring fisheries in chapter 8, 2) analyses of the spatial distribution of Dutch herring fisheries and various shore-based fisheries in chapters 4, 9 and 10 and 3) analyses of the fishing strategies used by the Dutch fishers in chapters 7, 8 and 9. Their fishing strategy involved considerations on how, when and with whom to fish, both on a day-to-day basis and over the course of an entire fishing trip and the entire fishing season. The fishing strategy of the fishing fleet as a whole is analysed over the course of several years, decades and the entire time span between 1600-1860.

So far, the issues at stake have an ecological perspective. Nevertheless, this study also analyses a good deal of historical issues. The assessment in chapter 4 of the main herring producers and amount of salted herring produced over a two-hundred-year period provides the most comprehensive coverage of the supply side of the European herring sector. Chapter 6 builds on this in an overview of trading and consumption patterns for salted herring in Northern parts of Europe.

The primary sources in this study were selected on the basis of their ability to bring the analyses as close as possible to the actual fishing. In chapter 7, a source-critical analysis of logbooks from Dutch herring fishers reveals the use of a highly sophisticated information sharing system during fishing. In chapter 9, the fishing strategies of Dutch herring fisheries are analysed in a more quantitative manner, exposing an extremely flexible fishery, highly capable of adapting to the fleeting presence of herring shoals.

Narrative structure

From a narrative point of view, this study – which attempts to bridge the gap between two distinct traditions of scholarly writing – bears resemblance to a type of narrative where the same phenomena (the exploitation of North Sea herring) is described from one (scientific) perspective at a time, during a fixed time frame (approx. 1600-1860). This means each of the chapters 4 – 10 can be read individually as separate articles. Given the structure of the study, this preliminary section on methodology, sources and historiography

is relatively short for a historical study.

Instead, each of the articles has an introductory section containing relevant background information and explanations of the work presented and hypotheses tested. Thereafter, short sections describe the methods and procedures used to collect the data and information. In the more historical articles the analysis section consists of longer prose. In each chapter though, the discussion section contains an interpretation of the results relative to literature and current knowledge. The conclusion section concisely summarises the entire text and especially important findings.

The idea behind the synthesising chapter 11 is to bring more to the table than the sum of the previous chapters, and attempt to answer the three main overarching questions. These questions transcend the scope of the individual historical and ecological disciplines and the perspective of the arguments presented in the articles in chapters 4-10.

4 | Producers and Production of Salted herring

Introduction

Herring is – both today and historically – a welcome guest in the waters of northern Europe, having been exploited by various European powers at different times. In the Middle Ages, the Danish king hosted Europe's then largest fishery for herring at the Sound. By the 17th century, the Dutch high seas herring fishery had risen to prominence and dominance, whereas the 18th century saw the growth of a number of different major herring fisheries in European waters. In the 19th century, Scottish and Norwegian herring fisheries came to dominate the European market for salted herring. During this entire period, salted herring was one of the principal bulk commodities to be traded in the North Sea and Baltic area, and was the most important type of food transported between the two seas in the early modern period with the exception of grain.

This chapter argues that it is possible to calculate the total size of the North Sea herring industry and the herring fisheries of the individual countries around the North Sea over the 1600-1850 period.

Moreover, while the largest producers of herring in the North Sea area have given rise to speculations as to their size over the past 400 years, several smaller-scale herring fisheries around the North Sea are less well described in modern fisheries historiography. However, since they all contributed to the overall production of salted herring in the North Sea area, the herring fisheries based in northern France, Flandern, the German North Sea ports of Emden and Bremen, as well as the Danish herring fisheries in the Limfjord

along the North Sea, and the town of Altona, outside of Hamburg are all included in this chapter.

How much?

Surprisingly, only a handful of attempts have been made at estimating the total production of herring in Northern Europe during the last 30 some years, while many of the existing figures are highly exaggerated.

Within the field of marine biology, the search for mechanisms and dynamics behind the wildly fluctuating North Sea herring populations has been at forefront of research for the last 100 years. In view of the fact that these fluctuations are likely to be caused by some sort of environmental and therefore long-term changes, this analysis will require long-term time series to provide insight into catch rates and the scale of herring production. English marine scientist Cushing presented an overview of the total production of herring in the North Sea area. For the period after 1600, Cushing included the fisheries off East Anglia, The Netherlands and – for the 19th century – Scotland. East Anglia's production was estimated at 60,000 tonnes during the 18th and 10-50,000 tonnes in the 19th century, whereas the Dutch total was estimated at 120,000 tonnes in the 17th and 100,000 tonnes in the 19th century. Finally, Scottish production was estimated at approx. 200,000 tonnes during the 19th century.[1]

In 1992, German marine scientists Sahrhage and Lundbeck published an overview of the History of fishing in which they included an attempt to estimate the total production of salted herring in the North Sea area. They presented a rough estimate for the fisheries at Bohuslen in 1560 at 60,000 tonnes, approximating Dutch production in the 17th and 18th century as declining from approx. 90,000 tonnes to virtually nil by the start of the 19th century. In Scotland, production rose from next to nothing in the mid-18th century to approx. 60,000 tonnes around 1850.[2]

With regards to the 1814-1900 period, marine scientist Steven Mackinson produced an estimate for the total catches of herring in The Netherlands, England, Scotland, Germany, Belgium, Denmark, France and Norway. Mackinson estimated that approx. 10,000 tonnes of herring were caught in the 1810s and 20s, while close to 150,000 tonnes were caught in the middle of the century.[3]

Scottish geographer Coull's attempt to provide an overview of herring fisheries in Europe during pre-industrial times makes mention of the large

---

1 Cushing, *The Provident Sea*, p. 99.

2 Sahrhage and Lundbeck, *A history of fishing*, p. 79.

3 Mackinson, http://saup.fisheries.ubc.ca/report/impactmodels/NorthSea.pdf, p. 4. Mackinson took an interest in the North Sea ecosystem itself. The Norwegian spring spawning herring is not part of the ICES' definition of the North Sea which probably explains why Norwegian catches do not figure prior to the mid-1860s.

Dutch, Scottish, Norwegian and Swedish herring fisheries. He offers a total estimate for The Netherlands of approx. 30,000-40,000 tonnes during their heyday, and a similar figure for Bohuslen, while proffering that the Norwegian herring fishery exported approx. 70,000 tonnes in the 1860s.[4]

In 1977, A. R. Michell presented a historic overview of The European Fisheries in Early Modern Period.[5] Michell covered the period from approx. 1500-1750 and focused on the herring fisheries from all countries bordering the North Sea except the Bohuslen herring fishery which is not mentioned. Michell was cautious when it comes to estimating the size of the herring fisheries and regrets '...that quantitative records concerning fishing pre-1750 are few'.[6] He concluded that the total European landings in all of Europe's herring fisheries amounted to rather less than 50,000 lasts, or the equivalent of approx. 75,000 metric tonnes.[7]

As the analysis below will demonstrate this last estimate by Michell is not far off the marks established in this chapter, but there are clearly large differences between the various estimates listed above. However, the handful of attempts to assess the overall production of herring in the North Sea prior to the late 19th century advent of modern fisheries statistics have been held back by a reliance on extremely heterogeneous historical research. Firstly, historical sources from the 1600-1850 period often take forms that make quantification extremely laborious. In view of the fact that statistical accounts are a phenomenon of more modern origin and units of measurement were far from standardised in this period, conversion into a uniform standard is a necessity. Moreover, since much historical research on fisheries was conducted within a particular national framework, the relevant language and library is often inaccessible to many scholars.

When putting numbers to events and phenomena of the past, the source material itself also presents a problem, rooted in loosely based assumptions, often of contemporary origin, that have been handed down over generations gaining more and more credibility over time. For example, some estimates of the size of the early modern herring industry are based on contemporary accounts in pamphlet literature. These present large and quite often very round figures on the fleet sizes. One such commentator was I. Burroughs who – in 1633 – boldly stated that in that year 6,400 herring busses had taken part in the summer herring fishery at the Shetlands, and that the Dutch share there-

4 Coull, *World Fisheries*, pp. 35-37.

5 Michell, 'European Fisheries', pp. 133-184.

6 Michell, 'European Fisheries', p. 134.

7 Michell, 'European Fisheries', p. 155. In the conversion from lasts to metric tonnes the assumption is that an average European herring barrel contained approx. 125 kg of salted herring, and that 12 barrels made up one last.

of was around 3,000 vessels. This number has since been taken at face value in modern estimates.[8] Another piece of anecdotal evidence is a report on the Dutch fisheries, stating that 2,000 busses were engaged in the herring fisheries, 120,000 tonnes of herring were exported annually and that 450,000 people in the Netherlands made a living from the herring fisheries.[9] This stems from a book by Walter Raleigh published in 1603 and has been quoted as a credible figure almost until this day. In 1808, the English commentator Tobias Gentleman estimated the Dutch herring fishery to have landed up to 150,000 tonnes annually, probably basing his figures on Raleigh, who's trade estimates have been quoted as late as 1988.[10] However, recent analyses of the scale of Dutch herring fisheries has provided us with much more accurate figures. As the analyses below will demonstrate, this also applies to a number of other fisheries.

Analysis

The following analysis traces the development of major salted herring production in the North Sea area during the period from approx. 1600-1850. Most of the data presented in this analysis stems from published accounts of the state of the fisheries in one particular country or area, or are derived from written sources originating from recorded economic interactions such as export statistics and tax accounts. The size of the herring fisheries in each major town, region or country is analysed individually, with the total size and main characteristics of each fishery compared in the subsequent discussion.

The Dutch Republic

The Dutch herring fishery was the largest Early Modern herring fishery in the North Sea area from at least the early 16th until the end of the 18th century. The Dutch herring fishery was also extremely well organised for its time, and definitely the most regulated open sea fishery anywhere in the world prior to the 19th century. In the 1560s a number of towns formed a political body, the *College van de Grote Visserij*. During the last decades of the 16th century, this body was granted jurisdiction over the entire Dutch herring industry with respect to the catch, processing, distribution and marketing of salted herring.[11]

The privileged towns that formed the College upheld a monopoly on the landing of salted herring in the Netherlands until the 1850s. Dutch archives

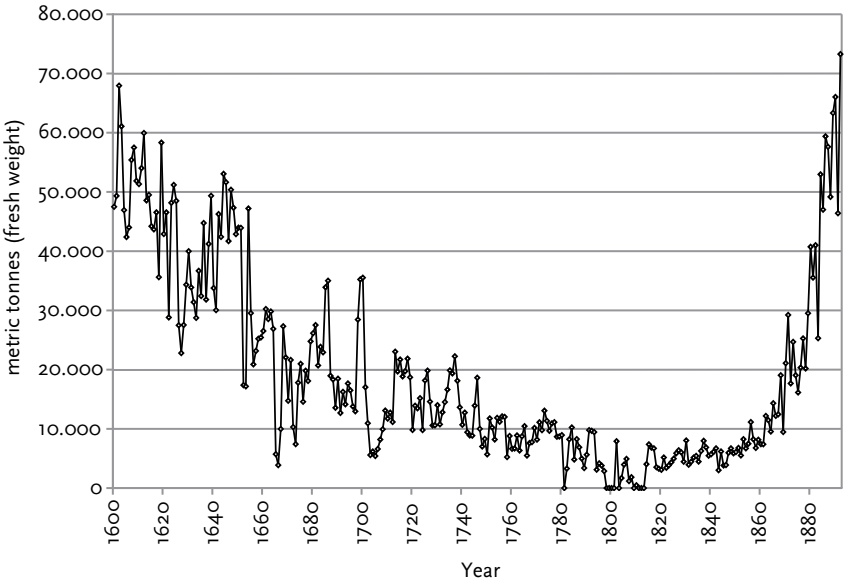
8 Goodlad, *Shetland Fishing Saga*, p. 85.
9 Coull, *Fisheries of Europe*, p. 73.
10 Cushing, *The Provident Sea*, pp. 82-83.
11 Mietes, *De archieven van de colleges*, pp. 11-18.

contain a large amount of documents from this 250-period, allowing for a historical reconstruction. Due to the fact that the College regulated the size and use of fishing gear, driftnets and the length of the fishing seasons, we can standardise the technological and institutional factors affecting the fishery. Regulations are common features in the management of modern fisheries resources; the main purpose of the *College van de Grote Visserij* was to uphold the quality of the top brand of salted herring in Europe.[12]

The season started on the eve of St. John's day, 24 June. Following a government decree in 1582, the fishers were not allowed to fish for herring after 31 December. In 1604 however, the fishing season was extended to 31 January, which signalled the end of season.[13] These key dates and in fact most of the regulations were in place until the *College van de Grote Visserij* was finally dissolved in 1857.[14]

Figure 4.1

The total estimated production of salted herring in The Netherlands, 1600-1892



12 In late 1577, one last of Dutch herring could be sold in France for 24.10 Flemish Pounds, while English Yarmouth was worth 20.12 pounds, Irish herring 18 and Scottish and coastal herring was sold for 11 Flemish pounds. Baasch, *Wirtschaftsgeschichte*, p. 60.

13 Van Vliet, *Vissers en Kapers*, p. 46 – quoted from Cau's Plakkaatboek. Vol. 1, folio 723, 736.

14 Mietes, 'De Hollandse Visserijcolleges', pp. 166-172.

The tight regulations allow for an estimation of the total production of salted herring in The Netherlands. Figure 4.1 illustrates the total estimated production of herring in metric tonnes, based on a number of sources.[15] In a recent study, Dutch historian Van Bochove reconstructed the overall production in Dutch lasts in the dominant Holland province over period between 1600-1795.[16] For the southern part of the Netherlands, the Zuiderkwartier, an almost unbroken list of records of the taxation, lastgeld as well as published series of landing records from the towns within the College van de Grote Visserij are available, providing a precise overview of the total amount of landings over time. For the northern Noorderkwartier, parallel records exist for the period dating back to the 1660s. However, since the Noorderkwartier mainly catered to markets in the Baltic, it has proved possible to calculate the total landings for the remaining years until 1600 on the basis of herring exports listed in the Sound Toll registers.[17] The unbroken records of all landings in Schiedam allow for a comparison of the annual catch per buss in Schiedam, which is in line with the above calculations.[18]

The general trends show the first half of the 17th century to be the peak of Dutch herring production with annual landings of between 30-60,000 tonnes, followed by a drastic decline until approx. 1680, when yearly landings fell to less than 10,000 tonnes. With the exception of a few years leading up to the turn of the 18th century, the heyday of Dutch herring fisheries had come to an end. During the period between 1700-1750, however, catches stabilised to between 10 and 20,000 tonnes. After 1750, another phase of decline set in, following average catches of 10,000 tonnes in the preceding years. During the 1795-1813 period, the fisheries were seriously disrupted by the English blockade of the continent, and the French occupation of the Netherlands. In the years when fishing was possible at all, total landings were at their lowest level in 300 years, consistently bringing in less than 10,000 metric tonnes per year.[19] After 1814, the North Sea once again became a peaceful fishing ground. The Dutch struggled to regain their former strength, landing 5-8,000 tonnes a year. It wasn't until the late 1860s, with the introduction of new regulations and technology that Dutch fishers began to catch more fish than before the Napoleonic years.[20]

The gradual century-long decline in total production was more or less mir-

15 A conversion was made from lasts, with one last being the equivalent of 1.976 m^3. The calculation was made on the assumption that one cubic meter weighs one ton.

16 Van Bochove, 'De Hollandse haringvisserij', pp. 3-27.

17 Van Bochove, 'De Hollandse haringvisserij', pp. 1-27 and http://www.iisg.nl/research/haringvisserij.html

18 GA. Schiedam inv. no. 614-622.

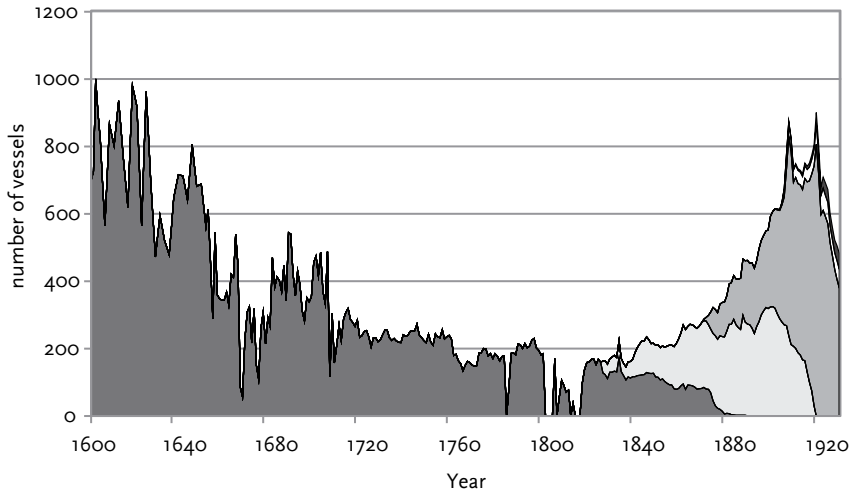
19 Vermaas and Sigal, *De haringvisscherij van 1795 tot 1813*.

20 NA. CGV. Inv. no. 396 and Hoogendijk, *De grootvisscherij*, pp. 233-234.

rored by a decline in the overall fishing effort in the high sea herring industry. This is demonstrated in figure 4.2, which shows the number of different vessels used in Dutch herring fishery from 1600-1926.[21] During the 17th century, the industry was characterised by a rather steep decline from around 800 busses in 1600 to a mere 300 at the turn of the 18th century. Thereafter a stable period unfolded, where 200-300 vessels would be fitted out each year until the 1750s. For the rest of the 18th century less than 200 vessels were fitted out, whereas the consequences of the Napoleonic Wars were felt deeply from the mid 1790s until 1814. For the rest of this period, the number of herring vessels kept falling; in the 1850s less than 100 vessels were fitted out each year for the offshore herring fisheries.

Figure 4.2

Vessels used in Dutch herring fishery from 1600-1926.



21 Information used in reconstructing Dutch herring vessels is derived from: Vermaas and Sigal, *De haringvisscherij van 1795 tot 1813*, Schippers, *De standplaatsfactoren*, pp. 137-139 and van Bochove, *Database Hollandse haringvisserij 1500-1795*. http://www.iisg.nl/research/haringvisserij.xls . For every even year in the period 1604-1650, the number of busses does not correspond with van Bochove's published calculations, which assume that every buss catches an average of 40 lasts per year. Instead the amount was been calculated in collaboration with van Bochove by dividing the total annual catch of the whole with the catch per boat per year for the Schiedam fleet. This method is analysed below. For the uneven years 1604-1650, for which the catch per buss is unknown, the number of busses is derived from an interpolation between even years.

Norway

The northernmost major producers catering to the European herring market were the fisheries off the west coast of Norway from Trondheim in the north to the area south of Stavanger. Unlike the other countries involved in the herring fisheries, the Norwegian herring fishery was based on the spring spawning Atlanto-Scandian race, which lives in the eastern North Atlantic between Iceland and Norway. This is a slightly bigger species than the herring populations in the North Sea, and has been known as a periodical source of major herring fisheries since the Middle Ages. One such period occurred from 1518-1572.[22]

During the era under examination here, from 1600-1850, extremely large shoals of herring came close to the Norwegian shoreline for spawning in the spring in at least two instances during at least two periods. Although no information on herring catches in Norway is available this far back in time, long time series of export statistics allow for the reconstruction of salted herring production in Norway from 1650-1850. Norwegian historian Fossem has published time series of the size of herring exports from Bergen in about half the years during the 1650-1795 period.[23] Data on the total exports from west coast ports is available for the decade 1749-60. During this period, the average export from Bergen was 57% of the total Norwegian export. For the years where there is only information on Bergen export figures, the assumption has been made that total exports equal the Bergen export figures * 1.74.

With regards to the 19th century, the calculation of total catches does not pose a problem. Norwegian historian Solhaug has published the figures for total annual salted herring exports in barrels from 1814-1880.[24]

1 Norwegian barrel = 115.8 litres.[25] As is the case in the reconstruction of Dutch catches, the conversion ratio from volume in litres to weight in kilograms is assumed to be 1:1. Finally, the years for which there is no data whatsoever have been estimated by means of an interpolation between the existing figures.

There is one exemption to this pattern of periodical major spring fisheries in Norway. For the first half of the 17th century from approx. 1620-1650, the Sound toll registers reveal that Norway exported a large amount of herring through the Baltic – of a magnitude similar to the herring shipments from Norway through the Sound in the 1680s and 1690s.[26] The estimate of total Norwegian salted herring production thus assumes that the quantities

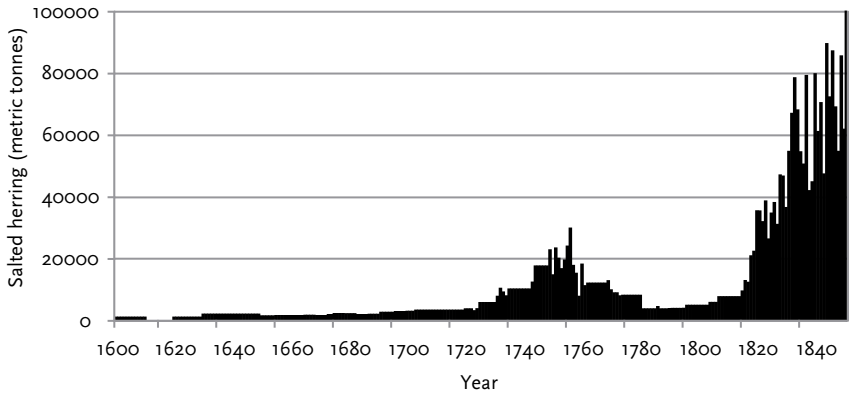
22 Nedkvitne, *Mens bønderne seilte*, p. 472.
23 Fossem, *Bergen Bys Historie*, p. 414, 600 and 604.
24 Solhaug, *De norske fiskeriers historie*, vol. II, p. 743-744.
25 Solhaug, *De norske fiskeriers historie*, vol. 1, p. XXIV.
26 Michell, 'European Fisheries', p. 165.

exported through the Sound in the first half of the 1600s are comparable in terms of their share of total production to the latter half of the 17th century, for which both export figures from Bergen and figures from the Sound toll registers are available.

Contemporary qualitative evidence suggests that the herring period in the 1620s-1650 did not coincide with the emergence of spring spawning Atlanto-Scandian herring near the Norwegian shoreline. Rather, a few surviving custom rolls suggest – based on the timing of the exports – the occurrence of a major herring fishery for autumn spawning herring. This took place near the town of Stavanger and to the north near Bergen and Trondheim, the same centres that saw the emergence of spring fishery in later times.[27]

The total estimated Norwegian export of salted herring from 1600-1850 is shown on figure 4.3. In the 1650s, spring herring definitely made a comeback, as we can tell from the traces of commercial fishery that gradually developed over the next century. By the 1730s, 40s and 50s, the Norwegian spring fishery for herring peaked, with an estimated total export of around 20,000 metric tonnes a year.[28]

Figure 4.3
The total estimated Norwegian export of salted herring from 1600-1850.



After 1757, herring fishing took a distinct turn for the worse in the northern part of the traditional fishing grounds. Spring fishery was also meagre in the

27 Nedkvitne, *Mens bønderne seilte*, pp. 473-474.
28 Nedkvitne, *Mens bønderne seilte*, pp. 474-475.

southern areas around Bergen and Stavanger after 1785. In the year of 1814, however, Norwegian spring spawning herring came back in full, remaining a reliable appearance in spring until the latter half of the 19th century.[29]

In fact, the total Norwegian export reached unprecedented heights in the 19th century. By the 1830s, Norwegian exports had surpassed the all time high of Dutch production, with production reaching 60-80,000 metric tonnes by the 1840s.

The methods used to calculate the total production of Norwegian herring leave room for uncertainty. Bergen was the dominant town in the area, which makes it plausible that the Bergen exports continually dominated total export figures. The long-term success of Norwegian herring fisheries is confirmed by one other source, the Sound toll registers. These registers testify that the Norwegian share of herring shipments through the Sound was significant but not dominant in the 17th century, reaching a dominant position in the 1740s and 1750s when Norway became the single largest exporter of herring into the Baltic.[30] The relative status of Norwegian herring exports into the Baltic corresponds well with the reconstructed figures for total output. These figures also confirm Norwegian herring production as being the largest in Europe during the 1740s and 1750s. This beggars the question how so many herring were caught in western Norway.

In the 17th and 18th centuries, the Norwegian herring fisheries depended on farmer-fishers and seasonal migrant fishers operating in the fjords and inside the skerries. In the 17th century, small purse seines were the fishing gear of choice, whereas gill nets, beach seines and drift nets became more common in the 18th century as the herring industry grew rapidly. During the mid-18th century heyday though, large purse seines of more than 150 metres in length were used; locally, there were many differences in terms of technology and fishing practices.[31] The location of the fisheries near the commercial centres of Bergen, Stavanger and Trondheim was also of importance in creating a large-scale herring fishery, offering access to foreign salt and the wider north European trade networks.[32]

One exception was the establishment of a privately financed fishing company in the town of Farsund in south west Norway. Under the leadership of merchant Jochum Lund, a fleet of 12 vessels was fitted out for both Dutch style fishery with driftnets and long line fishery off the Icelandic coats and in the North Sea. In the early years of the 19th century however, the Farsund Company went into rapid decline. Situated in the heart of the dual kingdoms

29 Dyrvik, *Norsk økonomisk historie*, p. 154.
30 Hitzbleck, *Bedeutung des Fisches*, p. 274.
31 Nedkvitne, *Mens bønderne seilte*, pp. 487-502.
32 Nedkvitne, *Mens bønderne seilte*, p. 474.

of Denmark-Norway loyal to Napoleon, the Farsund Company lost its export market during the Napoleonic Wars and the fishing vessels were refitted for privateering purposes. After the war ended, the high seas herring fisheries never got underway again.[33]

The Farsund Company was unique to Norway in terms of its economic set-up, but a mere 12 vessels did not add significantly to the total Norwegian export of salted herring. Below, an overview is provided of the annual catch per boat at comparable fisheries from Emden and Altona. If the Norwegian herring company had more or less the same catch rates, they will have harvested a total of no more than approx. 500 metric tonnes a year.

The organisation and technology of the Norwegian herring fisheries remained more or less unchanged during the 19th century. During the 19th century surge in the Norwegian fishing industry, the technology and set up of the fishery was still very much the same, although the use of boats in open sea probably came to play a more important role.[34]

In general though, the Norwegian herring industry relied on the herring to swim near the shores; the operation was comparatively low-tech, and organised locally. The herring industry as such was highly responsive to changes in the available abundance of herring during springtime. It is thus assumed that the downward trend in terms of production during the 1780s and 90s was caused by fluctuating herring populations.

Bohuslen

In the Middle Ages, Bohuslen was Norwegian territory. After Norway's union with Denmark in 1380, Bohuslen came under the rule of the Danish king. However, a peace agreement between Denmark and Sweden in 1658 saw Bohuslen become part of Sweden, which it remains to this day. In historic times, the great herring fisheries were thus an important resource for different rulers at different times. The Bohuslen area stretches along the Skagerack coastline from the Norwegian border in the north until just south of Gothenburg in the south. Ever since the Middle Ages, records testify to the existence of frequent 40-60-year periods in which the region could enjoy excellent fishery, as large shoals of herring came close by the rocky shoreline in late autumn.[35]

Throughout the period under examination, the herring was caught inshore with beach seines.[36] This was an inexpensive technique that – unlike the Dutch high sea operations – did not require large-scale coerced invest-

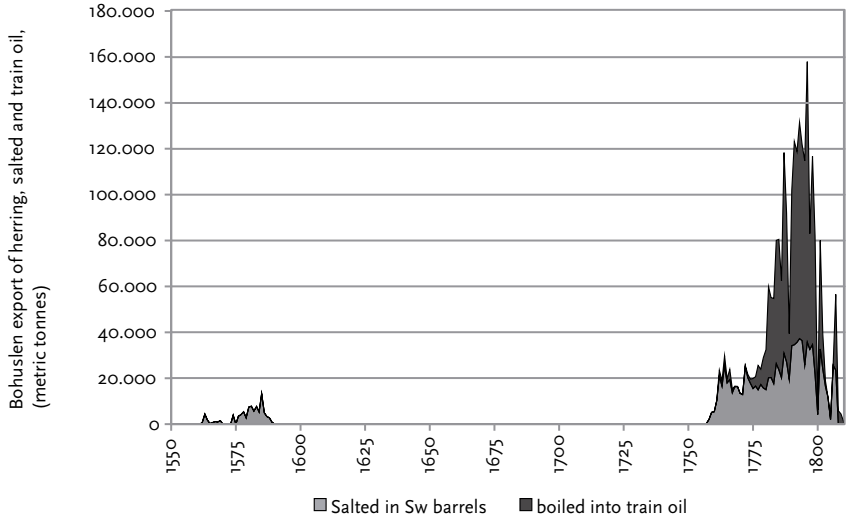
33 Holm, *Kystfolk*, pp. 114-116.
34 Solhaug, 'Vårsildfiskeriet', pp. 57-72, Solhaug, *De norske fiskeriers historie* vol. 2, pp. 380-384.
35 Dalén, *Bohuslänska Fiskelägesbygden*, p. 41.
36 Hasslöf, *Svenska Västkustfiskarna*, pp. 118-123.

ments. In addition, the entire operation was safer near the shore, where the wear and tear on gear will also have been relatively slight. In early modern times, two such herring periods occurred.

In the years 1556-1587, both trade statistics and anecdotal evidences testify to the notion that the sudden appearance and later disappearance of herring caused the fisheries' to bloom and bust.[37] Although we cannot reconstruct the total production at Bohuslen so far back in time, Danish historian Holm has reconstructed the late 16th century export of ship lasts of herring from the Bohuslen area into the Baltic.[38] For the sake of comparison, the numbers have been converted into metric tonnes by assuming there are 12 barrels to the last, and 122.5 litres per barrel.[39]

Figure 4.4

Export of herring, both salted and boiled into train oil, from the Swedish west coast, Bohuslen, 1555-1810.



37 Dalén, *Bohuslänska Fiskelägesbygden*, p. 41. The most thorough contemporary account is: Claussøn Friis, *Norrige oc omliggende Øers*. His findings were written down in the 1580s and 1590s, and published posthumously.

38 Holm, 'The Bohuslen Herring', pp. 282-288.

39 Söderberg, http://www.iisg.nl/hpw/data.html.

As illustrated by figure 4.4, exports reached a peak of more than 13,000 tonnes in 1585, with an annual averaging almost 6,000 tonnes during the years from 1574-1588. For most of the 17th century, the Bohuslen area hardly saw any herring fishery. One possible exception may have been the period between approx. 1663-1673.[40] After the disappearance of the herring in around 1590, Gothenburg had become a net importer of herring rather than an exporting port. 200-500 barrels were imported each year, with the exception of the years between 1661-1676, where an average of only 50 barrels were imported annually.[41] At the same time unusually large quantities of salt were imported to the city.[42] More significant evidence, however, is the fact that an average of 50 metric tonnes of herring was actually exported annually from Gothenburg during the period 1664-1674.[43]

Another sign that something was happening near the coast during these years is the fact that fish became the by far most important protein-rich food source for the inmates in the hospital in Falun. Swedish historian Morell estimated the annual consumption of unspecified salted fish over the 1659-1837 period. In 1659, every inmate received an average of 12 kg of fish; in 1663, by contrast, the annual intake of fish per capita had reached more than 60 kg, and in 1674 as much as 100 kg of fish were eaten every year. By 1688, the level was back to 60 kg, whereas annual consumption was less than 10 kg only a few years later in 1695.[44]

The food budget for such hospitals would have been tight, so we can assume that a commonly served dish was cheap, easily available at the market, and therefore an important food source for a large proportion of the Swedish population. In such large quantities, dried codfish would have had to be imported from Norway, which makes herring from the nearby Skagerack the most likely source.

In any case, the production of herring at Bohuslen remained of minor significance to the overall development of the North Sea and Baltic herring markets during the entire 17th century and first half of the 18th century. It could be said that the markets in the Baltic were not ready for the Bohuslen herring in the mid-17th century. The previous herring period in the 1570s benefited from an economic jumpstart, partly due to the outbreak of the Dutch revolt in 1572 which prevented the usual supplier from reaching the markets in the Baltic. Such a coincidence did not occur in the 1660s, which may be one reason why this Bohuslen period did not have a larger impact on the over-

40 Holmberg, 'Perioden 1550-1880', pp. 228-234.
41 Dalén, *Bohusländska Fiskelägesbygden*, p. 117.
42 Nystedt, *Sillen i Bohuslän*, p. 17.
43 Holmberg, 'Perioden 1550-1880', pp. 228-234.
44 Morell, *livsmedelkonsumptionens historia*, pp. 199-201.

all trade. Also, contemporary accounts claim that the herring did not arrive before 1663, and was already starting to disappear by 1674.[45] This is a very short time span in which to build up a major fishing operation and distribution network; from this time on until the mid-18th century, herring was a rare species in the Swedish west coast fishery.

In 1745, the *Arfwedsonska Fiskeribolaget* fishing company received a royal charter and permission to fish for herring. The company bought two herring busses from the Netherlands and fished for herring at the Shetlands and Dogger Bank for the next decade. In 1756, the company was dissolved due to financial problems. Another company, *Fiskeribolaget i Göteborg*, had been founded in 1752 and continued fishing at The Shetlands until the late 1750s.[46] By then, interest once again turned towards the inshore potential at Bohuslen.

From 1748-1808, the herring shoals of the North Sea moved close to the coast once again in autumn.[47]

The latter half of the 18th century saw the emergence of a herring fishery of hitherto unprecedented size in European history. The size of the fishery is well-documented, since salted herring became an important commodity in the exports from Gothenburg and a few other towns in the area. Figure 4.4 shows the total export of salted herring, and – from the 1770s onwards – the large-scale export of train oil. The annual production of salted herring alone reached close to 20,000 metric tonnes in the 1760s, with a highpoint of over 30,000 tonnes in the 1790s and early 1800s. When combined with train oil production, the total export of herring was over 100,000 tonnes in the 1790s, with a peak of almost 160,000 tonnes in 1796. The potential must have appeared limitless in the Bohuslen archipelago, at a time when the Baltic herring market was entirely in Swedish hands. However, the herring disappeared as suddenly as it had come. In 1807, more than 56,000 tonnes of herring were exported, but the year after only 5,600 tonnes were shipped from Bohuslen with exports coming to a complete standstill after 1810.[48] The herring simply stayed away, devastating the large herring industry. At the highpoint in the 1780s, more than 25,000 people were employed in the Swedish herring industry. 7,500 fishers, 1,500 boatmen, 8,000 workers employed in the train oil production industry and another 8,000 working to cure, salt and barrel the herring.[49] The Baltic market now lay open for competing herring producers in the North Sea.

---

45 Holmberg, 'Perioden 1550-1880', pp. 228-234.
46 Dalén, *Bohuslänska Fiskelägesbygden*, pp. 127-128.
47 Dalén, *Bohuslänska Fiskelägesbygden*, p. 41.
48 Nilsson, 'Det stora sillfisket, 1752-1808', pp. 294-295 and pp. 301-302.
49 Dalén, *Bohuslänska Fiskelägesbygden*, p. 144.

Scotland

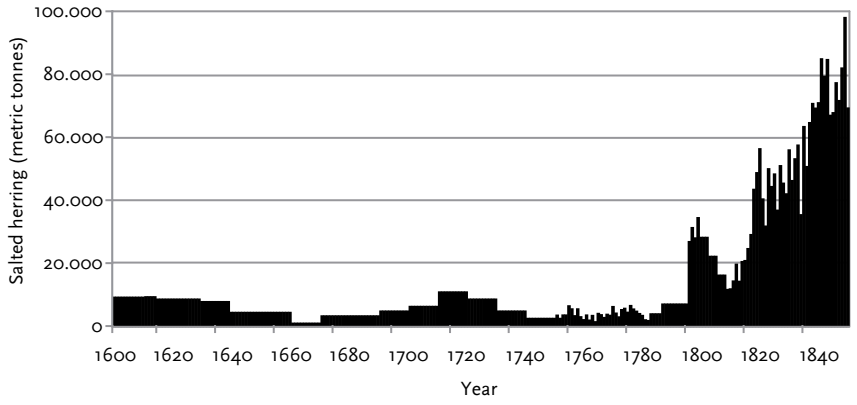
Scottish herring played an important role in North Sea herring production throughout the period from approx. 1600-1850. Due to a lack of published statistics, however, it is quite difficult to estimate an accurate figure for the total production of herring before 1800. Nevertheless, indirect sources such as export figures and accounts of initiatives to set up fishing companies help provide an overview of the Scottish herring industry.

Reportedly, the 1610s were a highpoint in the first half of the 17th century, although there is scarce evidence to confirm this. The Sound toll registers testify to a decline towards the middle of the century, which Scottish historian Smout has linked to the political turmoil caused by the English Civil War, and the subsequent restoration period headed by Cromwell.[50] For the period between 1660-1780, German historian Hitzbleck calculated the Scottish share in shipments through the Sound, discovering another boom in Scottish herring exports in the early 1700s.[51] But how can we use the Sound toll data in drawing up an estimate of the total Scottish herring export?

In the decade 1750-60, data from the sound toll registers overlaps with data from Scottish export statistics. During this period the data from the Sound tolls account for one tenth of total production. So, is it valid to assume that this ratio applies to all the years for which Sound toll registers are available? Not quite; in the 1750s, Baltic shipments were dominated primarily by Norwegian herring and – to a lesser extent – the Dutch and expanding Bohuslen herring industry from 1756 onwards.

Figure 4.5

Estimated production of salted herring in Scotland, 1600-1850.



50 Smout, *Scottish Trade*, pp. 219-223.

51 Hitzbleck, *Bedeutung des Fisches*, p. 274.

The total estimate, figure 4.5, is calculated on the assumption that Sound toll figures represent approx. one fifth of total exports. This number is based on a comparison between the total Dutch production of salted herring and the Dutch and Scottish share in exports through the sound. The herring exported from Holland into the Sound mainly came from the town of Enkhuizen, and Dutch historian Bochove has found a close correlation between the production of herring in Enkhuizen and Dutch herring exported through the Baltic.[52] Enkhuizen's production in the 17th and 18th century was roughly five times the size of the official figures derived from the Sound toll registers, so if we take into account that Scottish herring competed for more or less the same markets, it seems fair to assume a similar relationship between Scottish herring transports through the Sound and total Scottish export figures. All in all though, Scottish estimates from before 1750 may be flawed by a systematic error as a result of this assumption. In any case, the estimated total exports from Scotland are converted from lasts into metric tonnes, on the basis of 12 barrels per last and a weight of 127 kg for one Scottish barrel.[53]

The estimate for total Scottish production amounts to approx. 9,000 tonnes in the early 17th century, which – regardless of the uncertainty as to the above calculations – surely made Scottish herring fishery the second largest in Europe. A drop to a mere 1,000 tonnes followed in the middle of the 1600s, while the highpoint in the 1710s saw an estimated average export of more than 10,000 metric tonnes per year. This is backed up by information indicating that the Scottish areas of Forth on the east coast and Clyde on the west coast exported a combined total of 54,000 barrels around the turn of the 18th century, equivalent to 6,858 metric tonnes.[54] After this highpoint, the herring fishery went into decline again. More solid data is available from 1750 onwards.

In 1785, Scottish commentator John Knox published a forward-thinking two-volume account of the state of the Scottish economy, mentioning the potential for developing the herring fisheries.[55] As part of his works, Knox published a series of tables comprising *An account of the Quantity of British Herrings and Cod exported from Scotland*, from Christmas 1750, to Christmas 1782, distinguishing each year, and the Ports from whence exported.[56] The tables were signed by a 'Catchcard Boyd, Examiner of salt and fishery accounts', which lends a lot of credibility to the quality of the data, covering the

52 Van Bochove, 'De Hollandse haringvisserij', p. 25.
53 Hitzbleck, *Bedeutung des Fisches*, p. 318.
54 Coull, *Sea Fisheries of Scotland*, p. 74.
55 Knox, *A view of the British Empire*.
56 Knox, *A view of the British Empire*, pp. 385-390.

Shetland and Orkney Islands and some 24 different Scottish fishing villages. Viewed from the broader perspective of the thirty-year period under examination, this was a rather meagre point in the history of the Scottish herring fisheries, with an average of approx. 3,500 tonnes per year.

In this period, Scottish herring fishery was subsidised by the British government who paid a bounty on the tonnage of some vessels and on the catch of other vessels. This enabled Scottish geographer Coull to reconstruct the total output of the Scottish herring fisheries in the final 15 years leading up to the turn of the 19th century. This period saw a renewed rise in production, with total Scottish production in the late 1790s reaching a figure of around 30,000 metric tonnes.[57] This impressive rise came to a halt in the early 1800s; by 1809 – the first source of new data – only 10,000-15,000 tonnes were exported. It is likely that the Scottish producers were hampered by the Napoleonic period, when much of the main markets in Germany and central Europe were in the hands of Napoleon, enemy of the British. Immediately after the end of the war in 1814, however, Scottish herring fishery really took off. During the next 40 years, Scottish-produced herring managed to surpass any previous historical production of salted and barrelled herring, firmly establishing the nation on the European herring market.[58]

When it comes to the technology and organisation of the Scottish fisheries, information is scarce when it comes to the 17th century, but we do know the main types of gear were drift nets and seines. When the herring came close to the eastern shores for spawning in August and September, beach seines and smaller inshore boats with crews of 4-6 men were used, while larger boats had 7-8 men on them.[59]

Besides this rather unregulated form of inshore fishery, the Scottish and subsequently British governments made several attempts to promote a Scottish high sea fishery modelled on the Dutch herring fishery. The Scots had been envious of the Dutch fisheries' virtually unrestrained access to large busses of herring as early as 1493, when local officials were asked to fit out boats with a capacity of more than 20 tons.[60] In the latter half of the 17th century, the government made several attempts to set up actual fishing companies, but all collapsed within a few years without making any long-term impact on the Scottish herring industry.[61]

The only successful attempt was made in the 1750s, when it was decided

57 Coull, 'Fishery Development in Scotland', pp. 11-13 and p. 18.

58 NA. *Commissie van Onderzoek omtrent de regelingen der Zeevisserijen, 1851-1857*, inv. no. 14, appendix 7.

59 Coull, *Sea Fisheries of Scotland*, pp. 56-63.

60 Coull, *Sea Fisheries of Scotland*, p. 65.

61 Smout, *Scottish Trade*, p. 221.

to put a bounty on the tonnage of herring busses. In the 1750s, less than 10 busses were fitted out, but in the 1760s this number rapidly rose to more than 200.[62] Following a few years of relative inactivity around 1770, the number of busses went up again and continued to do so until the turn of the 18th century, with in between 200-300 busses fitted out each year.[63]

From 1786 onwards, both the large Scottish busses and the smaller boats received bounties – the busses on the basis of their tonnage, the boats on the basis of the number of barrels cured.[64] It is thus likely that this systems of bounties – unlike the 17th century attempts to build a fleet of large vessels to rival the Dutch – in the latter half of the 18th century contributed to the eventual dominance of Scottish herring fishery in the 19th century. However, the initial Scottish success both in the late 17th and late 18th century was mainly built on the flexible growth in the number of smaller inexpensive boats rather than the fitting out of large vessels.[65] Scotland's southerly neighbour England never developed a herring fishery quite the size of the Scottish. In a North European context, however, the English production of herring still constituted a sizable contribution.

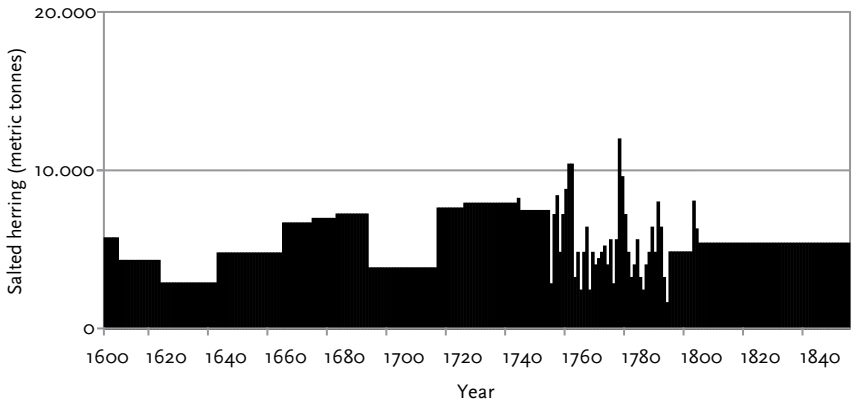
England

The main centres of the English North Sea herring industry were the towns of Great Yarmouth and Lowestoft in East Anglia, whereas comparatively small herring fisheries developed in Yorkshire, to the northeast.[66]

With regards to the English herring fisheries outside of East Anglia, the published quantitative evidence is quite scattered and heterogeneous over the 1600-1850 period. For this reason, this estimation does not include herring production outside of the main East Anglia herring centres. Thus the total estimated herring production in England shown in figure 4.6 is actually the total production of East Anglia. In order to quantify the size of the English production of salted herring, a number of published time series can be collated in order to cover most of the 1600-1850 period. Data on the English herring fishery is presented in lasts and barrels, on the basis of 12 barrels to the last. One English barrel is assumed to weigh 127 kg.[67]

62 Knox, *A view of the British Empire*, p. 233.
63 Coull, 'Fishery Development in Scotland', p. 9.
64 Coull, *Sea Fisheries of Scotland*, pp. 70-71.
65 Smout, *Scottish Trade*, p. 222 and Coull, *Sea Fisheries of Scotland*, p. 64.
66 Michell 'European Fisheries', p. 143.
67 Hitzbleck, *Bedeutung des Fisches*, p. 318.

Figure 4.6.
Production of salted and red herring in East Anglia, 1600-1850.



Nevertheless, an attempt has been made to present an overall estimate of the East Anglia herring production based on late 18th century data, most of which is solid. For the years 1750-1790, English marine scientist Cushing calculated the annual production of herring in Lowestoft based on contemporary accounts by Edmund Gillingwater, who wrote an extensive account of the town of Lowestoft.[68] The figures show large inter-annual fluctuations in the catch of herring, but with an average of approx. 1035 metric tonnes per year.

How, one might ask, can we relate the catch at Lowestoft to the whole of East Anglia? Mid 19th century commentator Nall used late 18th century government reports on the state of the British fisheries to compile a list of all herring produced in Great Yarmouth during the 12 years between 1739-1782.[69] For the years when data is available from both Cushing and Nall, the ratio between the catches at these two main ports of East Anglia was calculated. Great Yarmouth produced 4.2 times as much salted and smoked herring as Lowestoft.

For the rest of the period between 1600-1850 catch and export data on the herring industry is available for only one of the two ports. Despite the considerable margin of error, the ratio of 4.2 is maintained in the overall estimates.

Throughout most of the 17th century until 1720, catch figures for Great Yarmouth were calculated by historian Michell.[70] Despite some gaps in the

68 Cushing, 'The East Anglian Herring Fishery', pp. 323-329.
69 Nall, *Great Yarmouth and Lowestoft*, p. 329.
70 Michell, 'European Fisheries', p. 147

time series, the general impression is that of a gradual build up of production following the low point of less than 3,000 metric tonnes in the 1620s and 1630s, towards a highpoint in annual production between approx. 1660-1690 of around 7,000 tonnes. The next 20 years or so saw a decline to less than 4,000 tonnes, but from 1712 until approx. 1750, the annual average reached close to 8,000 metric tonnes, an estimate also corroborated by Nall and Knox.[71] Until 1750, the figures are all averages of 10-20 year periods, but the detailed figures for the 1750-1789 period testify to large annual fluctuations with an average of 5,300 tonnes.

For most of the 1790s, the figures are based on interpolation, but English historian Robinson's estimate of a production of 8,012 tonnes in 1798 and 6,247 tonnes in 1799 fits in well with the overall picture.[72]

In light of the general increase in bureaucracy during early modern times, it is surprising that there are no annual statistics on the total production of the English herring fishery for the first half of the 19th century. However, a mid-19th century estimate of the average English catch by commentator Palmer suggests that 3500 lasts, or 5,355 tonnes were produced annually in this period.[73]

In 1866, Nall wrote that a total of 56,625 barrels or 7,220 tonnes were produced in 1862, which seems to indicate that Palmer's average estimate was not far from the 1862 level, and suggests that the English production of herring does not seem to have surged during this period in the same way as the Scottish herring industry further to the north. In fact, when viewed in the long-term perspective of the 1600-1850 period, English herring fisheries seem to have remained remarkably stable throughout. Periodical dips occurred in the periods between approx. 1620-1640 and 1690-1710, whereas the more precise indications for the 1750-1789 period testify to extremely large inter-annual fluctuations. But what were the characteristics of the East Anglian herring industry in this period?

Part of the English catch was gutted, cured and salted in the same manner as the Dutch, but most of the English herring production – during the entire period in question, in fact – consisted of 'red' herring. Red herring was salted but not gutted and left to rest for two or three days before being smoked over a slow-burning fire in special smokehouses.[74] The English red herring was regarded as an inferior product in comparison with the salted Scottish

71 Nall, *Great Yarmouth and Lowestoft*, p. 329 and Knox, *A view of the British Empire*, p. 286.

72 Robinson, *The English Fishing Industry*, p. 21.

73 Cushing, *The Provident Sea*, p. 86. Cushing converts 3,500 lasts into the equivalent of 8,610 tonnes. However, the following the conversion ratios used elsewhere in this section would put production in metric tonnes at 5,355 tonnes.

74 Butcher, 'Lowestoft as Microcosm', p. 58.

'white' herring. When curing standards were imposed in Scotland, the same measures were not applied to English production.[75] This could also be a matter of adapting to nature, as the North Sea herring had already spawned by the time it reached the fishing banks off East Anglia. This spent herring netted a lower price than mature herring when cured, gutted and salted in barrels, so perhaps it was not worth the effort in East Anglia to produce the finer salted 'white' herring, when much of the catch would have reached a state where the texture of the flesh was more suited for smoking anyway.

When it comes to the size and number of vessels used, scarce quantitative evidence has been published. For a brief period in the 18th century, there are indications that the entire English fishing industry grew from 1,378 vessels in 1772 to 1584 vessels in 1786.[76] However, we do not know how large these vessels were, or whether they chiefly fished for herring, cod or other species.

With regards to Lowestoft, however, English historian Butcher has estimated that approx. 300 men were employed in the autumn herring industry in the late 16th century, while approx. 200 people took part in the herring fisheries in the first half of the 18th century, mostly on small boats with a crew of 2-4 in each vessel.[77] This indicates that the English herring fishery was one of the more low tech, local fisheries in the North Sea area, but that part of fleet was just as well equipped as the Dutch. The gear used mainly consisted of drift nets, and surviving data indicates that the size and length of the drift nets could be just as large as the Dutch drift nets, spanning as much as 100 nets of 20 yards each, or the equivalent of approx. 1.8 km. However, such long nets will have been the privilege of the largest vessels in the English fishing fleet, and a contemporary source such as Isaac Gillingwater, the older brother of the aforementioned Edmond, noted that the largest English herring vessels had crews of 10-11 eleven men.[78] Like the Dutch busses, the English busses were suitable for onboard curing. The government enviously eyed the Dutch enterprise, and on three occasions in 1705, 1718 and 1750 initiatives were taken to set up a system of bounties that would stimulate fishers to develop large scale enterprises, allowing the English to compete in the European market. However, all these schemes failed to gain much of a foothold on the English seaside.[79]

From the late 1790s until 1830, however, technological innovation took place in the English herring industry, when new three-mast luggers replaced the buss vessels previously used in the English herring industry. The luggers

75 Haines, 'The Herring Fisheries, 1750-1900', p. 67.
76 Haines, 'The Herring Fisheries, 1750-1900', p. 65.
77 Butcher, *The Ocean's Gift*, pp. 75-77.
78 Butcher, 'Lowestoft as Microcosm', pp. 56-57.
79 Haines, 'The Herring Fisheries, 1750-1900', p. 65.

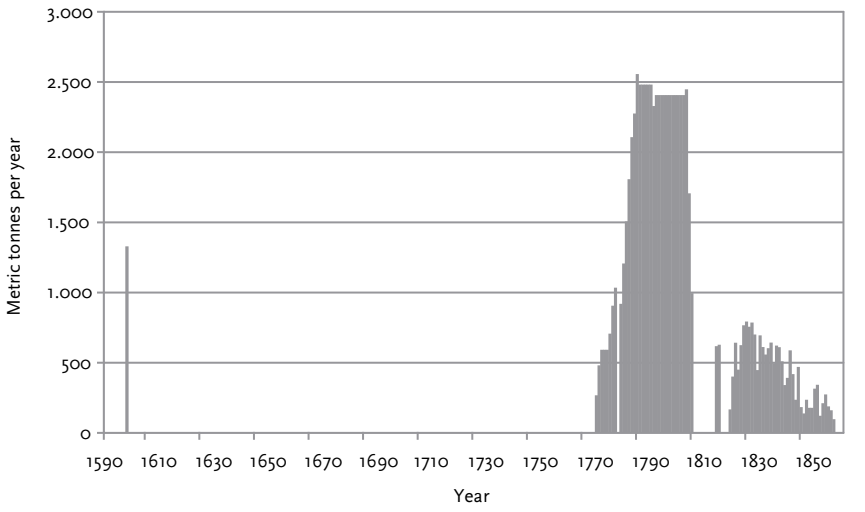
were smaller, cheaper and more manoeuvrable than the older heavier vessels and could bring the last ashore in time for curing. Even if English herring production did not manage to grow in the first half of the 19th century, it did undergo structural changes.[80]

German states

The town of Emden, located in East Frisia in present-day Germany near the Dutch border, was the only early modern German base for large-scale herring fishery in the North Sea. In the last decades of the 16th century, evidence suggests that Emden developed a high seas fishery based on the Dutch model, with similar regulations. Although there are no figures on catch and fishing effort for the early period, we know that a ship with 25 Dutch-standard herring busses caught 1,322 metric tonnes of salted herring in 1597. For reasons not known to the present day, the Emden herring company disappeared during the first half of the 17th century. As a result, there was no significant German high seas fishery for salted herring until the latter half of the 18th century.[81]

Figure 4.7

Recorded landings of salted herring in Emden, East Frisia, 1597-1858.



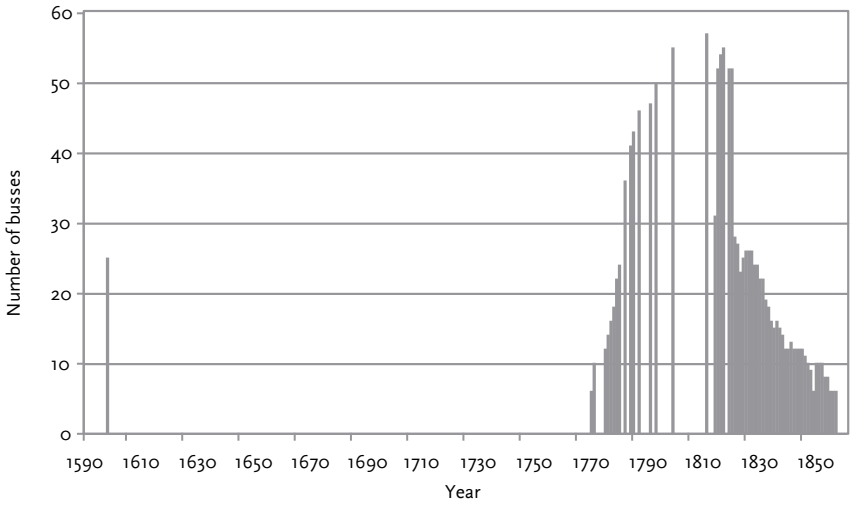
80 Haines, 'The Herring Fisheries, 1750-1900', pp. 65-66.

81 Hahn, *Ostfrieslands Heringsfischereien*, p. 17.

In 1769 however, a new herring company was set up in Emden based mainly on local capital, but with the protection of the Prussian state. In the following year, six brand new locally built busses fashioned after the Dutch model set sail for the first time. During the next two decades, the fleet continued to expand, so that by the 1790s and 1800s more than 50 vessels were operating out of Emden. Major investments started flooding in from all over the Prussia. During the years 1807-1814, Emden was under Dutch and French control, and the herring company was split into five smaller companies.[82] After peace broke out in the North Sea area in 1814, the herring fisheries of Emden went into a free fall. The performance of the Emden-based herring fisheries is illustrated in figures 4.7, 4.8 and 4.9.[83]

Figure 4.8

Number of herring busses based in Emden, East Frisia, 1597-1858.



After having enjoyed an annual harvest of 2-2,400 metric tonnes in the late 1700s, the total catch fell dramatically in the post-war years 1814-1849 that saw average annual catch decline to as little as approx. 500 tonnes. One rea-

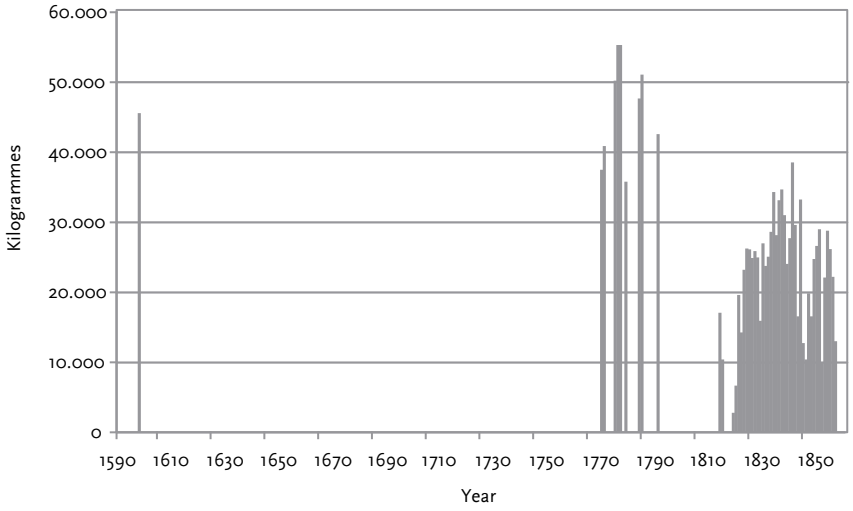
82 Hahn, *Ostfrieslands Heringsfischereien*, pp. 30-49.

83 The three time series are based on: Hahn, *Ostfrieslands Heringsfischereien*, pp. 17, 31-32, 45, 49, 61, 66, 75 and pp. 87-89. For the years, 1772-74, 1780-83, 1786-90 and 1792-1802 the total catch estimate is based on interpolations between the years for which there is data available on total catch as well as total effort.

son for this development was the fact that almost half the fleet, or 24 busses, relocated to Enkhuizen in the Netherlands in 1821.[84] Nevertheless, the main reasons for the continued decline was the combination of falling prices after 1814 and very poor catch results. The CPUE – catch per boat per year – fell from approx. 40 tonnes to around 20 tonnes in the first decade of the 19th century. This development was simultaneous with the falling catch rates in the Dutch herring buss fishery during the same period. In 1857, only six busses sailed out from Emden. Just before the start of the season of 1858, the warehouse containing all stockpiles for the fisheries burned down. This marked the end of an era of Emden herring fisheries.[85]

Figure 4.9

Average catch per buss landing of herring in Emden, East Frisia.



Somewhat smaller in scale, *Der Bremer Heringsfischerei Compagnie* was set up in the German free state of Bremen in 1806 when the company bought two herring vessels from Emden. The Bremen Company gradually expanded and nine vessels were fishing in the years around 1820. As soon as 1828, however, the company was liquidated and the shareholders lost their money. The Bremen herring company's downfall has been attributed to a drastic drop in prices in the 1820s.[86] Within the German states, the Bremen herring com-

84 Hahn, *Ostfrieslands Heringsfischereien*, p. 87.

85 Hahn, *Ostfrieslands Heringsfischereien*, p. 89.

86 Rohdenburg, *Hochseefischerei an der Unterweser*, pp. 18-35.

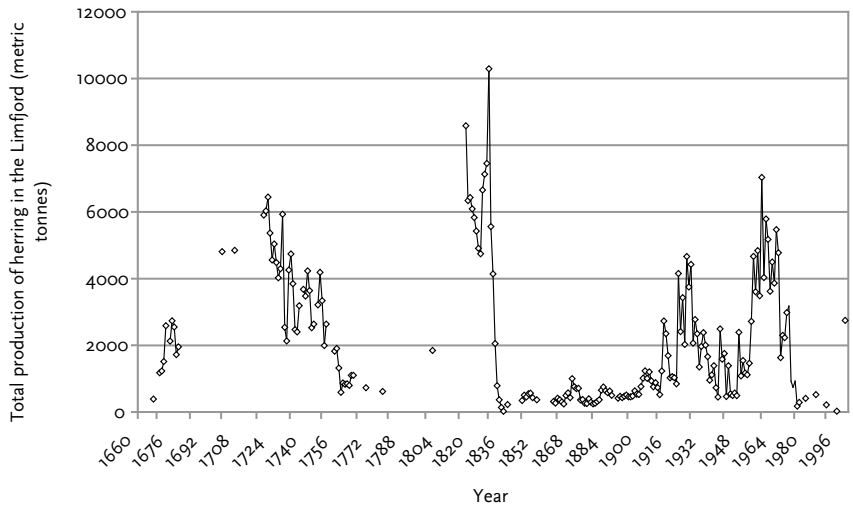
pany was second only to nearby Emden, but the total catches never exceeded more than 100-200 metric tonnes per year.[87]

Denmark

The largest herring fishery in Denmark took place in the fiord, the Limfjord in the northern part of Jutland. Customs records and account books have made it possible to estimate the total production of herring in the Limfjord area back to year 1600, which is shown in figure 4.10. By this time, the herring fishery was already renowned throughout the nation, and for the first 70 years of the 17th century between 500-2,000 tonnes of herring were produced annually. The fishery then grew rapidly over the next 30 years to

Figure 4.10

Estimated total output from the herring fishery in the Limfjord, Denmark



around 4,000 tonnes per year, and in the 1710-1740 period, the fishers harvested in between 8-12,000 tonnes every year. This was followed by a slump in the latter half of the 18th century, but in the year 1800 herring was reported to have come back in large quantities and for the next thirty years the Limfjord saw its last great herring period with annual production rates of 8-12,000 tonnes. By 1830, however, the fishery crashed, never to regain

87 Rohdenburg, *Hochseefischerei an der Unterweser*, p. 245.

its former size. Records of catch per unit effort for the 18th and early 19th centuries indicate that both large herring periods ended due to poor catches rather than reasons such as politics or competition on the Baltic export markets.[88] However, the figures for the Limfjord include salted herring, train oil and dry-salted herring. Therefore the amount of exported salted herring only makes up two thirds of total production.

Besides the fishing efforts in the Limfjord area, the long West Jutland shoreline facing the North Sea was home to fisheries for cod, haddock and plaice in early modern times, but no major herring fishery ever developed here. This is most likely due to the fact that the attractive fishing grounds were located along the English and Scottish shorelines rather than the Danish. The west coast fishers would have required large amounts of capital and safe harbours in order to develop a herring industry.

The only place where both capital and infrastructure were in place was Altona. Until 1864, the town of Altona outside Hamburg was the southernmost part of the Danish king's realm. In 1767, the merchant Schimmelmann – the force behind the aforementioned fishing company at Farsund – set up a fishing company in Altona, which fished for herring in the Dutch manner with busses, onboard curing and a ventjager to head home with the first herring of the season. In 1769, the company fished with 13 herring busses, with 28 busses and three ventjagers in operation by 1780.[89] One year later, another herring buss was added to the company's fleet.[90] We also know where they went fishing, at least in the summer of 1783, when 29 busses with a crew of 14 men each were engaged in herring fishery at Shetland.[91] The luck of the Danish company was fleeting though. The government had to intervene with grants, later incorporating the company into the Canal Company in 1781, which was eventually liquidated in 1792.[92]

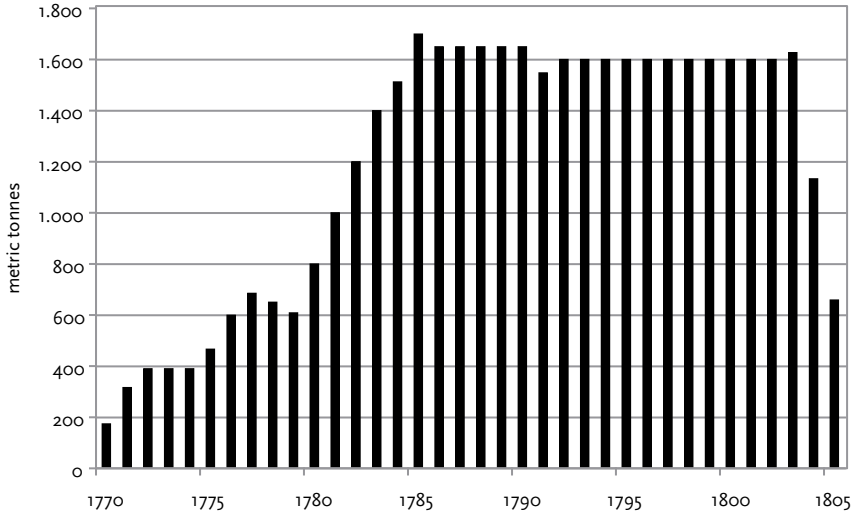
The fishing itself, however, went on for another decade, and when the Dutch were caught up in the Napoleonic Wars the Danes enjoyed short-lived success due to their neutral position. This ended when Denmark intervened in support of Napoleon. In 1807, England took the island of Helgoland along with 18 herring busses from Altona, which were anchored there. This was the end of the Danish high seas herring industry.[93]

---

88 Poulsen, 'The Limfjord Herring Fishery', pp. 287-304.
89 Grotenwold, *Die deutsche Hochseefischerei*, p. 135.
90 Holm, 'European and Native Ways', p. 137.
91 Goodlad, *Shetland Fishing Saga*, p. 168.
92 Holm, 'European and Native Ways', p. 137.
93 Grotenwold, *Die deutsche Hochseefischerei*, pp. 135-136.

Figure 4.11

Estimated landing of salted herring in Altona, Duchy of Holstein, 1770-1805.



The herring company of Altona is not described in any detail in historical literature, and the size of the catches is not known. Nonetheless, the account of herring vessels fishing at Shetland in 1783 states that the Danish effort was two thirds of that in Emden. Since the technology and methods used by the Altona fishers were similar to those in Emden, it is tempting to make an estimate of the Danish catches on the basis of the figures from Emden. Using the Emden figures for the years 1770-1805, and interpolating for the years when data is missing, a useful time series can be produced, which is illustrated by figure 4.11. This puts the average annual production of the Altona herring company at approx. 1200 metric tonnes of herring.

Flanders

Due to a Dutch invention in the early 15th century, the 'Dutch model' of fishing for herring with large offshore vessels soon spread to the Flemish coastal areas in what is currently Belgium[94], and during the 15th and 16th centuries Flanders hosted a large herring fishery. With the advent of the Dutch Revolt and the subsequent blockade of the river Schelde and frequent blockades of

94 In this section the English name for the region, Flanders, is used rather than Belgium, since the kingdom of Belgium only came into existence in 1830. In the early 1600s Flanders was first part of the Habsburg empire, then the Austrian Netherlands and from 1814-1830 became part of The Netherlands.

the main fishing ports Ostende and Nieuwpoort, the Flemish herring industry fell into decline. Belgian commentator Verbrugge has pointed out that Flanders became caught up in the intense and often bloody rivalry between France, England, Spain and Dutch Republic during the rest of the 17th century, ruling out any renewed interest in the herring fisheries.[95]

In 1727, a privately funded *Compagnie van Visch-Vaert* was set up in Nieuwpoort, specialising in cod fishery off Iceland, although the company probably also engaged in North Sea herring fishery. This company was short lived though, and went bankrupt in 1737.[96]

In order to promote an otherwise slumbering enterprise, the import of foreign herring was prohibited in 1767, and in 1770 the government put a bounty on every vessel engaged in the herring fisheries.[97] These measures seem to have made a difference – the 1784 overview of herring vessels at the Shetlands reveals that 13 of these boats came from Oostende and 11 were from Nieuwpoort, both towns along the Flemish coast. These vessels were manned by a crew of 13.[98] This means that a total of 312 fishers aboard 24 vessels were fishing in the north western part of the North Sea, equalling approx. 50% of the Emdener herring company's activities. Judging from this, the total Flemish output in this period would have been approx. 1,200 metric tonnes,

In the 1820s, the Flemish fisheries grew during the period of Dutch governance. In 1832, two years after a political revolution had lead to the establishment of the modern state of Belgium, the Belgian fishing fleet comprised a total of 142 vessels with 825 men aboard.[99] However, it is highly doubtful that the majority of this fleet focused on herring, and there is no available catch data to help establish the truth. In the 1830s, several measures were taken in order to subsidise the fisheries, and the number of people employed in the Belgian sea fisheries rose from 1003 in 1836 to 1646 in 1865. Although Oostende was by far the dominant port in this period, no more than 4 vessels from Oostende took part in the high seas herring fisheries by 1850, making up only a tiny portion of the overall Belgian sea fisheries.[100]

The above section on the Flemish herring fisheries is hampered by a lack of available published accounts on the size of the industry. Therefore, Flanders has been left out of the estimated total output of herring in the North Sea region.

---

95 Verbrugge, 'Die belgische Seefischerei', pp. 6-7.
96 Parmentier, 'The Asian challenge', pp. 298-299.
97 Verbrugge, 'Die belgische Seefischerei', p. 9.
98 Goodlad, *Shetland Fishing Saga*, p. 168.
99 Verbrugge, 'Die belgische Seefischerei', p. 11.
100 Verbrugge, 'Die belgische Seefischerei', pp. 13-14.

France

French herring fisheries are scarcely mentioned in the historiography of the North Sea fisheries, and there are no figures for most of the 1600-1850 period making it impossible to estimate the size of the French herring fishery. The assessment of French herring production is thus based on no more than a few 'snapshots'.

The 17th century capital of the French herring industry was the town of Dieppe in Normandy, from where fishing trips to the English Channel and the Great Yarmouth area were launched. In 1649, the French fleet had 150 boats of various sizes. By then, fishing trips to the Shetlands had abandoned, and it wasn't until 1771 that the French finally attempted to fish in these waters again.[101]

Shetland accounts reveal that seven of the herring vessels engaged in summer fishery at the Shetlands in 1784 originated from Dunkerque in northern France. These vessels were probably smaller than the Dutch, since only 10 men were aboard each of them.[102] This was smallest contingent from any one country in this year, and it would appear that Shetland fishery was abandoned after a few years.[103]

In 1788, the French government initiated a survey of the state of the French fisheries. As it turned out, the herring industry proved to be quite substantial in the northernmost parts of France, with important fishing villages in the towns of Boulogne-sur-Mer, Dunkerque and Dieppe. This situation made it possible to fish for the herring stocks in the north western parts of the North Sea as well as the English Channel. A total of 330 vessels used for herring fisheries were counted, but many of these were quite small, possibly rowing boats for 1-2 fishers. In the towns of Fécamp, St. Valéry and Dieppe, however, a total of approx. 180 boats of notable size were fitted out for what was probably high seas fishing.[104] The catch from these vessels is difficult to estimate. The fact that only seven French vessels were present at the Shetlands a few years earlier might indicate that a sizable part of the French herring fisheries took place in the Channel area, which is known to have seen various periods of excellent fishing.

Around this time, Boulogne-sur-Mer emerged as the leading herring port and developed its fleet from 30-40 boats in 1771 to 120-130 in 1789. In 1810, 200 vessels based in Boulogne cast their driftnets for herring. By 1821, however, the number had already dropped to 142, with no French herring vessels taking part in the herring fisheries off Scotland and Shetland during these

101 Gall, 'Die Fischerei mit Treibnetzen', p. 44.
102 Goodlad, *Shetland Fishing Saga*, p. 168.
103 Gall, 'Die Fischerei mit Treibnetzen', p. 44.
104 Villiers, 'La flotte de pêche', pp. 57-78.

years. Failing to expand substantially in the 19th century in a similar manner to the Scottish herring industry, the number of herring vessels at Boulogne remained at around 160 in 1836 and 157 in 1869, although more of the larger boats appeared in this period.[105] There are records of these large French vessels near the English shore, with one report mentioning the sighting of as much as 100 French boats off the coast of East Anglia in a single day.[106] Large round figures from past centuries often spell exaggeration, but there is no doubt the French were actually present off Great Yarmouth in the first half of the 19th century.

There is little catch data available for the French herring fishery, despite its significance in the southern parts of the North Sea. As a result, it has not been possible to construct a longer time series for the production of salted herring in France. However, for the sake of adding to the total production of North Sea herring, the combined French herring fisheries have been attributed an annual catch of 4,000 metric tonnes in the years 1750-1797 and 1814-1850. The catch undoubtedly dropped during the British blockade of Napoleonic France, whereas the number of boats indicates a fishery somewhat smaller than the East Anglian and Dutch counterparts during the same stages of the 250 years under review.

Discussion, producers and production

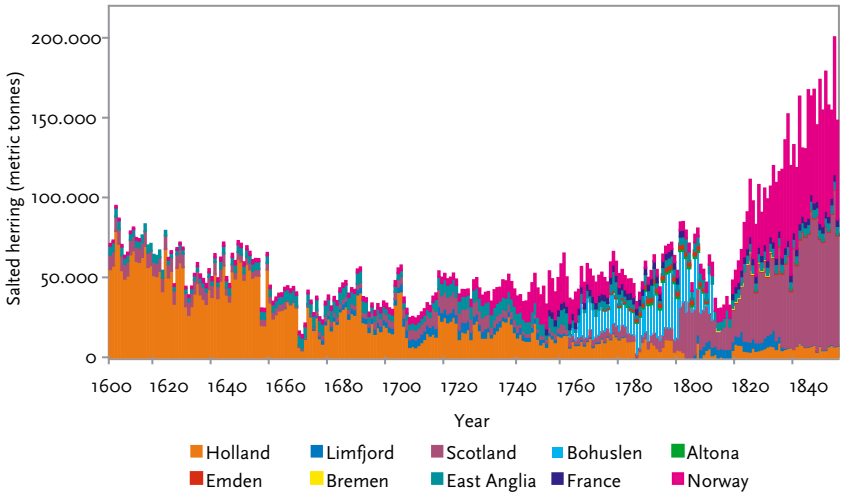
Total European production

The above sections provide an analysis of the herring fisheries in nine different countries around the North Sea, aimed at establishing an overall figure for the production of salted herring in each country and the North Sea area as a whole. Besides estimating the size of each herring fishery, the characteristics of the organisation and technology used in each fishery is briefly summed up. This results in the following conclusions.

The total production of salted herring in the North Sea area is illustrated by figure 4.12. In the early 1600s, total annual production was approx. 60,000-80,000 metric tonnes, dropping to 50,000 tonnes by the middle of the century. A more drastic decline then set in during the 1650s and 1660s, reaching a low of less than 14,000 metric tonnes in 1666. With the exception of a few good years, production in Northern Europe remained at around 25,000-35,000 tonnes until approx. 1710, when numbers rose again. This rising trend saw in between 40,000-60,000 tonnes of salted herring produced during the years

105 Gall, 'Die Fischerei mit Treibnetzen', p. 44.
106 Haines, 'The Herring Fisheries, 1750-1900', p. 66.

Figure 4.12
Production of salted herring in Northern Europe, 1600-1850.



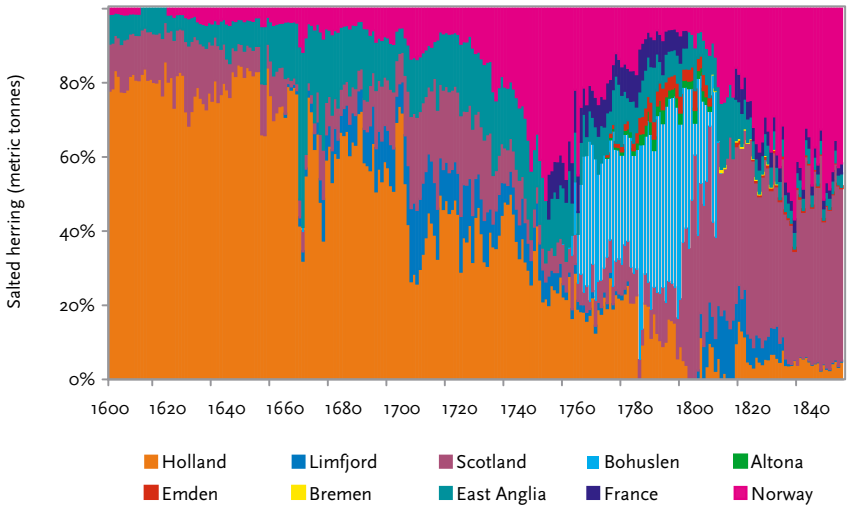
1710-1780. During the last two decades of the 18th century, total production reached 70,000-80,000 tonnes per year, the same level seen during the first decades of the 17th century. A temporary decline then set in during the first decade of the 1800s, with production dropping to just under 40,000 tonnes between 1809-1811. A rapid increase in production followed, and in the next 40 years covered by this analysis production rose to unprecedented heights reaching 200,000 tonnes in 1849. Overall, the development from 1600-1850 represented a phase of decline in the years between approx. 1600-1700, followed by a steady increase in the rest of the 18th century. After a short setback in the early 1800s, production grew at a previously unparalleled rate.

The Dutch Republic stands out as the dominant producer of herring in the entire 17th century. In this period, the Dutch herring industry was responsible for 75% of the total North Sea production, although the nation gradually lost its share in the total North Sea supply during the 1600s. The Dutch production was in full decline by the turn of the century, with less than 10,000 tonnes produced in the years 1703-1708. The industry recovered, and although Dutch production in the first half of the 18th century was much lower than in the 17th century, the Dutch were still the prime producer of herring in northern Europe. This ended in the 1740s when Norwegian production of salted herring rose to more than 20,000 barrels a year for two decades until approx. 1760. If the period until approx. 1740 could be termed as the age of Dutch dominance, the years 1740-1760 saw Norway lead in northern

European herring production. In the 1760s the Norwegians lost out to the Swedish Bohuslen fishery, which became all dominant from 1762-1807, after which the Bohuslen herring disappeared. The relative dominance of the various herring fisheries is illustrated in figure 4.13.

Figure 4.13

Total production of salted herring in Northern Europe, 1600-1850. The relative importance of ten different herring fisheries is presented as a percentage of the total production.



The Swedish and Scottish herring fisheries were the only major fisheries that do not seem to have suffered greatly from the Napoleonic era, approx. 1798-1813, when the North Sea and the surrounding nations became engulfed in warfare and trade embargos. In any case, the Scottish herring fisheries emerged as the dominant producer of salted herring after 1807, and although Norwegian herring production also grew rapidly in the first half of the 19th century, Scottish production was slightly larger than that of Norway and the largest in Europe for most of this period. In the 1830s and 1840s, the Scottish and the Norwegian herring industries both reached the same production level for salted herring as the Dutch had more than 200 years before.

The East Anglian herring industry was consistently present during the whole period, and seems to have been the second largest producer during parts of the latter half of the 1600s. However, since most of the English herring was processed and marketed as 'red' herring, the industry may have ca-

tered partly to different market than the other producers of 'white' herring. In the early 1700s and early 1800s the Danish Limfjord fishery was of noteworthy size, also by European standards.

In the period after approx. 1750, the number of countries with large herring industries seems to have grown. More data is available for the latter half of the 1600-1850 period, although a lack of data on French herring production lack unfortunately makes it impossible to assess the size of the French herring fishery prior to approx. 1750.

Shore-based and high sea fisheries

However, the above analyses of the various producers of salted herring in Northern Europe also allows us to present an overview and generalisation of the technology and organisation of the various herring fisheries. Roughly speaking, we can conclude that two main types of herring fisheries coexisted.

Most pre-modern herring fisheries in the North Sea region were basically shore-based operations. In the Bohuslen fisheries on the Swedish west coast, the fishers mainly fished with beach seines and standing gillnets operating within the archipelago, a technique also used in the Norwegian fiords. In western Norway, the fishers would also row out in the open sea to fish with long gillnets.[107]

This practice was common throughout the North Sea area, both along the Scottish east coast, the Yorkshire and East Anglian coast and off the Dutch coastline.[108] Finally, Danish herring fishery in the Limfjord along the North Sea primarily involved the use of pound nets, as well as gillnets and beach seines.[109] These fisheries seem geographically dispersed and technologically different from one another, but they all have one important thing in common; once caught, the herring was transported to shore for processing into salted or smoked herring, or cooking for train oil production. Due to the fact that herring decay rather rapidly, the fishers have to go ashore within a few days of catching the live fish, limiting the scope of these fisheries' area of operation.

This geographical restraint is one of the factors that separated the Dutch North Sea herring fisheries from all other pre-modern fisheries. Some time during the latter half of the 14th century, Dutch and Flemish fishers started to process the herring aboard their fishing vessels. The technique itself was

---

107 Solhaug, 'Vårsildfiskeriet', pp. 57-72, Solhaug, *De norske fiskeriers historie*, pp. 380-384, Hasslöf, *Svenska Västkustfiskarna*, pp. 118-123.

108 Coull, 'Fishery Development in Scotland', pp. 1-21, Robinson, *The English Fishing Industry*, pp. 16-20, Butcher, 'Lowestoft as Microcosm', pp. 55-58, Kramer, 'De Visserij van de zijde', pp. 175-177.

109 Poulsen, 'Breach of Agger Tange in 1825', pp. 26-47.

Figure 4.14
Verpacken der haring

When the fishers returned to port the salted herring had already shrunk in the barrel. Therefore, and in order to secure a high quality, every barrel of herring was repacked and checked before further distribution. Source: The Packing of the Herrings into the Barrels.', etching by Adriaan van der Laan, (1705). P0167, Visserijmuseum, Vlaardingen.

well known in Europe before 1300 in – for instance – the Danish province of Scania.[110] Using this technique on board a cargo ship made the Dutch herring fisheries virtually independent of geography. They would bring along salt and barrels, so the herring could be cured and salted immediately after being caught, ensuring a high quality product. It was also around this time that the herring buss was introduced as a fishing vessel with large storage capacity.[111] As long as the fishers had enough provisions on board, they could focus on following the herring round the North Sea rather than waiting for it to appear near the shores of the continent. This extended the fishing season in comparison to the other herring fisheries in Northern Europe. Over the course of the 15th and 16th centuries this Dutch model of production developed into a major enterprise, with large investments in both shipbuilding

110 Unger, 'The Netherlands herring fishery', pp. 335-356.
111 Doorman, 'Het Haringkaken', pp. 373-375.

and fishing and the development of a widespread distribution network for the finished salted herring product throughout Europe.

Other northern European nations envious of this access to rich herring resources made several attempts (with varying degrees of success) to copy the Dutch model during the 17th and 18th centuries. This has been regarded as one explanation for the large overall decline of the Dutch herring industry in this period.

According to historian Unger, 'over time, Dutch technical superiority was eroded as competitors developed the same skills. As alternate sources of supply emerged, the Dutch chose to limit production in order to maintain the premium prices their herring commanded.'[112] This chapter has looked into several of the competitors' attempts to copy the success of the Dutch:

With regards to Emden, the above analysis demonstrates how the herring company based there in the early 17th century faded away during the first half of the 17th century, but little is known about what actually happened.

In England and Scotland, all attempts to establish large fishing companies failed until the establishment of the bounty system favouring large vessels in the 1750s, which continued all through the 1700s. The data on the East Anglian herring fisheries suggests that a number of their herring vessels were of more or less the same size and thus cost as the vessels used in the Dutch enterprise, but the available data does not allow for a quantitative assessment of their importance to the overall East Anglian herring industry.

In Flanders, the privately funded Compagnie van Visch-Vaert founded in 1727 was short lived and went bankrupt in 1737. Likewise in Bohuslen the two small fishing companies Arfwedsonska Fiskeribolaget – founded in 1745 – and Fiskeribolaget i Göteborg from 1752 were both short lived enterprises, due to financial problems and – possibly – the emergence of the cheap shore based operations in Bohuslen from the late 1750s onwards.

The increase in historical source material data and research does not justify the apparent rise in the number of private fishing companies in the 1760s and 1770s, often backed by government subsidies. Fishing companies were established in Emden in 1769, and within the realm of the Danish king (Altona, 1767) with a gradual build up in Farsund during the 1760s. Neither the Altona Company nor the Farsund Company survived the Napoleonic Era, partly because of pre war financial problems caused directly by political events. So, is it fair to say that they might have continued their existence, had war not erupted in Danish-Norwegian territory in 1801? We may be able to find the answer by means of a comparison with the Emden herring company.

In spite of economic problems and several efforts to rebuild the company,

112 Unger, 'Dutch Herring, Technology', p. 254.

the production of salted herring in Emden based on the Dutch model did survive Napoleonic times. Nevertheless, the first half of the 19th century saw the Emden based herring fisheries slip into inevitable decline. The annual catch per buss dropped to less than 50% of the tonnage in pre-war times. This was probably one of the main causes of the financial problems and eventual end of the Dutch style herring fisheries in the area. So, if the Danish and Norwegian enterprises continued after 1814 they probably would have encountered the same problems. Der Bremer Heringsfischerei Compagnie, set up in the German free state of Bremen in 1806, suffered a similar fate. In any case, the Norwegian upsurge in herring production from 1814 onwards was founded on the shore-based and coastal fisheries, whereas the Danish interests shifted away from high seas fishery towards the Limfjord.

Finally, the Dutch themselves abandoned what we have referred to here as 'the Dutch model' of fishing, when during the 1850s the College van de Grote Visserij was dissolved, the fishing laws were liberalised and new types of fishing vessels were introduced. It would, in other words, be fair to say that the various attempts at copying the Dutch Grote Visserij were not successful, so even if the scale of the Dutch herring industry diminished, this was not the result of emerging 'copycats.' Rather, the main threat to the supply of herring came from the cheaper and less sophisticated shore based fisheries.

Conclusion

This chapter has sought to persent an overview of the production of salted herring in Northern Europe in the period from approx. 1600-1850.

Overall, the period from 1600-1850 saw a phase of decline in the years between approx. 1600-1700 with an annual total production of approx. 60,000-80,000 metric tonnes. Then a more drastic decline set in and the production in Northern Europe remained at around 25,000-35,000 tonnes until approx. 1710. This was followed by a steady increase in the rest of the 18th century with a production of in between 40,000-60,000 tonnes of salted herring. During the last two decades of the 18th century, total production reached a level of 70,000-80,000 tonnes per year, the same level seen in the first decades of the 17th century. A rapid increase in production followed in the first half of the 19th century and production rose to unprecedented heights reaching 200,000 tonnes in 1849.

With regards to the size of the individual herring fisheries in the various countries, we can conclude that The Dutch Republic, Norway, Sweden and Scotland each went through phases in which they were Europe's leading producers of herring, although several other herring fisheries also played an important role in various stages of the period between approx. 1600-1850.

5 | Did fisheries impact herring stocks?

Introduction

The above analysis of the total production of salted herring is also relevant to the question whether or not the amount of herring extracted from the North Sea in the 1600-1850 period could significantly impact the abundance of North Sea herring. A historical study suggests this by asking whether 'Perhaps overfishing reduced the catches…'.[1]

If the herring fisheries during the 1600-1850 period impacted fish stocks, the fishing pressure would have to be taken into account in applying fisheries data as a reflection of the spatial movement and relative abundance of herring stocks over this long time span. If, however the fisheries had an insignificant impact on stock abundance, then fishing pressure can be taken out of this equation. One way to address this issue is to compare the past catches of North Sea herring with today's knowledge as to how much herring can be taken from the North Sea in a sustainable manner.

Present distribution of North Sea herring

The population of herring in the North Sea consists of both spring spawning and autumn spawning herring. The autumn spawning stocks are the most prolific and these were the potential targets of Dutch fishers. The au-

1 De Vries and Van der Woude, *The first modern economy*, p. 252.

tumn spawning herring in the North Sea consist of three sub-populations or stocks, primarily separated by a different spawning behaviour and characteristics. The Northern stock, Buchan herring spawn in the area in between the Shetland Islands and the Scottish east coast off Aberdeen. The Bank herring has spawning grounds off the English coastline in between Yorkshire and Norfolk and on Dogger Bank, in the central North Sea. The third and southernmost herring stock in the North Sea is the Downs herring, which spawn in the Southern Bight of the North Sea and the English Channel. The Buchan herring tend to spawn first, followed by the Dogger while the Downs herring spawn in late autumn. In winter and spring all three sub-populations drift around the North Sea in a counter clockwise movement, wintering in the eastern part of the North Sea, while the Buchan and Dogger stocks move on the North Eastern areas during spring, feeding on zoo-plankton, primarily *Calanus finnmarchicus*. In early summer around June the Buchan herring reach the Shetlands, which is where the Dutch fishers would await the start of the fishing season, on the night of St. John, the 24th of June.[2]

Further discussions of the biology and migration pattern of North Sea herring stocks can be found in chapter 10 and 11.

Total allowable catch, (TAC)

Within the last generation, the International Council for the Exploration of the Sea, (ICES) performed annual analyses of the stock abundance of North Sea herring. This is an essential tool in the management of herring stocks. An important part of stock assessment is to provide advice on how much herring can be caught in the upcoming season without damaging the stock abundance. The suggested limit on the amount of herring that can be caught safely each year is referred to as the Total Allowable Catch, (TAC), and all analyses and results are published annually in the *Report of Herring Assessment Working Group for the Area South of 62° N*.[3] For the purpose of research and management, the North Sea is divided into sub areas, based on where the North Sea herring are usually located and caught. The recommendations with regards to the North Sea thus cover the area south of the 62° N, just north of the Shetlands, and the area to the south of the North Sea herring stretches into the English Channel.

For 2005, the TAC for the North Sea area is set at no more than 535,000 metric tonnes. If fewer herring are caught, the targeted total Spawning Stock Biomass, (SSB) of more than 800,000 metric tonnes can be maintained.[4] The SSB represents the amount of herring that have reached the state of ma-

2 Cushing, *Climate and Fisheries*, pp. 58-63 and pp. 199-208.

3 Anonymous, *Report of Herring*.

4 Anonymous, *Report of Herring*. p. 40.

turity and will spawn to contribute to the annual supply of new herring.

The herring stocks in the North Sea though, have been heavily fished in the past century. The present SSB is thus hardly in a pristine or natural state. In the 1960s and 1970s, fishing pressure on North Sea herring became especially heavy due to the introduction of new fishing gear such as bottom trawls, pelagic trawl and purse seines. In addition to the problem of catches with a large percentage of immature fish, annual landings reached a level of more than 1,000,000 tonnes per year. This had a serious impact on the SSB, and resulted in a decrease in the supply of new herring, and a rapid decline of the SSB as well as the total stock biomass. A fishing moratorium in the mid-1970s gave the stock a chance to recuperate. From 1983 onwards, tight regulations have been in place with regard to the maximum herring catch allowed under the TAC system.[5]

The estimated SSB is currently approaching the level of the early 1960s, at approx. 1,500,000 metric tonnes. The total biomass is somewhat higher, which is regarded as a healthy number for this fished resource.[6] If no fishing had taken place at all, the SSB would most likely have been somewhat higher, but not indefinitely so. At some point the natural mortality of the herring would cause the net recruitment to reach zero. So, does the amount of North Sea herring caught in the 1600-1850 period indicate that fishing mortality had a significant impact on the size of the fish stock biomass?

Past extraction of North Sea herring stock

Although the previous chapter featured an estimate of the total production of salted herring in Northern Europe, the salted herring produced in Norway originated from the Atlanto-Scandian herring stock which is a peripheral guest in the North Sea and genetically separate from the North Sea herring populations. The Norwegian production should thus be excluded from this estimate.

Moreover, not all of the herring caught in the North Sea ended up in the salted herring industry. Much herring will have been consumed locally, thus evading the customs records and commercial catch registers analysed in the above chapter. This poses the problem that solid evidence from documentary records is hard to come by with regards to locally consumed production and has not been included in the estimated total extraction of North Sea herring.

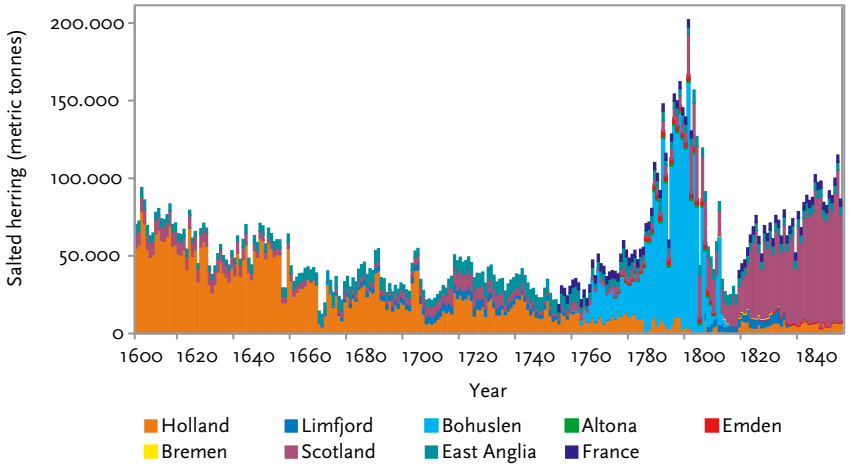
One important exception to this pattern is the train oil industry, which experienced a boom during the great Bohuslen herring period in the latter half

5 Corten, *Herring and Climate* pp. 22-24.

6 Anonymous, *Report of Herring*, p. 142.

of the 18th century. In the 1780s and 1790s the scale of train oil production greatly exceeded that of salted herring production, with around 100,000 metric tonnes of herring boiled into train oil exported each year from Bohuslen.[7] This staggering amount of herring must thus be included in the total figure for North Sea herring extraction between approx. 1600-1850, presented in figure 5.1.[8]

Figure 5.1
The total extraction of North Sea herring, 1600-1850.



The figures for the total extraction of North Sea herring paint a somewhat different picture than the figures for the total production of North Sea herring. Discounting the Norwegian catches, the total catch is seen to have declined over the period from approx. 1600-1750, when Bohuslen fisheries caused a major upsurge in herring landings until 1808. In the 1790s, total extraction reached a level of 150,000 tonnes per year. In the first half of the 19th century, the total catch seems to have remained under the level of 100,000 tonnes.

7 Nilsson, 'Det stora sillfisket, 1752-1808', pp. 294-295 and pp. 301-302.

8 The sources used to estimate this figure can all be found in the previous chapter on producers and production of herring.

No impact

This short analysis of the likelihood that pre-industrial fishing had a significant effect on North Sea herring stocks is based on the assumption that the ecosystem in which the herring lived during the early modern period is similar to the present-day North Sea ecosystem. Herring has a particular place in the North Sea ecosystem, and its abundance is kept in check by the predation of larger fish and seals, while herring in turn feeds mainly on copepods.

Environmental changes can also have an effect on the abundance of stocks, caused by – for instance – climate variability. However, when it comes to an ecosystem this far back in time, there is no way of documenting the location of herring relative to other species, and any arguments concerning the impact of predation would be highly speculative.

So could the total catches of North Sea herring have impacted the North Sea herring stock biomass? No. Even with the very high catch level of 150,000 tonnes in the 1790s, herring catches in the period under review are still a far cry from the North Sea herring TAC of more than 500,000 tonnes in the early 21st century. If we also take into account that the total SSB is likely to have been much higher in this period, when fishing pressure was much less severe than in the 1960s and 1970s, the past extraction of North Sea herring is well within the present-day ICES recommendations.

6 | Markets, Prices and Consumption. Herring trade in the North Sea and Baltic region

Introduction

This chapter presents an overview of the long-term trends in terms of trading patterns for salted herring in the area of the North Sea, the Baltic Sea and their respective hinterlands in the period between approx. 1600-1850. The market is defined as 'the interaction between supply and demand to determine the market price and corresponding quantity bought and sold.'[1] In this period the north European herring market underwent several changes. These changes are analysed from four different perspectives:

The first main section examines the main trading routes for herring in Northern Europe on the basis of records from the Sound toll registers as well as accounts of herring imports in the German North Sea and Baltic cities. Subsequently, a number of price series for various parts of northern Europe provide indications as to the long-term development of herring prices. This

1 http://www-personal.umich.edu/~alandear/glossary/m.html.

is followed up by an analysis of the consumption patterns for salted herring, and an evaluation of the influence of mercantilist policies. The area under review and most of the towns mentioned in this chapter feature on the map in figure 6.1.

Figure 6.1
Map showing the position of the main cities mentioned in this chapter.

Markets

The Dutch herring production and exports all over Europe in the 17th century provide an indication of the scope of the European herring trade. By the time the salted herring came ashore, the content had usually shrunk. In order to control the quality of the landed product and make optimal use of the empty space in the barrels, the entire cargo would be repackaged. Therefore, the

barrels containing the finished product ready for export contained 12 barrels per last against the 14 barrels per last landed by the fishing vessel. Packed in barrels, the finished product could be easily transported over large distances, and the cured salted herring could last for a long time. As the prime product, all the salted herring from the North Sea area was processed and barrelled so it was easy to transport. But where did all the salted herring go in the 17th and 18th centuries?

Dutch historian Kranenburg calculated that in the heyday of the Dutch herring trade during the first half of the 17th century approx. 80% of all salted herring was exported to other countries, and only 20% was consumed in the Dutch Republic. The main herring port Enkhuizen in the Noorderkwartier, the northern part of the Holland province, traded mainly with Hamburg in northern Germany and the countries in the Baltic area. The southern fishing ports along the Maas – Schiedam, Rotterdam and Delftshaven – handled exports to the central German marketplaces of Cologne and Frankfurt, as well as Rouen north of Paris and England. Herring from Enkhuizen was also shipped southwards, just as the southern town occasionally shipped herring to the Baltic, but in general the pattern was clear-cut.[2] The following section focuses the herring trade between the North Sea and the Baltic, as these areas provide a number of excellent sources to examine the long-term changes in trade patterns.

Through the Sound

In estimating the scale of the development of trade in northern Europe, we can rely on various statistics to help clarify who were the dominating market players from the late 16th until the mid 19th century.

One of the most important markets for the herring fisheries around the North Sea was the Baltic. Salted and barrelled North Sea herring were practically always transported to the the Baltic by sea. This meant that they had to pass through the Sound. For the duration of the period under review here, all ships entering the Sound had to pay a toll to the Danish king for safe passage through the narrow straits of Denmark. Each skipper was obliged to present an account of his ship's origins, destination, cargo and port of departure. Most importantly, the ship had to pay a fee based on the amount of goods it was carrying. Records of all ships were kept for almost 300 years, and a large scale historical undertaking in the first half of the 20th century led to the publication of the sound toll registers.[3] The Sound toll registers make up one of the longest time series with regards to the transport of goods and has been the subject of much historical research.

---

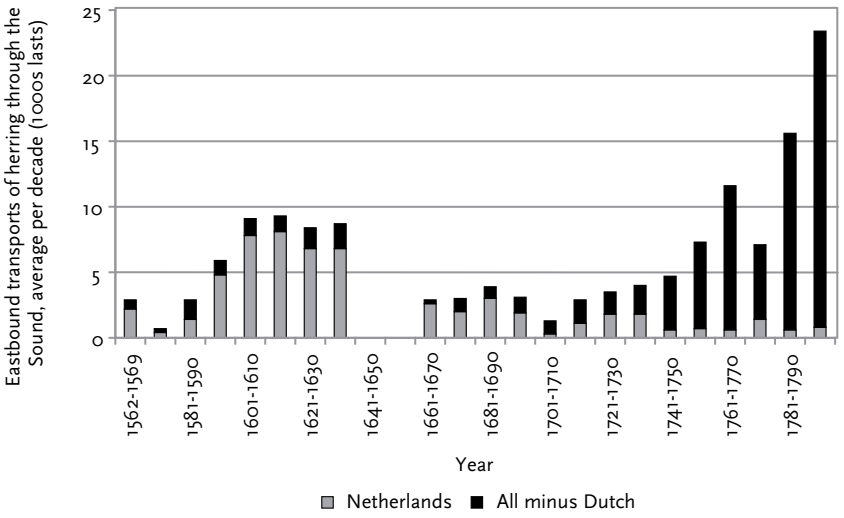
2 Kranenburg, *De zeevisscherij*, pp. 130-131.

3 Bang, *Varetransport,* vol I-II.

The Sound toll registers have been criticised for inaccuracy and errors with regards to the quantities of goods registered per vessel, and the heterogeneous nature of measurements for ship lasts from various countries. This makes it difficult to use the absolute figures on – for example – the herring transported through the Sound as a precise indication of the consumption of North Sea herring in the Baltic region. However, as historian Aksel E. Christensen remarked in relation to the Sound toll registers, 'the utility and importance of relative figures cannot easily be overestimated in the case of quantitative history of earlier periods.'[4]

Figure 6.2

Herring transported through the Sound into the Baltic, 1562-1795.



Extractions from data on herring transports through the sound allow us to present an estimation of the overall development of the various herring producers competing for the Baltic market. Based on a number of published sources, figure 6.2. shows the total amount of herring transported through the Sound in the periods between 1562-1640 and 1660-1795.[5] The significance of this figure is twofold.

4 Christensen, *Dutch Trade to the Baltic*, p. 31.

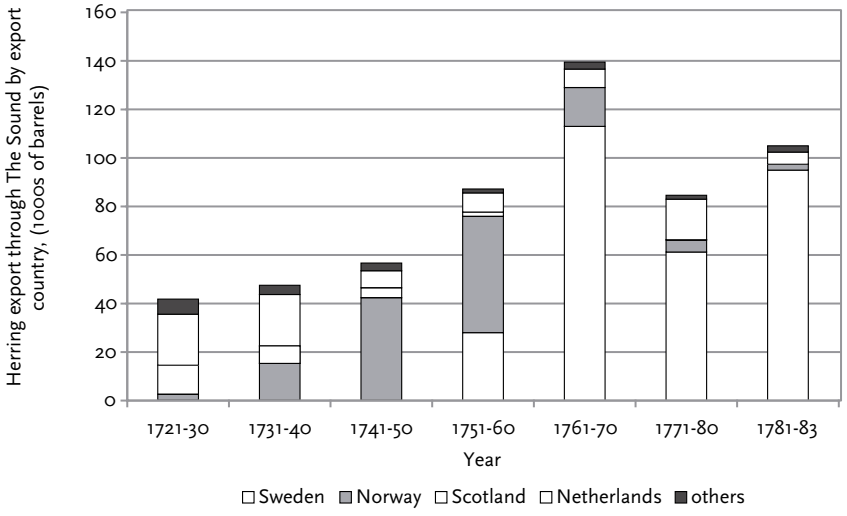
5 Christensen, *Dutch Trade to the Baltic*, p. 337, Hitzbleck, *Bedeutung des Fisches*, p. 274 and Johansen, *Shiping and Trade*, p. 105.

First of all, there seems to have been a highpoint in the transports of herring through the Sound in the first half of 17th century, followed by a decline to a third of this level in the following century. In the latter half of the 18th century, transports picked up again, so that by the 1760s the amount of salted herring passing through the Sound had surpassed the best periods of the previous century. By the 1790s, the size of the herring transports through the Sound into the Baltic had more than doubled when compared to the heights of the 17th century.

Secondly, the figure reveals how the salted herring produced in the Netherlands accounted for 70 to 90% of all herring transports during the 17th century, as overall amounts declined. It wasn't until the turn of the 18th century that Dutch dominance of the trade through the Sound dwindled, with the Dutch remaining minor players in the Baltic herring trade throughout the 18th century. This leads us to ask: who took over?

Figure 6.3

Herring exported through the Sound, sorted by export country, 1721-1783.



For the years 1721-83, Swedish historian Högberg examined the sound toll registers to establish the amount of herring exported into the Baltic from the fishing nations in the North Sea area, as illustrated in figure 6.3.[6] In the

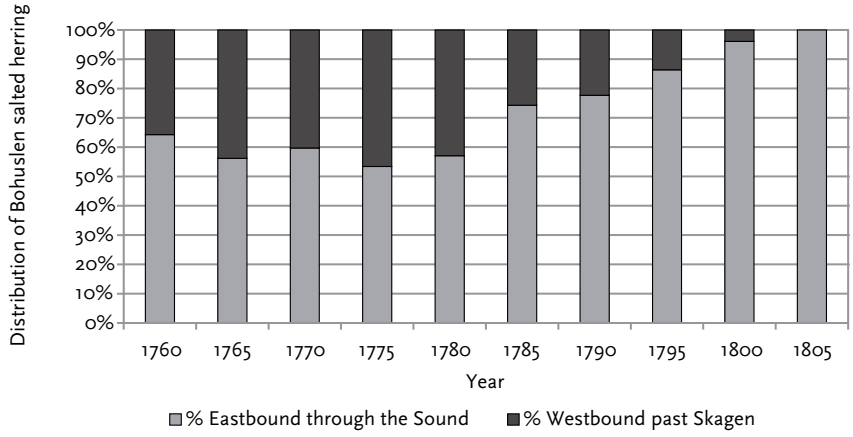
6 Högberg, *Utrikeshandel och sjöfart*, p. 166.

1720s, Scotland was the main rival to the Dutch, whereas Norwegian exports rose dramatically in the 1730s and 40s; during this period, the Sound toll registers mainly make mention of shipments from Norway. From the 1750s onwards however, the Swedish-produced herring from Bohuslen began to feature in the tables, and from the 1760s until the end of the century Sweden remained the single most dominant exporter of herring into the Baltic. The make-up of trade through the Sound thus changed dramatically over the course of the 18th century.

Calculations of the Swedish herring exports from Bohuslen 1760-1805 show how much herring went eastward into the Baltic and how much was shipped westward into the North Sea region and further. Figure 6.4. illustrates how approx. two thirds of Swedish export went through the Sound until 1780.

Figure 6.4

Distribution of eastbound and westbound salted herring exported from Bohuslen, Sweden, 1760-1805.



In the following 25 years – which also saw the largest overall export figures – almost all exports went to the Baltic.[7] In 1795, the German towns in the Baltic bought more than 80% of all Swedish salted herring, while 4% went to Russia and 1% to Denmark. Of the westward bound shipments, 9% went to 'the North Sea', 2% to the German North Sea coast and 1% to the

7 Dalén, *Bohuslänska Fiskelägesbygden*, pp. 140-141.

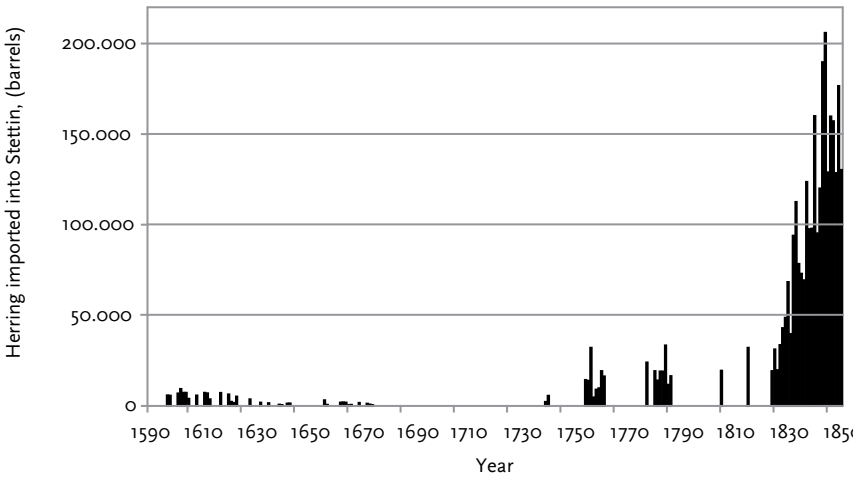
Mediterranean. Norway, Great Britain and the Netherlands did not import significant quantities of Bohuslen herring, but may have been at the receiving end of some of the unspecified North Sea exports.[8] However, the relative decline of the westward transports after 1780 is probably attributable to the Revolutionary Wars and Napoleonic Wars, both of which impacted the North Sea area more seriously than The Baltic.

Stettin

Once the herring shipments had passed the Sound on their journey eastwards, one of the most important herring ports of the Baltic area was Stettin in present day Poland. In the case of Stettin, we can trace the annual import of herring for most years between 1597-1674, and again from 1739-1850. This is illustrated by figure 6.5.[9] Over the long term, these import figures for Stettin closely reflect the trading pattern observed in the Sound toll registers, although the contraction of trade set in earlier in Stettin during the 17th century than in the Baltic at large. In spite of considerable gaps in the 18th century data, imports via Stettin rose again here, surpassing the 17th century highpoint in the latter half of the century. From the 1820s onwards, trade rose to 5-7 times the level of the previous century.

Figure 6.5

Import of salted herring into the town of Stettin, Pomerania, 1597-1850.



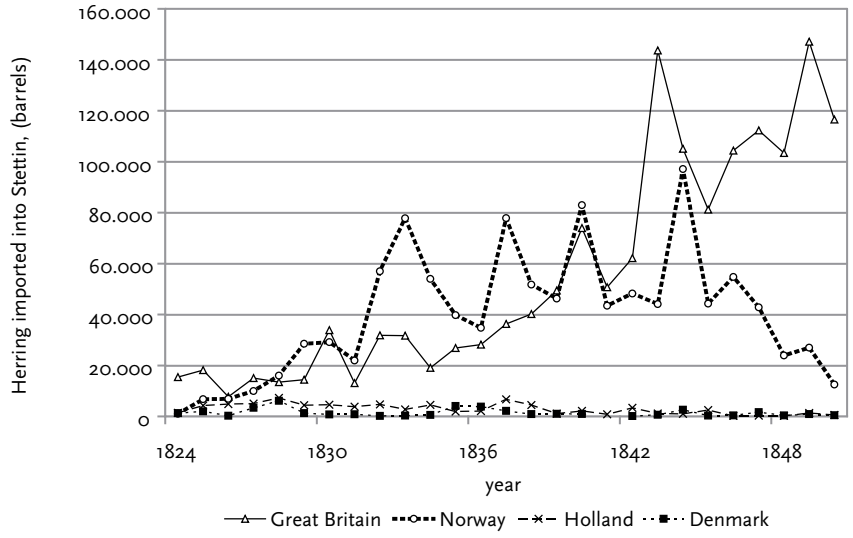
8 Dalén, *Bohusländska Fiskelägesbygden*, p. 142.

9 Blümcke, 'Stettins hansische Stellung', pp. 193-196 and NA. *Commissie van Onderzoek omtrent de regelingen der Zeevisserijen, 1851-1857*, inv. No. 14, appendix 25, "Invoer van haring te Stettin van 1824 tot 1850".

In the 17th century, herring most likely came from the Netherlands, but from 1739-1759 trade figures allow us to establish that the herring was of either 'holländischer' or 'nordischer' origins. As late as 1740, the Dutch were still the most important exporting nation, but over the course of the 1750s the import of Nordic herring by far exceeds that of Dutch herring.[10] This pattern of change is consistent with data from the Sound toll registers showing how Norwegian and Swedish produced herring took over the herring trade. The origin of herring imported during the rest of the century does not feature in published statistics, but there is no doubt that the Bohuslen herring catered to the market of Stettin and its German hinterland. Data from the period between 1824-1850 allows us to track (on a year-by-year basis) which countries provided the herring imported into Stettin. This data is represented in figure 6.6.[11]

Figure 6.6

Salted herring from various countries imported into the town of Stettin, Pomerania, 1824-1850.



It becomes clear that the Dutch were still present in the Baltic by the 1820s, whereas the Swedish herring industry was completely wiped out following

10 Blümcke, 'Stettins hansische Stellung', p. 195.

11 NA, *Commissie van Onderzoek omtrent de regelingen der Zeevisserijen, 1851-1857*, inventory no. 14, appendix 25; 'Invoer van haring te Stettin van 1824 tot 1850'.

the decline of the great Bohuslen herring periods. Scottish herring took their place as the dominant producer, but by the early 1830s Norwegian herring export was surging and continued to take the lead throughout this decade. Imports from all other areas were insignificant. In the 1840s however, Norwegian herring was on its way out again, whereas the import of Scottish herring kept increasing throughout the period, signifying how the Scottish rose to prominence on the Baltic herring market during the first half of the 19th century.

Geographically, Stettin functioned as a market for further sale and distribution in the German hinterland. In the 17th century, herring imported through Stettin was sent to the province of Pomerania, and parts of neighbouring provinces Mecklenburg and Western Prussia. To the east into Poland and the river Wisla they were competing with Danzig, and to the west the merchants of Stettin were competing with Stralsund and Greifswald. This covers some 300-400 km of the Baltic coastline. To the south, the trade route followed the river Oder at least 500 km to the south into Breslau in Silesia, currently south west Poland.[12]

The huge increase in the herring trade in the 19th century is most likely linked to a regional population increase and a broader process of urbanisation, whereby Berlin witnessed especially staggering growth, expanding from an insignificant town in the 17th century into the major capital of the Prussian Kingdom.

Hamburg

The main North Sea port for the import of salted herring was Hamburg. Published data on the annual import of herring allows us to trace the annual import of herring over the years 1623-33, 1693-1744, 1779 and 1815-22.[13] In spite of large gaps during years with no available data, some trends can be distilled from time sequence, as illustrated in figure 6.7.

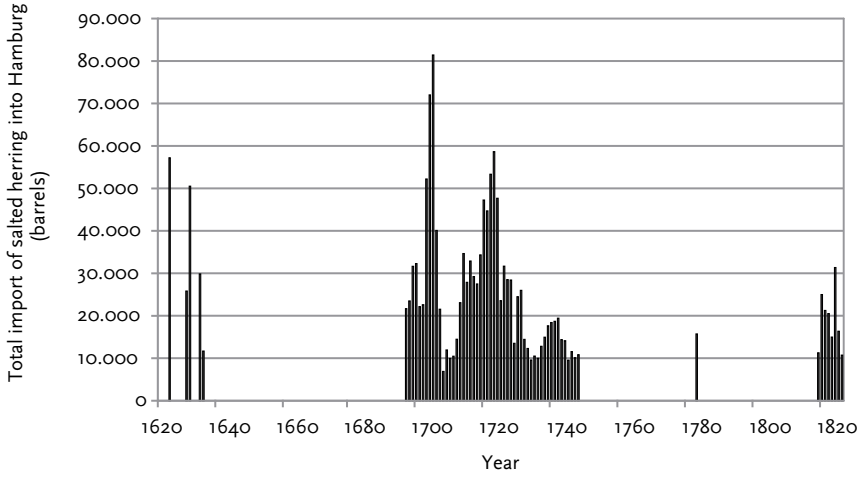
In comparison with Stetting, a much larger amount of herring was imported into Hamburg in the 17th century and first half of the 18th century. The available data reveals large interannual fluctuations during this period ranging from 10,000 to a peak number of 80,000 barrels imported at the start of the 18th century. However, the general trend seems to have been one of decline over the whole 200-year period covered by import statistics. Contrary to the situation in Stettin, there seems to have been no rise in imports during the late 18th century, nor was there a drastic take off in herring trade through Hamburg in the 1820s.

---

12 Blümcke, 'Stettins hansische Stellung', pp. 218-229.

13 Baasch, 'hamburgischen Heringhandels', p. 100, Hitzbleck, *Bedeutung des Fisches*, p. 195 and Röhlk, *Schiffahrt und Handel*, pp. 114-115.

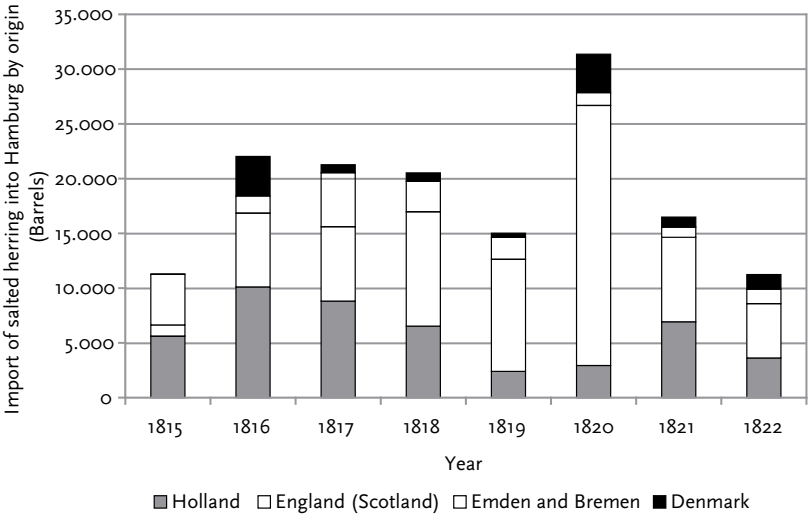
Figure 6.7
Total imports of salted herring into the city of Hamburg, 1623-1822.



With regard to the origin of the imported herring, the Dutch managed to stay ahead in the Hamburg trade until well into the 1750s, unlike the trade through the Sound and into Stettin. In the 17th century they accounted for virtually all herring imported into Hamburg, with Scottish herring amounting to a mere one sixth of total imports by as late as 1717. In 1753, 64% of herring came from The Dutch Republic, and in the years 1789-1792, when the Swedish herring were of paramount importance in the Baltic, 46% of imports into Hamburg were of Dutch origin. When it comes to the years immediately after the end of the Napoleonic Wars, the origins of herring imported in Hamburg can be traced more accurately. This is illustrated in figure 6.8., where the Dutch contribution is still substantial. The legend 'England' in the table also covers Scotland, which emerges as the most important production location for the Hamburg herring trade in this period, while herring from Denmark, probably from the Limfjord, and nearby Emden and Bremen also figured in the trade in Hamburg.[14]

14 Röhlk, *Schiffahrt und Handel*, pp. 112-115.

Figure 6.8
Salted herring imported into the city of Hamburg, by country of origin, 1815-1822.



The waning importance of the herring trade in Hamburg can partly be traced back to the specific trade relationship between the city council of the free state of Hamburg and the government of the Dutch province engaged in the herring industry. Hamburg agreed to buy up the Dutch herring, and give them a privileged position when it came to resale from Hamburg, by treating the salted herring from competing producers as an inferior product. In return the Dutch producers upheld very tight regulations with regards to the quality of the finished product.[15]

This would have made it less attractive for the Scottish, Norwegian and Swedish producers to engage in herring trade with Hamburg, and conversely increased their interest in exports into the Baltic area. Hamburg and the hinterland up the river Elbe and further into the western parts of Germany also experienced a population growth in the 18th and 19th century. Although this does not seem to have been reflected in the import figures for herring, the following sections on prices and consumption will readdress this issue.

15 Röhlk, *Schiffahrt und Handel*, pp. 112.

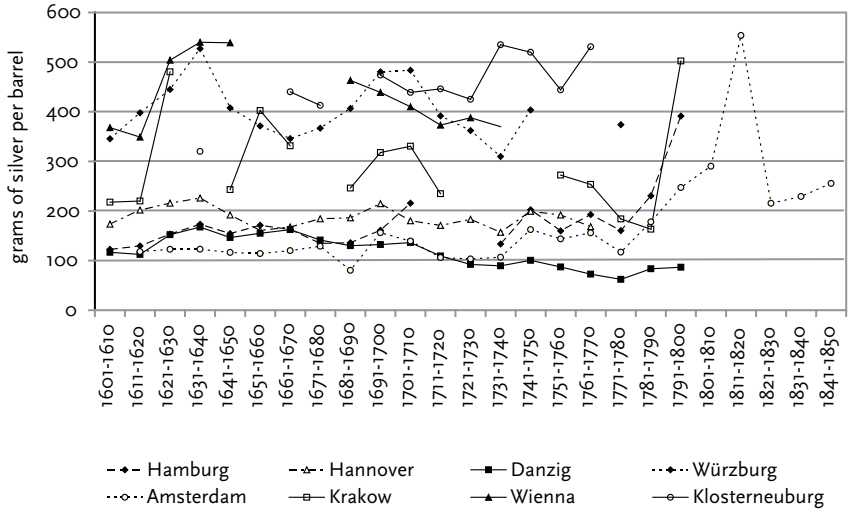
Prices

Long term relative decline

German historian Hitzbleck established 19 different price series for salted herring over the period 1259-1850 for most of northern and central Europe.[16] Eight of these are shown on figure 6.9. as ten-year averages of the amount of silver it took to buy one barrel of herring. Hitzbleck noticed that the herring prices were higher in market places far from the production location in comparison with those located closer by. He also observed that since the transportation costs by sea were lower than the costs of transporting the same amount over the same distance via inland shipping, herring prices were lower in the coastal areas.[17] Indeed, prices were lowest in the Low Countries, England, Hamburg and Danzig, whereas inland cities Würzburg, Munich, Vienna and Krakow generally had very high prices.

Figure 6.9

Average price of herring per decade in eight different cities, 1600-1850



In general, prices at markets in the vicinity of the North Sea did not vary much throughout the 1600-1850 period, especially those in Amsterdam

16 Hitzbleck, *Bedeutung des Fisches*, pp. 324-325.

17 Hitzbleck, *Bedeutung des Fisches*, pp. 148-153.

and Hamburg, as well as the Hamburg hinterland of Hannover and Braunschweig. But there were exceptions to these general patterns.

Divergence between North Sea and the Baltic

Two politically-motivated deviations from this pattern occurred. The first example would be market prices in Antwerp and nearby Mechelen in the first half of the 17th century, when prices rose to more than twice those in cities such as Amsterdam. Antwerp was the main hub of traffic and commerce in Northern Europe in the 16th century, but with the outbreak of the Eighty Years War, the Dutch fight for liberation from Habsburg rule, Antwerp got caught in the middle. The city was controlled by the Habsburgs, but a fleet of Dutch vessels effectively sealed off the main entrance to Antwerp by sea by blocking the Schelde river. As soon as the war was over in 1648, prices fell to a level closer to the other North Sea ports. Secondly, prices in Frankfurt skyrocketed in the 1630s as a result of the plague – which hit Frankfurt twenty times harder than normal in 1635 – and the turmoil of the Thirty years War. Together, these two disruptive factors served to distort the herring trade.[18] Soon after, prices in Frankfurt were normalised.

Moreover – and more relevant with regards to the dynamics of the herring market – a more structural divergence from market prices in coastal cities occurred in the mid 18th century in Danzig, when prices began to fall and deviate more and more from those in Amsterdam and Hamburg. In these cities, prices remained relatively stable up until the 1780s and 90s, when the problems associated with the Napoleonic period caused prices to increase. In the 17th century, prices in Danzig were actually higher than those in Amsterdam, but this changed in the 18th century and by the 1760-80s Amsterdam prices were twice as high as those in the Baltic entrepôt. This becomes clear from figure 6.10, showing a calculation by Dutch historian van Bochove of the year-to-year price fluctuations between the Netherlands and Danzig.[19]

Hitzbleck also noticed this deviance, in a comparison with the development of grain prices. The grain prices in Amsterdam, Würzburg and Vienna fluctuated in concordance with the herring prices; in Danzig, however, grain prices went up in the latter half of the 18th century, while herring prices went down.[20]

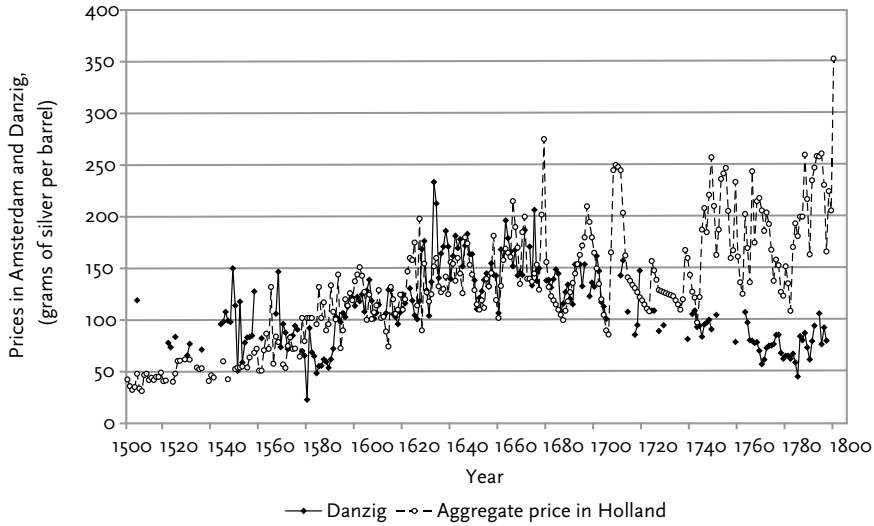
Canadian historian, Unger also commented on the 18th century divergence between price levels in Amsterdam and Danzig. According to Unger, the price differential between Amsterdam and Danzig during the 17th century

18 Elsass, *Geschichte der Preise und Löhne*, vol. 2 part 1, p. 65, and vol. 2 part 2, p. 2.

19 Bochove, Christiaan van, (pers. comm., 2005). Data originates from: Van Bochove, 'Haringvisserij in Holland'.

20 Hitzbleck, *Bedeutung des Fisches*, pp. 242.

Figure 6.10
Price of salted herring in Amsterdam and Danzig, 1500-1800.



bears no statistical resemblance to the one seen in the 18th century. During the same period the Dutch also lost out on their most important trade, the grain trade, known as the 'mother trade'. Unger though, found that the development of herring prices was linked to internal factors within the herring industry rather than changes in the grain trade.[21] He saw the difference as a reflection of the Dutch loss of market shares in the Baltic herring trade, but did not offer an explanation as to why this could be; this would cause the Danzig prices to go down.

But if transportation costs grew higher as the distance to the production site increased, then what might be the effect of the shift in production location during the great Bohuslen period of 1756-1808?

Bohuslen herring and the 16th century analogy

Figure 6.10 also reveals a historical precedent for the 18th century situation with the prices in Danzig being significant lower than those in Amsterdam. In the decade 1575-1585, prices in Danzig also fell dramatically in a decade where the Dutch prices rose. At this time the Northern parts of the Netherlands were revolting against the Habsburg rulers, so an increase in

21 Unger, 'Dutch Herring, Technology', pp. 272- 274.

market prices was to be expected. The drop in Danzig prices though, coincided with the Bohuslen period in the latter half of the 16th century.

In the years 1556-1587, trade statistics as well as anecdotal evidence testify to the notion that the sudden appearance – and later disappearance – of herring from the shores caused the fisheries to bloom and bust.[22] It is not possible to reconstruct the total production at Bohuslen so far back in time, but Danish historian Holm has reconstructed the late 16th century export of herring from the Bohuslen area into the Baltic by ship. Holm also put forward the hypothesis that the production of herring at Bohuslen was able to substitute the shipments of Dutch herring over the Sound river to the markets in the Baltic. Dutch exports went down around the year 1570 due to the eruption of the Dutch Revolt against the Habsburg rulers. When the Dutch started exporting herring into the Baltic again in the 1590s, this coincided with the disappearance of herring from the shores of Bohuslen.[23]

The two phases in which prices in Danzig were lower than those in Amsterdam are analogous with the two periods during which major inshore herring fisheries took place at Bohuslen. This phenomenon is not just a visual statistical impression. The correlation between prices in Danzig and Amsterdam between 1500-1795 is 0.10. But when the significant Bohuslen herring periods, 1570-1589 and 1760-1795 are discounted, the correlation is a lot stronger at 0.39.

The main explanation for the fall in Danzig prices is linked to the 18th century change in trading patterns observed in the Sound toll registers, where Bohuslen herring became dominant in the Baltic and was sold in unprecedented quantities. Moreover, the Swedish salted herring is likely to be of inferior quality to the salted Dutch herring, so this can also have added to the change in average market prices. There was also a comparable difference in quality during the late 16th century.[24]

The Bohuslen periods are a well-established environmental phenomenon occurring approx. once every century since the Viking Age. Besides the aforementioned Bohuslen periods, there was a shorter one in the mid 17th century which had no significant economic effects[25] It would thus appear that an environmental phenomenon, the occurrence of large quantities of herring in the inshore skerries of Bohuslen, profoundly affected the development of the North Sea and Baltic herring markets two times in a two-hundred year period.

---

22 Dalén, *Bohusländska Fiskelägesbygde*, p. 41, Claussøn Friis, *Norrige oc omliggende Øers*.

23 Holm, 'The Bohuslän herring', pp. 282-288.

24 Frandsen, 'Danzig's Salted Herring Trade', pp. 145-167.

25 Alheit and Hagen, 'Long-term climate forcing', pp. 130-139.

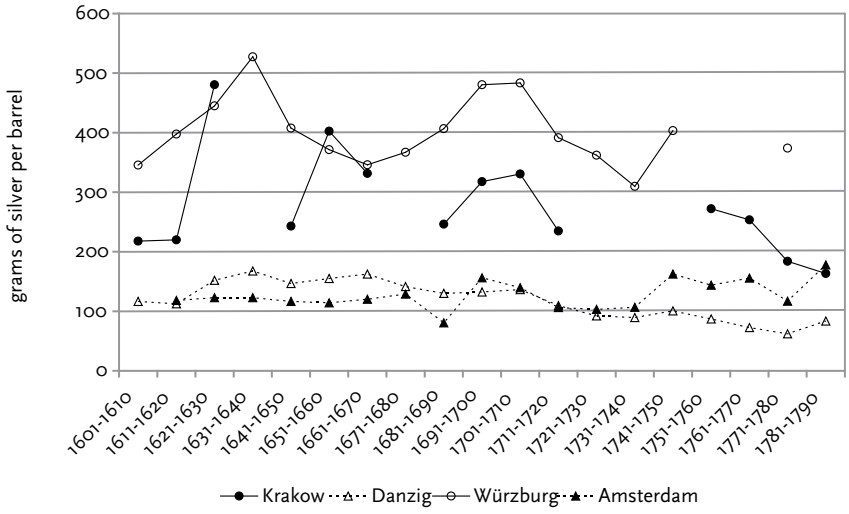
Hinterland divergence

We have now seen two instances where prices on the Danzig market diverged from those on the North Sea markets, and as Hitzbleck observed herring prices in the central European heartland were much higher near the sea than further inland. So, would the falling prices in Danzig also have a regional effect on the prices in its hinterland?

The pricing data on central European cities is not quite as complete as that regarding the coastal cities, but a changing pattern can also be distinguished here. Prices in Würzburg, Vienna and Klosterneuburg just outside of Vienna remained at a quite stable high during the 18th century, but when we look at Krakow we can see that herring prices started falling here quite rapidly in the 1760-80s. In the 1780s the market price in Krakow was lower than that in Hamburg for the first time in the 200-year period for which data is available. Prices in the inland city of Würzburg catered for by herring imported via the Rhine from the Rotterdam area, also do not seem to have fallen in the late 18th century, as the Krakow prices did. This may indicate a similar divergence in central Europe, comparable to what happened in between markets by the sea. This is all shown in figure 6.11., but unfortunately the relatively low number of data points available does not allow for a statistical test of this relationship.[26]

Figure 6.11

Trends in herring prices in inland cities, Würzburg and Krakow, and coastal cities, Danzig and Amsterdam.



26 Hitzbleck, *Bedeutung des Fisches,* pp. 324-325.

Krakow's closest and thereby cheapest access to the sea was the river Wisla, which flows through Danzig before reaching the Baltic Sea. Therefore, it would seem likely that the large influx of Swedish-produced herring also influenced the markets in the deep south of what was then the Kingdom of Poland. In the 1790s however, herring prices in Krakow tripled, while they remained stable in Danzig. This need not influence the theory of a connection between the Bohuslen herring fisheries and the Krakow herring market, since the most likely cause for the jump in prices was the second partition of Poland in 1893. Prussia, Austria and Russia divided Polish territory amongst themselves, whereby Poland ceased to exist for more than 20 years and Krakow came under Austrian control, while Danzig was included in Prussia.

In 1941, Swedish historian Dalén commented that the occurrence of Bohuslen herring periods coincided with periods of generally rising prices in Europe.[27] This may be true, but this analysis of the specific price differentiations in the North Sea and Baltic illustrate how the general demand for herring did not in itself drive forward the Bohuslen fisheries. In the case of the Bohuslen herring fisheries it seems to be the case that the supply – the sudden appearances of easily accessible and thus cheap herring – changed the market and drove down prices. With the German States and The Baltic area at large being the principal market for European herring in the 17-19th century, it is of interest to investigate the demand for herring in these areas.

This can be checked by comparing the development of herring prices with grain prices – an indication of the buying power of the average consumer. When estimating long-term price fluctuations in the early modern period, it is difficult to account for inflation rates, so if price developments are to be used as an indicator of the demand for salted herring, it is better to view the herring price in relation to the commodity most stable and important, which was the grain price. When demand falls, the relative price of herring will do the same. As we saw above, herring prices in all of Germany rose in the 17th century, but when we look at the entire whole 1600-1850 period, herring prices were falling – relatively speaking – compared to grain prices.[28] But what if prices go down as a result of a surge in production rather than a fall in demand? A means to check this is to look at the consumption patterns in the principal markets to see what role the salted herring played in the diets of people in the North Sea and Baltic areas.

27 Dalén, *Bohuslänska Fiskelägesbygden*, p. 78.

28 Hitzbleck, *Bedeutung des Fisches*, pp. 228-244.

Consumption

Historical changes in diet with regards to the fisheries have not received much attention in historical research. Norwegian historian Nedkvitne though, detected a structural change between approx. 1500- 1730 in the relationship between grain prices and prices of dried codfish in Amsterdam. He interpreted this as being related to a shift in demand for fish from dried cod towards herring and cod salted in barrels.[29] However, in the Dutch market of the 17th and 18th centuries, the taste for salted herring seems also to have declined. From approx. 1640 until the middle of the 18th century, domestic consumption of herring as a percentage of the total production of herring in the Netherlands dropped, even though this was also a period where the size of overall production fell significantly. At the same time population levels increased, indicating that by 1750 the consumption per capita had fallen to an estimated 25% of the level a century before.[30] The successful introduction of the potato as an important part of the staple diet in the Dutch Republic has also been credited for a declining interest in salted herring.[31]

In Scotland, also a major production location for herring, anecdotal evidence suggests that the fisheries were a major source of food for the common people in the 17th century.[32] This however, cannot be backed up by a later quantitative verification from the mid 18th century provided by the same author. During the 18th century, potatoes became part of the diet, while fish was always an extremely rare product on the dinner table. Only along the Scottish coast did herring, saithe, haddock and shellfish play a significant role in local consumption from 1550-1780.[33] Accounts of households derived from a number of Scottish institutions in various years between 1639 and 1790 indicate that fish, mostly herring, made up an average of 2.1 percent of the staple diet.[34] Unlike the Baltic region, the average diet in Scotland seems to have consisted mainly of porridge, diary products and occasionally meat.

A lack of demand as well as a tradition for eating fish in the Scottish hinterland compared to other parts of the North Sea and Baltic region is likely to have hampered the 17th and 18th century attempts to build up a competitive Scottish herring industry, and indeed – as seen above – the 19th century growth was driven by exports to Germany and the Baltic region.

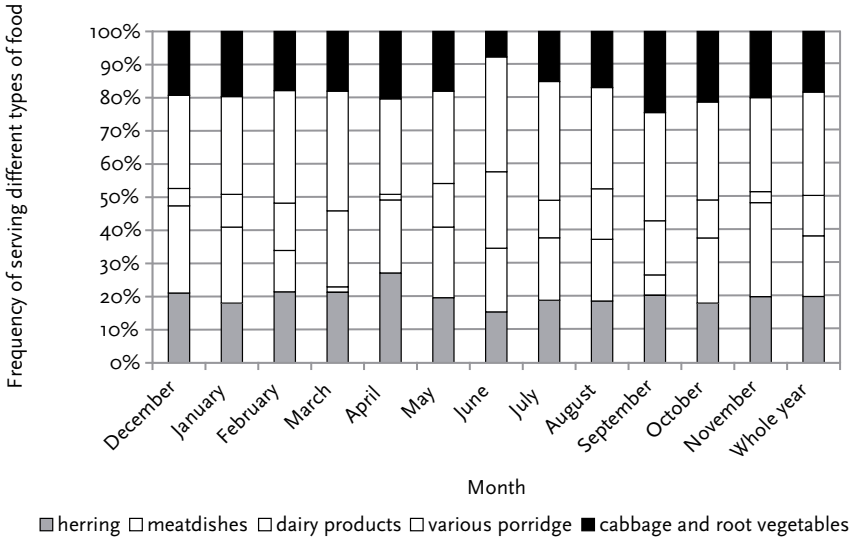
In England, the expansion of the foreign market is also seen as the key

29 Nedkvitne, *Mens bønderne seilte*, pp. 589-598.
30 Kranenburg, *De zeevisscherij*, pp. 135-136.
31 De Vries, *De economische achteruitgang*, p. 143.
32 Smout, *Scottish Trade*, pp. 219-220.
33 Gibson, *Prices, food and wages*, pp. 225-243.
34 Gibson, *Prices, food and wages*, pp. 249-260.

to the rise of the English herring industry over the course of the 19th century. Recently, English historian Haines noted that although the population of England almost tripled in the century from 1750-1850, the domestic demand for herring did not follow suit. According to Haines, '...cured fish did not appeal to the taste of the English, perhaps on account of its inferior cure and poor quality.'[35] In any case, an e silentio reasoning on account of the consumption of salted herring in England, would hint that this was not a dish commonly served in the 17th and 18th centuries. In the seven volumes of *A History of Agriculture and Prices in England* covering the period 1259-1793, market prices for herring are no longer listed after the 1660s, while works of synthesis on English consumption also contain no mention of salted herring.[36]

Figure 6.12

Frequency of food types served in the Hospital of The Holy Ghost in Elbing, East Prussia, 1624-25.



Several pieces of evidence from the territory of the German states point towards a gradual decline in demand for herring per capita. Figure 6.12. illustrates how salted herring featured prominently in the food served at the

35 Haines, 'The Herring Fisheries, 1750-1900', p. 65.

36 Rogers and Thorold, *Agriculture and Prices in England*, Shammas, *Pre-industrial Consumer*.

Hospital of the Holy Ghost in Elbing, Eastern Prussia in the early 17th century.[37] Here, herring constituted about one fifth of dishes served virtually all year round, and this amount of herring surely exceeded the levels reached in Scotland around the same time.

In Lüneburg in northern Germany approx. 15.5 kg of herring was consumed per capita in the 15th century, while in Hannover, also in the northern part of the country, a mere 3-4 kg per head was served at poor people's homes in the period from 1728-1755. With regards to the latter half of the 18th century, an estimate of 6 kg per capita for the whole of the German area has been made.[38] In any case, the general pattern between 1600-1850 seems to be one of decline.

One of the best available sources of information on changing diets stems from Sweden, where historian Morell analysed the diet in a hospital in Falun, north of Stockholm. With regards to the 1659-1837 period, we can trace the annual consumption of unspecified salted fish. In 1659, an average of 12 kg fish were consumed by each inmate of the hospital; in 1663, by comparison, the annual intake of fish per capita had reached more than 60 kg, and in 1674 as much as 100 kg of fish was consumed every year. In 1688 the figure was back to 60 kg, whereas just a few years later in 1695 annual consumption was less than 10 kg. In the 18th century, the average consumption of fish rose again to a level of approx. 60-80 kg in the mid-18th century, and stayed at around 80 kg until the start of the 19th century. In the 1820s and 1830s the level was back at approx. 10 kg, per capita per year. There is reason to believe that salted herring was the main fish produce used at the hospital, since dried cod amounted to only a tenth of the total quantity eaten every year.[39]

It appears that the Swedish per capita consumption of salted herring was the most prolific in the investigated area of northern Europe at the time. To some extent the rising and falling levels of consumption followed the rhythm of the Bohuslen herring periods. It can hardly have been a coincidence that close to 100 kg of fish was consumed in an inland place such as Falun, when the herring shoals were flocking along the western shoreline, both in the middle of the 17th century and in the latter half of the 18th century. Still, when the herring did not come close to Sweden the consumption was much higher than known figures from Germany, The Netherlands, England and Scotland.

The overall trend in the north European consumption of fish thus seem to have been declining over the years 1600-1850, especially in the westerly

37 Klonder, 'Die Nahrung', pp. 349-375.

38 Hitzbleck, *Bedeutung des Fisches*, pp. 306-312.

39 Morell, *livsmedelkonsumptionens historia*, pp. 199-202.

areas around the North Sea, where the herring no longer played an important role, possibly replaced by the potato. In the eastern parts around the Baltic, Sweden and Germany, available data points towards a much higher per capita consumption, but also a declining tendency over the 250-year period. Large regional differences can thus be distinguished in the consumption of salted herring. This pattern would affect the herring trade in such a way that the eastbound export gained in relative importance with regards to the herring producing areas around the North Sea, while home consumption in these areas dwindled.

Trade policy

Import restrictions

The trade however, was also affected by government policy in the countries of the North Sea and Baltic region. Apart from the challenges of waning consumption, the European herring trade was also affected by the introduction of mercantilist economic policies during the 18th century.[40] In 1689, French king Louis XIV prohibited the import of any foreign salted herring into France.[41] This restriction must have been lifted later, as France reintroduced a complete import ban on herring in 1751.[42] During the second half of the 18th century the export markets for Dutch herring further diminished as Denmark prohibited import of foreign herring in 1774.[43] In the Southern Netherlands, the import of foreign herring was prohibited in 1767, and in 1770 the government decided to subsidize the fisheries by putting a bounty on every fishing vessel.[44]

The direct effect of such historical policy measures can often be difficult to verify, but in the case of 18th century trade between Sweden and The Dutch Republic historian Lindblad compared the economic policy of the Swedish government with the actual development of trade figures. In the late 1730s, a new Swedish government introduced a harsh mercantilist policy, whereby the Swedish import of several products was banned, while high import tariffs were levied on others. The trading relationship between Sweden and the

40 Here 'mercantilism' is defined as: '...the economic theory that a nation's prosperity depended upon its supply of gold and silver, that the total volume of trade is unchangeable. This theory suggests that the government should play an active role in the economy by encouraging exports and discouraging imports, especially through the use of tariffs.' Cited from: http://en.wikipedia.org/wiki/Mercantilism

41 Smout, *Scottish Trade*, p. 222.

42 Vries, *De economische achteruitgang*, p. 142.

43 Röhlk, *Schiffahrt und Handel*, p. 113.

44 Verbrugge, 'Die belgische Seefischerei', p. 9.

Figure 6.13
Debiteren

Each Dutch herring skipper had his own mark, which was branded onto every barrel sold. In this way herring sold in markets all over Europe could be traced back to its original producer. Source: 'The Selling of the Herring.', etching by Adriaan van der Laan, (1705). P0208, Visserijmuseum, Vlaardingen.

Dutch Republic deteriorated, and the rapidly declining herring trade serves as evidence of the effectiveness of this mercantilist policy. This was before the start of the great Bohuslen period, when the Swedish consumption of herring was dependent on import, with almost 2,000 barrels of herring imported into Sweden in 1738 and 1739. However, in the following 50 years annual import figures remained at an average of approx. 300 barrels per year.[45]

Judging from this piece of evidence from Sweden it would appear that the import restrictions mentioned above were an effective measure in protecting the domestic herring industries in the latter half of the 18th century. Bearing in

45 Lindblad, *Sweden's Trade,* pp. 18-20 and p. 62.

mind the above analysis of changing consumption patterns, whereby the North Sea herring producers – especially The Netherlands – became increasingly dependent on export markets, such import restrictions would become a bigger threat to The Dutch Republic and Scotland than – for instance – Sweden.

Debate

At the start of the period, Dutch-produced salted herring from the North Sea dominated the herring trade, whereas during the 18th century Scottish, Danish and Norwegian herring featured prominently. In the latter half of the 18th century though, the Swedish-produced Bohuslen herring rose to become the largest source of export into the Baltic, while Norway and Scotland regained their status in the Baltic herring market in the 19th century. Price data on various parts of northern Europe give indications for the long term development of herring prices. Three especially significant results can be gleaned from this information: Herring prices in coastal areas were generally lower than those further inland. Secondly, there was a general trend whereby herring prices in the North Sea area and the Baltic fluctuated in unison. Thirdly, this pattern was disrupted twice by the appearance of two periods between approx. 1570-1589 and 1760-1808 of very large fisheries at Bohuslen on the Swedish west coast. In these two periods, the Bohuslen herring came to dominate traffic through the Sound and thereby the Baltic herring trade, but in neither of the two periods did Bohuslen herring succeed in dominating the North Sea market for herring as it did in the Baltic. This became clear from the import data from Hamburg, where the Dutch managed to keep a foothold during the last decades of the 18th century.

The observed general decline in herring prices can have two causes. The supply of salted herring can have gone up, or the demand for herring per capita can have gone down. Comparisons between grain prices and herring prices in the German territories indicate that the buying power of herring declined in comparison with the price of grain.

The consumption patterns for salted herring were then analysed. The results of this analysis indicate two things. Firstly, the figures for consumption point towards a falling demand for salted herring in the period in question. Secondly, the consumption of herring was larger in the north eastern and central parts of Europe than in the countries surrounding the main area of production, the North Sea. Finally, the mercantilist policies of the European states in the 18th century would have worked mainly against the export-oriented producers such as the Dutch and Scottish. A summation of the findings in this chapter is the following general characterisation of the development of the herring market in the North Sea and Baltic areas.

Conclusion

The trade in salted herring appears to have been highly integrated between the main area of production in the North Sea and the main areas of consumption in the Baltic area and European continent. This is evident from the two periods during which Bohuslen herring rose to prominence. The appearance of large shoals of herring is a well-documented environmental phenomenon, but this chapter argues that the economic impact of the fisheries developing in Bohuslen was equally felt in the herring trade in northern Europe. The end of the Bohuslen period in the late 16th century marked the beginning of Dutch supremacy on the Baltic market, while the 18th century Bohuslen period was instrumental in ending this era of Dutch dominance in the Baltic herring trade. After a phase of Swedish dominance that lasted until the early 19th century, salted herring from Scotland and Norway became dominant in the Baltic.

7 | Cooperation and communication in the Dutch herring fisheries

Introduction

For centuries, the Dutch North Sea herring fisheries were the largest in Europe and the envy of other nations. This study applies economic resource theory and the results of anthropological case studies in order to discuss institutional, technological and cultural information sharing in a historical context.

How did the Dutch herring fishers manage to find the fish at sea? How and to what extent did they cooperate with each other, and which environmental and institutional incentives did they have for cooperation? The political body, Het *College van de Grote Visserij*, governed the regulations of the Dutch herring fisheries for almost 300 years, emerging gradually in the latter half of the 16th century until it was finally dissolved in 1857.

This study establishes that the Dutch North Sea herring fisheries were managed and organised in a manner that favoured large-scale cooperation and the sharing of knowledge between fishers. It analyses the regulations imposed by the *College van de Grote Visserij* aimed at controlling how the fishers interacted at sea. Registers of herring landings in the Netherlands and diaries and logbooks kept aboard fishing vessels are other important sources in this study. Together, they provide the documentation needed for an as-

sessment of formal and informal systems for cooperation and communication within the Dutch North Sea herring fisheries.

The analysis demonstrates that the fishers communicated intensively, but the question remains to what extent valuable information on the fishing grounds was shared freely. Did certain groups of Dutch fishers interact more closely with one other, and if so, what determined the limits to their information sharing?

Theories on fishers' behaviour

The behaviour and interaction within groups of fishers at sea is an important aspect in any large-scale fishing operation. From the point of view of fisheries management, it is desirable to understand how the different strategies adopted by a group of fishers influence the fishing effort and thus the fishing pressure on a given limited natural resource. In assessing the economic performance of a fishing fleet, it is also of interest to know what type of behaviour is adopted by the individual fishers as well as the group as a whole.

In the view of marine scientists Ray Hilborn and Carl J. Walters, however, the issue of fishers' behaviour is still poorly understood. In 1992, they wrote the following in their highly influential textbook on *Quantitative Fisheries Stock Assessment*: "Fleet dynamics is probably the most understudied subject in fisheries".[1] Later in the same chapter they go on to say that, 'fisheries science will be far richer, and our understanding of how fisheries behave more advanced, if half the energy that goes into biological studies of fish were devoted to behavioural studies of fishers'.[2] Despite having recognised the need for such studies, the same textbook takes a rather narrow view of the behaviour of modern fishers:

'In making the supposition that fishers have dynamics analogous to natural predators, we are taking a competitive and market-oriented view of the economics of fishing; this is more realistic for most fisheries than to assume that fishing is a communal, cooperative, and altruistic process'.[3]

This view is modified in a recent introduction to Marine Fisheries Ecology, where the authors put forward that 'Fishing is not just about catching fish and making money; rather it is bound up in the culture of coastal societies'.[4]

A similar recognition of the need to take both economic, social and environmental factors into consideration when analysing the behaviour of fish-

1 Hilborn and Walters, *Fisheries Stock Assessment*, p. 153.
2 Hilborn and Walters, *Fisheries Stock Assessment*, p. 154.
3 Hilborn and Walters, *Fisheries Stock Assessment*, p. 104.
4 Jennings *et al.*, *Marine Fisheries Ecology*, p. 126.

ers has also emerged in the field of resource economics. In a now classic 1954 article on common property resources, Canadian economist H. Scott Gordon proposed that in an open access fishery, new fishers will continue to enter the fishery until the profit margin reaches zero. This is due to the law of diminishing returns: under unregulated private exploitation, the marine resource in question will yield no profits, either because of economic problems or due to the depletion of the natural resource. However, if the fishers succeed in imposing some sort of social control on their activities, they can make a greater profit. For example, fishers would turn the open resource into a local monopoly by regulating the entry of new fishers and controlling their own operations. The fishery thereby changes from being an entirely open access fishery into a limited entry fishery.[5]

In 1968, biologist Garett Hardin also examined the problem of common property resources, and proposed that common property resource exploitation would inevitably lead to a severe depletion of the natural resource. In describing this process, he coined the term 'Tragedy of the Commons'.[6] This problem is highly relevant to many modern fisheries, but in the period between approx. 1600-1850 the Dutch North Sea herring fisheries did not extract enough fish from the sea in order for the North Sea herring populations to be affected. This is analysed in chapter 5.

What neither theory deals with though, is the problem of finding the fish. This issue has been discussed by economist James A. Wilson, who supplements the above theories by proposing that every fisher has a learning problem when searching for fish. Since the ocean is large, no individual fisher acting alone could hope to acquire the experience needed to establish the regularity or predictability required for a successful exploitation of large marine resources. Rather, fishers need to cooperate and exchange information with other fishers. But whoever catches the fish owns it, and this gives an incentive for individual rather than collective acquisition of new knowledge. Knowledge of good fishing locations thus becomes a potentially important economic asset, although this depends on the nature of the natural resource being exploited. Some fish aggregate in groups, such as herring schools – also known as patches. If the individual fisher has the capacity and technology to completely exhaust a patch of fish on his own, he does not have an incentive to share his acquired knowledge of this particular patch of fish. If, however, there is plenty of fish available once a patch has been located, the fisher responsible for finding the patch holds a valuable asset, which he can exchange for similarly valuable assets from other fishers he trusts. When such a phenomenon occurs and fishers collaborate they

5 Gordon, 'The Economic Theory', pp. 124-142.

6 Hardin, 'Tragedy of the Commons', pp. 1243-1248.

are basically forming an association.[7]

Economist Neal Stuart Johnson has compared a number of empirical studies on information sharing in limited entry fisheries. Johnson concurs with the aforementioned incentives mentioned by Wilson that the formation of information sharing groups is especially common in herring fisheries.[8]

This is due to the fact that herring is a highly migratory species that aggregates in schools or patches often larger than the capacity of any boat in the fleet and located far from the fleet's port of origin. The benefits of coordinated searching would then tend to be relatively high with catch reduction costs relatively low. This favours relatively small and stable groups of cooperating fishers and highly disadvantages independent, non-cooperating fishers, the so-called free riders.[9]

With regards to the theories on common resource exploitation, recent research points to an increasing awareness of the role of social and cultural factors in fishing strategies, such as the fisher's choice to fish alone or within more or less loosely formed information sharing clubs.

The above arrangement between a fishing fleet operating far from home, targeting a migratory species such as North Sea herring without risking the overexploitation of fish stock, reflects the challenges facing an early modern high seas fishing operation such as the Dutch North Sea herring fisheries. In view of the above theories, it would seem likely that they would expect to catch more and reap greater profits the more they cooperated during fishing. So, how well did the Dutch herring fishery conform to modern theories on information sharing in limited entry fisheries? The economic culture of any past or contemporary commercial fishery is much influenced by its historical setting. In order to properly assess the significance of the fisheries strategy in the Dutch herring fisheries it is useful to place it in its Early Modern historical context.

Fishers' behaviour within *the College van de Grote Visserij*

The first modern fishery

Historians Jan de Vries and Ad van der Woude characterised The Dutch Republic as the World's first modern economy. Although the republic was not modern in the sense of today's industrial economy, they found a number of qualities that set the Dutch society apart between around 1500 until the advent of the industrial revolution. These qualities are the existence of

7 Wilson, 'Fishing for Knowledge', pp. 12-29.

8 Johnson, *Synergies in the commons*, pp. 108-126.

9 Wilson, 'Fishing for Knowledge', p. 24.

relatively free markets for both commodities and labour, land and capital. Another important factor is the existence of substantial agricultural productivity, enabling a complex social and occupational structure that allows for the extensive division of labour. Moreover, the policies created and enforced by The Dutch Republic took a conscientious approach to property rights, the negotiation and upholding of contracts as well as the material well being of its inhabitants. Finally, De Vries and Van der Woude found a level of technology and organisation capable of sustaining a material culture with market-oriented consumer behaviour.[10]

Having analysed all economic sectors of society, they concluded that the herring fishery outperformed all other branches of economic activity in terms of employment and capital during its 17th century heydays.[11]

In the 1560s, a number of towns formed a body – *College van de Grote Visserij* – which was granted privileged by the Dutch Republic during the last decades of the 16th century. The college was thereby granted jurisdiction over the entire Dutch herring industry with regard to the catch, processing, distribution and marketing of salted herring.[12] The privileged towns forming the College upheld a monopoly on the landing of salted herring in the Netherlands until the 1850s. The College regulated the size and use of the fishing gear, driftnets, and the length of the fishing season. Regulations are common features in modern fisheries resources management; when it comes to 21st century fisheries, they are mainly introduced in an attempt to preserve fish stocks and ocean biodiversity in the face of human exploitation. In the early Modern Era however, the main purpose of the regulations upheld by the *College van de Grote Visserij* was to preserve the quality of the top brand of salted herring in Europe.

The season started on the eve of St. John's day, 24 June. Following a government decree of 1582, the fishers were not allowed to fish for herring after 31 December. In 1604 however, the fishing season was extended to 31 January, which signalled the end of season.[13] These key dates remained in place until the *College van de Grote Visserij* was finally dissolved in 1857. The main body of legislation drawn up by the *College van de Grote Visserij* stems from 1580, and remained effective until The Batavian Republic imposed a new but only slightly updated set of rules in 1801. 1827 saw the final renewal of regulations under the auspices of the *College van de Grote Visserij*.[14]

According to De Vries and Van der Woude, these regulatory measures

---

10 De Vries and Van der Woude, *The first modern economy*, p. 693.
11 De Vries and Van der Woude, *The first modern economy*, p. 266.
12 Mietes, *De archieven van de colleges*, pp. 11-18.
13 Kranenburg, *De zeevisscherij*, pp. 151-155.
14 Mietes, 'De Hollandse Visserijcolleges', pp. 166-172.

forced the fishers to function as a de facto consortium, which produced and sold a standardised product. The College oversaw that the large driftnets with a length of up to 1.4 km and spanning 22,000 m2 had the correct height and length and a standardised mesh size.[15] The process of curing the catch aboard large factory-like ships, herring busses, the size of the barrels used for packing the salted herring, the quality of salt used as well as the branding of the finished product ashore were all carried out in the manner prescribed by the college.[16] The herring fishery is illustrated in figure 7.1. This 17th century etching depicts a fleet of fishing vessels in the midst of hauling in the catch while the sun rises in the far right. The cliffs could be a representation of The Shetlands.[17]

Figure 7.1

A fleet of fishing vessels hauling in the catch while the sun rises in the far right.

15 Tillema, *Nederlandsche haringvisscherij*, p. 104.

16 Kranenburg, *De zeevisscherij*, pp. 18-22.

17 Visserijmuseum, Vlaardingen, *Harinck-Buisen*, approx. 1640-1664, etching by Reinier Nooms, 'De Zeeman' (approx. 1623-1664).

In other words, the Dutch herring fishery was in many ways representative of the first modern economy, and could hence be termed the first modern fishery.

The behaviour of the Dutch fishers could thus be analysed in the same manner as any well-regulated, large-scale capitalist enterprise. When it comes to fishing strategy, it can be said that the fishing club of the *College van de Grote Visserij* provided the framework for limited entry into the Dutch North Sea herring fishery. But to what extent did the fishers interact and collaborate when fishing?

Ventjagers

When the College was first inaugurated in 1567, representatives from 13 different towns and villages participated. By 1600, the College consisted of representatives from towns from the two main administrative areas of the Holland province. From the Noorderkwartier, Enkhuizen sent deputies to the College, while the Zuiderkwartier towns of Delft, Brielle, Rotterdam and Schiedam also held seats in the College. During the 18th century the neighbouring towns of Vlaardingen and Maasluis became the main ports for salted herring, landing more than half of the total Dutch production.[18] See the map of herring ports in The Dutch Republic, figure 7.2.

Figure 7.2

Map of the herring ports within the *College van de Grote Visserij*.

18 Kranenburg, *De zeevisscherij*, pp. 180-181.

However, it was not until 1795 that they were granted the formal right to participate in the management of the College. After the end of the Napoleonic era, the College was reorganised. In 1822, its management was appointed by the towns of Vlaardingen, Maasluis, Enkhuizen, De Rijp, Amsterdam and Rotterdam.[19] The distance between the towns along the River Maas in the Zuiderkwartier and Enkhuizen and De Rijp in the North is almost 100 kilometres, so one might expect fishers to form alliances not just through the College, but within their home town or region. One of the instruments of cooperation at the time was the concept of *ventjagers*.

The *College van de Grote Visserij* had an interest in controlling the market for salted herring. Prices were highest at the start of the season, in June, July and August, when the quality peaked and the European markets longed for freshly salted herring. This would give some fishers an incentive to rush home with a half empty boat if they had been lucky during the very first days of fishing and caught a large amount of herring in comparison to other fishing boats fishing within the *College van de Grote Visserij*. This would give the fast fishing and sailing fisher a relative advantage over the majority, but not necessarily lead to an increased overall profit for the fleet as a whole.

The College however, had the foresight to regulate this traffic from as early as 1604. From 1632 onwards, the rules of the College stipulated that no fishing vessel was allowed to leave the fishing grounds and return home before 15 July, nor were ships allowed to land along the coast line before 19 July.[20] In cases of violation, the offender was to pay a huge fine. In the early 1800s, this fine amounted to 3,000 Guilders, or what was seen as the equivalent value of a full last of herring.

The ventjagers were often older used fishing vessels, which were transformed into pure cargo vessels. Any merchant could apply to the college for permission to send out ventjagers to buy up herring from the fishing vessels in open sea. They would then sail in the proximity of the herring vessels and collect barrels of salted herring from various vessels. The herring landed by the ventjagers could then be sold at a very high price, and the profit shared among the fishing boats. Each crew of fishers that had transferred fish to the ventjager at sea received payment in proportion to the amount they had handed over. If a ship acted as a ventjager without the prior consent of the College, they would be fined 1,000 guilders.[21] The period from the start of the fishery on 24 June until 15 July was even known as the *jaagtijd*, meaning the time of the ventjagers.[22]

---

19 Mietes, 'De Hollandse Visserijcolleges', p. 171.
20 Beaujon, *Nederlandsche Zeevisscherijen*, pp. 51-53.
21 NA. CGV. Inv. no. 686, p. 32.
22 NA. CGV. Inv. no. 686, p. 12.

A further tightening of regulations with regards to the ventjagers came in 1725, with the establishment of the 'Gemeenschap van ventjagerije', the community of ventjagers. Hereafter, the ship owners of the Grote Visserij decided on an annual basis how many ventjagers would be allowed to join the fishing fleet, and how much the merchants aboard the ventjagers would have to pay for a barrel of salted herring. They even agreed on how much every ventjager was supposed to buy up and bring home. In order to make sure all parties were aware of this decision, a list of ventjagers was drawn up each year, stipulating – for example – that the first ventjager would go to one of the towns in the Zuiderkwartier, the second ventjager to Enkhuizen in the North, the third and forth ventjager to the Zuiderkwartier etc., thus furthering the ship owners' monopolistic control over the production side of the herring industry.[23]

The ventjagers thus served as instruments of cooperation between the fishers within the college. Regulations though, did not include stipulations that ventjagers from one town should only receive herring from vessels from their own town, so in theory the ventjagers could receive herring from all nearby fishing vessels.

Selling herring to Schiedam ventjagers

The actual operation of the ventjagers can be traced through testimonies, which every skipper of a ventjager – along with two other members of the crew – was obliged to provide to the local clerk of the *College van de Grote Visserij* upon arrival in Holland. Records from some of the towns in the College have survived to this day, allowing us to assess the pattern of buying fish in open sea. Two years, 1680 and 1720, were randomly chosen to investigate ventjagers buying salted herring and landing the catch in Schiedam.

The selected ventjagers bought herring at sea from skippers from all over the Holland province.[24] In 1680, three ventjagers (five in 1720) supplied testimonies of their business in Schiedam. Each testimony includes references to every acquisition of herring, noting the date, the amount of herring, the name of the skipper, and in most cases the skipper's hometown. The skippers mostly came from towns taking part in the College, such as Enkhuizen or Schiedam, but other towns were also recorded, as shown in table 7.1. In order to establish whether the ventjagers cooperated with any fishers within the *College van de Grote Visserij*, the assumption has been made that skippers from an area within the Noorderkwartier would be fishing out of Enkhuizen, and that skippers from the southern parts of the Holland province were

23 Akveld, 'Noordeevisserij', p. 324.

24 GA Schiedam, Gerechten van Schiedam, inv. no. 618 and 621.

fishing out of one of the towns in the Zuiderkwartier. The skippers from Schiedam landed their catches in their hometown.

Table 7.1

Hometown of skippers selling herring to Schiedam ventjagers.

1680		**1720**	
Area	no. Skippers	Area	no. Skippers
Schiedam	16	Schiedam	27
Rest of Zuiderkwaartier			
Maassluis	2	Maassluis	4
Rotterdam	1	Rotterdam	12
Vlaardingen	7	Vlaardingen	16
Delfshaven	7	Delfshaven	5
Brielle	9		
Katwijk	2	Katwijk	1
Noordwijk	1	Noordwijk	3
Scheveningen	1		
Noorderkwartier			
Enkhuizen	8	Enkhuizen	2
Texel	3	Texel	1
Petten	1	Petten	1
Egmond	3	Marken	5
Broeckhuizen	1	De Rijp	1
Venhuizen	3		
Graft	1		
Unidentified	8	Unidentified	2
Total	74		80

The table illustrates that the ventjagers would buy herring from fishers from any part of Holland, which has a further implication. The ventjagers in question bought most of their herring on 3-4 specific dates. During a single day, they would receive herring from a great variety of skippers. This suggests that cooperation and communication between fishers was not limited to a

single town, but that fishers from all areas were fishing within short sailing distance of each other. The business of the ventjagers as well as the fishery itself does thus not seem to have excluded certain areas in favour of others. Nevertheless, when comparing the number of encounters between the Schiedam ventjagers and skippers and the rest of the Zuiderkwartier and the Noorderkwartier with the known figures for total herring landings in the various areas of Holland, certain discrepancies emerge, as illustrated by figures 7.3 and figure 7.4.

In both 1680 and 1720, less than 15 percent of the Dutch production of salted herring was landed in Schiedam. In 1680 however, the Schiedam ventjagers bought herring from a Schiedam herring vessel one out of four times. In 1720, every third purchase of herring stemmed from a Schiedam skipper. The other areas of the Zuiderkwartier also figured more heavily in the ventjager statistics, whereas they made up a representative share of the off shore acquisitions in 1720.

On the other hand, the Noorderkwartier – located far from the Schiedam merchants operating the ventjagers – did not appear as often in the statistics as their share in total herring production would suggest. In 1680, more than 56 percent of all salted herring in Holland was landed in Enkhuizen, but only three times out of ten did the ventjagers from Schiedam buy herring from a skipper based in the Noorderkwartier.

Thus, the business of the ventjagers played an important part in the cooperation of the Dutch North Sea herring fishery. By law, they operated as a joint venture between all participating towns in the *College van de Grote Visserij*. In practice, the ventjagers from Schiedam also facilitated fishers from all over Holland. If we examine which fishers sold to the ventjagers, however, we can see a distinct bias favouring the local fishers from Schiedam. There can be two rationales behind this phenomenon.

From the viewpoint of a Schiedam merchant investing in a ventjager, the main objective must be to maximise the acquisition of herring regardless of its origins. On the other hand, such a merchant would be more likely to have had other financial and social ties to the local ship owners and skippers than an off shore fish buyer. In Vlaardingen during the first half of the 19th century, herring skippers seemed to change frequently between commanding a ventjager and one of the herring vessels.[25]

25 NA. CGV. Inv. no. 387-395 + 626-654.

Figure 7.3

Origin of the 66 different skippers selling herring to the five ventjagers landing herring in Schiedam in 1680.

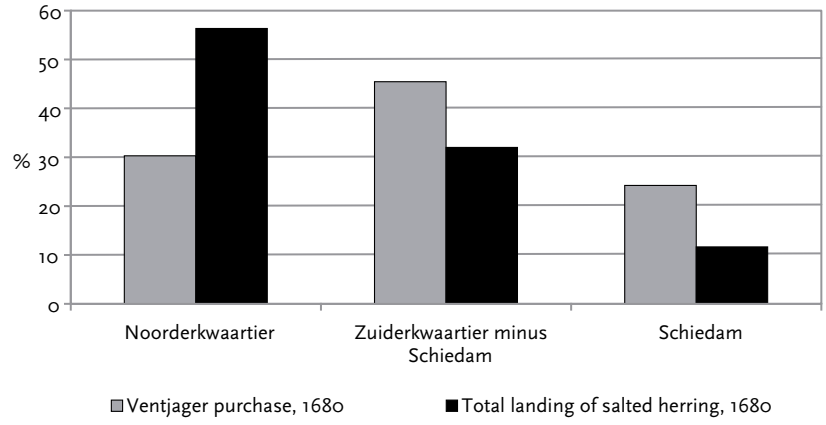
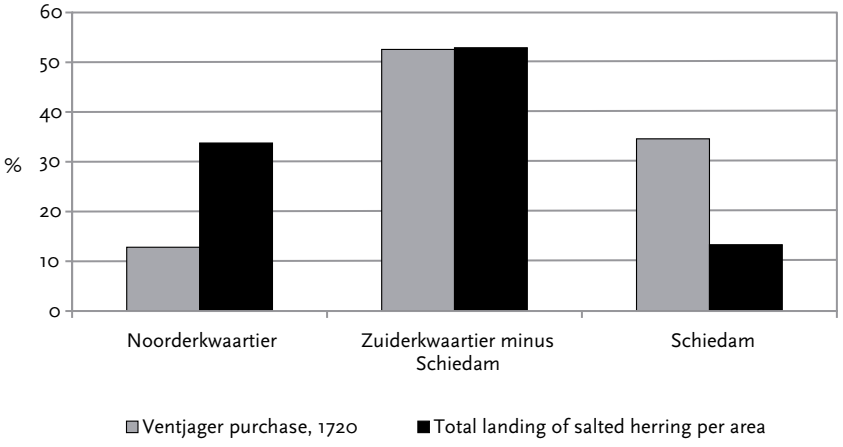


Figure 7.4

Origin of the 78 different skippers selling herring to the five ventjagers landing herring in Schiedam in 1720.



The other reason could be the fishing operation itself. Assuming that skippers from Schiedam and possibly the other towns in the Zuiderkwartier were fishing alongside each other, rather than randomly with skippers from all over Holland, the ventjagers could stick primarily with their own townsmen, and buy fish from them.

But did the fishing operation itself offer opportunities for groups of fishers from – for instance – Schiedam or other towns to form a club of their own within the larger group of Dutch herring fishers? In order to answer this question we must analyse the nature of the fishing operation at sea itself and the behaviour of the fishers. How did the fishers assist or hinder each other at sea, and how did they control and exchange knowledge as to the best fishing locations?

Buying fish with De jonge Hendrik Jacob

On the morning of Tuesday, 16 June 1789, the crew aboard the hoeker, *De jonge Hendrik Jacob* lifted anchor, set sail and headed out of the Zuiderzee in northern Holland. We know this, since a diary of this voyage has been preserved. Perhaps the author was the captain of the ship, Jacob Zalmten.[26] The investor was merchant Cornelis Jantjes from Enkhuizen and the hoeker served as second ventjager for the Noorderkwartier in the season of 1789. The diary was written in prose, and offers an eyewitness account of life at sea. The ventjager left The Netherlands in the company of some 30 herring vessels, and on Friday 19 June the Hendrik Jacob reached the Shetland Islands and anchored in the Baai van Hitland on the east coast of the main island near the town of Lerwick. This bay was the main meeting point for the Dutch fishing fleet, where they could rest, buy provisions on land and still be close to the summer fishing grounds.

In the following days more and more vessels arrived at the Baai van Hitland, and on Wednesday 24 June at the start of the fisheries more than 130 Dutch herring vessels headed out to the fishing grounds where they would set out their drift nets in the evening and pull them in again in the early morning. The crew of *De jonge Hendrik Jacob* was ready to receive herring on the morning of 25 June and "waved at a few ships for catch but nothing had been caught as far as we could see there were no signs of catches."[27]

The next morning, *De jonge Hendrik Jacob* was scouting for signs of herring vessels. To the north east, they spotted another ventjager with 8-10 herring vessels drifting alongside as if they were about to hand over herring. Later that day they caught sight of the 1. ventjager from Vlaardingen and a fleet of approx. 60 herring vessels were spotted sailing to the south west.

---

26 NSA, inv. no. 5 187, 'Jonge hendrik Jacob'.

27 NSA, inv. no. 5 187, 'Jonge hendrik Jacob', 25 June 1789.

On Sunday, the fishers rested – having chosen not to set out their nets on Saturday night – and had time to communicate with the first Enkhuizen ventjager, who spread the word that the first ventjager from Vlaardingen had already sailed back with a last of only 13 barrels of salted herring.

On Monday morning the crew of *De jonge Hendrik Jacob* continued their search for freshly salted herring, but with little success. They spoke to (signalled with), several ships both from Vlaardingen, Maassluis and Enkhuizen, but only very few herring had been caught. *De jonge Hendrik Jacob* remained with a fleet of 30-40 vessels and on Friday morning finally 'saw a few ships with the flag up, we spoke to the ships…', and eight different ships hand over a total of 15¼ barrels of herring.[28]

The following Monday night *De jonge Hendrik Jacob* was within sight of 14-15 ships throwing out their nets. The following morning, there were 20 vessels in the vicinity, one of which handed over a quantity of herring. After a slow start, the following week proved to be more prosperous; the description of this week is a further indication of the high level of communication at sea. On Wednesday 8 vessels handed over a total of 44 barrels of salted herring, on Thursday 111 barrels came aboard. Having received herring from 8 different vessels, they cruised around and suddenly spotted 'a ship to the north laying out its net, with its flag waving from the top. We immediately went there to hear what herring they had for us, and who the skipper was and found it to be Jacob van de Spek (with) 133 barrels of salted herring'.[29]

On Friday 10 July, *De jonge Hendrik Jacob* had collected a total of 214 barrels of salted packed herring, or the equivalent of 15 lasts and 4 barrels, a number with which captain Jacob Zalmten and his crew must have been content. They started to move south, encountering approx. 50 herring vessels near Fair Isle in between the Shetlands and Orkney Island. On Sunday 12 July, they estimated their position to be 58 degrees and 25 minutes, which is off the Scottish coast, reaching the shallower waters of Dogger Bank three days later. The homebound journey seems to have been slowed down by windstill and bright summer days. Nevertheless, on the morning of 22 July they finally sighted Egmond aan Zee and managed to get inside the Zuiderzee area later that day.

Judging from the accounts of the above landings by ventjagers and the regulations imposed by the *College van de Grote Visserij*, this journey of *De jonge Hendrik Jacob* seems to give a representative eyewitness account of the Dutch herring fishery in the first four weeks of the season.

First of all, the diary contains information on the other vessels in the vicinity of the boat for each day spent in the fishing grounds. In the days spent

28 NSA, inv. no. 5 187, 'Jonge hendrik Jacob', 3 July 1789.

29 NSA, inv. no. 5 187, 'Jonge Hendrik Jacob', 9 July 1789.

fishing, the crew encounter as many as 50 vessels during one day, which is a substantial part of the 180 Dutch vessels active in the season of 1789.[30]

They are able to communicate with everybody within sight by way of flags raised to the top of the mast. This allowed the fishers who had just caught a given amount of herring to sell it to the ventjager. Nonetheless, in the process of 'airing' the information that good catches were to be had in the area of the boat, ventjager would alert all other fishers in the area, up to a quarter of the entire Dutch fleet in 1789. Knowledge as to where the schools of herring were moving is a valuable economic asset, but in the context of the Dutch North Sea herring fishery it seems to have been an asset which was rather freely shared among the skippers. If indeed the individual skippers formed one large group or information sharing club, one should expect that this influenced the temporality of catches. Now, the diary or journal of *De jonge Hendrik Jacob* was in prose form, and may not contain information on everything that happened at sea, but when it comes to the business operation of buying herring in open sea, there is reason to assume the information is accurate and satisfactory. Bearing in mind that *De jonge Hendrik Jacob* is in the vicinity of so many vessels every day it is striking that virtually all acquisitions of herring take place in the course of five days, namely 29 and 30 June and from he 7 to 9 July. This reveals that not just one or two vessels, but a large part of the group fishing in close vicinity had hit upon schools of herring at virtually the same moment. This makes sense if they hunted together and engaged in an unlimited exchange of information.

Although the diary aboard the ventjager *De jonge Hendrik Jacob* is highly valuable as an objective account of the fishing operation, it fails to tell the story from the perspective of the fishers themselves.

Legal codes of conduct

As was the case when it came to the business of the ventjagers, the fishers themselves had to abide to regulations regarding their methods of fishing and communicating. Besides the aforementioned general regulations on who was allowed to take part in the herring fisheries, the length of the season, what fishing gear to use and the quality of the fish, the *College van de Grote Visserij* also imposed a number of official codes of conduct, which the fishers were obliged to follow when fishing. The most thorough regulatory measures stem from the 1580 body of laws.

One matter that seems to have taken priority is the issue of keeping clear of other boats; 'Everybody taking part in the herring fisheries should beware of keeping the rudder clear of nets drifting in the sea'.[31] In fact several ar-

30 Kranenburg, *De zeevisscherij*, p. 222.

31 Cau, Cornelis, vol 1, p. 684. art. 1.

ticles explain how boats should go about handling their own nets as well as those of others, while article 5 even stipulates that anyone who physically or otherwise harasses a fellow fisher should be corporally punished. This illustrates the severity of the problems that could arise at sea.[32]

In order ensure that fishers behaved in a manner that was advantageous to the fisheries as a whole, the laws also specified certain means of communication. When a ship arrived at the fishing grounds, and the weather was right, the skippers were to place a signal at the aft to make it clear they were ready to fish. When the sun set and the time was right for fishing, the skippers were to raise the anchor and fish. Skippers that did not take part in the actual fishing but harassed the other fishers through their presence would be penalised. Sitting on the fence was not tolerated! If anyone had bad weather, they were expected to set up a light at the bow when anchored. When they raised the anchor again to set out the nets, they should then set up a second light in the front of the ship. Furthermore, the second light was not to be dimmed before the anchor had reached the bottom again.[33]

The renewed version of these laws from 1801 was less detailed with regards to the issue of behaviour at sea, but the main issues regarding keeping clear of other fishers' nets and signalling with lights when fishing were still upheld.[34]

To the extent that the above regulations were observed in practice, putting up lights to signal when one was fishing would communicate to any neighbouring fishers that there was fishing activity. Still, the rules of conduct imposed by the *College van de Grote Visserij* primarily appear to have helped avoid trouble at sea.

So, what happened during the everyday practice of fishing? How did good and bad news spread? In the period spanning almost three centuries until around 1860, tens of thousands of fishers worked aboard the herring vessels, yet only a few accounts of the fishing operation have been recorded in writing. A few surviving diaries and logbooks however, offer the chance to analyse the fisheries from the viewpoint of fishers at sea.

Fishers' accounts from the Shetland herring grounds

An important entrepreneur in the Vlaardingen herring industry was the Kikkert family. In 1848, ship owner Hendrik Kikkert equipped five vessels for the herring fishery. Aboard one of these vessels, the hoeker *De Toekomst*, Hendrik Kikkert's 19 year old son Cornelis kept a diary of a jour-

32 Cau, Cornelis, vol 1, p. 684. art. 5.
33 Cau, Cornelis, vol 1, p. 684. art. 2-4.
34 NA. CGV. Inv. no. 686, p. 19-20.

ney lasting from 3 until 30 June.[35]

In 1846, the starting date of the season was moved forward two weeks to 10 June, in response to reports from Scotland that made mention of good fishing from early June.[36] The skipper of *De Toekomst*, Hermanus Schouten and his crew took advantage of this extra time, and started their voyage on 3 June. Just before noon on 7 June, they caught sight of the Shetlands. In the afternoon they arrived in the Baai van Hitland, where they found a large number of vessels. In the next few days, the crew of *De Toekomst* visits other vessels, and receives visits from other skippers in Hendrik Kikkert's fleet, as well as other skippers from Vlaardingen.

In the following week *De Toekomst* fishes in the area south of the Shetlands and communicates frequently with other vessels, both Kikkert's vessels and others. On 12 June, for example, they communicate with five other vessels, exchanging information on how much each has caught. Two of the skippers he speaks to are Leendert Schouten and Cornelis Storm, who also fished for Kikkert. The other skippers are all from Vlaardingen with the exception of one from Amsterdam. It does not appear that less information was shared with the vessels with which *De Toekomst* had no affiliation other than a shared membership of the *College van de Grote Visserij*.

But how representative is Kikkert's journal of the behaviour of the fishing fleet as a whole?

De Toekomst and Cornelis Kikkert were part of an unusual fishing trip. As early as 25 June they had stopped fishing and announced their return home to two other vessels. In the afternoon they set sail to head back bringing back some letters, and after what seems to have been a smooth journey without any references to meeting other vessels on their way, they set foot on dry land in Vlaardingen on 30 June.[37] The short journey in itself would seem to indicate that *De Toekomst* functioned as a ventjager, but this was not the case. They were not on the approved list of ventjagers for the Zuiderkwartier, and there are no indications in Cornelis Kikkert's diary that they bought home any barrels of herring. Instead, they seem to have been fishing in the same way as the other herring vessels, and on the same scale. On 22 June, for example, they set out '46 netten', which is the equivalent of a full set of driftnets with a total length of about 1.4 km. On the other hand, *De Toekomst* is not featured in the landing statistics for Vlaardingen for this year's first season. If something had gone wrong while fishing, say a broken mast or lost driftnets, it appears strange that the diary does not mention such an accident. The short journey thus seems to have been planned from the outset

35 Borsboom, 'Journaal van een zeereis', pp. 42-52.

36 Beaujon, *Nederlandsche Zeevisscherijen*, p. 263.

37 Borsboom, 'Journaal van een zeereis', pp. 50-52.

and could be interpreted as more of an exploratory journey, to test whether fishing from mid June was actually a good idea. This might explain why the diary was written in the first place, since Cornelis Kikkert does not indicate to the reader why he is writing.

However, some of the information can be checked thanks to logbooks from two other vessels fishing at the same time. The ship's owner, Jan Boon Jr. from De Rijp near Enkhuizen, had equipped the buss, *Het Bruine Paard* for the herring fisheries with Klaas Moeneswerf as skipper.[38] Originating from Vlaardingen, the hoeker *Willem Beukelszoon* was also at the fishing grounds off the Shetland Islands with Klaas Schep as its skipper.[39] The information in these two logbooks is written down in preformatted tables, ensuring a high degree of uniformity but leaving little space for the sort of miscellaneous information contained in Cornelis Kikkert's diary.

Nonetheless, on the evening of Saturday 10 June, *De Toekomst, Willem Beukelszoon* and *Het Bruine Paard* all set out their nets for the first time, off the Baai of Hitland. *Willem Beukelszoon* estimated that at least 100 vessels set out to fish that night. This is surprising since the Dutch fishers normally would not set out their nets on Saturday night, so that they could rest on Sundays. On Sunday 3, 17 and 24 June there is no entry in the *De Toekomst* logbook, but we can assume that they rested as the two other logbooks reveal that no nets were set out.

On 13 and 14 June *De Toekomst* did not fish. Kikkert wrote that 'stortregen' – torrential rain – poured down on both days. On the 15th they speak to Leendert and Willem Schouten who both tell them they have not caught very much so far, and have not fished at all for the previous two nights. Judging from their logbooks, the same goes for *Het Bruine Paard* and *Willem Beukelszoon*, and rain is also mentioned in the journal of *Willem Beukelszoon*. *De Toekomst* was in between the Shetlands and the Orkneys near Fair Isle, while the two other vessels were north of the Shetlands. The weather situation, however, seems to have affected fisheries in both places.

In the following days *De Toekomst* travels north again, and on the morning of 20 June they speak to a Klaas Schep. He tells the men aboard *De Toekomst* that he 'caught 2 barrels of herring and few herring yesterday'. Since Klaas Schep was the skipper of *Willem Beukelszoon*, his communication with Kikkert can be verified. The tables in the logbook from *Willem Beukelszoon* reveal that 2 barrels of 'maatjesharing', meaning herring which is not yet ripe were caught on 20 June, and on the same day at 9 in the evening both barrels were sold to the 4 ventjagers. Another table shows that the 2 barrels were caught while fishing on the latitude of 61 degrees north, which also cor-

38 Museum In 't Houten Huis, De Rijp, inv. no. 03537.

39 NA. CGV. Inv. nr. 682, 'Journal, Willem Beukelszoon'.

responds with the information in Cornelis Kikkert's diary. Around noon on 20 June, shortly after speaking to the fortunate Klaas Schep, Kikkert writes that they were on the 61 parallel, which would indicate that they seem to be in agreement about their positions.

However, judging from the logbook, the 2 barrels that Klaas Schep handed over to the jager were the first good catch they had made in that year's fishing season. We can thus conclude that when Klaas Schep told the crew aboard *De Toekomst* that he only caught a few herring the night before he was surely downplaying the size of his immediate success. The personal relationship between Klaas Schep and the skipper Hermanus Schouten is not known, but it would seem that he was not telling the whole truth in this case. Judging from the accuracy of other information in the diary it does not seem likely that Kikkert simply got his facts wrong.

A third option is that the notion of catching 'a few herring' was merely a form of understatement used in conversations between the Dutch herring fishers at sea. During interviews with Danish fishers in the 1980s, Danish social anthropologist Torben A. Vestergaard found that the group of fishers would use a special language to keep information secret from anyone they did not trust. For example, sailing south meant sailing 'up', and sailing 'down' meant sailing to the north. This meant outsiders trying to pry out information from the existing club of shared knowledge would be given away immediately by not knowing the subtleties of the fishers' language.[40]

So, what appears to be a lie – the 2 barrels were not aboard his ship 24 hours earlier – might have been acceptable information and even reasonably easy to decode for Hermanus Schouten, Cornelis Kikkert and the rest of the crew of *De Toekomst*.

In any case, Klaas Schep was not the only fisher in the area who found his net filled that morning. Kikkert notes that they also spoke to Jac Schouten, who was almost certainly closely related to Hermanus Schouten. Even if he was not hired by the ship owner, Hendrik Kikkert, Jac Schouten is thus likely to have been an ally of Hermanus Schouten, as well as Leendert Schouten who also fished for Hendrik Kikkert. Like Klaas Schep, he mentions having caught 'a few herring yesterday'. Jac Schouten, though, also names 7 other skippers that have caught a few barrels each, which would indicate that he is spreading news about vessels that were out of sight of *De Toekomst*. When *De Toekomst* speaks to H. van der Velden that same day, he also mentions having caught 'a few herring yesterday'.

No matter how this may have been interpreted aboard *De Toekomst*, they set out their nets at night. Unfortunately, there are only 12 herring in the

40 Vestergaard, 'Hemmeligheden ved fiskeriet', pp. 86-99.

nets by 1 0' clock in the morning. Nevertheless, they stay in the area and have more luck the next night, bringing in 1½ barrels. As they talk with the other vessels in the area, it becomes clear that several have caught a few barrels of herring.

Klaas Schep also had good luck; according to his logbook the crew caught a total of 14 barrels of herring in two days on 22 and 23 June. This proved to be their best days of the season's first journey, which ended in the port of Vlaardingen on the afternoon of 27 August. The next day they offloaded the last, and the registers of herring landings in Vlaardingen assert that – on the same day – Klaas Schep testified to having caught and cured all the landed herring in the prescribed fashion. Klaas Schep's 1st journey then lasted approx. 2½ months, which was quite normal in the season of 1848.[41]

So, how do the experiences of the skippers fishing in the summer of 1848 fit into the larger picture of information sharing in the limited-entry Dutch North Sea herring fisheries?

Discussion

The above analysis of fishing strategies in the Dutch North Sea herring fishery serves to demonstrate the degree to which this historical fishery conformed to modern theories on information sharing in limited entry fisheries. The fishers within the *College van de Grote Visserij* were fishing far from home, targeting a migratory species (North Sea herring). It is assumed that they would expect to catch more and reap a larger profit the more they cooperated when fishing.

With regards to the institutional set up, the *College van de Grote Visserij* facilitated a limited entry fishery, and the concept of ventjagers certainly favoured cooperation amongst the Dutch fishers operating within this framework. They cooperated not just within their own town or area, but also with fishers from the rest of the Holland province. The analysis of the practice of the ventjagers however, adds a further degree of complexity to this notion. The ventjagers bought herring from all over the country, but were more likely to buy fish from their neighbouring fishers.

Today's fisheries managers are becoming increasingly aware of the role of fishers' knowledge and information sharing as a valuable source of information. Because of the nature if their work, it is difficult for fisheries managers to acquire such knowledge, partly since this information is a potentially valuable professional asset.[42] So, since it is difficult to study modern fisheries in

41 NA.CGV. inv.nr. 651.

42 Maurstad, 'Fishing in murky waters', pp. 159-166.

this area, would it make sense to conduct a similar investigation of a long gone low-tech fishery using archival material as the primary source of data?

The journal of the hoeker *De jonge Hendrik Jacob* illustrates that a ventjager was very much aware of the successes of different herring vessels fishing within its proximity. The fishers had to communicate to the ventjager, by signalling with flags, lights or simply shouting in order to make it clear that they had caught herring and were ready to sell it at high sea.

This made it difficult to hide information on good patches of herring between fishers within each other's eyesight. If broad knowledge on where to fish was easily shared, it is certainly not the case that more detailed knowledge was shared indiscriminately. Three different accounts from fishers fishing off Shetland in the summer of 1848 all provide lots of information on different fishers' success or lack of success. However, the encounter between the two hoekers *De Toekomst* and *Willem Beukelszoon* on 20 June reveals that the whole truth was not always told, with certain information being held back.

This is not regarded as surprising in modern anthropological studies on information sharing amongst fishers. In the 1960s autumn fishery for herring off the Swedish West coast, local fishers were challenged in much the same way as the Dutch herring fishers fishing in the North Sea in previous centuries. Valuable information was scarce in the search for fast-moving herring schools. Radio communication whereby the Swedish fishers could coordinate their search proved a valuable tool, but as one fisher was quoted saying; 'When anybody's radio suddenly becomes silent, that's a sign as good as any that he has come across herring'.[43] Nonetheless, in the Dutch North Sea herring fishery valuable information seems to have been shared. Testimonies from the ventjagers as well as the ordinary herring vessels indicate that the successful days of fishing often came in clusters, where many vessels in the same area would enjoy good catches during the same couple of days.

In a study of Alaskan seine-based salmon fishery, information sharing clubs or cliques were found to exist, often dictated by kinship. Members of the same family were more likely to be trusted than others.[44] It is difficult to assert whether there was favouritism on the basis of kinship within the larger group of Dutch herring fishers. The skipper of *De Toekomst*, Hermanus Schouten, did remain in close contact with other skippers with the same last name, but there is no indication in the diary of Cornelis Kikkert that they appeared to share more information within the Schouten family than with other skippers from Vlaardingen.

---

43 Löfgren, 'Resource management', p. 88.

44 Gatewood, 'Cooperation, Competition', pp. 350-370.

Conclusion

This study has applied economic resource theory and results of anthropological case studies in order to discuss information sharing in a historical context, addressing institutional, technological and cultural aspects. Whatever the intricacies of information sharing in the Dutch North Sea herring fishery from approx. 1600-1850, fishers certainly did cooperate in managing the organisation of the fishery as well as in the actual fishing operation far from the shores of Holland. This is the first documentation based on archival studies of such a tightly organised fishery. However, we do not know whether other pre-modern open sea fisheries, such as those in North America, had a similar degree of organisation.

This study reveals a highly sophisticated historical fishery, where fishers were much more than simple predators chasing their prey. If we were to adopt the analogy of predator-prey, it would be fair to say that the Dutch fishers operated more like killer whales or piranhas realising their mutual interests by hunting together in large groups.

Formal and informal systems designed to share information and monopolise the benefits of the highly valuable first catches of the season reveal a fishery with strong incentives for cooperation in order to optimise catch rates. Three different accounts from fishers fishing off Shetland in the summer of 1848 indicate that valuable information seems to have been shared amongst groups of Dutch fishers, but also reveal that the whole truth was not always told, with certain information being withheld. Like many modern herring fisheries, the Dutch fishers hunted together, which is likely to have helped optimise their catch. The modern economic concept of forming information sharing clubs was, at least in practice, already applied in Dutch herring fishery between approx. 1600-1850. If any club members or independent fishers violated the established practices, social pressure and legal sanctions defended the interests of the club.

With regards to the institutional set up, we can conclude that the *College van de Grote Visserij* facilitated a limited entry fishery, with the concept of ventjagers favouring cooperation amongst the Dutch fishers operating within this framework. They cooperated not just within their own town or area, but also with fishers from the rest of the Holland province. The analysis of the ventjagers' mode of operation demonstrates that they brought in herring from all over the country. However, they were more likely to buy fish from their neighbouring fishers than from fishers from the other end of Holland. It also becomes clear that ventjagers were very much aware of the successes of other herring vessels fishing within their proximity. The fishers had to speak to the ventjager, by signalling with flags, lights or simply shouting in order to make it clear that they had caught herring and were ready to sell it

at high sea. This made it difficult for fishers operating within one another's sight to hide information regarding good patches of herring.

For centuries, the Dutch herring fishery was the largest in Europe and the envy of foreign nations. During the first half of the 17th century, 7-800 herring vessels went out fishing every season. Following various periods of decline and stability in the overall fishing effort, a mere 150 vessels sailed out in the first half of the 19th century. Nevertheless, the fishing operation continued more or less unchanged for a period of more than 250 years. One of the Dutch business secrets might have been their extensive use of information sharing and cooperation. As shown by Wilson and Johnson, fishers hunting together drastically reduce the cost of searching.

8 | Reconstructing stock fluctuations of North Sea herring, 1604-1850

Introduction

This chapter presents a reconstruction of the catch per unit effort (CPUE) of the Dutch herring fishery, approx. 1600-1850. This is the longest time series of CPUE ever compiled.

The CPUE time series is constructed by using historical data of a very homogenous nature from this entire period. This enables the standardization of all main units of catch and effort. The CPUE is analysed at three different levels: 1) catch per boat per year, 2) catch per boat per day at sea for each fishing trip and 3) catch per boat per day at sea over the entire season. This is supported by analyses of the average length of individual fishing trips as well as the average length of the entire season. The standardized CPUE in combination with the length of the examined period makes the time series suitable to test current marine biology theories on the natural variations of North Sea herring against the background of a historical fishery.

From a historical point of view, this chapter proposes that historical catch rates certainly played an important part in the 250-year rise and fall of the Dutch herring fishery in the mid 18th century, and especially the first half

of the 19th century. Catch rates per day at sea for individual vessels during the whole of each fishing season also allow for an assessment of the fishing strategy for each season. The annual catch per boat was by and large stable, while the average length of individual fishing trips varied with the success rate of the fishery. The better the catches were, the shorter was the trip.

The College van de Grote Visserij

The privileged towns forming the *College van de Grote Visserij* upheld a monopoly on the landing of salted herring in the Netherlands until the 1850s, and these 250 years have left a large amount of documents in Dutch archives enabling a historical reconstruction. The technological and institutional factors that affected the fishery can be standardised, as the College regulated the size and use of fishing gear, driftnets, and the length of the season. Regulations are common features in the management of modern fisheries resources. The main purpose of the *College van de Grote Visserij* was to uphold the quality of the top brand of salted herring in Europe.[1]

The season started on the eve of St. John's day, 24 June. Following a government decree of 1582, fishers were not allowed to fish for herring after 31 December. In 1604 however, the fishing season was extended to 31 January, which signalled the end of season.[2] These key dates – and, in fact, most of the regulations – were in place until the *College van de Grote Visserij* was finally dissolved in 1857.[3] The tight regulations provide us with a guideline when estimating North Sea herring stock fluctuations.

Distinguishing between natural and human developments – Catch per Unit Effort

In order to assess the affect of marine resources on the North Sea herring fisheries, it is necessary to relate the available abundance of herring to the intensity of the fisheries. The herring fishery in question predates the surveys and statistical gatherings of modern fisheries science. The only available source of information is the type of data known to modern science as commercial catch data. A recognized concept for measuring stock abundance by using commercial catch data is Catch per Unit Effort, or CPUE.[4] CPUE represents the amount of fish one can catch with the given amount of effort.

---

1 In late 1577 one last of Dutch herring could be sold in France for 24.10 Flemish Pound, while English Yarmouth was worth 20.12 pounds, Irish herring 18 and Scottish and coastal herring was sold for 11 Flemish pounds. Baasch, *Wirtschaftsgeschichte*, p. 60.

2 Van Vliet, *Vissers en Kapers*, p. 46.

3 Mietes, 'De Hollandse Visserijcolleges', pp. 166-172.

4 An introduction to the use of commercial catch data is found in Jennings *et al.*, *Marine Fisheries Ecology*, pp. 130-131. The historical development of scientific analysis of commercial catch data is analysed by Tim D. Smith, *Scaling Fisheries*, pp. 100-109. The problems of estimations based on CPUE is discussed at length in Hilborn and Walters, *Fisheries Stock Assessment*, pp. 175-192.

The CPUE depends on the available abundance of fish. A growing CPUE is indicative of more fish and vice versa.

Expressed as an equation, the Catch, C, is a function of the fishing effort, E, average fish population density, D, on the fishing grounds, and q, which is a fixed constant of proportionality related to the efficiency of the fishing gear. This is known as the catchability coefficient.

$$C = qED$$

The CPUE is thus expressed as:

$$CPUE = C/E = qD = qN/A$$

Here N is the number of fish in the fishing grounds, and A is the spatial area of those same fishing grounds. This means that changes in CPUE can be caused by a fluctuation in the population density of fish. But the same changes can also have their roots in what is known as spatial stratification, for instance a change in herring migration patterns that escapes the fishermen's normal fishing routines and patterns, or a change in terms of where the fishermen went fishing.[5]

The basic principle behind the above CPUE model was developed more than a century ago by marine scientists; in the last 30 years, however, this approach has been criticised. The above model assumes a direct linear relationship between CPUE and stock abundance, but this is not always the case in real life ecosystems. One reason for this is that most commercially fished stocks today are heavily exploited. CPUE analyses were applied in stock assessments for the North Sea herring fisheries in the 1970s, when the stocks of North Sea herring were severely depleted to the brink of extinction. However, the crash greatly surprised fisheries managers, since the CPUE did not decline as rapidly as the stock. Managers thus overestimated the actual stock abundance because of high CPUE rates until immediately before the crash.[6]

This problem is known as hyperstability. Herring migrate in large schools. Even if the total stock – and thereby the number of schools – is in decline, the fishermen are bound to catch a large amount of fish once they encounter a school of herring.[7] Moreover, schools of fish tend to cluster together. This means the hyperstability problem is repeated at cluster level, affecting the number of clusters. This type of spatial behavior is known as patchiness. In general, though, we can assume that the catch per set, (one occasion of setting out and pulling in the nets) is proportional to the school size, and that the mean school size reflects the stock abundance.[8]

---

5 Campbell, 'CPUE standardisation ', pp. 209-211.

6 Hilborn and Walters, *Fisheries Stock Assessment*, pp. 20-21.

7 Hilborn and Walters, *Fisheries Stock Assessment*, pp. 175-176.

8 Fréon and Misund, *Fish Distribution and Behaviour*, pp. 93-94 and pp. 218-221.

In the case of the Dutch herring fisheries however, it is not likely that fishing intensity had a serious effect on actual stock abundance. The issue of hyperstability is thus less of a problem here than in modern fisheries management. CPUE models remain an important assessment tool.[9]

Nevertheless, we must be cautious when it comes to the explanatory capacities of CPUE. In estimating CPUE for the Dutch North Sea herring fisheries, it is important that we keep several parameters in check. The ideal relationship between stock abundance and CPUE is determined by interaction between the following factors: 1) Characteristics of the fishing gear used in a single area, including search efficiency, gear handling time and catchability variation. 2) Determinants of effort by fishermen, especially the relationship between CPUE and total effort. 3) Determinants of the area fished by fishermen, including the quality of information, desirability of different areas, and differing CPUE levels. 4) Density of the fish population, and 5) the dynamics of stock movement.[10]

It was thus necessary to standardize the units of catch, effort, catchability coefficient and the spatial stratification of the fisheries.

Data collection and analysis

Standardising catch records

Every time the skipper of a herring vessel called in one of the designated herring ports, he was obliged to present a declaration of his last to the local representative of the *College van de Grote Visserij*. This practice remained in place during the entire existence of the College and Dutch archives still contain books with fishermen's testimonies. The longest uninterrupted series of these records details the situation in the town of Schiedam, where all landings from 1597-1788 have been registered. Each declaration follows a formula specifying what is to be mentioned when registering each landing. The declarations are contained in nine thick well-bound volumes with no interruptions or missing pages.

The Schiedam testimonies, the so-called *Haringcertificatien*, provide information on (i) the date of arrival of each individual ship, (ii) the size of the catch in the barrels, (iii) the tax paid per barrel, (iiii) the name and age of the skipper. The Schiedam register often contains information on (v) the number of fish that went into a barrel during different parts of the season (about 1000 fish per barrel). The Schiedam records also specify whether the herring is "maatjes" – still fat from feeding in the spring, "volle" – more mature fat-

9 *Fisheries Research* 70, (December 2004), pp. 137-428.

10 Hilborn and Walters, *Fisheries Stock Assessment*, pp. 188-189.

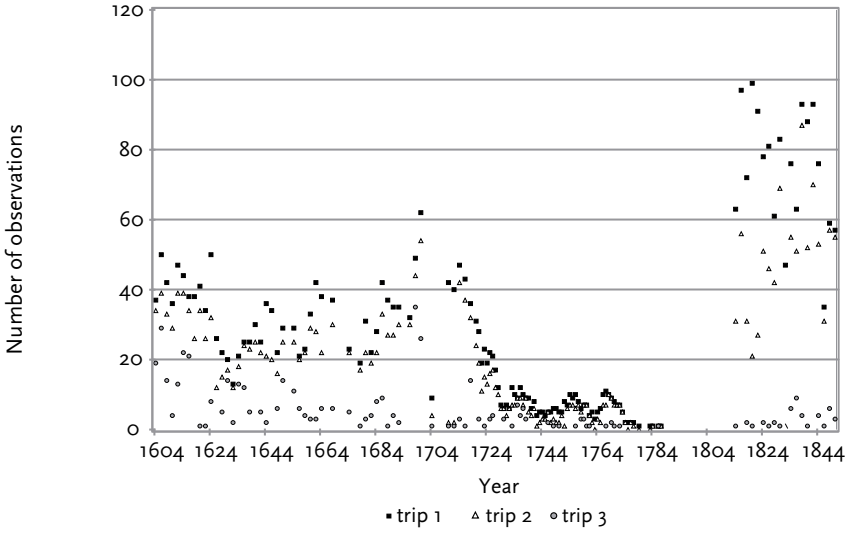
ness, and ready to spawn, "ijle" – a spent herring, "jacobi" – meaning caught around/after 25 July or "Bartholomaeus" – caught around/after 24 august and "kruytharing" – around or after 14 September. Sometimes there are also landings of "steurharing" – meaning dry-salted, and "vers" – fresh.[11]

The *Keurboeken* from neighboring town Vlaardingen served the same purpose as the haringcertificatien in Schiedam, and they offer an even more uniform data collection. For the years 1814-1850, these records contain data on (i) date, (ii) size of the landings of the various herring types as well as (iii) the skipper's name and (iiii) the name of the fishing vessel.

The uniformity of both the Schiedam and Vlaardingen records facilitated the transcript and digitization of approx. 8200 landings of herring. Observations for every year from 1720-1788 and for every other year in between 1604-1720 and again from 1814-1850 are presented in figure 8.1. For the years 1789-1813 no data is analysed, since the fisheries during much of this period were affected by the turmoil of the revolutionary wars and the Napoleonic Era.

Figure 8.1

Number of observations per trip, 1604-1850.



In addition to the landed herring, the Dutch fishermen sold part of their catch while sailing in open sea, handing the fish over to used herring vessels,

11 Wätjen, 'Statistik der holländischen Heringsfischerei', p. 136.

the so-called ventjagers, which then rushed home with the first catch of every season. This amount is specified in the margin of each of the Schiedam registers. This means all herring handed over to ventjagers is featured in the total catch figures for the first trip, for each ship. The ventjagers were not allowed to accept fish after 15 July, which means this information is relevant for the first journey only.

The Vlaardingen data (1814-1850) does not reveal how much herring each individual boat handed over at sea. Instead, the records specify the total landed value for each trip for the various herring vessels, with the amount of herring landed by the ventjagers noted separately. The average percentage of herring landed by the ventjagers was added to the amount of herring landed by each of the fishing vessels themselves.

Unit of effort – fishing vessels

In terms of standardising the unit of effort, the fishing technique and methods used by the fishing vessels are relevant in terms of holding capacity,[12] or how many fish a boat can carry. The development of average vessel size was analysed using approx. 200 records from the Dutch shipbuilding industry from the period between 1600 and 1850.[13] (figure 8.2) The herring fisheries involved three types of fishing boats, the *buis*, the *hoeker* and the *hoekerbuis*.[14] The average full length of the busses, hoekers and hoekerbusses was remarkably stable, and where the average weight is mentioned it rarely exceeded circa 30 ship lasts. A standard buss in the 17th –19th centuries could carry approx. 30 lasts of herring or a little less than 60 metric tons. One last consisted of 14 barrels.[15]

From the beginning of the 17th until the late 18th century the buis was the dominant herring vessel, landing at least 95 per cent of all herring in the important fishing town of Schiedam.[16] In the 19th century, however, the boats landing herring in Vlaardingen were all hoekers.[17] The different types of vessels are still very similar over these centuries, which only saw minor developments. From approx. 1550-1650, the boats had three masts and a flat stern. Between approx. 1650-1700, boats commonly had three masts with a round stern. From approx. 1700-1850 a typical herring vessel had only two masts

12 Hilborn and Walters, *Fisheries Stock Assessment*, p. 132.

13 Struijs, *bevaeren schip te maecken*, p. 242 and pp. 291-95 and pp. 300-307, Beylen, *Schepen van de Nederlanden*, p. 141. Kampen, *Rotterdamse Particuliere Scheepsbouw*, p. 207, Hoogendijk, *De grootvisscherij*, pp. 62-67.

14 Kranenburg, *De zeevisscherij*, p. 16.

15 One Dutch last of herring is roughly 1,976 metric tonnes. Wieringen, *Maten, Gewichten*, p. 92.

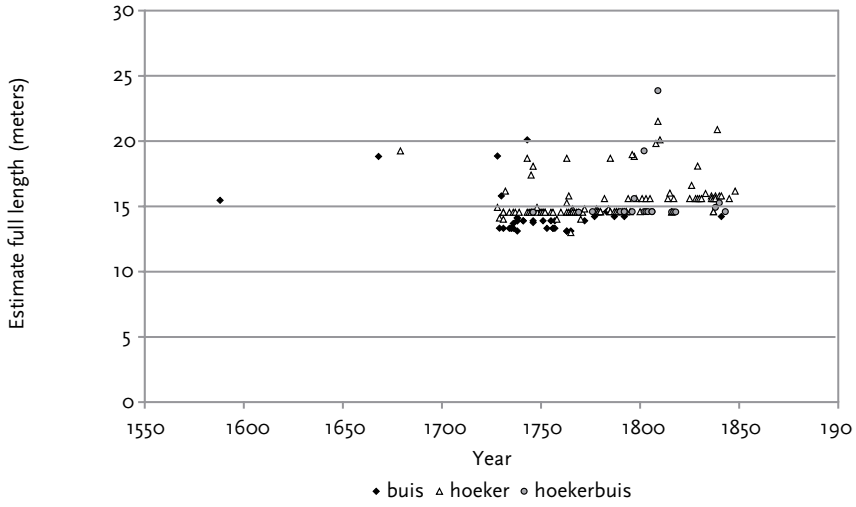
16 GA. Schiedam, Gerechten van Schiedam, inv. no. 614-622.

17 NA. CGV. inv. no. 387-395, 626-654.

and a round stern.[18] The removal of one mast can have slowed down the vessel slightly, but may have facilitated the handling of the catch on the deck.[19]

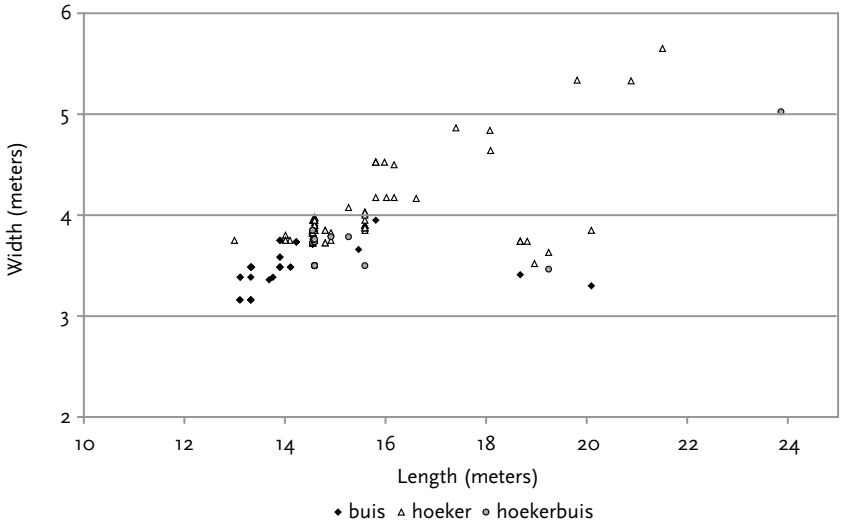
The length of the keel was then compared with the width of individual ships using the shipyard records. (figure 8.3) The buss is the slimmer of the ships, and was also lower, while the hoeker had a slightly more solid construction, thicker and taller. This suited the cod fisheries in the winter season, which is traditionally regarded as the primary use of the hoeker. The hoekerbuis introduced approx. 1750 combined the solidity of the hoeker with the low freeboard of the buss, facilitating the handling of heavy driftnets. The hoekerbuis could be equipped to fish for herring in the summer and autumn, and then altered to suit the cod fisheries in winter and spring.[20] The conservative nature of boat design and gear can be partly explained by the conviction that an optimal boat and net size would ensure the nets did not pull too hard on the boat.[21]

Figure 8.2
Estimated full length of Dutch fishing vessels, 1598-1848.



18 Ploeg, 'Speurtocht naar Haringbuizen', pp. 25-32.
19 Kranenburg, *De zeevisscherij*, p. 17.
20 Kranenburg, *De zeevisscherij*, p. 59.
21 Hoogendijk, *De grootvisscherij*, p. 175.

Figure 8.3
Length vs. width of Dutch fishing vessels, 1598-1848.



With regards to the size and nature of the fishing vessels, changes over the 1600-1850 period seem to have had little impact on the catch efficiency of the fishing vessels, which were busses in the 17th and 18th centuries and hoekers in the 19th century.

Unit of effort – fishing gear
The size and nature of the fishing gear remained the same for the entire existence of the *College van de Grote Visserij*. Each vessel operated one very long set of driftnets, known as a *vleet*. At night-time the fishermen would set out the *vleet*, and in the early morning they would pull it in again.[22] In the late 16th century one full *vleet* was made up of 45 nets.[23]

Since records of what actually happened at sea are not easily accessible, it is difficult to assess the number of nets used during most of the period under analysis. In the early 19th century, however, a full *vleet* of driftnets consisted of 45 nets, and most fishing vessels were actually fishing with a full *vleet*.[24] One good reason for fishing with a full *vleet* was the 19th century practice of awarding a 500 guilder bounty to anyone fishing with more than 40 nets. In 1807, for instance, only 11 out of 71 ships taking part in the herring fishery

22 Hoogendijk, *De grootvisscherij*, p. 155 and pp. 173-174.
23 Gelder, 'betreffende de Haringvisscherij', p. 8 and p. 32.
24 Vermaas and Sigal, *De haringvisscherij van 1795 tot 181*, p. 46 and p. 108.

were not equipped with a sufficient amount of nets.[25] In the 1840s, daily entries in four different logbooks just before 1850 testify to the actual use of a full *vleet* of 43-46 nets every day.[26] The number of nets in the *vleet* is in itself indicative of stability from the late 16th – 19th century and does not seem to differ depending on the size of the *vleet*, whether the nets were handled from a buis or a hoeker.

A more accurate assessment can be made of the size and shape of the individual nets and even the minimum size of the individual mesh, which were all subject to regulations put in place from the 16th century onwards. The regulations concerning Schiedam, even pre-dating the *College van de Grote Visserij*, state that a certain quality of hemp was to be used.[27] The use of hemp in net making continued until 1859.[28] In each town, the nets were controlled by a *Keurmeester* – 'master of curing', and only with his stamp could they be used at sea. The *Keurmeester* checked the mesh size with a *maaswijdemeter*, similar to modern day instruments.[29]

Every net consisted of *verrendeelen*, or 'quarters'. One quarter was to have a length of 74 meshes, with 13 meshes per *el*.[30] The length of the unit el varied slightly in different Dutch towns, but this calculation has been based on the 0.683 meters used in the neighbouring town of Delft.[31] The breadth (or height when in use) of one quarter is: (74 meshes * 0.683/13) = 3.89 meters. A full net is thus 3.89 * 4 = 15.55 meters. This is close to the 15.5 meters specified by 19th century commentator Hoogendijk as the height of a herring net. It therefore seems reasonable to apply his estimate of a 31.5 meters length, or roughly twice the height of the net.[32] The distance from the floats to the top of the nets was around 2.75 meters, so the bottom part of the nets would stretch approx. 19 meters down the water column.[33] One full *vleet* would thus have a length of 45 nets * 31.5 meters = 1,417.5 meters, which would indicate that the full size of the *vleet* was 21,971.25 m2.

An updated set of regulations from 1818 specifies almost the exact same driftnet size.[34] The only difference to the 16th century regulations is that one veerendeel in 1818 consisted of 69 or 70 meshes instead of 74, meaning that

25 Vermaas and Sigal, *De haringvisscherij van 1795 tot 1813*, p. 105.
26 NA. CGV. Inv. nr. 680-682. Museum In ,t Houten Huis, De Rijp, inv. no. 03537.
27 Heeringa, *Rechtsbronnen*, pp. 269-274.
28 Tillema, *Nederlandsche haringvisscherij*, p. 104.
29 van de Voort, 'De mazen van net', pp. 1-8.
30 Heeringa, *Rechtsbronnen*, pp. 272-273.
31 Wieringen, *Maten, Gewichten*, pp. 10-12.
32 Hoogendijk, *De grootvisscherij*, pp. 144-145, Tillema, *Nederlandsche haringvisscherij*, p. 104.
33 Hoogendijk, *De grootvisscherij*, p. 176.
34 NA. CGV. inv. nr. 396, "Maasluis 11 sept 1818. Waarschuwing tegen niet behoorlijk Tellen der Netten en Vierendeels", Art. 69.

the nets became approx. five percent smaller. With regards to the driftnets, it seems reasonable to conclude that – as was the case with fishing vessel technology – there were virtually no changes for 300 years.

Calculation of CPUE as catch per boat per day absent

The start of each herring season was the eve of St. John's day, 24 June. From 1604 onwards, the season would end on 31 January at the latest.[35] These key dates provide us with a guideline when estimating CPUE, since the date of departure was not featured in either the Schiedam or Vlaardingen source material. With regards to the first trip of the season, however, the pattern is clear. The busses gathered in mid June, and sailed north together departing with pomp and circumstance on the so-called 'buisjesdag' 15 June.[36] The fishermen could then be ready at the fishing grounds on 24 June. In 1846, the starting date of the season was moved forward two weeks to 10 June, since reports from Scotland had made mention of good fishing from early June.[37] For this reason, 10 June is used as the starting date for the years 1846-50.

There is every reason to believe the fishermen would start fishing as soon as they were allowed to, and that the skipper would certify his catch as soon as the ship called into their home port, since prices were usually highest at the beginning of the season. This is verified by 17th and 18th century Amsterdam market prices.[38] An account book of a herring company operating one buss, *Het Bruine Paard*, kept in the years 1822-1846 shows a consistent pattern, with registration of the catch taking place as soon as the buss arrived in Enkhuizen.[39]

So, how do the herring registers from Schiedam and Vlaardingen reveal how long the fishing vessels spent at sea? The fishermen usually embarked on one two or three trips per season, and data on the time spent at sea for each trip allows for the CPUE to be calculated as catch per day at sea. It is thus essential to identify each landing by the name of the skipper in order to determine whether a particular skipper has arrived at the port for the first, second, third, or very rarely fourth time in one season.

Instances where the same skipper arrives twice – or three or rarely four times in one season do not pose any problems. In this case, the earliest arrival of a specific skipper in a season is allocated a '1' in the database, with the same skipper's subsequent arrivals numbered '2' and '3'.

Occasionally though, a skipper enters the register for the first time very

35 Van Vliet, *Vissers en Kapers*, p. 46.
36 Hoogendijk, *De grootvisscherij*, p. 154.
37 Beaujon, *Nederlandsche Zeevisscherijen*, p. 263.
38 http://www.iisg.nl/hpw/data.html
39 Museum In 't Houten Huis, De Rijp, inv. no. 00024.

late in the year – say 1 November. If he was arriving home from his first trip, this would have a significant effect on the overall average catch per day of fishing. In order to get around this problem all landings labelled '1. trip' arriving later than 10 October have been excluded from the CPUE analysis. Judging from 25 19th century logbooks of herring vessels with data on both departure and arrivals, it never occurred that a vessel arriving later than 10 October was returning from trip 1.[40] So, a first entry of a skipper's name later than 10 October means that he either started on the first trip at a later date, landed in a different port earlier in the season, or took over a boat from another skipper in the middle of the season. The exclusion of arrivals later than 10 October reduced the sample of arrivals from trip 1 by about 15%.

The next step in the analysis would be to sort the data for trip 1 by year and calculate the difference in the number of days between 24 June and the date of landing. Finally, the total catch per boat for trip 1 is divided by the number of days at sea.

The second and third trips

The names of skippers and vessels mostly appeared two or three times in the dataset for a given season. The date of homecoming mentioned in the certificate then determines whether it represents an arrival from trip 1, 2, 3 or rarely trip 4. While it was generally agreed upon that the 'buisjesdag' marked the beginning of the first trip, the starting date of subsequent trips is entirely dependent on the length of the previous trip. Moreover, the starting date of subsequent trips is not mentioned in the landing records.

In order to estimate CPUE for the subsequent landings, the distance in days between the date of landing and the start of the season was estimated. The difference in days in between the second landing and the first landing represents the maximum number of days the vessel could have been at sea for the second voyage. But, based on known data from 19th century herring vessels, the assumption is that the crew and vessel would spend one week ashore in between trips, so a constant of 7 days is subtracted to give the estimated length of each second, third and fourth trip. A number of outliers were found, similar to the calculations for trip 1. For the first trips, dates of homecoming later than 10 October were left out of the analysis. This is the equivalent of subsequent trips with a length of more than 108 days, so these were also left out of the analysis.

Conversion of catch into kilograms

In order to facilitate a comparison of this CPUE analysis with modern as

40 KNMI, inv. no's. ABMZ0029, ABMZ0031, ABMZ0033, ABMZ0035, inv. No. 680-683,

well as other historical reconstructions, the figures on Dutch lasts and barrels were converted into kilograms of fresh weight herring. The original unit of catch was Dutch lasts with 14 barrels to one last. One Dutch last of gutted and salted herring was the equivalent of 1,976 m^3.[41] The assumption was then made that freshly caught herring and the salt added to it have the same density as water implying that 1 litre of just salted herring ≈ 1 kg of just salted herring. This means one last of salted herring weighs 1,976 kg. The content of one barrel then weighs 141.14 kg.

When converting this into fresh weight, a different source tells us that one last or 14 barrels of cured landed herring equals 17 barrels, *kantjes* of unprocessed herring.[42] One last of fresh herring is then 17/14 or 1.21 lasts of gutted herring. Salt also need to be taken into account, which is 29% of the total content in one barrel.[43]

The conversion would then be:

x last = x * 1976 kg * 0,71(deducting salt) * 1,21 (adding the guts etc.)
x last = x * 1698 kg
x barrels = x * 1698kg / 14
x barrels = x * 121.3 kg of fresh weight herring

Accounting for wars and piracy

In the 17th – 19th centuries, wars and piracy posed a great threat in the North Sea area. These external events have a potential effect on the dataset, which made it necessary to assess their impact. An especially turbulent period was the Eighty Years War, 1568-1648. The years 1595-1604, 1626-32, 1635-37 and 1642-46 have been categorized as the most disruptive periods affecting the fisheries, when Dunkerque privateers in particular took hundreds of herring busses, demanding ransom for both cargo and seamen. Skippers from Schiedam were also affected by this phenomenon.[44]Apart from these extreme years of violence at sea, the fisheries seem to have fared reasonably well during the first half of the 17th century.[45]

With regards to the CPUE reconstruction for Schiedam in the 1604-1788 period, one should expect to see a difference in the behaviour of fishing vessels in the years of especially intense piracy even if pirates were active in most years. However, this only seems to be the case in the 1626-32 period, which coincides with a drop in the number of active vessels. While the sample in 1604-1624 consists of 40-50 vessels, only 20-25 vessels operated out of

41 Wieringen, *Maten, Gewichten*, pp. 92.
42 http://www.vaartips.nl/tips.htm.
43 Van Vliet, *Vissers en Kapers*, p. 170, footnote 83.
44 Van Vliet, *Vissers en Kapers*, pp. 159-162.
45 Van Vliet, *Vissers in Oorlogstijd*.

Schiedam in the following decades. However, the CPUE is not markedly lower than in the decades just before and after, so these years are included in the analysis even if 4-5 skippers were attacked by pirates in each of these years.

In terms of reconstructing CPUE, the period from 1652 until 1714 was a lot more troublesome, with England and The Dutch Republic engaged in three wars from 1652-54, 1665-67 and 1672-74. In the last war, France even invaded The Dutch Republic, and the two powers continued to harass each other's maritime sector even after the war had officially ended.[46] In all three wars the herring fisheries were seriously disrupted. In 1652, 1670 and 1676 the landings for the first trip of the season are extremely poor for the entire fishing fleet. This could either be the result of the worst catch rates in 200 years, but is more likely due to the Anglo-Dutch War and the activities of Dunkerque privateers respectively; trip 2, which took place after the fighting season had ended, was quite prolific in all three years.[47] In 1666 and 1672, the fisheries came to a complete halt, when only one or two herring vessels landed their catch in Schiedam. In the 1690s, the Dunkerque privateers were at their peak of their activities, and the Dutch government prohibited fishing in open sea during the entire spring of 1691. They also issued a ban on paying ransom for captured herring busses, in an attempt to minimize the incentive for pirates. [48] The data for Schiedam specifies that almost no vessels returned home with fish before October during that year.

After a peaceful interlude, war broke out again in 1702-1708. This War of the Spanish Succession greatly impacted the Dutch herring fisheries. In 1703 a fleet of French warships burned and sunk around 100 herring busses fishing off the Shetlands.[49] In the remaining years of the War of the Spanish Succession, the Schiedam herring fleet was markedly smaller. In 1702, 1706 and again in 1708 first time landings took place in October and November.

Most of the 18th century though, saw a peaceful period in the North Sea. The outbreak of the revolutionary wars between England, France and The United States, however, impacted the herring fisheries, and in 1781 and 1782 no vessels landed herring in Schiedam.[50] The 19th century data is uncontroversial in this respect, since no major obstacles prevented the fishermen from going to sea after 1814.

Because of these instances of wars and piracy, the following years in the dataset were left out of the analysis: 1652, 1666, 1670-72, 1676, 1694, 1702 and 1706-08.

---

46 Beaujon, *Nederlandsche Zeevisscherijen*, pp. 68-75.
47 Beaujon, *Nederlandsche Zeevisscherijen*, pp. 75-78.
48 GA. Schiedam, inv. no. 614-622.
49 Kranenburg, *De zeevisscherij*, p. 37.
50 GA. Schiedam, inv. no. 614-622.

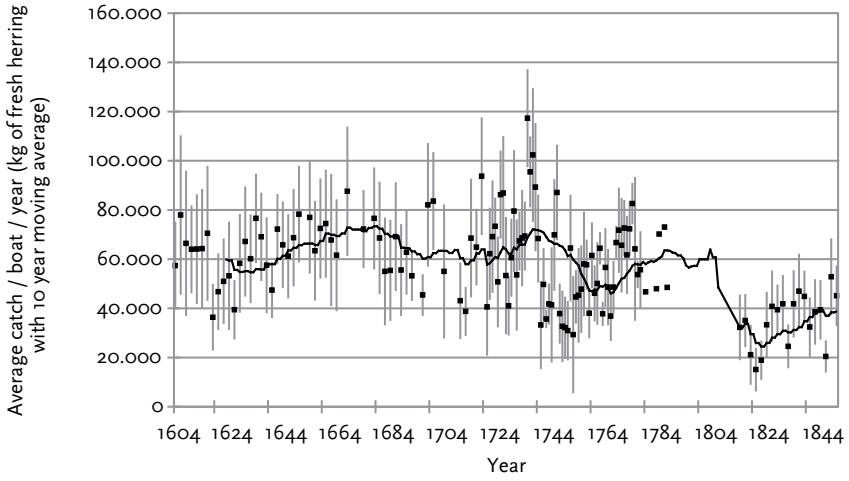
Results

Catch per boat per season

The average catch per boat over the entire season is expressed in metric tons. (figure 4) Overall, the time series shows a remarkable stability from 1600-1780, with an average annual catch of just over 60 tons per boat. Nevertheless, the latter half of the 18th century saw a drop to approx. 50 tons, while the 19th century was marked by very poor landings of between 30-40 tons per boat. This seems to suggest that – at least for the first 200 years of the time series – the fishermen went home with boats filled with salted herring to at least 60-80% of their capacity. So, did they rush home earlier in the 19th century, rather than staying out longer to fill the boats?

Figure 8.4

Average catch per boat per year, 1604-1850.



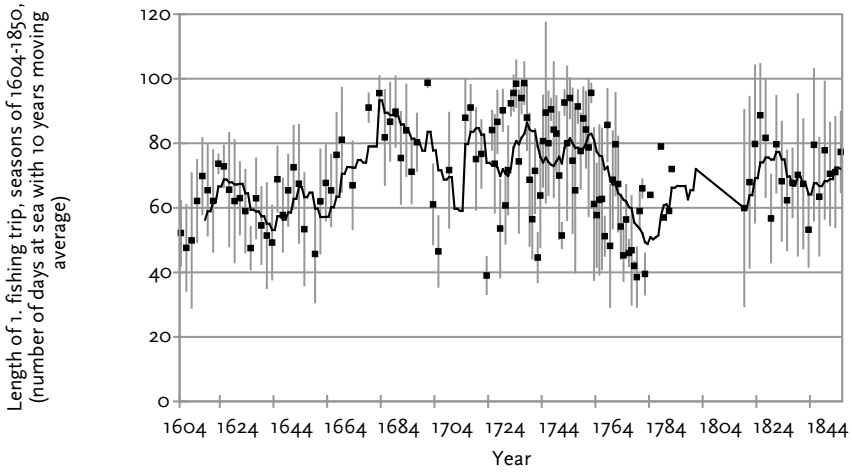
Length of fishing trips

This was verified by examining the number of days at sea for both the whole season and individual fishing trips. Figures 8.5, 8.6 and 8.7 show the length of the two, sometimes three fishing trips per ship per season. In this CPUE test, a total of 1,887 first trips and 1,882 second trips are included in the sample. The sampled data only contains 473 references to ships returning home from a third trip. The average length of all first trips was 69 days, while second trips lasted an average of 62 days, and third trips 53

days. For both the first and second trip, the standard deviation of all trip lengths was 20.7 and 20.5 days respectively, while the standard deviation of the third trip was 16 days.

For the first trip of the season the average number of days spent at sea between 1604-1850 fluctuated a great deal more than the average landings. (figure 5) During the period from 1600 until roughly 1660, an average herring buss spent around 60 days at sea before the skipper decided to return to Schiedam. Thereafter, the average time spent at sea rose greatly, reaching a level of around 90 days in the 1680s. The next century until approx. 1765 was marked by large annual fluctuations in the time spent at sea. In certain years, such as 1700, 1718 and 1737 the fleet of herring busses spent only 40 days at sea before returning home, but more often it took them almost 100 days to achieve a satisfying result. The plotted ten-year moving average remained around 80 days during this period. In the period between 1760-1780 fishermen spent an average of 40-70 days marking, while the 1800's saw an average of in between 60 and 80 days at sea.

Figure 8.5
Average length of first fishing trip, seasons of 1604-1850.

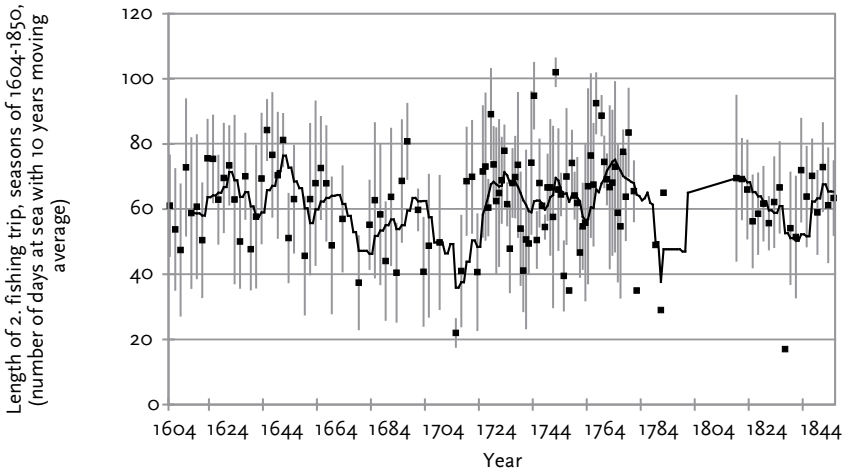


The average length of trip 2 saw more vivid inter-annual fluctuations. (figure 6) In the period between approx. 1600-1700, the average length of trip 2 was 60 days, with a slight declining tendency towards the end of the 17th century. In the 18th century, the average trip length rose to approx. 60-70 days, reaching an average of about 100 days in some years, and less than 40 days

in others. In the first half of the 19th century, the trip length remained in the area of 60 days. On the inter-decadal scale though, the second trips were marked by less consistent periods in comparison with the lengths of trip 1.

Figure 8.6

Average length of second fishing trip, seasons of 1604-1850.



In the years with a third trip, the general trend in trip lengths seems to have followed the pattern seen in trip two. (figure 7) In the 17th century, the trip length gradually declined from an average of 60 days at the start of the century to an average of only 20-40 days in the letter half of the century. In the 18th century, the average trip length ranged from approx. 40-75 days with an average of around 60 days. In the first half of the 19th century, the third trips on record lasted in between 40 and 60 days.

Figure 8.7
Average length of third fishing trip, seasons of 1604-1850.

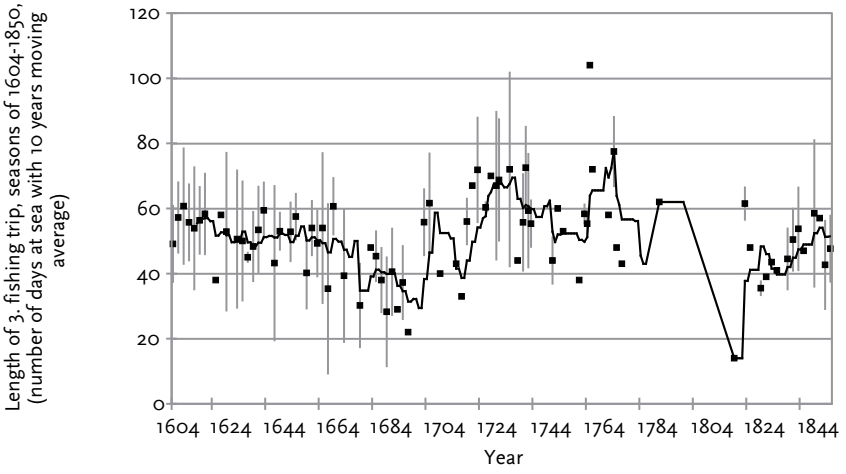
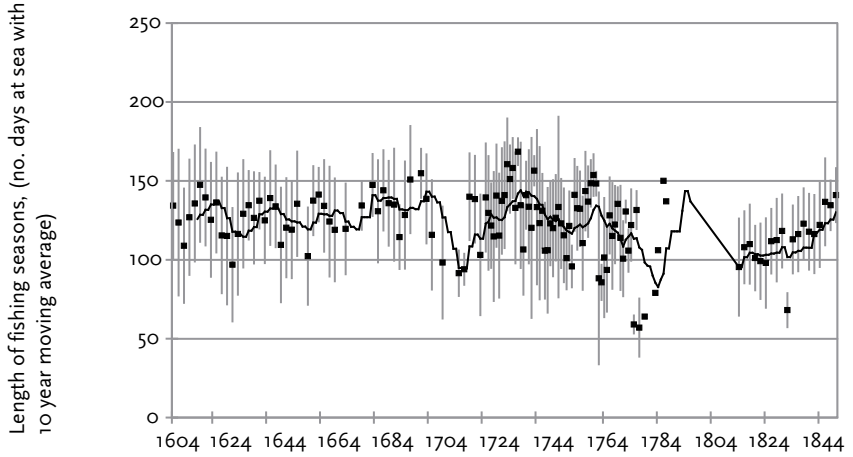


Figure 8.8
Annual length of fishing seasons 1604-1850.



Length of entire season
With the season lasting 222 days from 24 June until 31 January, the fishermen would have an absolute maximum of around 200 days at sea. (figure 8) The total length of an average fishing season though, never exceeded more than approx. 180 days, and in most years the average length of the entire fishing season did not exceed between 100 and 150 days at sea. The absolute maximum length of a trip does thus not seem to have limited individual and seasonal trip lengths. It was assumed that all vessels in the analysis began their operations at the official start of the season, while the official ending of the season does not seem to have delimited the fishermen's desire to fish for herring in winter.

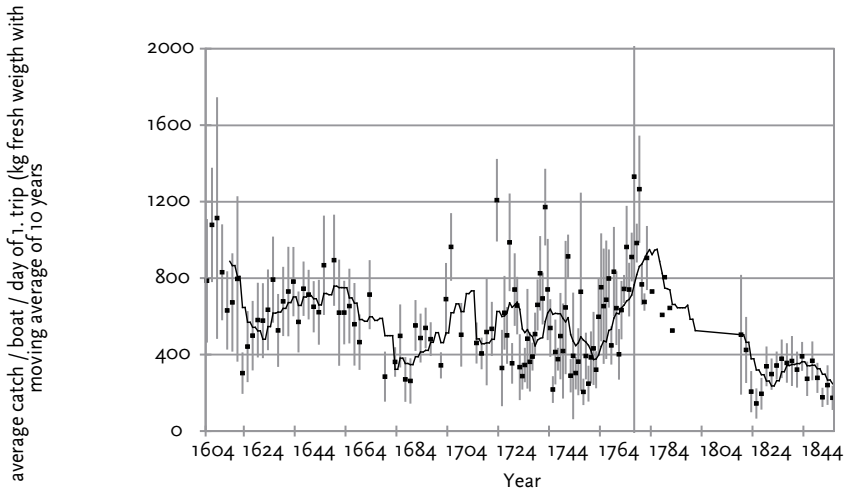
Although the length of individual fishing trips fluctuated a great deal, the average duration of the entire season was more stable when viewed from a 250-year perspective. Around 120-130 days were spent fishing at sea throughout the 17th century, while seasons during the first decade of the 18th century lasted a mere 100 days. This drop can be explained by the fact that only 2 out of more than 40 vessels sampled set sail for a second journey in the years examined here at the start of the 18th century. In the rest of the 18th century, the average length rose and fell a great deal more than in the previous century, but remained within the range of 100-150 days. Trip duration fell to only 60-80 days per season during a few years in the 1780s, which can be explained by the fact that no vessels embarked on a second trip in these years, which on the other hand could be a consequence of a small sample of vessels in the 1780s. After the interruption caused by the Napoleonic Era, the fishing season gradually increased in length over three decades from 100-140 days in average. If the figures are viewed in the context of the entire 250-years period, the 19th century stands out as a period of shorter fishing seasons than in the 17th and 18th centuries. So, how does this correspond with the catch rates per boat per day at sea? Again, the material is best analysed when broken up into the different trips of each fishing season, revealing a high degree of complexity in the CPUE.

Catch per boat per day absent, trip 1
With regards to trip 1, the first decades of the 1600s the Dutch herring fisheries saw a succession of very good years with catches of between 700-1,000 kg per day spent at sea. In the following period from approx. 1620-1670, the daily average was around 600-800 kg. This period was followed by a 30-year decline with an average of just 300-600 kg. The period from 1700-1760 was marked by the largest inter annual fluctuations in the entire 250-year period, with catch rates ranging from 200-1,200 kg per day, with a moving ten year average of 500-700 kg. (figure 9)

The decades from 1760-1780 showed a more consistent higher output of 600-1,000 kg, a pattern similar to that in the early 1600s. However, when the herring fisheries picked up to full speed following the Napoleonic Era, good catch rates were a distant memory. With regards to the 1600-1850 period, it is safe to say that catch rates were historically low during the years between 1814-1850, ranging steadily from 200-400 kg per day, or less than a third of the catch rates during the best periods.

Figure 8.9

Catch per boat per day at sea (CPUE) for first trip of season, 1604-1850.

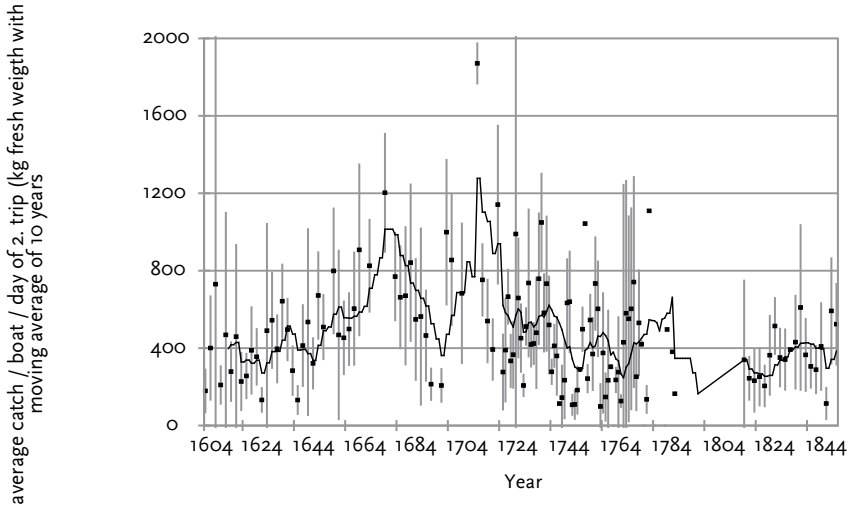


Catch per boat per day absent, trip 2 & 3

With regards to the CPUE for the second trip of the season, the pattern is a good deal different, as illustrated in figure 10. Over the course of the 17th century the average CPUE rose from a mere 200-400 kg per day to in between 700-1200 kg in the 1670s and 1680s. After a drop in the 1690s to just 200 kg, the high CPUE level continued for the first two decades of the 18th century. A decline then set in during the 1720s, with large inter-annual fluctuations in the rest of the 18th century, and a ten year moving CPUE average fluctuating at around 400 kg. This sluggish pattern continued in the 19th century with 200-500 kg per day at sea.

Figure 8.10

Catch per boat per day at sea (CPUE) for second trip of season, 1604-1850.



The development of the average CPUE for third trips tended to follow the pattern of the second trips. figure 11. An increase in CPUE from around 200 kg to 800-1200 kg per day at sea during the 17th century was followed by a sharp decline around 1700. Vivid fluctuations during the rest of the 18th century marked a gradual decline to just 100-300 kg in the latter half of the 18th century. In the 19th century, the average stood at 200-500 kg per day. The results of the CPUE test on third trip figures should be treated with caution, however. For many years only one or two of the third landings have been recorded in the sampled data.

Figure 8.11

Catch per boat per day at sea (CPUE) for third trip of season, 1604-1850.

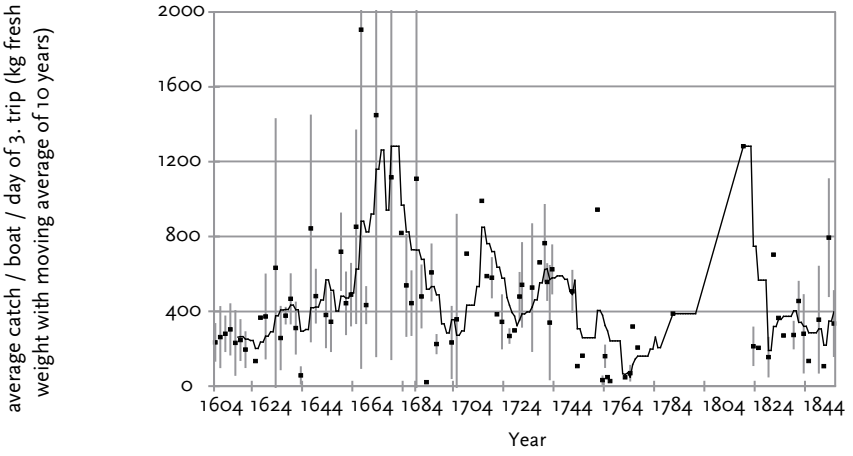
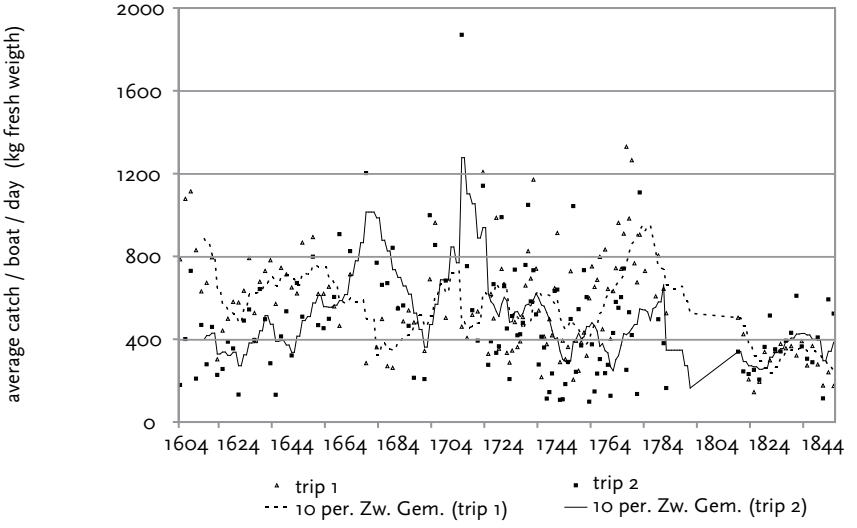


Figure 8.12

The average CPUE of trips one and two were plotted alongside one another, showing parallel as well as disparate developments from 1604-1850.



CPUE trips compared over entire seasons

The above sections on the CPUE of the three annual trips suggest it is possible to detect significant fluctuations over the span of two and a half centuries. However, they also indicate that the fluctuation in first trip CPUE and fluctuations in subsequent trips of the season do not follow the same overall patterns. (figure 12) The average CPUE of trips one and two was plotted alongside one another, showing parallel as well as disparate developments from 1604-1850.

We can thus identify five distinct phases in the historical, 250-year development of CPUE. The periods between approx. 1604-1660 and 1760-1780 saw a higher CPUE for the first trip, and the periods approx. 1660-1720 and 1814-1850 saw periods of higher CPUE in the second trips of the season corresponding to the latter parts of the fishing season. Finally, a period between approx. 1720-1760 proved more indistinct, with better first trip results in some years and better second trips in others.

In order to highlight the differences in catch seasonality, it proved useful to break up some of the data underlying the 250-year time series into a series of snapshots of individual seasons. The figures 13 – 19 highlight the landings of herring vessels during seven different seasons: 1604, 1640, 1680, 1720, 1760, 1814 and 1850. Each data point on the scatter plot represents one landing of salted herring by one herring vessel. The square dots represent landings for the first trip, the rings represent the second trip and triangles represents the less common third trip. The plots chart the size of the individual catch in relation to seasonality, expressed as the number of days after the start of the season in June.

In the first year, 1604, the first trip of the season was by far the most profitable since the bulk of the fishermen returned home within 70 days with almost fully loaded vessels. (figure 13) This enabled a lot of the fishermen to go out again for a second as well as a third trip, but neither the second nor third trip seem to have been very successful. The general pattern of the first trip being more successful than subsequent trips can also be seen in the charted landings of 1640, 1720 and 1760. In neither of these years however, did the fishermen embark on a third trip. In all three seasons the date of homecoming from the second trip was later than had been the case in 1604, and most second trips ended in the month of November, more than 150 days after the season had started. This will not have left much time for a third trip, and only very few third trips took place in these years.

The fishing seasons of both 1680 and 1814 show quite a different pattern, whereby the second trips yielded landings of the same magnitude as the first. (figures 15 and 18). In both years however, the date of return from

the first trip extended quite late into the season, and virtually no third trips were undertaken.

In 1814, a large cluster of ships chose to head home after fishing for only 20-40 days, despite declaring very low catches of 20-30 tons. This could have two reasons. Perhaps these vessels chose to head back fast in order to profit from the generally higher prices early in the season, thereby breaking with the general pattern of staying out until the boat was at least half full. Another possibility is that the skippers had made the assumption that the available abundances of herring would not increase any further, and decided they might as well head home. In any case the skippers that did stay at sea do not appear to have benefited from staying out longer.

Finally, in 1850, the frequency of landings sorted by catch size and trip length exemplifies the third pattern, whereby the second trip of the season had a markedly larger CPUE than the first.

Figure 8.13

Seasonal distribution of landings of salted herring in Schiedam in 1604.

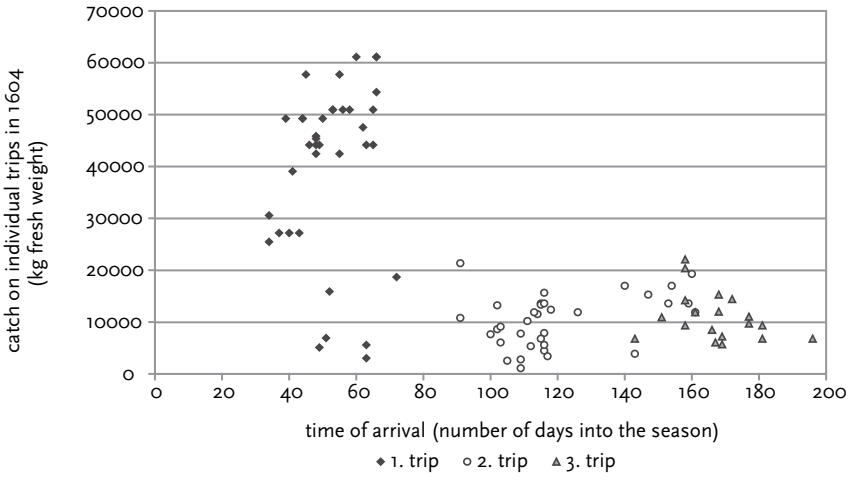


Figure 8.14

Seasonal distribution of landings of salted herring in Schiedam in 1640.

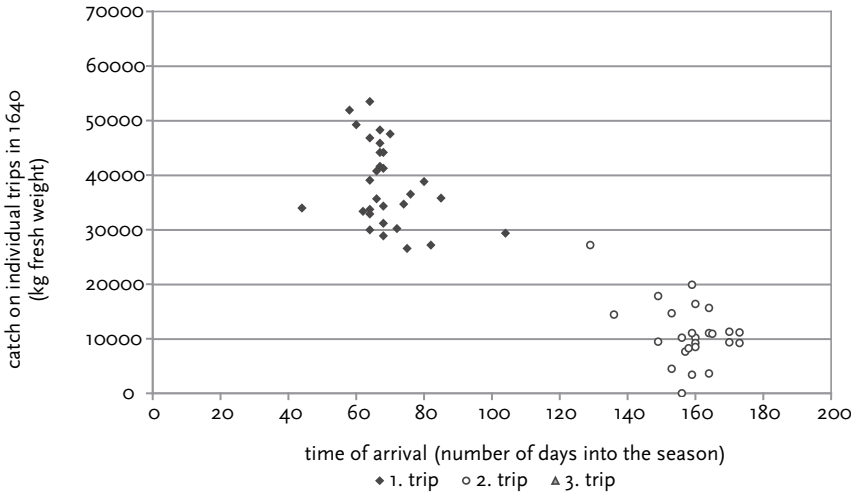


Figure 8.15

Seasonal distribution of landings of salted herring in Schiedam in 1680.

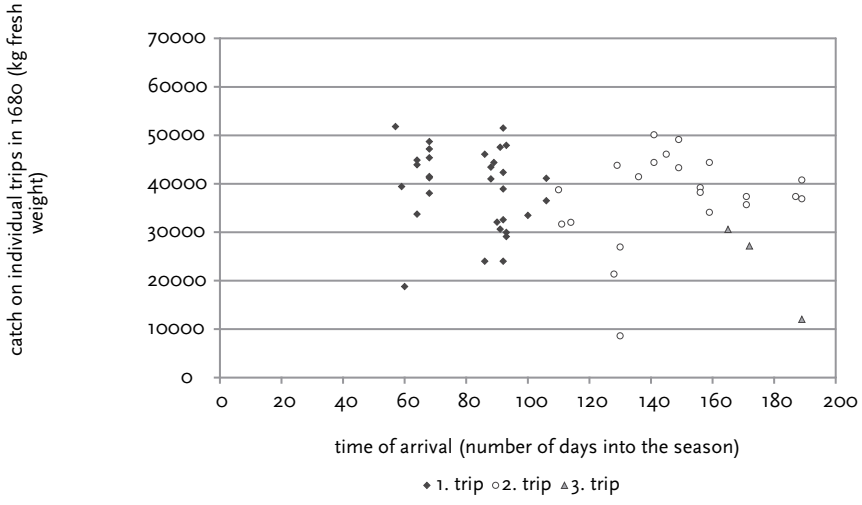


Figure 8.16

Seasonal distribution of landings of salted herring in Schiedam in 1720.

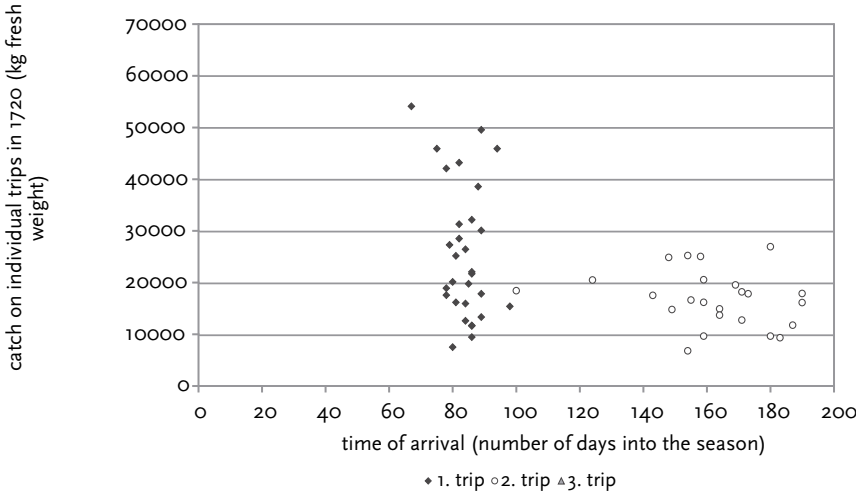


Figure 8.17

Seasonal distribution of landings of salted herring in Schiedam in 1760.

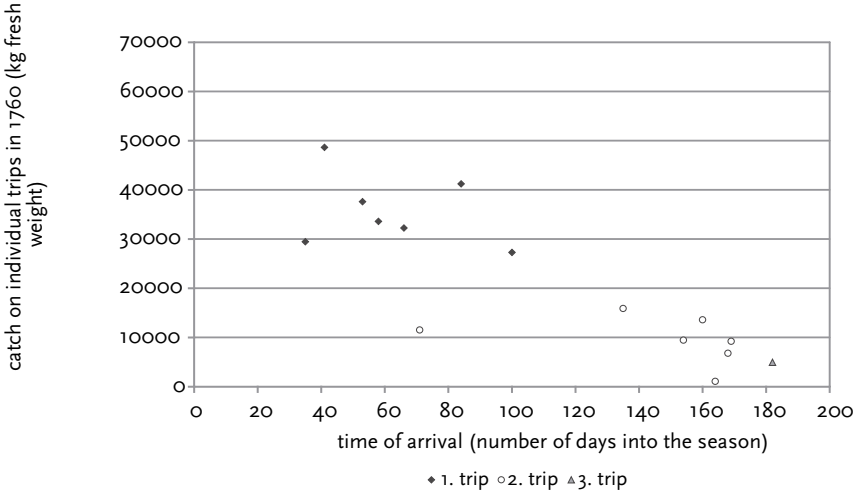


Figure 8.18

Seasonal distribution of landings of salted herring in Vlaardingen in 1814.

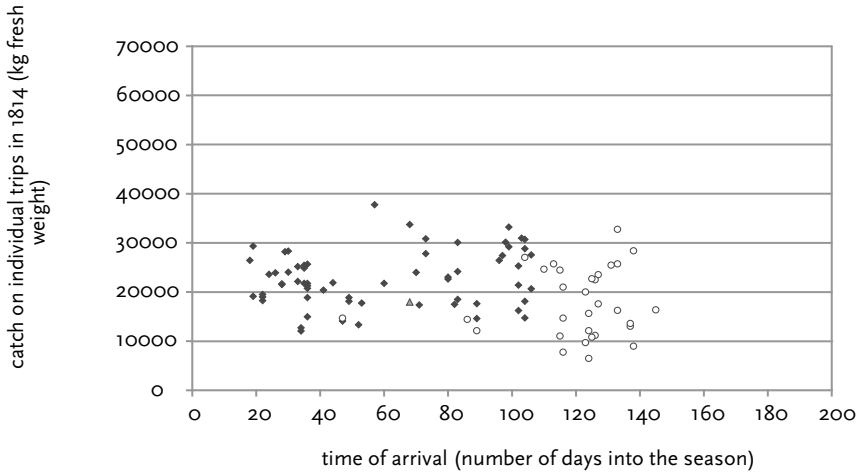


Figure 8.19

Seasonal distribution of landings of salted herring in Vlaardingen in 1850.

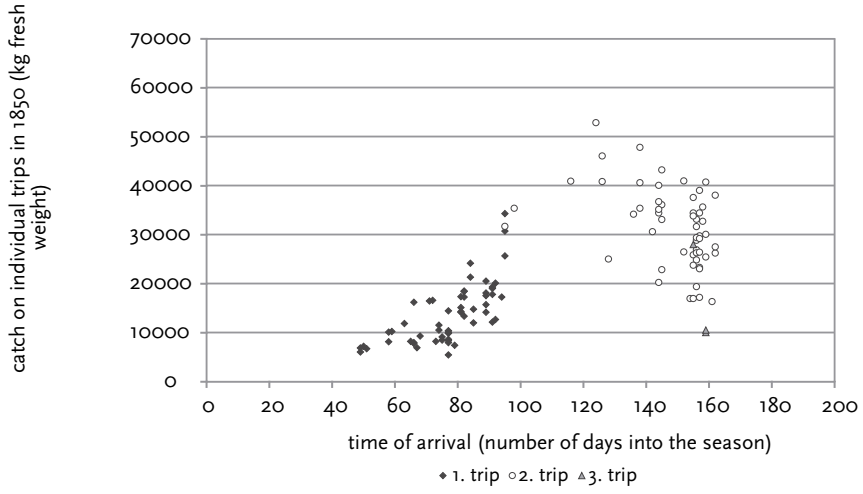


Figure 8.20
Kuypen der haringhtonnen

The herring barrels were made to measure, so that every barrel would contain the correct amount of herring. Source: 'The Hooping of Herring Barrels,' etching by Adriaan van der Laan, (1705). P0165, Visserijmuseum, Vlaardingen.

Discussion

The results of the above analysis can be examined at two levels. At a methodological level, the results testify to the potential uses of historical data from a pre-statistical era in establishing CPUE time series to serve as indicators of North Sea herring stock fluctuations. The data was analyzed empirically at two different CPUE resolution levels. These were 1) Catch per boat per year, 2) catch per boat per day at sea for each fishing trip. This was supported by analyses of the average length of individual fishing trips as well as the average length of the entire fishing season.

Method used to reconstruct CPUE

With regards to methodology, the above analysis was used to determine the potential for standardising historical data sets in order to use them as estimates for the catchability of North Sea herring in the 1604-1850 period. In this chapter, the Dutch herring fishery served as a case study for the reconstruction of Catch per unit Effort, CPUE, over a time span of more than 250 years.

A standardization of the technological and institutional factors influencing the fishery was made possible due to the *College van de Grote Visserij*'s regulation of the size and use of fishing gear, driftnets, and the length of the fishing season. These regulations ensured a highly uniform seasonal behaviour pattern in an otherwise geographically independent fishery. The fishermen used virtually the same unit of effort during the entire period. The vessels and their holding capacity may have grown about five percent between 1600-1850, during which period the driftnets became approx. five percent smaller. This standardization of the fishery has allowed for the use of herring landing records from the towns of Schiedam, 1597-1788, and Vlaardingen, 1814-1850. All landings were recorded in the same way, specifying the date, skipper's name, and size of catch.

In the case of the Dutch herring fishery under the *College van de Grote Visserij*, the units of both catch and effort were so uniform that they can be left out of the CPUE equation. The assumption being that CPUE reflects stock abundance as follows:

$$CPUE = C/E = qD = qN/A$$

The model assumes that the above changes in CPUE are caused by changes in the density of the available abundance of herring in the northern part of the North Sea. Based on the assumption that CPUE is a valid index for the available abundance of herring populations in the North Sea, the time series reconstructed in this chapter can be used to test current marine biological theories on the climate forcing of European herring populations against the background of historical fisheries.[51]

Interpreting CPUE

In terms of the annual catch per boat, a very stable development was found throughout the 17th and 18th centuries, with annual landings of approx. 60 tons per vessel, despite a slight drop in the latter half of the 18th century. In the first half of the 19th century, however, only half this amount was landed annually. However, this annual catch per buss does not reflect the available abundance of herring.

---

51 Corten, *Herring and Climate*, Alheit and Hagen, 'Long-term climate forcing', pp. 130-139 and MacKenzie *et al.*, 'hypothesis for a historical reconstruction', pp. 173-190.

While the annual catch per boat was generally stable, the average length of individual fishing trips varied with the success rate of the fishery. The better the catches, the shorter the trips. This applies to the analysis of data from the first and second fishing trips of the season.

For the purpose of analysis, the data was split up into figures on trips one, two and three. This resulted in the identification of five distinct phases in the 250-year development of CPUE. The period between approx. 1604-1660 and 1760-1780 saw the highest CPUE for the first trip, while the periods between approx. 1660-1720 and 1814-1850 saw periods of higher CPUE in the second trips. This implies higher CPUE in the latter parts of the fishing season. Finally, a period between approx. 1720-1760 saw a more indistinct trend with better first trips in some years and better second trips in others.

The question of whether a fishing vessel should make one, two or three trips per year seems to be determined by how soon a ship returned from the previous trip. If a skipper landed early from his first trip, he is very likely to have undertaken a second trip. If he came home early from both the first and second trip he is likely to have undertaken a third trip as well.

For most of the two and a half century period, the length of the entire fishing season fluctuated between around 120-130 days. The only exceptions were the approx. 100 days fishing per year around 1700 and again in the 1760s and 1770s, while the number of days spent at sea rose slightly from 100-140 during the first half of the 19th century. Thus, while the unit of effort remained stable with regards to technological and institutional changes, the effort measured in days spent at sea seems to have been a highly dynamic factor influencing the success of each year's fishing.

The analysis of catch per boat, length of season and CPUE, indicates that the fishermen always chose to keep fishing at sea until they had more or less filled the vessel. It was only in the 19th century that they deviated from this pattern, sailing home with half empty ships. This can be explained by historically low catch rates, which meant it simply was not possible to catch this much herring. The strategy behind devoting certain amounts of effort to the herring fisheries was important; due to the static nature of the fishery, however, this does not seem to have impacted the explanatory power of the CPUE indices as expressions of available stock abundance of herring in the North Sea from 1604-1850.

Conclusion

This reconstruction of the CPUE of the Dutch herring fishery between approx. 1600-1850 is the longest time series of CPUE ever constructed, and has allowed us to introduce the concept of marine environmental history into the

Figure 8.21
Brayen der haringh netten

Each herring vessel was equipped with a driftnet of approx. 15.5 x 1400 meters, and every mesh had to meet a standardized size. Source: 'The Knitting of the hering Netts,' etching by Adriaan van der Laan, (1705). P0168 Visserijmuseum, Vlaardingen.

pre-statistical era of the North Sea fisheries. The time series for CPUE was constructed by using historical data of a very homogenous nature, which facilitated the standardization of all main units of catch and effort. This, in combination with the length of the period under examination means the time series can be used to test current marine biological theories on natural variations of North Sea herring against the background of a historical fishery.

CPUE as catch per boat per season was quite stable over the years, but when the length of each fishing trip was taken into account, a much more diverse picture emerged. This showed CPUE as catch per boat per day at sea to be very different between the first and second fishing trips of the same fishing season. Extreme fluctuations suggesting almost alternating high and low points in CPUE were found. This testifies to the importance of resolving catch and effort data wherever possible in CPUE reconstructions.

9 | Fishing strategy and dynamics of movement, 1856-1863

Introduction

For the first time, this chapter presents an in-depth study of the spatial dynamics of mid 19th century Dutch North Sea herring fishery. This is the first quantitative study to use fishers' own logbooks as a main source of information on an essentially pre-modern North Sea herring fishery.

As we have established, the Dutch high sea herring fisheries were the only major North Sea herring fishery that could operate independently of geography. Most other pre modern herring fisheries were shore-based industries along the English, Scottish, Norwegian, Swedish or Dutch coastlines. In principle, the Dutch fishers could fish wherever they pleased.

The main factors affecting the dynamics of Dutch North Sea herring fisheries' spatial patterns can be assessed at different levels by analysing the high resolution data provided by fishers' logbooks. This provides an indication of the environmental adaptiveness of the Dutch fishers.

At a seasonal level, the spatial patterns reflect attempts to follow the migration patterns of herring in the north eastern part of the North Sea. The seasonal distribution of fishing was divided into a first, a second and occasionally third fishing trip, as the analyses in chapter 8 also demonstrated at a more macro level. However, they did not seem to have played a significant

role with regards to the spatial fishing pattern. On a day-to-day level, analysis of the spatial distribution of individual fishing trips allows us to assess fishers' geographical responsiveness to fishing success rates.

The timeframe of this study is restricted to the period between 1856-63, when the *Royal Dutch Meteorological Institute*, KNMI initiated and conducted an eight year long study into methods of optimising the Dutch catch of herring in the North Sea area.

In terms of technology and fishing practices, the Dutch method of offshore fishing in the 1850s and 60s was virtually identical to the methods used as far back as the late 16th century. Therefore, this rather short time frame provides a window of opportunity to evaluate the spatial flexibility of the Dutch herring industry.

Logbooks from herring vessels

The 1850s marked the beginning of a period of great changes in the Dutch herring industry. The dissolution of the *College van de Grote Visserij*, which had upheld a virtual monopoly for almost 300 years, was the beginning of a liberal phase in the organisation of the Dutch herring fisheries. The fishing industry hoped that this would lead to economic growth and expansion following a century long contraction of the herring industry, with fewer and fewer vessels catching less and less herring.

The mid-19th century however, also saw a growing interest in systematic studies of the herring fisheries. The remaining records of these endeavours now allow us to carefully reconstruct the spatial dynamics of the Dutch herring fishery in the period leading up to the modernisation of the herring fleet. The most important source material in mapping the fishing patterns of the Dutch pre-modern herring industry consists of logbooks from the herring busses themselves. Such logbooks exist for the last period to use herring busses and hoekers.[1] However, the best material in this regard consists of fishermen's logbooks from the archives of the Royal Dutch Meteorological Institute, KNMI, which has provided the main sources of information in this chapter.[2]

In 1856, the director of the KNMI, Buijs-Ballot, wrote to all ship owners

---

1 NA. CGV. Inv. no 680, Journaal van het hoekerschip, *De Jonge Aletta*, 1847; Inv. no. 681, Journaal van het hoekerschip, *Willem Beukelszoon,* 1847, Inv. no. 682, Journalen van haringschepen, *Willem Beukelszoon*, 1848; Inv. no. 683, Journaal van het hoekerschip, *De Haring en Kabeljauwvisscherij,* 1848. Museum In 't Houten Huis, De Rijp: Inv. no. 03537, Journaal van stuurman Klaas Moeneswerf op het buisschip *Het Bruine Paard*, 1848.

2 KNMI, De Bilt: Inv. no. ABMZ0029 Logbooks, *Noordstar*, 1856-57, 1860-61, *Visschers Welvaart*, 1858-61. Inv. no. ABMZ0031 logbooks, *Noordstar*, 1858-59, *Visschers Welvaart*, 1862-63. Inv. no. ABMZ0033 logbooks, *Vlaardings Welvaren*, 1856, *De Toekomst*, 1857, *Volharding*, 1860-61. Inv. no. ABMZ0035 logbooks, *Volharding*, 1859, 1862-63, *Noordstar*, 1863.

in the Dutch herring industry, and asked for their help in '...clarifying the optimal circumstances for fishing herring'.[3] In order to underline the high quality and credibility of the information found in these logbooks it is useful to note just how systematic and rigorous this study was.

The KNMI supplied the herring fishermen with standardised, pre formatted booklets with an extremely detailed and carefully laid out questionnaire, allowing space for 19 different types of information, and several variables. Moreover, the layout facilitated the recording of up to five logs per day. Each log allowed space for notes on the exact position of the vessel, the depth at sea, and the type of seabed encountered, as well as a number of meteorological observations, such as the direction and speed of the wind, and the weather situation in general.

The KNMI also provided three state of the art Celsius thermometers for each ship. All thermometers were tested before use and comment on the deviation of each thermometer was noted down in the preamble of each ship's booklet, along with an instruction on how to use the thermometers. One thermometer was to be used for measuring air temperature; one was for the temperature of the sea surface, and the last one was lowered deeper down to measure the water temperature at greater depth. All this data was needed for comparisons with information on the actual fishing. On fishing days, the crew could write down at what time in the evening the herring nets had been set out, as well as the time at which they were pulling back in later in the morning. If the fishing had been successful, the size of the catch, as well as the average size of the herring caught would also be recorded, along with the quality of herring.[4]

Needless to say, filling out the booklets proved a time consuming task for the fishermen, but the KNMI created incentives by issuing prizes for the three booklets that had been filled out most comprehensively. The first prize was 100 guilders.[5] This was the rough equivalent of the price of eight or nine barrels of salted herring.[6]

Attracted by the prizes and the promise of more detailed knowledge with regards to herring, 45 logbooks were submitted to the KNMI in the first year of the study, the season of 1856. This represented roughly one third of the total fleet. The KNMI then undertook the task of analysing the logbooks, and wrote the first in a series of short annual reports, consisting of a few pages. The following year, 44 logbooks were handed in for analysis, but gradually interest

3 NSA. inv. no. 1994.0697.

4 NA. CGV. inv. nr 675. 'Rondschrijven van den hoofddirecteur van het Meteorologisch Instituut aan de reeders van de Groote Visscherij over het houden van het journal, 1858'

5 NA. CGV. inv. no. 676, 'Beoordeling der Journalen van haringschepen, 1857-1858'

6 Museum In 't Houten Huis, De Rijp, inv. no. 00024.

declined. The last report on the herring fisheries was written in 1864, based on information from vessels active in the season of 1863. By then, the director of the KNMI's Department of Seafaring, van Asperen, reported that – in spite of eleven different prizes – logbooks had only been received from 21 vessels.[7]

It is not known why the efforts to 'clarify the optimal circumstances for fishing herring' ended after the season of 1863, but lack of interest from the fishermen may well have been one reason. Another plausible explanation would be time and money.

Today, less than a handful of these annual reports still exist in Dutch libraries and museums, and it does not appear that they have been put to any use in the last 140 years. Furthermore, these reports are the only remnants of any research efforts based on the submitted logbooks. Fortunately, though, many of the original booklets from the herring vessels still exist in the KNMI archives.

Sampling logbooks from KNMI

There are still 106 remaining pre-formatted booklets, covering the period between 1856-1865, and 1877-78, when the project seems to have been shortly revived. Some booklets contain information from more than one season, which means there is still information on a total of 142 fishing seasons by individual herring vessels. The potential amount of data is huge, so a sample of 20 seasons' worth of logbooks, or one seventh of the total, was selected for digitization and analysis. In spite of sampling, the data entered into a Microsoft Access database still contains 84,475 individual fragments of information, which is applied in the below analysis.

The main guideline underlying the choice of logbooks is to create optimally accurate parameters by following the same herring busses and fishermen year after year. The bias caused by the use of different gear or the traditions of different crews and skippers should thus be minimized. Vessels were also selected by assessing the quality of the information to be derived from the logbooks, with the preference going out to those booklets presumed to offer the most compelling and accurate data. All the logbooks specify the daily latitude in 'degrees' and 'minutes'. The longitude however, is often measured as 'distance from the shore'. This makes an accurate reconstruction of the position and movement of the herring vessels difficult and more time consuming. Therefore, preference went to logbooks specifying the longitude in 'degrees' and 'minutes' east and west of Greenwich.

The hour at which the logs were entered in the booklets is another factor to consider. On some vessels, the skipper entered not one, but up to four logs per 24-hour day. Usually the first log was taken in the morning at the time

7 NSA. inv. no. 1994.0697.

of pulling in the fishing nets. A second log was taken at noon, and a third log in the early evening when the nets were set out again. In order to obtain as much consistency and uniformity as possible, only the noon log has been used, since virtually every day in every logbook contains a noon log. This offers an advantage when measuring – for instance – the geographical distance between two noon logs, in that the recorded figures always reflect the distance covered in exactly 24 hours. Another advantage is that the fishermen will not have moved far from the actual place of the previous night's fishing by noon, thus providing an accurate depiction of the fishing ground.

Applying a combination of these considerations, five different ships – making up a total of 20 logbooks – were selected for the 1856-1863 period. Each logbook covers one season, so that 2-3 ships are represented in any given year, each providing a detailed account of 1-3 annual fishing trips.

As a result, a total of five different ships and four different skippers are represented in this chapter. M. den Admirantz was the skipper aboard the *Noordstar*, for which data exists on the periods between 1856-61 + 1863. In 1856, the longitude of the *Noordstar* is only mentioned in tersm of distance to the coast, but is still included in the sample thus adding a seventh year to the data from the *Noordstar*. The *Volharding* is represented in the years 1859-63, with Herman van Luik as its skipper, while Hermanus Schouten was the skipper of *Visschers Welvaart*, from which six logbooks spanning 1858-63 are included. Kornelis Horn was skipper of *Vlaardings Welvaren* in 1856, and heading *De Toekomst* the following year.

The selected herring busses are all from the town of Vlaardingen in the south of Holland. Vlaardingen was the dominant port in the Dutch herring industry in this period, despite the neighbouring town of Maassluis and the town of Enkhuizen in the northern part of The Netherlands also being active in the herring fisheries. Logbooks from these towns also exist in the KNMI archives, but none fulfilled the need for both sophisticated log keeping and access to logbooks from the same vessel over more than one year.

General pattern of fishing

The desirable catch and quality of herring

This chapter is based on the assumption that the Dutch herring fisheries worked around the seasonal fluctuations of the herring, as well as the desire to land a superior fish product. In spring, the autumn spawning herring are busy feeding and grow rapidly with their flesh becoming very loose and fat. This makes the fish unsuitable for salting. Starting the fishing season on 24 June would thus allow the fishermen to land a better product. Over the course of the season, the herring was packed and sold according to its condi-

tion. In the summer months, *maatjes* was the least mature product. When the flesh becomes firm, the prime product of *volle* haring could be landed, whereas the spawning herring was classified as *kuitziek*. During and after spawning, the quality and price dropped again, and the product of spent herring was known as *ijle*.[8] From the 16th century onwards, and throughout the period under investigation, these were the most important types of herring with surviving account books testifying that volle herring remained the most profitable type of herring.[9] This provided one incentive to aim for the more mature herring when searching for fishing grounds. The seasonal price fluctuations on the Dutch herring market form another reason. As a rule, the price of volle herring on the Amsterdam market was highest in July at the beginning of the season, while the average price dropped in the following months and continued to do so until the end of the year.[10] But how did the fishing practice reflect this fact in the mid-19th century?

Contemporary analyses, 1856-62

The succinct annual reports from KNMI contained summaries of each year's fishing. The best illustration of the success rate and spatial distribution of the fisheries is contained in a map of the Dutch North Sea herring fisheries, shown here as figure 9.1. The map was drawn up in February 1862 based upon the incoming herring logbooks from the previous six years. According to the legends on the map, the best areas of fishing varied greatly depending on the time of year. Divided into six months from the start of the season in June until November, the ideal fishing trip started in the area around Fair Isle, in between the Shetland and Orkney Islands in June, fishing between the 59° and 60° north. By July however, the best place for fishing had moved southward to the area in between the coast of Scotland and the English border, or in between the 58° and the 56° north. In August, the fishing fleet would ideally remain in the same area, then continue southward until the waters off Newcastle around 55° northern latitude, and then turn east towards the northern edge of the Dogger Bank.

In September, the picture was markedly different and the most favourable fishing took place in an area twice the size of the previous months, stretching north-south between 58° and 59.5°, and from east to west from below the Orkneys at 2.5° west of Greenwich until between 2° and 3° east of Greenwich. This wide area of optimal fishing was extended further north in October, when the nets would reap the greatest harvest from around 58.5°

8 Gelder, 'betreffende de Haringvisscherij', pp. 60-62.

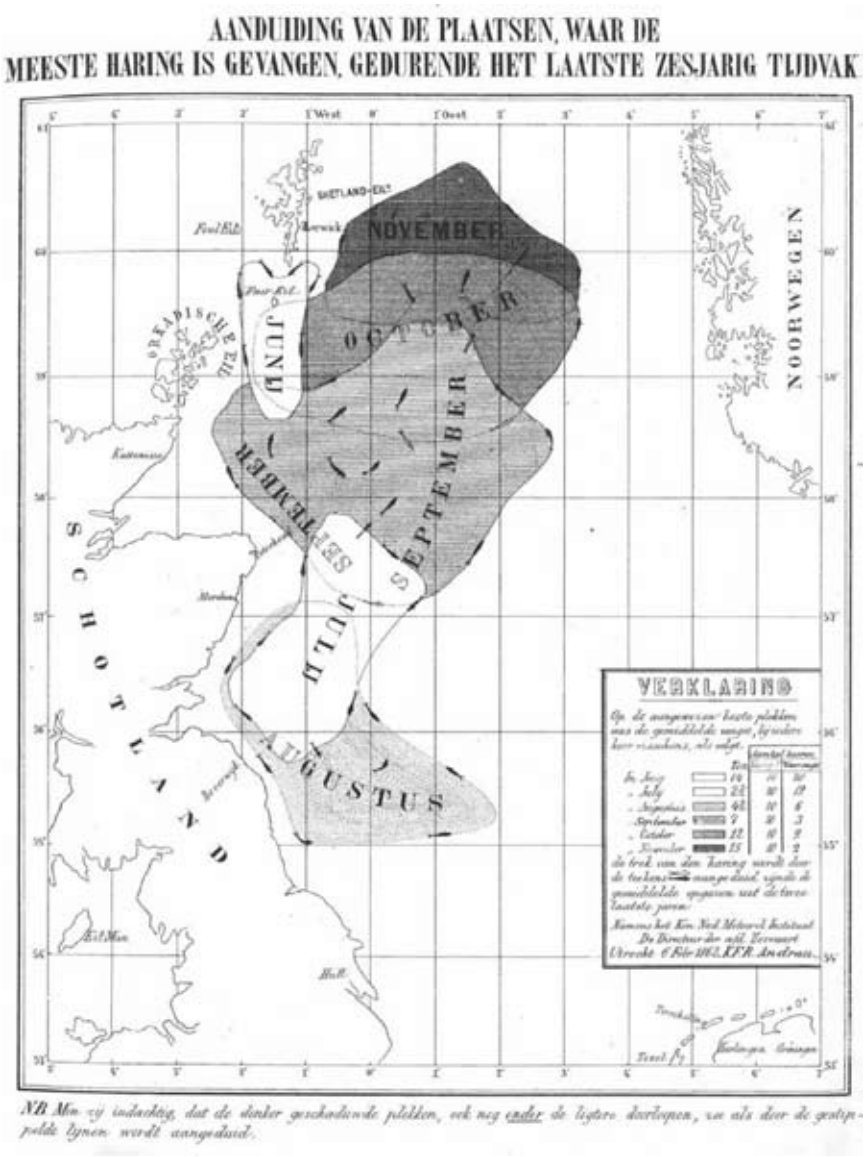
9 Gelder, 'betreffende de Haringvisscherij', pp. 22-56. and Museum In 't Houten Huis, De Rijp, inv. nr. 00024.

10 van Zanden, 'consumer goods', http://www.iisg.nl/hpw/brenv.xls

and 60° Northern latitudes. In November, yet another northward movement took place towards the west of the Shetland Islands, bringing the fishermen even further north at the end of the season than they had been when they started out in June.

Figure 9.1

Map of the monthly distribution of fishing efforts, 1856-62.



However, the KNMI map not only revealed the best fishing locations for each month. The monthly hotspots also reveal a striking difference in catch rates. In June, an average fishing vessel participating in the search would catch a mere 1.25 barrels of herring every time the nets were set out, with the chance of catching something only half the chance of bringing in no herring at all. As the months went by, however, the catch rates improved. Two months later in November, the average catch had doubled to 15 barrels, and the chance of catching herring in the nets was five times higher than the chance of catching nothing at all.

Finally, the 1862 map is indicative of the direction in which both the fishermen and the fish themselves moved. Roughly speaking, the fishermen's movement echoed the seasonal movement of the herring, which swam southward in June and July, whereas August was a turning point after which the autumn months witnessed a north – north eastward movement as far north as this essentially commercial data allows us to follow the fish.

In light of the sustained average increases in catch rates from the start until the end of the fishing season, it appears to have made good sense for the fishermen to follow this cyclical movement.

Patterns of movement

In the above sections, the assumption had been made that Dutch fishermen were keen to obtain the largest and most valuable catch under the given natural conditions. But how did they achieve this? How did the fishermen manage to reach their goals by turning a theoretical wish for success into a practical fishing strategy? In other words, how could they know where to fish, how did they know about the dynamics underlying the movements of individual fishing vessels? In order to answer these questions, we must conduct an in depth analysis of the KNMI logbooks. The logbooks reveal fishing patterns on a seasonal basis, within individual trips, on a weekly basis and within the daily rhythm of fishing.

Search time and fishing time for three vessels in 1859

In the figures 9.2-9.4. featured below, the annual performance of the three herring hoekers, *Volharding, Noordstar* and *Visschers Welvaart* is represented as the amount of herring in Dutch lasts landed by each vessel for each fishing trip per season, over the number of years featured in the source material. Two trends emerge from this data. All three vessels undertook an average of two fishing trips per season, with the second of the two providing the bulk of the catch for the entire season. There are two occurrences of a vessel making only one trip or journey per season, whereas a third jour-

Figure 9.2

Annual performance of herring hoeker, Volharding, 1859-1863.

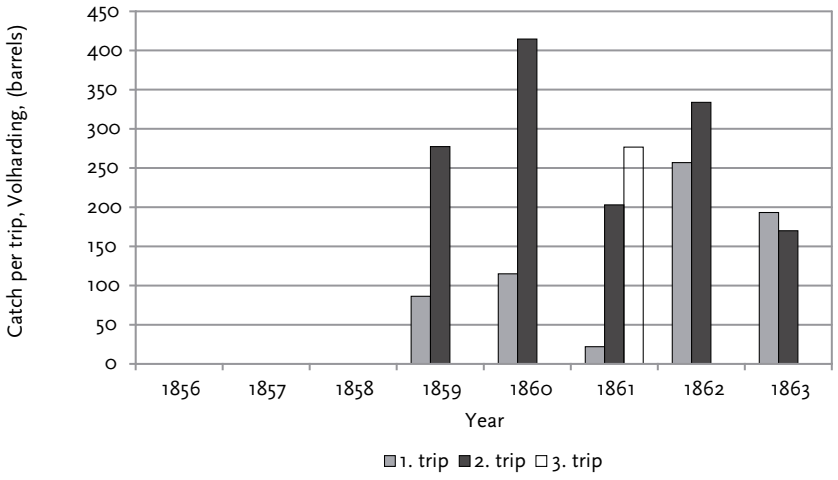
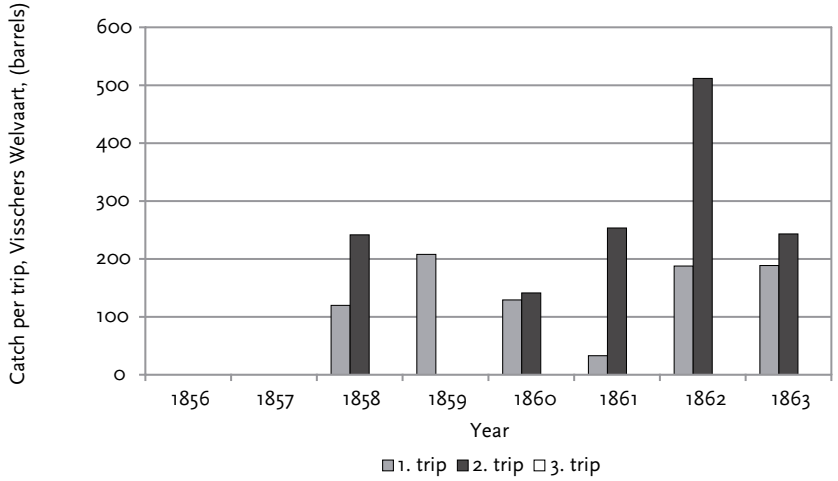


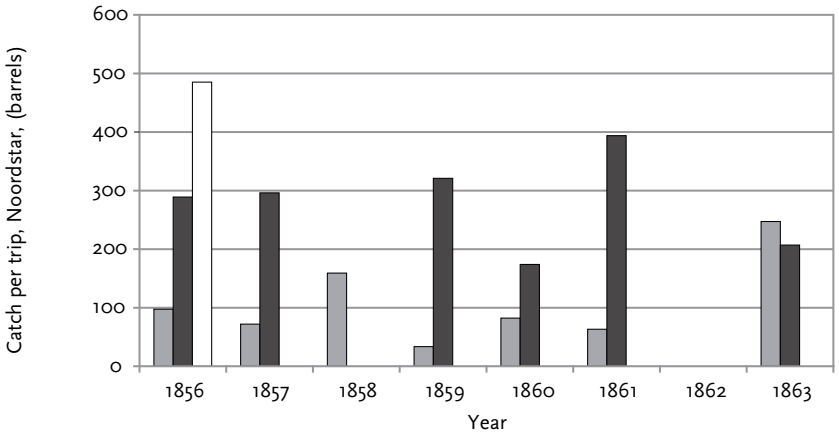
Figure 9.3

Annual performance of herring hoeker, Visschers Welvaart, 1858-1863.



ney was also undertaken on two occasions. In both cases the third journey appears to have been the most successful.

Figure 9.4
Annual performance of herring hoeker, Noordstar, 1858-1861 + 1863.



Which factors determine whether one, two or three journeys are made during the months of the fishing season? An answer to this can be found by examining how the catches of one single year, 1859, are distributed from the start to the end of the season. The figures 9.5-9.7 show the trips made by the same three vessels, all three departing from the port of Vlaardingen on the same day, 18 June, as represented by the blue lines in the diagrams. The red dots each represent one occasion of fishing. On the days of fishing, the driftnets were always set out in the early evening, and pulled back in during the early hours of the morning. Where, for example, the chart shows that the *Visschers Welvaart* caught the staggering amount of 62 barrels of herring on the 27 September, we can thus conclude that the herring was caught in the driftnets on the night between 26 and 27 September.

All three vessels started fishing on 28 June, and all three suffered a meagre harvest for the first four weeks of the season. A few herring then began to enter the nets, but *Noordstar* was the only boat capable of catching several barrels in one night. With a total of 33.5 barrels or the equivalent of 2.4 lasts aboard by the end of July, they decide to return to sell their cargo. 14 days after the last night of fishing of this first trip, they are back in the fishing grounds once again, setting out their nets on the night of 8 August.

Figure 9.5

Seasonal distribution of daily catches by Volharding in 1859.

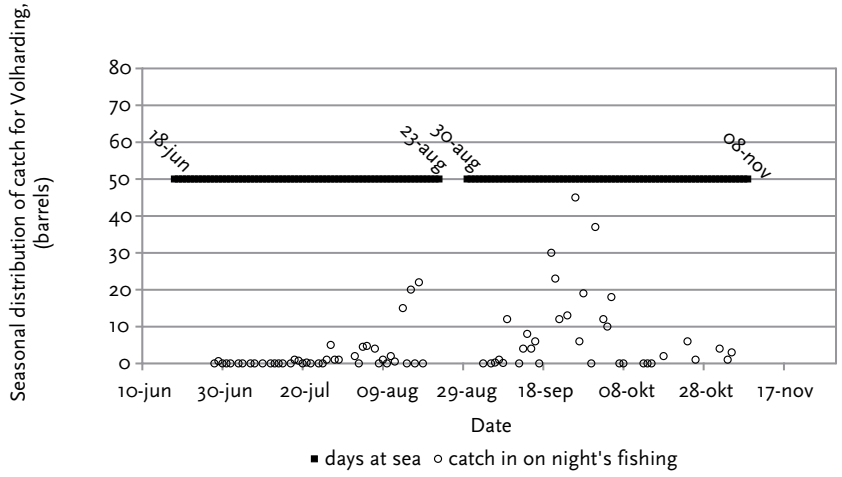
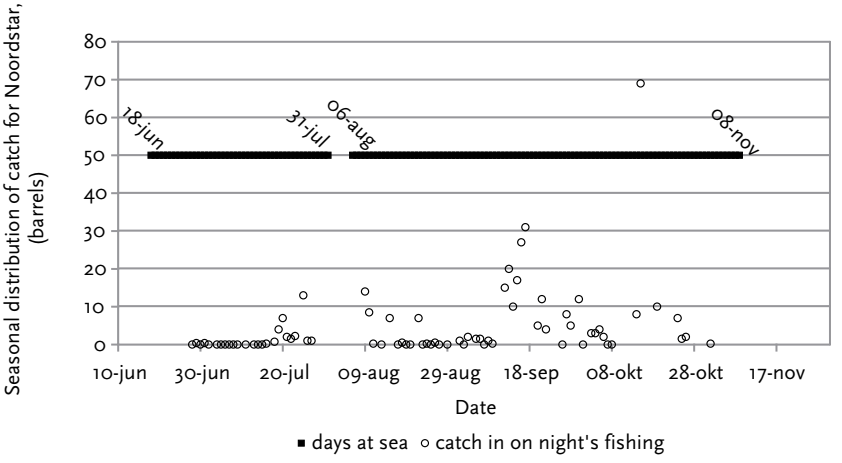


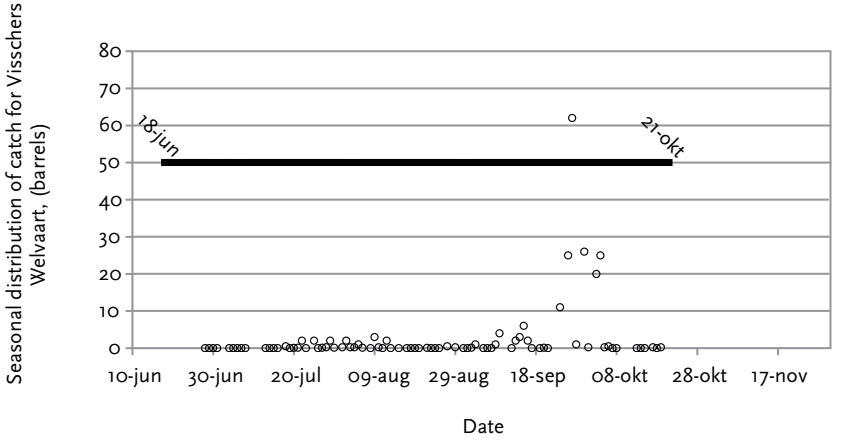
Figure 9.6

Seasonal distribution of daily catches by Noordstar in 1859.



By then, the other two vessels were still fishing, but in mid August the *Volharding* also hit a series of good catches, after which they sail home with just over 86 barrels, or 6.2 lasts of salted herring. By contrast, the *Visschers Welvaart* had a terrible season and by early September – with the *Volharding* as well as the *Noordstar* well into their second journey of the season – only 18 barrels of herring had found their way into the nets of the *Visschers Welvaart*.

Figure 9.7
Seasonal distribution of daily catches by Visschers Welvaart in 1859.



It took until mid September for the *Visschers Welvaart* to change its fortunes, catching a substantial amount of herring during the following two weeks, and landing in Vlaardingen for the first and only time this year on 21 October. 208 barrels or 14.8 lasts of herring were the fruits of their four months of hard labour at sea. The two other vessels both had greater luck with their second trip to sea, with the *Volharding* returning with 277 barrels or the equivalent of 20 lasts of herring. The *Noordstar* was even more fortunate, bringing home a total of 321 barrels, equalling 23 lasts of salted herring. The first half of August and most of September seem to have been the best periods for fishing, but the three skippers and their crew had quite different experiences in the season of 1859. However, it would not be fair to assume that the results of *Visschers Welvaart* were related to a lack of skills rather than luck, since the *Noordstar* had suffered a similar stroke of bad luck in the previous season of 1858.

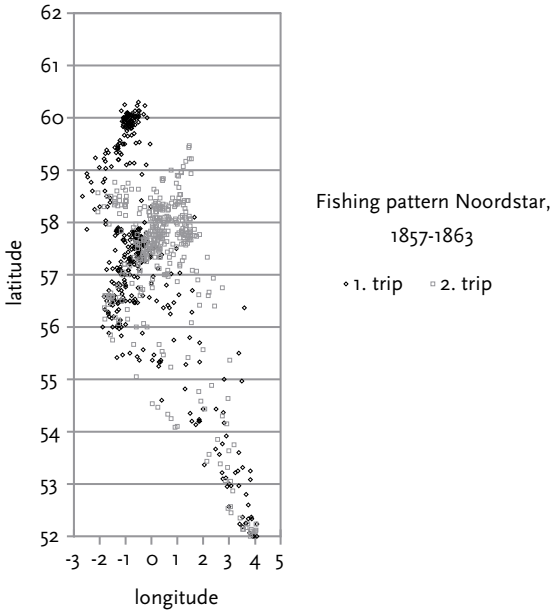
The daily entries of catch data from the various fishing trips by these three herring vessels illustrates the importance of the catch rates in determining the length of individual fishing trips. The better the catch in the early weeks of the season, the more likely it was that a second or third trip would be added to the first journey of the season.

Spatial distribution of fishing trips

So what is the spatial dimension of these three different fishing trips? Was the choice for a specific fishing location determined primarily by the season, or did tradition play a role in the sense of whether a vessel was fishing on

its first, second or third trip? This can be tested by looking at the spatial distribution of individual trips by individual vessels. For the years 1857-61 and 1863, all positions specified in the *Noordstar* logs are displayed in figure 9.8 according to whether they belong to the first or second journey of a season. The fishing pattern differs significantly from the first to the second journey. The first journey more or less follows the pattern of movement corresponding to June, July and partly August, while the positions of the second trip can be linked to the latter half of the season. Many positions however, seem to overlap. The waters off Scotland, from around The Firth to Aberdeen were especially often visited during both the first and second trip.

Figure 9.8
All daily positions for Noordstar, 1857-1863.



Having thus established a generalised spatial distribution for the first and second trip, it is useful to analyse in detail to what extent the vessels attempted to return to the same grounds they had last fished in, upon returning from landing the cargo of the first trip.

Spatial distribution of catches in 1859

The sailing routes used by the *Noordstar* in 1859 are displayed on figure 9.9, which illustrates how the rapid return to The Netherlands after the first voyage was followed by a westerly start to the second voyage. This could be partly attributed to the weather, but the crew resume fishing upon reaching the 57th parallel close to the Scottish shore, which is where they fished successfully at the end of the first trip. A similar pattern can be seen for *Volharding* in figure 9.10. The second journey of the *Volharding* commenced a couple of weeks later than that of the *Noordstar*, so even though the logbook of *Volharding* does not specify its route to the fishing grounds, the two ships cannot have followed one other. The *Volharding* though, also seem to have resumed their fishery upon reaching the area just east of Aberdeen. In the subsequent weeks of fishing, the two vessels chose different locations. The *Noordstar* had a good deal of success sailing due north to fish between the 58 and 59 northern latitude in September. In October and November though, the *Noordstar* has travelled east setting out its nets just east of the Greenwich meridian. This move brought the *Noordstar* close to the area where the *Volharding* were fishing all autumn, and not far from where the ill-fated crew of *Visschers Welvaart* found a bit of luck in the autumn months as shown in figure 9.11.

Figure 9.9

Daily position and catch for Noordstar, 1859.

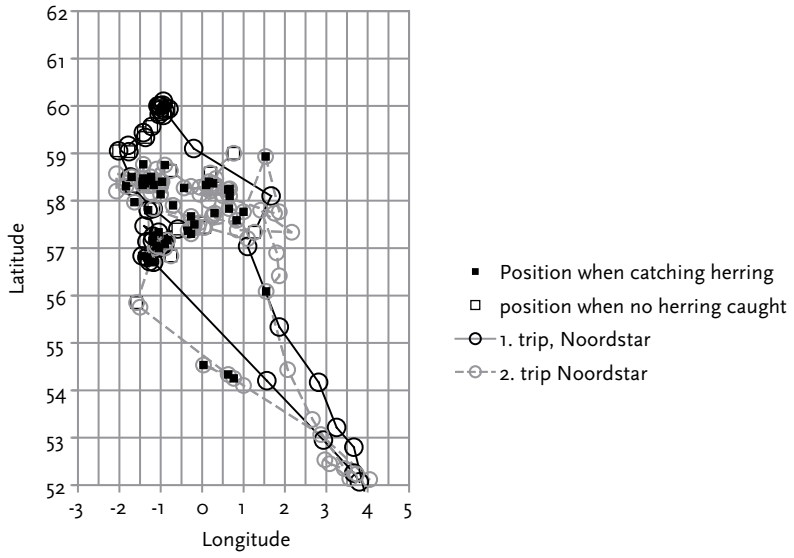


Figure 9.10

Daily position and catch for Volharding, 1859.

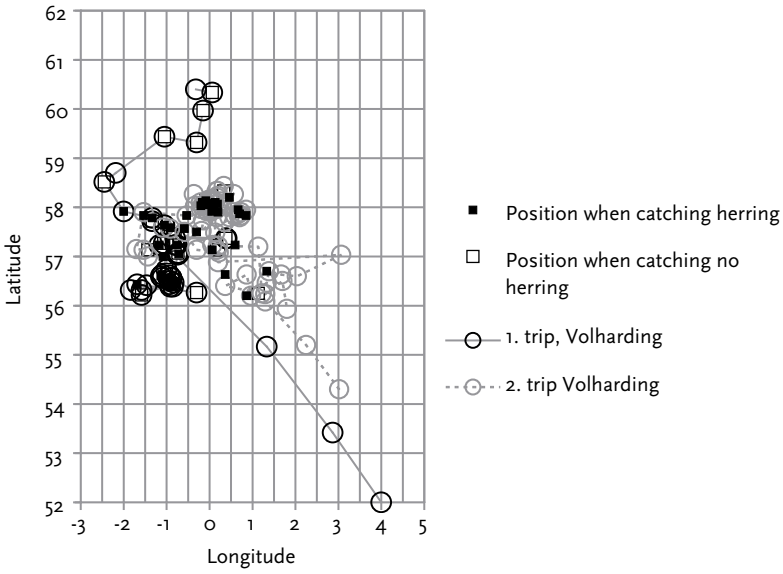
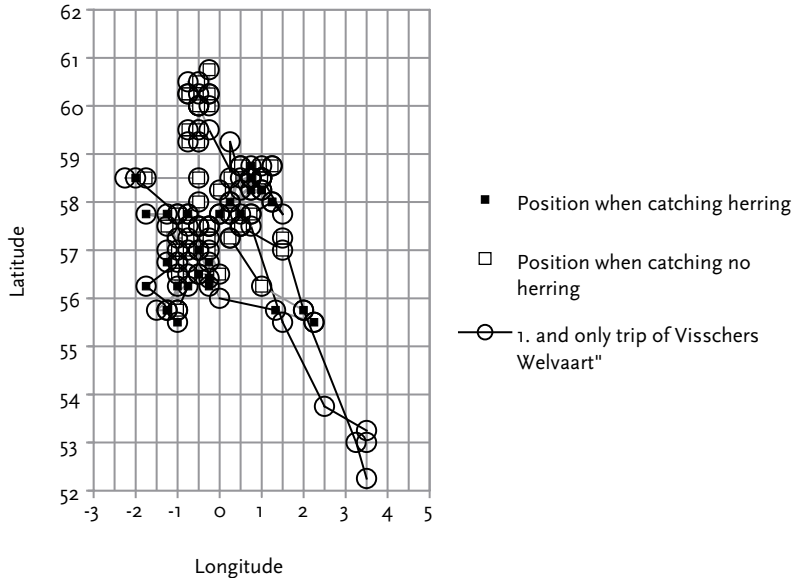


Figure 9.11

Daily position and catch for Visschers Welvaart, 1859.



The *Visschers Welvaart* followed the general seasonal pattern of movement, even if they had only completed a single trip. The other two vessels demonstrated how the timing of the homebound journey between the first and second trip does not seem to have influenced the seasonal pattern of movement, since they more or less resumed fishing where they last left off. This is underlined by the subsequent divergence when it came to deciding upon the northward and eastward routes for the autumn months. It appears that the main factor behind the chosen spatial pattern was a combination of a seasonal movement designed to catch up with the herring migration patterns, and the quest for a desirable catch and quality of herring, whereas the distribution of the first and second fishing trip does not seem to have played a significant role.

It does seem, however, that the fishing effort of the *Visschers Welvaart* was less geographically focused than the efforts of the other two vessels. In spite of the low catch rates – or perhaps because of them – it appears as if the *Visschers Welvaart* covered a larger geographical area during its fishing efforts, but is this really so? Following the day-to-day movements of the fishing vessels allows us to examine this relationship.

Travel distances and spatial distribution

To what extent does the catch on a given day influence the vessel's movements over the following day? The logbooks themselves do not reveal how many nautical miles a vessel travelled per day. However, the navigation coordinates allow us to measure the distance between two points. Since the Earth is round, the distance cannot be measured simply as a straight line between two points, but must be treated as a curve following the shape of the planet. This problem can be solved by applying a formula that converts navigational points into distance in kilometres.[11]

The herring vessels will rarely have followed a straight course when sailing from the navigational point of one day to the next. In the process of searching for shoals of herring they might have cruised back and forth, thus actually covering a larger area and thus distance than that found by measuring the distances between daily navigational points. Nevertheless, this systematic error applies to each data point, and is thus insignificant when establishing patterns of travel distances in relation to day-to-day fish finding and catch rates.

---

11 A formula for calculating the distance between two navigational points in miles can be found here: http://www.experts-exchange.com/Databases/GIS_GPS/Q_20383758.html this is multiplied by 1.609344 in order to convert miles into kilometres. The results found using this formula are tested against this online conversion form: http://www.wcrl.ars.usda.gov/cec/java/lat-long.htm.

The largest source of material for an analysis of the relationship between day-to-day catches and movement are logbooks from the herring vessel *Noordstar*, containing over 800 navigational reference points from 1857-61 and 1863. Having first applied the above formula to measure the distances travelled during 24-hour periods between noon and noon, these figures were compared with the size of the catch from fishing during the preceding night.

Next, the travelled distances were sorted and grouped into five categories according to both different catch rates when fishing, and the days of no fishing. In a handful of days, the *Noordstar* travelled more than 200 kilometres after having fished the previous night. The logbooks show that these long journeys occurred on the first day of a homebound journey, when the fishermen were not actively searching for fish. Therefore, these dates do not reflect the search effort and as a consequence all positions south of the 54th Northern Latitude were left out of this part of the analysis.

The figures 9.12-9.16 present the frequency of movement upon catching a given amount of herring. What stands out is a tendency to remain in an area when the fishing is good. The higher the catch rate the previous night, the less movement is observed the following day. When the crew aboard *Noordstar* had caught more than 10 barrels of herring in one night, the vessels moved less than 20 kilometres the next day. If the catch was smaller this tendency seems less pronounced. Following an average night, where less than 1 barrel of herring had gone into the net, the vessel tends to have moved more than 40 kilometres the next day in search of better opportunities.

Figure 9.12

Frequency of movement upon catching no herring the previous night.

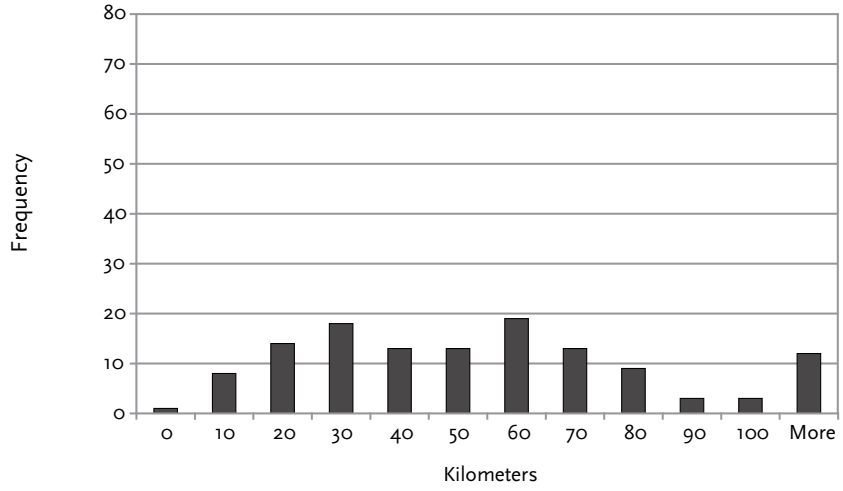


Figure 9.13

Frequency of movement upon catching <3 barrels of herring the previous night.

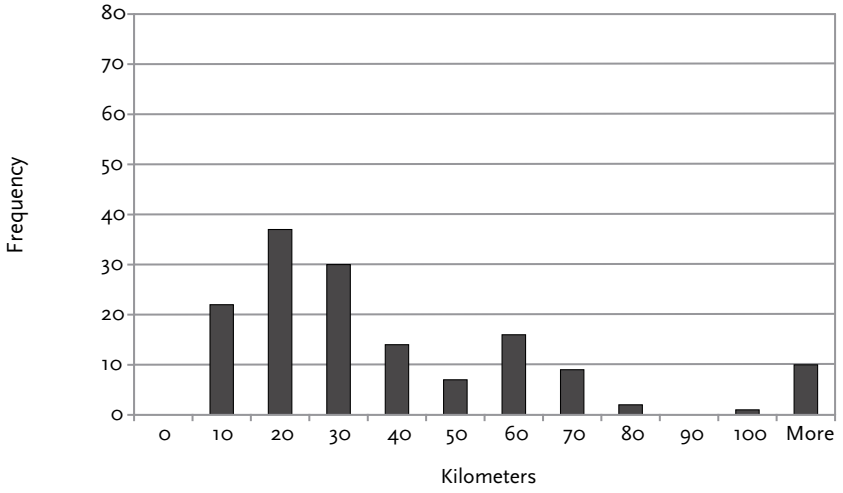


Figure 9.14

Frequency of movement upon catching 3-10 barrels of herring the previous night.

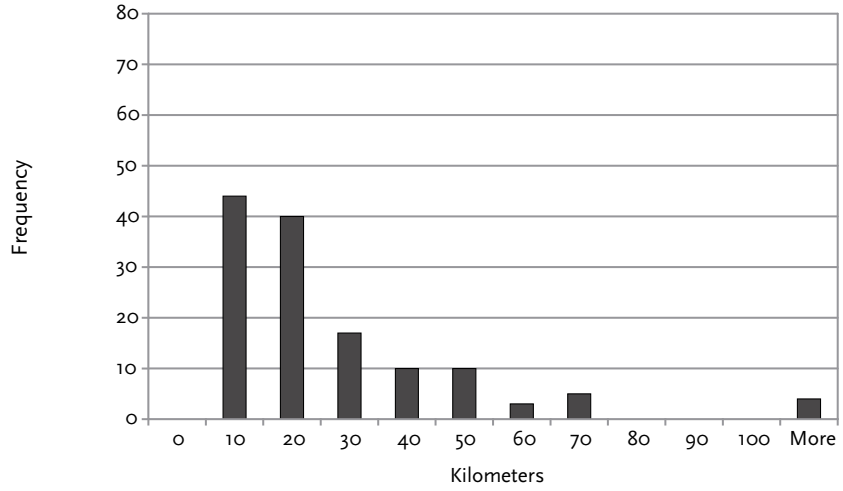


Figure 9.15

Frequency of movement upon catching >10 barrels of herring the previous night.

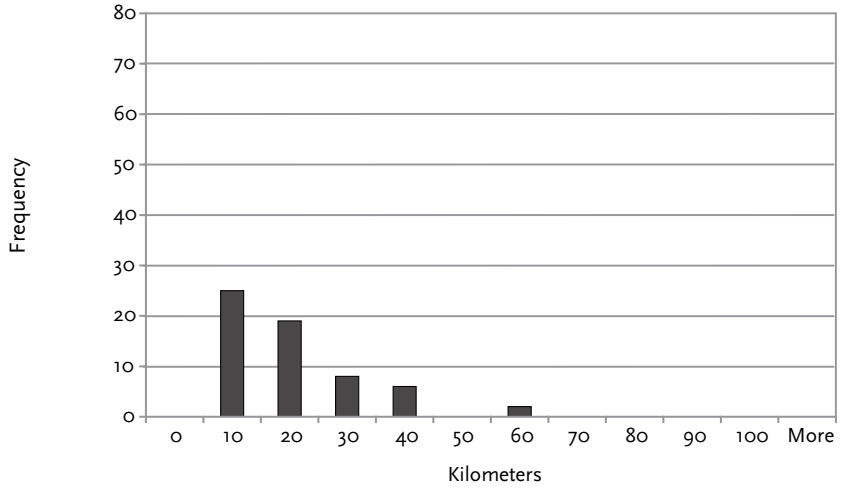
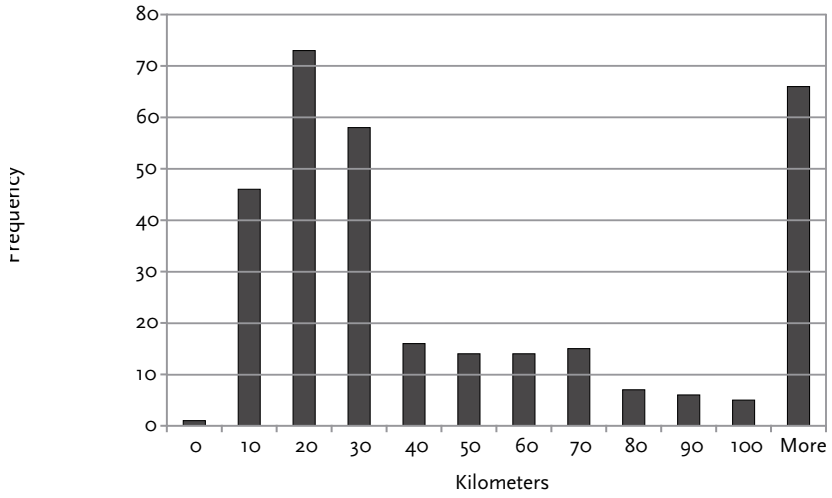


Figure 9.16

Frequency of movement after not fishing the previous night.



When no herring had gone into the nets, the fishermen seem to have searched a large area the next day, on average more than 50 kilometres away from the previous night's fishing grounds, and frequently more than 100 kilometres in one day.

Distances of more than 100 kilometres were also travelled in days following nights of no fishing. But although the average travelling distance on these days was 55 km, it frequently happened that less than 30 kilometres were covered. This phenomenon was most likely connected to factors that were not linked to the catch rates. In rough weather conditions, the fishermen would tend to rest rather than fish and travel, and Sundays was usually the weekly day of rest.

By travelling more on days following nights of bad fishing and vice versa the fishermen demonstrated an ability to adapt spatially to the highly migratory herring stocks. The above section has also established that the herring fishermen extended the length of individual fishing trips in response to the success of the fishing effort. As we saw above, the success rate dictated the duration of each fishing trip, but did this variation in days correspond to a similar geographical variability?

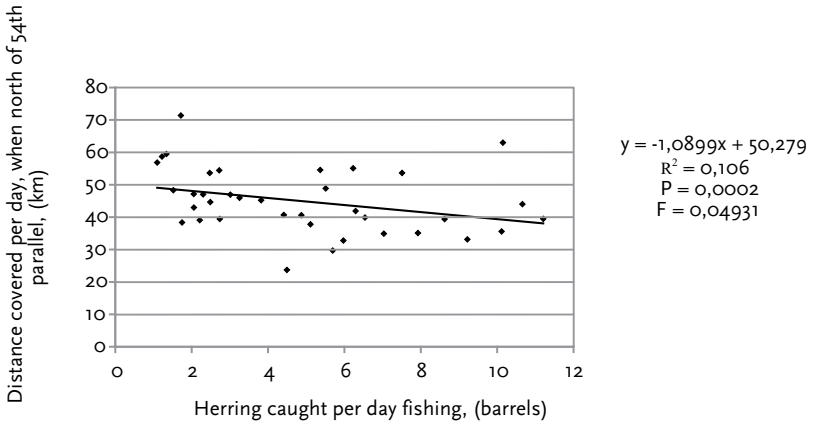
The detailed data on day-to-day movements and their relationship with catch sizes does not reveal to what extent the distances travelled during an entire trip correspond to the overall rate of fishing success, but were the fishermen actually capable of adapting to the fluctuating catch rates by moving on the basis of day-to-day catch rates on the scale of an entire trip of 40-100 days?

Catch rates and travel distance

The number of days fishing seems to be closely related to the number of days at sea. This can be verified by plotting the catch rates as catch per boat per day from a single fishing trip against the average daily travel distance per day at sea. In order to discount the long distances travelled between the Netherlands and the fishing grounds, all navigation points south of the 54th northern latitude have been left out. Figure 9.17 illustrates the relationship between the two factors, showing a slight but statistically significant drop in average daily travelling distance as the catch per day fishing increases. This means the catch rates influenced not only the length of the fishing trips in terms of the number of days, but also affected the daily travelling distance. A successful fishing trip, in other words, can be equated with little daily movement.

Figure 9.17

Catch rates as a function of travel distance (search area) for 37 trips, 1856-63.



With regards to the season of 1859, figure 9.11 illustrates how the spatial distribution of the *Visschers Welvaart's* hapless fishing efforts appeared to cover a larger area than the more successful vessels *Noordstar* and *Volharding*. The analysis of catch rates and travel distances has shown that an enlargement of the spatial pattern of fishing was a common way of trying to compensate for dwindling success when fishing. But the analysis also showed that on average the journeys with greater catch rates had travelled fewer kilometres per day at sea.

Discussion

Drawing on the results of studies – both contemporary and from the 1850s and 1860s – by the Royal Dutch Meteorological Institute KNMI, a clear seasonal pattern of movement by the Dutch fishing vessels was established. This anti-clock-wise cyclical movement meant that the fisheries started and ended in the Northern parts of the North Sea. Judging from the way in which the KNMI map highlights the seasonal direction of herring shoal migration, this seems to more or less correspond with the progression of the fishermen. In light of the sustained average increases in catch rates from the start until the end of the fishing season, it appears to have made good sense for the fishermen to follow this cyclical movement.

This pattern can be compared with knowledge of the present-day distribution of North Sea herring stocks. The population of herring in the North Sea consists of both spring spawning and autumn spawning herring. The autumn spawning stocks are the most prolific and consist of three sub-populations or stocks, primarily separated by different migration patterns and spawning behaviour. The Northern stock, Buchan herring, spawns in the area between the Shetland Islands and the Scottish east coast off Aberdeen. The Bank herring has spawning grounds off the English coastline in between Yorkshire and Norfolk as well as on the Dogger Bank, in the central North Sea. The third and southernmost herring stock in the North Sea is the Downs herring, which spawns in the Southern Bight of the North Sea and the English Channel.[12]

At the start of the season, the fishing grounds around Shetland resemble the spawning grounds of the Buchan herring, while the rapid southward move by fishers towards the Scottish coasts in July and between Northern England and the Dogger Bank in August would suggest that the Buchan herring or the so-called Bank herring were the likely target in these months. With regards to the autumn months when the herring fleet went north again, there is no clear data in the KNMI reports to confirm whether only one or both of these sub-populations of herring were the intended target. To the extent that the Dutch herring fisheries targeted the most attractive of the North Sea herring fisheries, the fishing pattern indicates that the two northern sub populations of herring provided the largest available abundance.

But how could the fishermen know where to fish, and how did they figure out the underlying dynamics of movement for the individual fishing vessels? The logbook data offers highly detailed, data, allowing us to analyse catches and catch rates for the individual fishing trips of three different herring ves-

12 Corten, *Herring and Climate*, p. 85.

Figure 9.18

Buysmans

This image was found on the inside cover of specially produced seamen's books containing psalms and maritime stories from the Bible. The fishermen hardly ever set their nets out on Saturday. In this way they could relax and sing together on Sunday morning.
Source: Schaink, H., Buysmans rustpoosen op de neering; zynde een ige predikatien gedaen op buysse dank-en bededagen voor de gemeente van Enchuysen; als mede een ige korte predikatien gedaen op het Oost-Indische huis aldaer ... (1733), 7353, Collection Visserij & Vlaardings Museum, Vlaardingen.

sels over several seasons. The sampled fishing vessels were seen to follow the same general pattern of movement as the fishing fleet as a whole, with the exception that they did not sail as far to the north as suggested in the KNMI analysis of the entire fleet. The spatial distribution of catch rates for all three vessels was extremely small in the early part of the season, whereas all three eventually secured one or more series of good catches towards the final months of the season, also in line with the fleet behaviour as a whole. The results of analysing the individual fishing trips of individual vessels indicate that the catch rates seem to have determined the length of the individual fishing trip. The better the catch in the early weeks of the season, the more likely it was that a second or third trip would be added to the first journey of the season.

When it comes to the the spatial dimension of the fishing trips, it can be examined whether or not the choice of fishing location was determined primarily by the season, or if decisions were based on whether a vessel was on its first, second or third trip.

This was tested by examining the spatial distribution of individual trips by individual vessels. The general spatial pattern seems to have been dictated by the calendar, regardless of whether the fishermen were on their first, second or third trip. It has also been demonstrated that the vessels tried to go back to the same grounds in which they had last been fishing upon returning from landing the previous trip's cargo.

The spatial dimension of the time allocated to searching for fish was also factored into the above analysis. The spatial distribution of the fishing efforts by the *Visschers Welvaart* appears to be less focused than the efforts by the other two vessels included in the analysis. An analysis of the day-to-day movements of the fishing vessels allowed us to examine the relationship between travel distances and the success of fishing. The results suggest that by travelling more on days following nights of bad fishing and vice versa the fishermen demonstrated an ability to adapt spatially to the highly migratory herring stocks. The low catch rates thus make it appear as though *Visschers Welvaart* covered a larger geographical area when fishing.

It was also demonstrated that the herring fishermen extended the length of individual fishing trips based on the success of their efforts. The success of the fishing effort dictated the duration of each trip. Furthermore, the duration of each trip corresponded to its spatial scope, and an enlargement of the search area proved to be a common method of compensating for dwindling success. On average though, the fishermen on fishing trips with higher catch rates had travelled fewer kilometres per day at sea than they had on less successful trips. This means it was not possible to fully compensate for poor fishing by increasing the area of fishing and the length of the fishing trip.

Conclusion

This chapter presented the first in-depth study of the spatial dynamics of mid 19th century Dutch North Sea herring fishery. The archival data from the Royal Dutch Meteorological Institute's eight year long study of the methods used to optimise herring catches in the North Sea has been instrumental in creating a documentation of the seasonal fishing patterns. Based on 20 log-books kept by Dutch herring fishermen in the period between 1856-63, the main factors affecting the dynamics of the herring fisheries' spatial patterns have been analysed.

On a seasonal level, the spatial patterns reflect an attempt to follow the migration patterns of herring in the north eastern part of the North Sea, most likely the Buchan and Dogger subpopulations. The seasonal distribution of fishing was divided into a first, second and occasionally third fishing trip, but whether a ship was on its first or second trip does not seem to have played a significant role in terms of the spatial pattern of fishing.

On a day-to-day level, the analysis of this spatial distribution of individual fishing trips has enabled an assessment of the fishermen's geographical responsiveness to fishing success rates. In a clear day-to-day response, the fishermen's travel distance is strongly affected by the previous night's catch. On average though, the fishermen were not able to fully compensate for dwindling catch rates by increasing the average distance they travelled per day.

10 | Long-term spatial distribution of fisheries, 1600-1892

Introduction

"I remember a night near Bahia, when I was enveloped in a firework display of phosphorescent fireflies; their pale lights glowed, went out, shone again, all without piercing the night with any true illumination. So it is with events; beyond their glow, darkness prevails."[1]

French historian, Fernand Braudel was not necessarily thinking about fisheries when he coined the above analogy of fireflies and historic events. But the fleeting apparitions of fireflies against a background of darkness perfectly illustrate the starting point for this chapter. The movement and fishing patterns of the Dutch North Sea herring fisheries appear only in glimpses in an age before modern statistics. Nevertheless, this chapter offers a series of snapshots of the monthly fishing pattern from June – January through the use of contemporary accounts, historical maps, mid-19th century scientific surveys as well as logbook material from hospital ships and convoy ships from the 17th – 19th centuries. The chapter argues that the fishing patterns observed thus can be regareded as indicators of the best fishing areas in the

1 Braudel, *On History*, pp.10-11.

North Sea at given points in time within these three hundred years. The spatial distribution of an offshore fishery has never before been documented this far back in time.

On a methodological level, this reconstruction of the spatial dimensions of a past marine resource exploitation combines historical research techniques and modern marine science. The findings highlight the historical aspects of natural stock variability, while the reconstructed fishing patterns allow us to further investigate the context of current theories on the behaviour of both the autumn spawning herring in the North Sea as well as the fishermen hunting them.

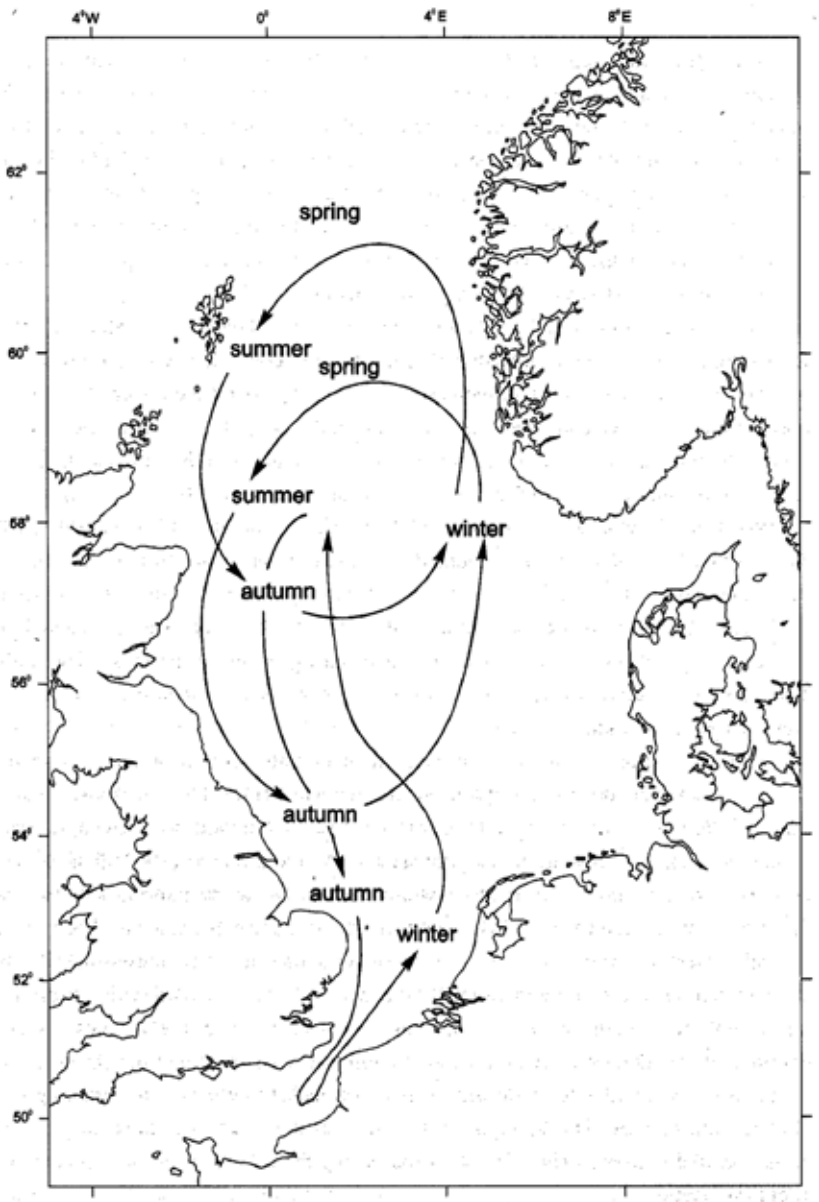
Fishing ground historiography

Present distribution of North Sea herring

The spatial distribution of North Sea herring has been the focus of much marine research in the past 50 years. The population of herring in the North Sea consists of both spring spawning and autumn spawning herring. The autumn spawning stocks are the most prolific and since these were the targets of Dutch fishermen, they will be the focus here. In the 1950s and 1960s, marine biologists Cushing and Bridger investigated the lengths and growth rates of different North Sea herring, discovering that the autumn spawning herring consist of three sub-populations or stocks, primarily set apart by different spawning behaviour patterns and characteristics. The Northern stock, Buchan herring, spawn in the area in between the Shetland Islands and the Scottish east coast off Aberdeen, while the Dogger Bank herring prefer spawning grounds on Dogger Bank and off the English coastline. The third, southernmost stock is the Downs herring, spawning in the Southern Bight of the North Sea and the English Channel. (figure 10.1).[2]

2 Cushing and Bridger, 'The stock of herring in the North Sea', p. 17.

Figure 10.1
Present-day annual migration of North Sea herring.



The Buchan herring tend to spawn first, followed by the Dogger, while the Downs herring spawn in late autumn. In winter and spring all three sub-

populations drift in around the North Se in an anti-clockwise movement, wintering in the eastern part of the North Sea. The Buchan and Dogger Bank herring continue to the North Eastern areas during spring, feeding on zooplankton, primarily the copepod, Calanus finnmarchicus. By around June, the Buchan herring have returned to the waters off the Shetlands.[3]

During the last twenty years, several studies have been conducted of the relationship between climate and herring. Scientists Alheit and Hagen proposed that long-term developments in temperature affect the abundance as well as the spatial distribution of herring, sardines and anchovies in Northern European waters. A comparison between different testimonies from a number of shore-based fisheries revealed similarities on a decadal level with regards to the abundance of herring in various areas, such as Western Norway, the Swedish west coast at Bohuslen and The English Channel. No information was available with regards to the historical abundance and distribution of high seas herring fisheries in the North Sea.[4]

Recently, the spatial aspects of the relationship between climate and the natural variability of North Sea herring have been studied by marine biologist, Corten. In the light of surveys undertaken since the 1950s, Corten suggested that the so-called North Atlantic Oscillation (NAO), which is the driving force behind weather systems, sea temperatures and ocean currents in the North Sea, is responsible for changes in the spatial distribution of North Sea herring.[5]

Ideally though, the proposed links between herring and climate change should be tested against longer time spans, taking into account the long-term spatial distribution of the various sub-populations. In order to address this issue properly, a historical reconstruction of the fishing pattern will be necessary.

In recent years, much ground has been gained by using historical data to reconstruct the offshore spatial distribution of fishermen and marine species. The mid-19th century biomass of cod in the Gulf of Maine has been calculated through the elaborate use of logbooks kept by New England cod fishermen.[6] A similar set of whalers' logbooks from the mid-19th century containing information on whale sightings have been used to reconstruct the spatial distribution of North Atlantic right whales.[7] With regards to European waters, the spatial distribution of the Swedish cod and ling fisheries in the Skagerrak and North Sea have been documented for a period of approx. fifty years in the

3 Cushing, *Climate and Fisheries*, pp. 58-63 and pp. 199-208.
4 Alheit and Hagen, 'Long-term climate forcing', pp. 130-139.
5 Corten, *Herring and Climate*.
6 Rosenberg *et al.*, 'The history of ocean resources', pp. 78-84.
7 Reeves et al., 'North Atlantic right whales', pp. 295-305.

late 19th and early 20th centuries.[8] If we look further back in time, there are no previous reconstructions of the exact whereabouts of offshore fisheries and whaling activities; with regards to North Sea herring, however, the most suitable historical data for such a reconstruction can be derived from the Dutch North Sea herring fisheries between approx. 1600-1892.

Historiography of Dutch herring grounds

From the 16th – 18th century, the Dutch herring fisheries were the largest in Europe. Fishing with driftnets from large vessels known as busses and hoekers, the fishermen carried provisions, salt and barrels, allowing them to stay at sea fishing and processing the catch until every barrel was full, for periods of as long as three months at a time. The Dutch were thus capable of sailing to where the herring was, unlike the various shore-based fisheries around the North Sea, which were all vulnerable to local changes in the distribution of herring. Since the Dutch used the same technology and set of regulations from the late 16th century until 1857, the spatial pattern of the Dutch herring fisheries can be used as an indicator of the best historical fishing grounds in the North Sea.[9]

Historical research on the Dutch fisheries has devoted little attention to the issue of fishing patterns. One plausible reason for this could be that the availability of natural resources has often been regarded as a historical constant, something unaffected by time. Another reason might be that there was complete consensus as to the seasonal pattern of herring fishery in the North Sea. This was outlined in great detail by Dutch historian Kranenburg, in reference to four different primary sources:

Both a late 16th century fish auctioneer from the Dutch town of Scheveningen and a 17th century French ambassador to the Netherlands described the seasonal movements of fishermen. Both sources made reference to an initial trip to the North along the Shetlands and Orkneys to fish for maatjes and full herring, a second trip to the Dogger Bank area, and a third trip to the waters off East Anglia.[10] Kranenburg also found this pattern in a description of the Dutch herring fisheries from 1640, in which the author, Semeyns, mentions the area between the Shetlands and Buchan Ness in Scotland as the preferred fishing grounds until the end of July, followed by a shift in autumn to the south eastern part of the North Sea off Great Yarmouth in East Anglia. In some cases, the fisheries would continue throughout December and January. Finally, Kranenburg found references to the gradual shift from north to south

8 Poulsen, 'North Sea ling and cod fisheries'.

9 Kranenburg, *De zeevisscherij*.

10 Boelmans Kranenburg, 'fisheries and the Shetlands', p. 101.

in a German treatise on economic matters published in 1780.[11]

Another 18th century source of information is the merchants' magazine *De Koopman*, which was published weekly in the years, 1768-1776. In volume 1 from 1768, the seasonal distribution of the herring fisheries is listed as follows: 'van 24 Juny tot 25 July, omtrent Fairhill en Hitland, enz. / – 25 July – 14 Septemb. – Boekenes en Seveniot / – 14 Sept. – 25 Novemb. – In 't Diepwat. beöosten Yarm. / – 25 Nov. – * February – verder op by Yarm. en Nordfolk.'[12]

This pattern was recently acknowledged by Dutch historian Adri van Vliet, who added that the fisheries would sometimes continue into the English Channel during the months of December and January.[13]

In the first half of the 18th century, a report on the state of the British fisheries mentioned the methods of their Dutch competitors, with details concurring with the aforementioned pattern.[14] A letter dated 9 March 1785 by an individual from the herring capital of Lerwick in the Shetlands commented on the Dutch summer fishery: 'The vessels often fish within sight of land, and sometimes very near it, so as they are seen riding under their nets from the shore, but that is always with an off-shore wind. They shift ground as they find herring more to the north or south, but are seldom upon the coast, at least a few of them, after the end of July, or first week of August, alleging that the herrings all go southward as the season spends, and they generally end that fishery near Yarmouth.'[15]

Consistent with the north-south pattern, Dutch historians Van der Veen and Pons each presented a map of the north seas herring fisheries.[16] Both maps are reproductions of a map originally drawn up in 1892 and published two years later by the Dutch ship owner and tradesman Arij Hoogendijk in his publication on the state of Dutch fisheries (figure 10.2 on page 193). In the legend, Hoogendijk describes to an area marked with yellow and the letter "H" in the central northern part of the North Sea as 'grounds where 'northern herring' used to be caught in October.'[17] This area on Hoogendijk's map does not appear in the later reproductions, so that the 'H' on the original map is the only remaining reference to deviate from the north-south pattern.

This is linked to another difference of opinion regarding the existing historiography. According to some commentaries, the season lasted un-

11 Kranenburg, *De zeevisscherij*, p. 15.
12 Boon, *De Koopman*, p. 356.
13 Van Vliet, *Vissers en Kapers*, p. 46 and Van Vliet, *Vissers in Oorlogstijd*, p. 66.
14 Anonymous, *The British Fishery*, pp. 18-20.
15 Knox, *A view of the British Empire*, p. 274.
16 van der Veen, 'niet gegane bedrijfstak', p. 144 and Pons, *De bakens verzet*, p. 11.
17 Hoogendijk, *De grootvisscherij*, pp. 185-186.

til November, while others are convinced aw the season extended until the end of January. How frequently did the fishing season extend into the winter months?

Since this analysis spans almost 300 years, the available data is quite heterogeneous and unevenly available over the three centuries. In general, the most recent source material has the highest quality. The late 19th century therefore, is the starting point for this reconstruction, which will gradually extend backwards in time to provide an overview of the entire period from approx. 1600-1892.

How long was a season?

With the Dutch herring fisheries starting on 24 June and ending on 31 January, the season would last a maximum of 222 days. But how long was the actual fishing season during the years 1604-1850? From the late 16th century until 1857, the nature of the organization of the Dutch herring fisheries prompted a registration of all vessels landing their herring in the Dutch ports. Sampled registers of all herring batches destined for the towns of Schiedam (1604-1788) and Vlaardingen (1814-1850) list approx. 8000 cargoes. The lists show that the batches from each season were sorted by month of landing and grouped June-November, December and January, indicating that the fishermen always fished until the month of November, but not in December or January. (figure 10.3.)

Figure 10.3

Frequency of landings per month, 1604-1850.

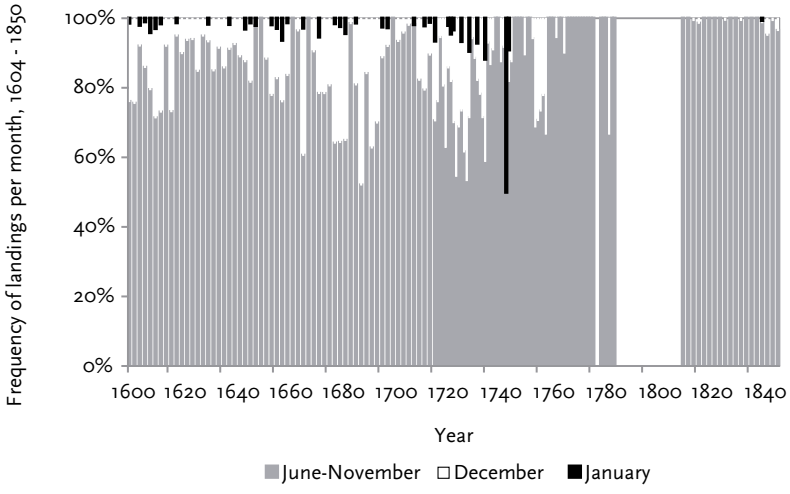
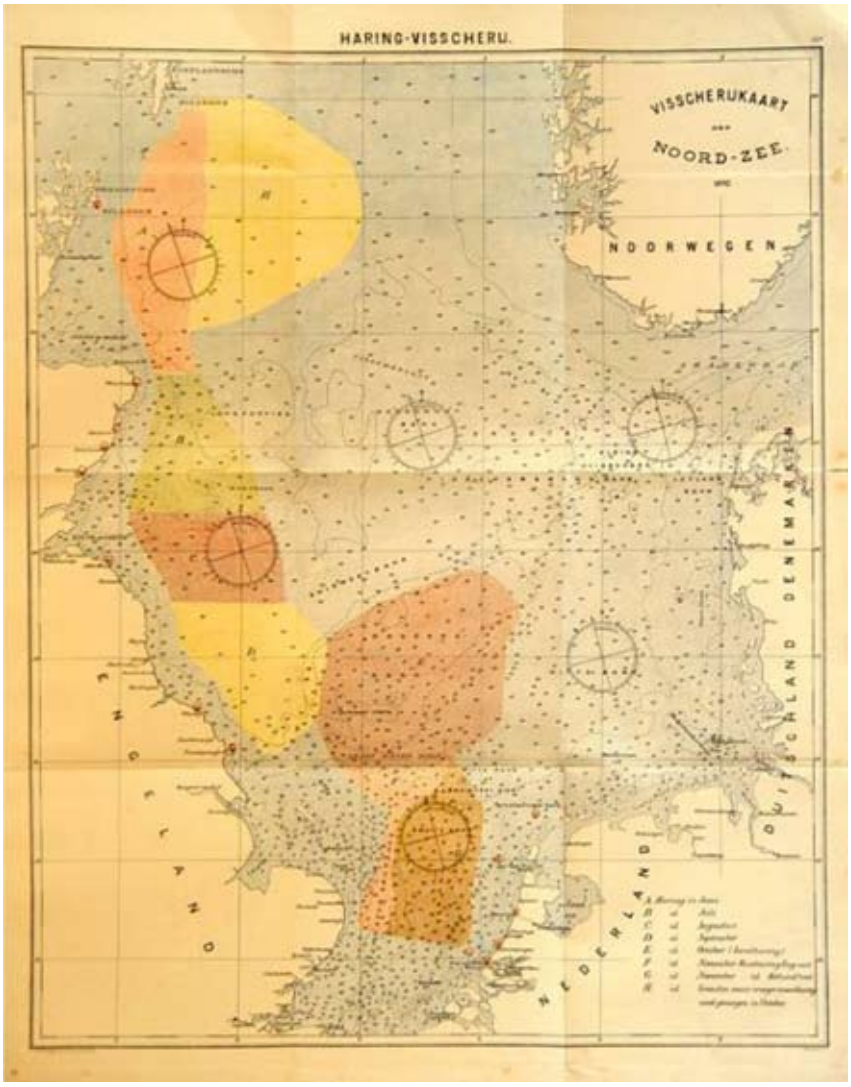


Figure 10.2

Contemporary map showing monthly distribution of fishing efforts, 1892.



Between 1604 and 1748, Dutch fishermen would occasionally return from a fishing trip in January. In the same period it happened virtually every year that the fishermen were out fishing during December, while this became rare from the mid-18th century onwards.

Data analysis

Seasonal fishing pattern, 1856-1863

In 1856, the director of the Royal Dutch Meteorological Institute (KNMI), Dr. Buijs Ballot, wrote to all ship owners involved in the Dutch herring industry, and asked for their help in 'clarifying the optimal circumstances for fishing herring.'[18] The reports analysed in chapter 9 contains summaries of each year's fishing, and a map illustrating the success rate as well as the seasonal distribution of the fisheries (figure 9.1).

The map drawn up in February 1862 was based on the herring logbooks from the previous six years. According to the legends on the map, the best fishing areas depended on the time of year. Divided into six months from the start of the season in June until November, the ideal fishing trip would start in the area around Fair Isle between Shetland and the Orkney Islands in June, fishing between 59° and 60° N. By July however, the best fishing ground had moved south to the west of Scotland and through to the English border, while the best fishing in August could be had by staying in the same area and then continuing southward until the waters off Newcastle around 55° northern latitude, followed by a turn east towards the northern edge of the Dogger Bank.

In September the picture was notably different and the most favourable fishing took place in an area twice the size of the previous months, stretching north from 58° to 59.5°, and east to west from below the Orkneys at 2.5° west of Greenwich until 2° to 3° east of Greenwich. This wide area of optimal fishing was extended further north in October into the present-day fishing bank Fladen ground, when the nets would reap the greatest harvest from around 58.5° to 60° N. In November yet another northward movement was notable to the west of the Shetland Islands, bringing the fishermen even further north by the end of the season than they had been when they started out in June.

The KNMI map, however, not only showed the best fishing places for each month, but also revealed a striking difference in catch rates. In June, an average fishing boat would catch a mere 1.25 barrels of herring every time the nets were brought in and the likelihood of catching anything was only half that of not taking any herring. As the months went by, however, the catch rates improved. By September an average of seven barrels were caught upon every attempt and the chance of success was more than three times as high as the chance of not catching anything. Two months later in November, the average catch had doubled to 15 barrels, and the chance of getting herring in

18 NSA, Inv. no. 1994.0697, *Uitkomsten verkregen uit de journalen der haringschepen.*

the nets was five times as high as the chance of not seizing any.

Finally, the 1862 map roughly echoes not just the fishermen's movement but also the seasonal migration of the herring, which went south in June and July, whereas August was a turning point after which the autumn months saw the herring move in a north–north-easterly direction, as far north as this basic commercial data allows us to follow the fish.

Based on the results of the KNMI's contemporary analysis of the logbook material, the seasonal pattern of the fishing vessels forms an anti-clockwise cyclical pattern starting and ending in the northern parts of the North Sea. Judging from the way in which the KNMI map highlights the seasonal migration of the herring shoals, the movement would seem to more or less correspond with the progression of the fishermen. Considering the average increase in the season's catch rates, it appears to have made sense for the fishermen to follow this cyclical movement.

But how unique was this pattern? How far back in time had it existed? Did it date back centuries, or was it a merely temporary shift in a more recent pattern of fishing?

Spatial distribution of hospital ships, 1819-1857

In 1801, the government of the newly declared Batavian Republic, which succeeded the Dutch Republic of the late 16th century, reinstated the old regulations concerning the herring industry.[19] These rules mainly pertained to issues concerning the catch and processing of the herring, but as an innovation the purpose and equipment of hospital ships were mentioned for the first time.[20] The fishing industry would finance the equipment of one or more of these boats, each of which carried on board a surgeon, a carpenter, extra anchors, sails and ropes. If a fishing vessel were to lose a fisherman at sea, the hospital ship could even provide an extra set of hands, by lending out a ship's mate. The hospital ships were obliged to be present at the fishing grounds during the fishing season, and were allowed to go ashore only to get provisions of food and water. Finally, the captain was '...obliged to keep an accurate journal every day of the trip...'.[21]

Some of these journals still exist. The archives of the *College van de Grote Visserij* contain 21 logbooks from hospital ships in service during the 1816-

19 NA. CGV, inv. no. 686, 'Publicatie van het uitvoerende bewind der Bataafsche Republiek, houdende Ordonantien en Maatregelen, concernerende het Vangen, Zouten, Havenen, Keuren, Pakken, Ophoogen en Leggen van den Haring, enz'., (Delft, 28 July 1801).

20 Beaujon, *Nederlandsche Zeevischerijen*, p. 200, pp. 220-222.

21 NA. CGV. inv. no. 686, *Publicatie*, 69.

1857 period.[22] The 1801 regulations seem to suggest that two hospital ships could be in operation at the same time, but the logbooks themselves contain no mention of a second hospital ship, and the archives only refer to one ship per season. The logbooks contain a wealth of information on the Dutch North Sea herring fisheries during this period. Most of the logbooks contain daily annotations on the position of the hospital ship, the weather situation as well as information on the fleet of herring vessels. They also contain information regarding the duties of delivering prescriptions, fresh water and provisions to the fishermen, as well as taking care of fishermen with more severe illnesses.

The hospital ship logs cover a period of time in which documents from the fishing vessels themselves make no mention of the actual place of fishing. Therefore, they form an important source of information in this matter. The hospital ships were active for more than 100 days each season, and with entries being made on a daily basis, it has proven necessary to take a sample from four of the available copies. These samples seek to cover as much of the period between 1816-57 as possible. Another precondition was that the logbooks should contained precise information on the geographical position of the hospital ship in order to facilitate a reconstruction of navigation points. The analysis below thus refers to the logbooks from the *Cornelia Lucia* for 1819 and *De Morgenster* for 1828. The season of 1840 is covered by *Scheepsbouwlust*, while *De Drie Gebroeders* covers the fishing season of 1857. The captain of the hospital ship should '...continuously sail around in the midst of the fleet of herring vessels paying attention to where help was needed.'[23] If the positions of the hospital ships are known, we should thus be able to use this information as an approximation of the Dutch herring fleet's geographical position.

Positions of De Drie Gebroeders, 1857

In order to check the reliability of the hospital ship logs, we can compare the KNMI logbook material for 1857 (figure 10.4.) with the seasonal movement of hospital ship *De Drie Gebroeders* in that same year. (figure 10.5.)

The same principle was applied to the hospital ship *De Drie Gebroeders*, also divided into the months June-October in which the hospital ship was active. In the month of June, the fishing vessels and *De Drie Gebroeders* are located just off the coasts of the Shetland Islands, while they both travel south during the month of July, fishing along the Scottish east coast until the area

22 NA. CGV. inv. no. 380, *Cornelia Lucia* 1816; inv. no. 381, *Cornelia Lucia*, 1819; inv. no. 382, *Juno*, 1820; inv. no. 585-586, *De Morgenster*, 1827-28; inv. no. 587-591, *Scheepsbouwlust*, 1838-42; inv. no. 592-602, *De Drie Gebroeder*s, 1847-1857.

23 NA. CGV. inv. no. 686, *Publicatie*, 68.

off the Firth of Forth. In August, the fishing vessels concentrate their efforts off the coast of Scotland, whereas the hospital ship can also be traced to the area between the Shetlands and Scotland for a few days. However, this is due to the fact that the hospital ships used the Bay of Lerwick on the Shetlands to acquire new provisions. In September, the hospital ship and fishing vessels relocated their efforts in an eastwardly direction. In October, *De Drie Gebroeders* travelled back to the Netherlands, and left the remaining fishing vessels unattended.

This means that for the last part of the fishing season, after approx. 1 October, it is not possible to follow the movement of fishing vessels through the written accounts of the hospital ship. The hospital ships' logbooks however, also reveal information on fishing vessels, and regularly contain data on the amount of fishing vessels they spotted. The logs of *De Drie Gebroeders* contain information on 'sightings' of fishing vessels, as illustrated in figure 10.5. Apart from a few sightings of herring vessels as the hospital ship sailed to and from the fishing grounds, all sightings occurred at the site of the actual fishing effort.

Figure 10.4

The movement of 20 herring busses covering the seasons 1856-1863.

Each dot on the map represents one navigation point, coloured to represent the month (June(6) – November(11)) in which it was logged.

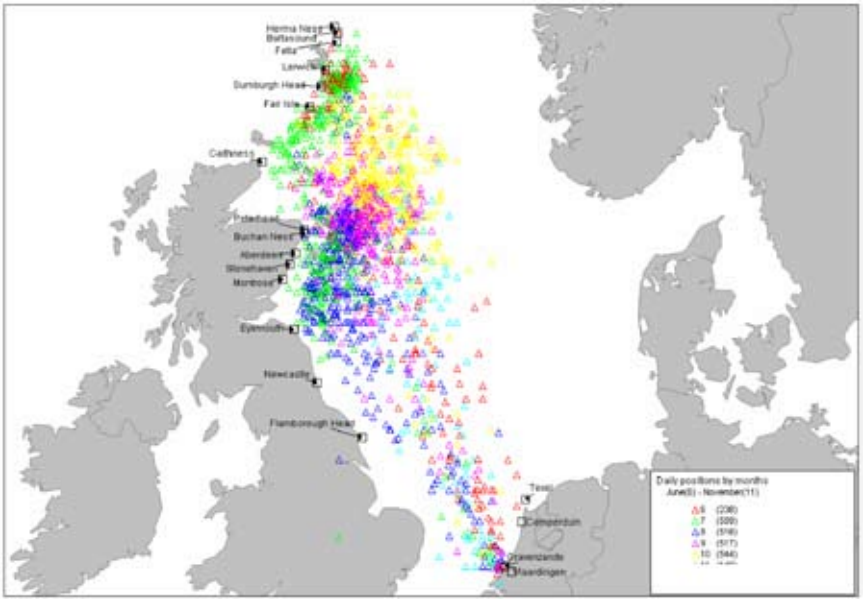


Figure 10.5

Monthly movement of hospital ship, De Drie Gebroeders, 1857.

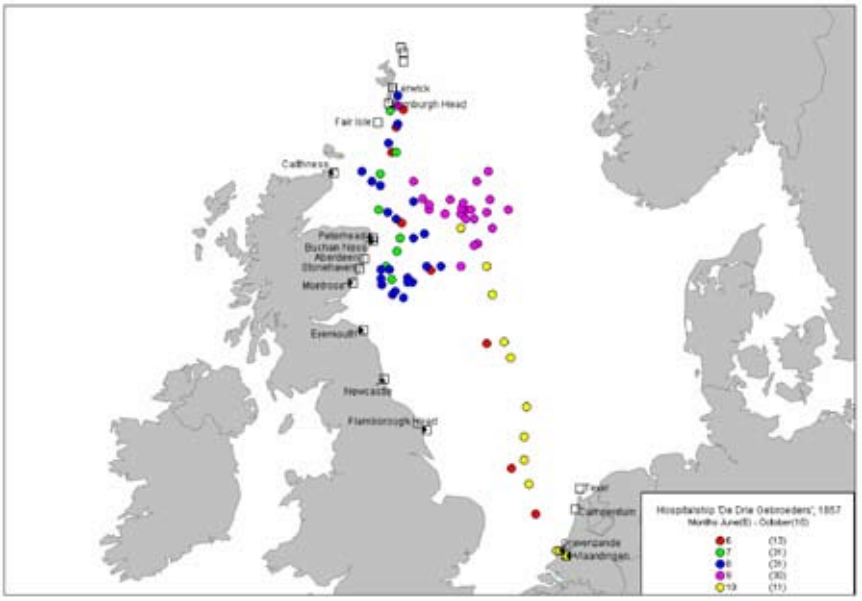
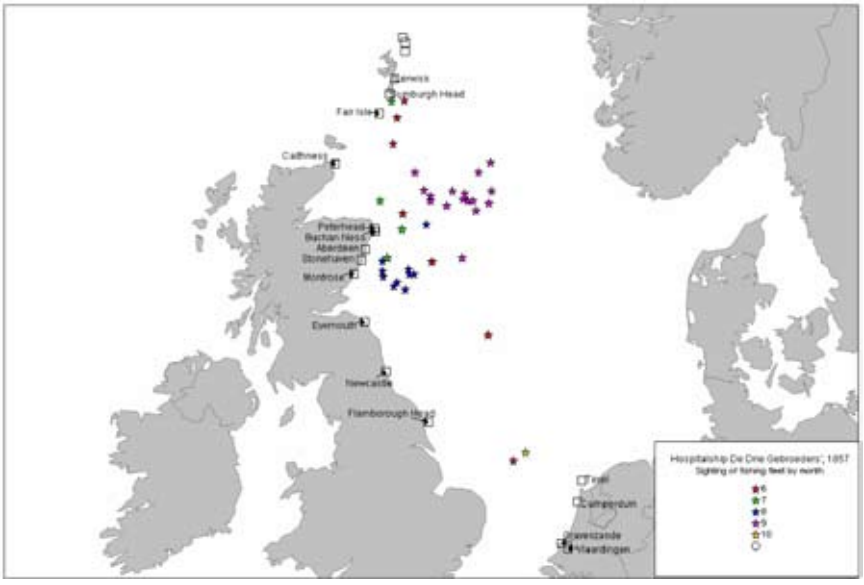


Figure 10.6

Sightings of herring fleet by hospital ship De Drie Gebroeders, 1857.

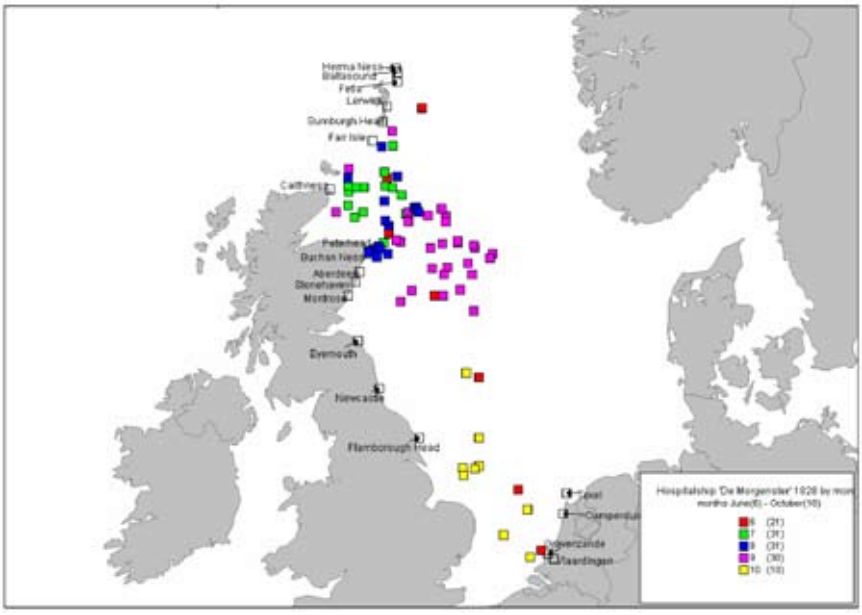


Positions of De Morgenster, 1828

For all their accuracy and wealth of information, the logbooks from the hospital ships rarely included information about their exact position. The latitude was recorded almost every day, whereas the longitude is listed in just a few logbooks, such as that of *De Drie Gebroeders* and the journal of *De Morgenster* from 1828 (figure 10.7). Compared to the seasonal distribution in the late 1850s, the general picture is very similar.

Figure 10.7

Monthly movement by hospital ship, De Morgenster, 1828.



The season started near the Shetlands. Throughout the time in which *De Morgenster* was assisting the herring fleet, the ships remained in the north western part of the North Sea. During the month of July, however, the hospital ship did not venture as far south as *De Drie Gebroeders* did a generation later. Instead *De Morgenster* went cruising in the area between Caithness at the northernmost tip of Scotland and down to the area off Peterhead, as shown on the map. In August, *De Morgenster* remained in more or less the same area, although slightly more to the south east. Continuing into September, *De Morgenster* moved further south east, away from the coast-

line towards an area due east of north east Scotland, from Peterhead down to Montrose.

De Morgenster, and thus the Dutch fishing fleet, thus moved in a more duly south-southeast direction than *De Drie Gebroeders*.

Latitudes compared

The captains of the *Cornelia Lucia* in 1819 and the *Scheepsbouwlust* in did not note their longitudes in the logbooks. Neither were they very good at recording their distance from distinct landmarks, which makes it difficult to chart their seasonal movement on a map. The latitudes themselves though – in combination with notes on sightings of the herring fleet – present a valuable basis for assessing their spatial distribution (Figure 10.8).

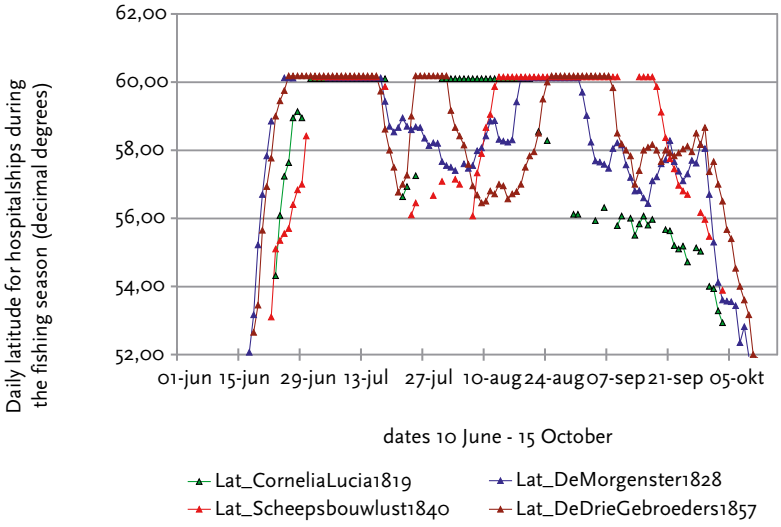
All four hospital ships commenced their trip to Shetland around 17 June, and upon reaching the Shetlands around 1 July they tended to stay in or just outside of the Bay of Lerwick for a couple of weeks. All four left the Shetlands again on 17 or 18 July, heading out to assist the herring fleet in open waters, and remained on more or less the same latitudes during the months of July and August, with the exception of shorter time periods of one or two weeks in which they returned to the Shetlands for new provisions. The later visits to the Shetlands did thus not reflect the behaviour of the fishing vessels. As the hospital ships move into late August and September a clear pattern emerges with *Cornelia Lucia* moving considerably more to the south in 1819 than *De Morgenster* in 1828 and especially *De Drie Gebroeders* in 1857.

When it comes to *Scheepsbouwlust* in 1840 the September movement appears to be a prolonged or gradual journey home. But while the *Scheepsbouwlust* went south, this was not necessarily the case for the fishing vessels. As they state in the logbook entry of 13 September: 'We sailed southwards along the coast... (of The Shetlands)... and the herring boats northwards.'[24] The following days though, from 22 – 30 September the *Scheepsbouwlust* met more herring vessels, so it is difficult to assert whether the fishing fleet as whole behaved much differently in September 1840 than it did in the other seasons.

24 NA. CGV. inv. no. 589.

Figure 10.8

Daily latitudes for four hospital ships, 1819, 1828, 1840 and 1857.



With regards to the comparison of latitudes, the general seasonal distributions in 1819 and 1828 seem to reflect a gradual southward movement, in that the latitudes in late August and September were lower then than they were in June and July. With regards to 1840, the picture is too blurred to offer a precise indication, but the positions in 1857 indicate that the hospital ship and thereby the fishing fleet as a whole were more to the north in September than they were in July. This means the pattern of fishing observed in the period of 1819-1863 is indicative of a gradual shift in the overall pattern. The overall fishing pattern evolved in the north western parts of the North Sea. In the first half of the period under review, however, the fishing vessels moved gradually southeast in a more or less straight line, while the mid-1850s were marked by a more cyclical movement whereby the season evolved in an anti-clockwise movement starting and ending around the Fladen ground in between the 58th and 60th parallel.

Spatial distribution of convoy ships, 1691-1745

The Dutch North Sea herring fisheries date back in time as far as the 15th century. The need for protection against pirates, privateers and fleets of en-

emy states is almost as old as the fishing operation itself.[25] As a result, some of the oldest eyewitness testimonies on the Dutch North Sea herring fisheries stem from war ships.

The Dutch state and the governing body of the Dutch herring fisheries, De *college van de Grote Visserij*, collaborated with regards to the equipment of convoy ships from the late 16th century until 1795.[26] Each year, a small fleet of ships were assigned the task of protecting the herring fisheries, and the daily logbook entries from some of these ships allow us to present a rough estimate of the areas in which the herring fisheries took place. The warship logbooks do not contain exact navigation points, but they do occasionally mention latitudes and the distance from and direction to specific landmarks. This information allows us to reconstruct the ships' positions.

Reconstructing navigation points

First of all, we need to identify the navigation point for each landmark. Most of the landmarks were very common in Dutch seafaring and are mentioned by their distinct Dutch names in the logbook. Names such as 'Lerwick' and 'Aberdijn' can be translated easily into their modern equivalents, while 'Abbenhooft' is roughly the equivalent of modern day Eyemouth in south east Scotland, but this task was significantly eased by a mid 20th century reconstruction of old place names on Dutch maps from the 16th and 17th century (table 10.1).[27]

The convoy ships' logbooks specify the direction from ship to landmark as 'north east' or 'south south east'. Each of these directions was then converted into degrees from 0 – 360 starting clockwise with the magnetic north as zero. This allowed the data to be entered into a pre-formatted function in Microsoft Excel.[28] Finally, the function for estimating latitudes and longitudes requires data on the distance from the known position, the landmark. To this end, the old Dutch nautical miles were converted into modern nautical miles.

---

25 James Tracy, 'Herring Wars', pp. 249-272, Sicking, *Zeemacht en Onmacht*, Van Vliet, *Vissers en Kapers*. and Van Vliet, *Vissers in Oorlogstijd*.

26 Bijl, *nederlandse convooidienst*, pp. 64-71.

27 Damsteegt, *Nieuwe spiegel der zeevaart*.

28 http://nmml.afsc.noaa.gov/Accessibility/AccessExcelGeoFunctions.html The validity of this formula was tested against this internet-based resource for converting navigational points into distance in kilometres, miles and nautical miles. http://www.wcrl.ars.usda.gov/cec/java/lat-long.htm

Table 10.1
Location of old Dutch landmarks

Modern name	Old landmark	Longitude	Latitude
Aberdeen	Aberdijn	-2.06	57.14
Baltasound	Baltasont	-0.81	60.76
Buchan Ness	Boekenese	-1.77	57.46
Caithness	Catenese	-3.03	58.64
Camperduin	Camperduin	4.65	52.73
Eyemouth	Abbenhooft	-2.10	55.88
Fair Isle	Fayerhill	-1.64	59.53
Fetla	Fetla	-0.82	60.60
Flamborough Head	Flamburger Hooft	-0.08	54.12
Gravenzande	Gravesant	4.14	52.00
Herma Ness	Noorthoek van Hitland	-0.89	60.85
Lerwick	Lerwick	-1.15	60.14
Montrose	Montros	-2.44	56.71
Newcastle	Nieuw Castels	-1.42	55.01
Peterhead	Peterhead	-1.79	57.51
Stonehaven	Steenhooft	-2.21	56.96
Sumburgh Head	Zuidhoek van Hitland	-1.29	59.87
Texel	Texel	4.77	53.10
Vlaardingen	Vlaardingen	4.35	51.91

Het Huijs te Neeck, 1710

In the early 1700s, The Dutch Republic took part in the War of the Spanish Succession, siding with England against France. In 1710, Captain Cornelis van Brakel of the ship *Zeelandt* commanded a fleet of six convoy ships. With a total of more than 1,500 men and 300 cannons, the convoy ships protected a fleet of some 270 herring busses. The convoy was active from 24 June until 24 September, and the logbook of the *Zeelandt* allows us to reconstruct a series of 'sightings' of the herring busses.[29]

The herring busses were first sighted off the Scottish coast between Aberdeen and Buchan Ness, where they set out their nets in the last week of July. At the beginning of August, the *Zeelandt* was bound for the Fair Isle

29 Poldervaart, 'Het konvooi', pp. 7-18.

and the Shetlands, where the herring vessels were seen to have enjoyed good catches. It is not certain though, whether these herring vessels had been fishing off the Shetlands since the start of the season, or if they had been in the company of commander van Brakel on his way from Scotland. In any case, the fleet of convoy ships and herring vessels returned to the area off Buchan Ness in mid August, where they remained until the beginning of September. By then, the fishermen began to signal that their busses were filled. On 1 September, 20 busses were full, on 5 September the number had risen to 90, and the next day between 210 and 220 busses had gathered near the convoy ships ready to be escorted back to The Netherlands. 161 of them signalled that they were full, and on 11 September they all reached the Dutch shores.[30]

On 18 August, van Brakel met the warship, *Het Huijs te Neeck*, which served as a convoy ship for the Dutch herring fishermen travelling from the northern parts of the Holland province, Noorderkwartier. The logbook of *Het Huijs te Neeck* has been preserved to this day, and contains information that complements the accounts of herring vessels mentioned above.[31] For a number of days, the logbook reveals the latitude of the vessel, with the distance from and direction to certain landmarks added to the logbook on some occasions. All logs containing the necessary information have been used to reconstruct and map the position of the convoy ship *Het Huijs te Neeck* using the GIS program MapInfo. The log of the ship's journey as part of the convoy in 1710 reveals information on herring fleet sightings. These sightings are marked in red, while a red circle represents just one fishing vessel. The blank square represents positions at which no sightings of fishing vessels are recorded. (figure 10.9).

The first records of the position of *Het Huijs te Neeck* are from 21 June, when the ship was located at the Shetlands. There are no indications of herring vessels, which does not necessarily imply that the fishermen were absent from The Shetlands. By mid July, the ship is back in the Northern parts of Holland, where sightings of several herring vessels are recorded on 15 July. After almost two weeks in Dutch waters they resumed to the business of escorting the herring fleet through the North Sea. From the first of August until early September, they cruised off the coasts of Scotland and northern England. This period also contains records of various incidents – such as the taking of several busses by privateers – that allow us to link the reconstructed navigation points to the sighting and thereby position of herring vessels. During the latter half of August, a frequent contact was maintained with commander van Brakel aboard the *Zeelandt*, and the sight-

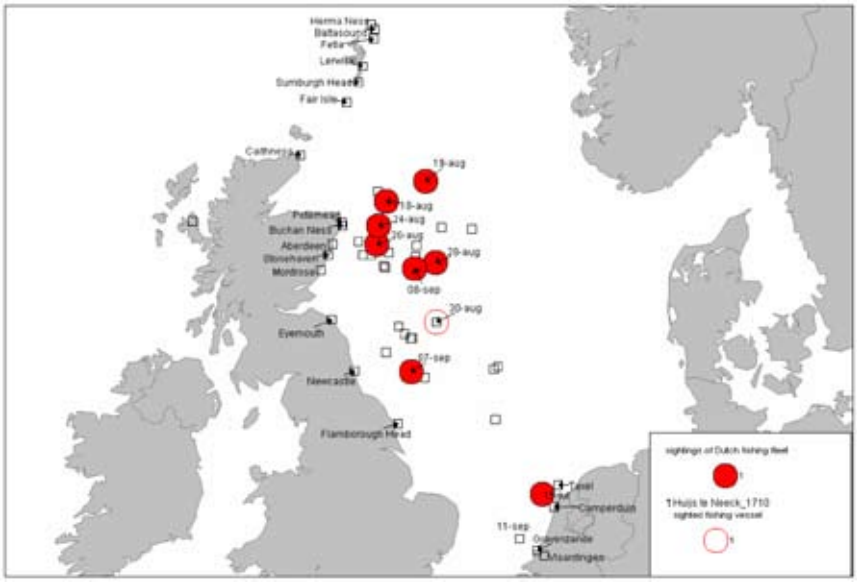
30 Poldervaart, 'Het convooi', pp. 11-16.

31 NA, *Admiraliteits Colleges*, inv. no. 3264.

ings of herring busses by *Het Huijs te Neeck* correspond to the sightings mentioned by van Brakel.

Figure 10.9

Position of convoy ship, 't Huijs te Neeck and sightings of herring vessels, 1710.



Based on the combined information in the two logbooks, it is fair to assume that the position of the greater part of the Dutch herring fleet is reflected in the positions of the convoy ships, at least in the month of August and early September, when the ships were located in the north western part of the North Sea. However, since the convoy ships both finished their escort in mid September, it is not possible to track the spatial distribution of the herring fleet after this time.

Rossem, 1719

Data from 1719 also allows us to locate some of the daily positions of the convoy ship *Rossem*, lead by captain Nicolaes Kievit. The navigation points of the *Rossem* have been reconstructed in the same way as the data on *Het Huijs*

te Neeck.[32] *Rossem* was present at the herring grounds off Shetland by as early as mid June, well in time for the start of the herring season, while the trip ended back in The Netherlands on 9 August (figure 10.10).

Figure 10.10
Sightings of herring vessels by the convoy ship Rossem in 1719

From 15 to 18 July, herring vessels were observed just east of the northern tip of the Shetlands. On 23 July the *Rossem* left the Shetlands, heading south to the area east of Scotland. The ship's movements suggest it was looking for herring busses. On 1 August they caught sight of a fleet of herring busses at a good distance from the east of the English shoreline, around Newcastle. This corresponds with modern day Dogger Bank, which was also a known fishing ground in the Early Modern period.

We cannot establish how long the herring vessels had been in the area of Dogger Bank, but we do know that they were already their way home by 5 August. The fishermen might have been lying in wait for an escort for the last stretch home with their vessels already fully loaded, or perhaps they had been fishing on Dogger Bank for a while and only just filled their cargo

32 NA, *Admiraliteits Colleges*, inv. no. 1130.

when captain Kievit's ship came by. A third option is that the herring fleet had been sailing along with *Rossem* all the way from the Shetlands since 24 July, and that this fact was simply not recorded in the logbook. These possibilities illustrates the caution with which the information from the convoy ships should be treated, but the findings from *Rossem* do confirm the herring vessels' north westerly fishing pattern in the first two months of the 1719 herring season.

The information from the *Het Huijs te Neeck* and *Rossem* records is most suitable for mapping the fleet's position in GIS, but a few other convoy ships also provide information on the herring vessels. In 1691, a captain Wassenaer was in charge of a naval ship 'on the convoy to Scotland'.[33] His logbook does not contain much information on herring vessels, but in mid July some herring vessels were sighted in the area east around Scotland and England. From a somewhat later period, in 1745, we also have access to the logbook of captain Mauritius van der Ster on the *Vredehoop*, a ship active off the Scottish coast in late July. However, these logbooks do not mention any sightings of herring vessels.[34] In general though, the analysis of the convoy ships indicates a fishing pattern in line with existing knowledge on the Dutch herring fisheries. This would indicate a season starting close to the Shetlands, then gradually moving to the south during the first three months. Unfortunately the service of the convoy ships ended in early October.

Monthly distribution of fisheries, approx. 1600-1892

The above analysis was carried out using historical maps and qualitative evidence from early modern commentaries, in particular logbook material from convoy ships, hospital ships and individual herring vessels. This allows us to create a series of snapshots of the monthly distribution of the Dutch herring fisheries during the period between approx. 1600-1890s (table 10.2). The table shows a schematic representation of these snapshots, which builds on and adds to the existing knowledge of the Dutch North Sea herring fisheries. Each field is labelled according to the land mass or area nearest to the targeted fishing ground, or by commonly known fishing grounds such as the Fladen ground, Dogger Bank and The English Channel.

33 NA, *Admiraliteits Colleges*, inv. no. 1097.

34 NA, *Admiraliteits Colleges*, inv. no. 3269.

Table 10.2
Spatial distribution of Dutch herring fisheries, approx. 1600-1892.

Year	June	July	August	September	October	November	December	January
c. 1600	Shetland	Shetland – Scotland	Scotland	N. England	Doggerbank / East Anglia	East Anglia	East Anglia / English Channel	East Anglia / English Channel
c. 1640	Shetland	Shetland – Scotland	Scotland	N. England	Doggerbank / East Anglia	East Anglia	East Anglia / English Channel	East Anglia / English Channel
c. 1700	Shetland	Shetland – Scotland	Scotland	N. England	Doggerbank / East Anglia	East Anglia	East Anglia / English Channel	East Anglia / English Channel
c. 1750	Shetland	Shetland – Scotland	Scotland	N. England	Doggerbank / East Anglia	East Anglia	East Anglia	(Not fishing)
c. 1780	Shetland	Shetland – Scotland	Scotland	N. England	Doggerbank / East Anglia	East Anglia	East Anglia (Rarely fishing)	(Not fishing)
1819	Shetland	Shetland – Scotland	Scotland	N. England	Doggerbank / East Anglia	East Anglia	(Rarely fishing)	(Not fishing)
1828	Shetland	Shetland – Scotland	Scotland	Scotland	?	?	(Rarely fishing)	(Not fishing)
1840	Shetland	Shetland – Scotland	Scotland	Scotland	?	?	(Rarely fishing)	(Not fishing)
1857-1863	Shetland	Shetland – Scotland	Scotland	Scotland	Fladen Ground	Fladen Ground	(Not fishing)	(Not fishing)
1892	Shetland	Scotland	Scotland	N. England	Doggerbank	East Anglia	(Not fishing)	(Not fishing)

For the 17th century onwards, the monthly distribution corresponds with the existing notion of a gradual seasonal movement from north to south. Whether the fishing season ended in the waters off East Anglia or further to the south in the English Channel remains open to debate. This pattern is matched by the behaviour of the convoy ships in the first decades of the 18th century, but only during the months June-September. In the later parts of the season, the result is based on qualitative evidence, which is also the case in the snapshot of the years around 1780.

From approx. 1745 onwards, the fishing season was found to be short-

er, generally ending in November. In some cases, it would extend into December, but almost never into January. In the 19th century, the season consistently ended in November.

Out of the entire period of approx. 300 years, the 19th century offers the best source material, with the first half of this century marked by a distinct shift in fishing patterns as reflected in the snapshots of 1828, 1840 and the years 1856-1863. The logbook material from the hospital ships was found to be highly indicative of the movement of the Dutch herring vessel fleet, which deviated from the north – south pattern in autumn. In 1828 and 1840, the location of the fishing fleet does not seem to have moved south of the area to the east of Scotland instead of continuing along the English shores. However, since the hospital ships went home in early October, the herring fleet cannot be tracked during the last month or so of the season.

In the 1850s and 1860s, logbooks of the Dutch herring vessels projected a fishing pattern resembling a U-turn starting off The Shetlands and ending around Fladen ground in the north western part of the North Sea. This is a very strong deviation from the north – south pattern observed in the rest of the material.

In the 1892 map from Arij Hoogendijk's meticulous book on the Dutch herring fisheries, the north – south pattern seems to have been re-established. However, Hoogendijk's map also referred to an area in the north western part of the North Sea, where herring used to be caught in the month of October. This analysis clearly indicates that the area mentioned by Hoogendijk represents the mid-19th century fishing pattern. In fact, the general impression of the 300-year period is that of a stable fishing pattern, apart from the marked divergences in decades around the mid-19th century. This coincides with the phase providing the best source material, and if larger quantities of evidence were available for the previous centuries this might affect the general impression of stability throughout the 17th and 18th centuries.

The desirable catch and quality of herring

We can assume that the Dutch herring fisheries tried to follow the herring's seasonal fluctuations in order to land a superior product for the fish market. In spring, when the autumn spawning herring stocks in the North Sea are busy feeding and grow rapidly, their flesh becomes very loose and fat. This makes the fish unsuitable for salting, so making 24 June the starting point of the fishing season would ensure that the fishermen could land a better

product. Over the course of the season, the herring would be packed and sold according to its condition. In the summer months, maatjes was the least mature product, while the prime product of volle haring could be landed when the flesh had become more firm. From the 16th century onwards, surviving account books testify that volle herring remained the most profitable type of herring. In later times, spawning (kuitziek) and spent (ijle) herring were less highly regarded and sold at a lower price.[35] This was one good incentive for the fishermen to target the mature, volle herring. The seasonal price fluctuation on the Dutch herring market was another. As a rule, the average price of volle herring on the Amsterdam market was highest in July at the beginning of the season, falling in the following months until the end of the year.[36]

Why take a U-turn?

The organisation and market conditions affecting the Dutch herring fisheries suggest that the fishermen targeted the earliest spawning Buchan herring first, followed by the Dogger and Downs herring. That is, if the Dutch fishermen behaved rationally, and if the available abundance of herring was distributed evenly in terms of all three sub-populations.

In terms of rational fishing, the fishers certainly had the necessary technology to go where the fish went, as outlined in the above section on the Shetlands. The fishermen's logbooks also indicate that the gradual anti-clockwise movement in the north western part of the North Sea certainly paid off. The months from September to November, in which they would fish in the – historically speaking – wrong place, were also the most rewarding period of the season.

On the other hand, their information could not have been perfect, and traditions in terms of the best fishing grounds can be persistent. In modern fisheries, where decision-making is presumably based on better data than was the case in the 17th-19th century, studies have shown that simple force of habit can lead fishermen to maintain traditional fishing patterns despite potential gains that might be derived from changing these patterns.[37] It is very likely that the Dutch herring fisheries were struck by such cases of spatial inertia at various points in time. This means the general north – south pattern of movement is not necessarily affected by the natural fluctuations below the surface. In terms of shifting towards the U-turn pattern, the biological rationale for doing so is likely to have existed for a while before the

35 Gelder, 'betreffende de Haringvisscherij', pp. 22-56 and pp. 60-62. Museum In 't Houten Huis, De Rijp, Netherlands, inv. nr. 00024, "Rekeningboek van de haringbuis 't Bruine Paard ' uit De Rijp, 1822-1846."

36 van Zanden, 'consumer goods', http://www.iisg.nl/hpw/brenv.xls

37 Holland and Sutinen, 'Location Choice', pp. 133-149.

fishermen made the actual change.

This indicates that the south western parts of the potential fishing area in the North Sea became increasingly less attractive over the course of the three centuries in question. From the mid-18th century onwards, the season was shortened making it unlikely that the fishermen would have pursued herring into the English Channel. The 19th century shift towards the U-turn pattern underlined this development, whereas the 1892 map indicates a renewed interest in the southern fishing grounds.

With regard to the shortening of the season, one should not overlook factors external to catchability. Winter was a preferred season for the Dutch cod fisheries, and after approx. 1750 the leading towns in the Dutch herring fishery started to use slightly heavier fishing vessels suited for fishing with both driftnets for herring and long lines for cod and haddock in the winter months. Thus, the appeal of cod could have diverted the fishing effort away from herring in December and January.[38]

Turning to the role of the environment, the mechanisms underlying the changes observed over the 300-year period seem to be attributable to factors below the surface just as much as the skills and strategies of the fishermen. We do not know which of the three sub-populations of North Sea herring the Dutch were actually fishing for, but they certainly played a role in shaping the various fishing patterns of the Dutch herring fisheries. We know from 20th century data that – in spite of the general latitudinal differences – the Fladen grounds can be visited by both Buchan, Dogger and Downs herring, with overlap blend at various points during the season. Normally though, this happens in September and not in October and November as observed in the mid-19th century U-turn pattern.[39] Against the background of the snapshots covering approx. 300 years, it would thus appear that the observed U-turn pattern can be regarded as a reflection of a hitherto unknown environmental anomaly. In light of current theories on the natural variability of herring this may be linked to changing climatic conditions.

Conclusion

This chapter has sought to investigate – for the first time – the spatial pattern of the Dutch North Sea herring fisheries over a 300-year period from approx. 1600 – 1892. Through the use of contemporary accounts, historical maps, mid-19th century surveys as well as logbook material from hospital ships and

38 Kranenburg, *De zeevisscherij*, pp. 58-59 and for the 19th century see Pons, *De bakens verzet,* 12-14.

39 Cushing and Bridger, 'The stock of herring in the North Sea', p. 17.

convoy ships, the analysis has resulted in the construction of a series of snapshots of monthly fishing patterns from June – January.

To a large extent, the observed fishing pattern can be applied as an indicator of the best fishing grounds in the North Sea area. The nature of the data, however, provided a more precise reconstruction of the fisheries in the 19th century than has thus far been availabe for previous centuries. During most of this period, the observed fishing pattern saw the Dutch fishermen starting the season off the Shetlands, then moving gradually to the south to end up in the area off East Anglia in November. In the 17th century, they may have moved as far south as the English Channel in December and January. However, it was also observed that the length of the fishing season declined over the years from approx. 1745 – 1780.

The results also showed a significant deviation from the seasonal pattern of moving gradually from north to south, as mid-19th century fishermen found the best fisheries when moving north and north east from September onwards, fishing in the Fladen ground during autumn. This fishing pattern has not been documented before and points towards a phase of abnormal environmental conditions.

At a methodological level, this investigation has asserted the feasibility of using historical research techniques in reconstructing the spatial dimensions of long-term marine species exploitation. It also highlights the historical aspects of natural variability in marine ecosystems. The fishing patterns reconstructed here now allow us to examine the context of current theories on the behaviour of autumn spawning herring in the North Sea.

11 | Dynamics of change and the exploitation of North Sea herring stocks

A system of pre-industrial resource exploitation

The starting point for this book was the formulation of three overarching questions.

- What were the main forces stimulating changes in the exploitation of North Sea herring in the period between approx. 1600-1860. In other words, what were the dynamics of this particular historical system?
- What was the role of the natural environment in this regard?
- What caused the long-term decline of the Dutch herring fisheries?

An assessment was then carried out to determine the potential of marine environmental history and historical ecology as a tool in answering these main research questions. Much of current environmental history is occupied with the human perception of the natural environment and the politics of dealing with environmental issues. By comparison, marine environmental history is more ambitious, aiming towards historically-based studies and assessments of interactions between human society and natural resources.

These interactions are best understood by applying adapted methodologies from the world of marine science. When it comes to the scientific study

of herring, long time series – and thus a historical approach – have been advocated since as early as 1879, when Ljungman proposed his aforementioned sun spot theory to explain the mechanism behind the occurrence of Bohuslen herring periods. The historiography of historical ecology has demonstrated that the use of long time series is a longstanding tradition within herring studies, that has been especially popular during the last few decades, with climate related research at the centre of attention and marine ecologists attempting to construct long time series to assess fish stock fluctuations. The HMAP approach used in a great number of research projects around the globe is one practical example of this phenomenon. This particular study is the most in-depth historical reconstruction of the spatial and temporal fluctuations of any European herring stock in the pre-statistical era.

In order to conceptualize the methodology behind this study, the triangular relationship between Cognition, Production and Resource was applied to the exploitation of North Sea herring between approx. 1600-1850. One of the common denominators of history and ecology is that they both study change and stability within a set time and space, or – to put it in different terms – within a historical system. In order to establish a coherent system of marine resource exploitation, it is necessary to analyse factors such as the impact of human production and cognitive aspects on the natural resource, as well as the reversed impacts. Therefore, the issues addressed can take on multiple perspectives, anthropogenic as well as ecological. This was illustrated by arrows capable of moving in any direction between the corners of the triangle.

Hypotheses and questions

The next step was to apply this theory to the empirical past of the North Sea ecosystem and North Sea history as they were investigated through the exploitation of North Sea herring between approx. 1600-1860. In order to construct relevant sets of observations, a number of hypotheses had to be defined and tested. The main hypotheses assessed in this study are listed below, according to their primary perspective on each particular issue:

Methodological:

- A uniform set of historical data allows for the reconstruction of long time series on fishing effort and catch rates.
- Historical research allows for the reconstruction of the spatial dimensions of the North Sea herring exploitation pattern.
- The above two hypotheses allows us to differentiate between natural and human impacts on a former ecosystem.

- Theories from modern marine ecology can provide new insights into the history of the North Sea herring fisheries

Mainly ecological:
- The total extraction of North Sea herring can be measured over several centuries
- Did fisheries have a significant impact on the abundance of North Sea herring, or not?
- How did the population of North Sea herring fluctuate during the defined time period?
- How did the stock of North Sea herring migrate, both seasonally and in a decadal perspective?
- Do the observed North Sea herring stock fluctuations and migration patterns conform to current theories on the relationship with environmental forcing?

Mainly anthropogenic:
- What was the total production of salted herring in the North Sea area?
- Who were the main producers of herring during this period?
- How did the main producers differentiate in terms of their mode of production?
- What characterised the development of European herring consumption?
- How was the European salted herring market integrated?
- How did the organisation of the Dutch herring fisheries influence fishing strategy?
- Does the cooperative behaviour of the Dutch fishers coincide with modern theory on information sharing systems?
- To what extent were fishing strategies adaptive to the challenges of a species with vivid temporal and spatial fluctuations?
- How did external historical developments impact on the fisheries?

Synthesising:
- Is it possible to distinguish between factors affecting the observed environmental and anthropogenic developments, or even to establish a hierarchy of causations?
- How did the environment affect the development of historical herring fisheries?
- What was the main dynamic behind pre-industrial resource exploitation?
- How can knowledge of this past ecosystem contribute to today's understanding of and management of marine resources?

The analysis of these hypotheses required the use of three different types of

analytic tools. These were 1) Catch per unit effort analyses of the Dutch herring fisheries in chapter 8, 2) analyses of the spatial distribution of Dutch herring fisheries and various shore-based fisheries in chapters 4, 9 and 10 and 3) analyses of the fishing strategies deployed by the Dutch fishers as analysed in chapters 7, 8 and 9. These fishing strategies involved considerations on how, when and with whom to fish, on both a day-to-day basis and over the course of an entire fishing trip and season. The fishing strategy of the fishing fleet as a whole was analysed over several years, decades and the entire span of 1600-1860.

These three types of analyses – intrinsic to the herring fisheries – were situated within a context of external forces. These were: 1) environmental forcing, 2) the probability of fishing mortality in chapter 5 and 3) their historical context mainly in chapters 4, and 6 and partly in chapters 7 and 9. This contextualisation serves to address the starting point of the three main questions in this synthesising chapter 11.

Results of analyses

Producers and production

The development of European herring production from 1600-1850 can be divided into a number of characteristic phases. The years from approx. 1600-1700 represented a period of decline with a total annual production of approx. 60,000-80,000 metric tonnes. A more drastic decline followed as the production in Northern Europe remained at around 25,000-35,000 tonnes until approx. 1710. This was followed by a steady increase in the rest of the 18th century to a production of between 40,000-60,000 tonnes of salted herring. During the last two decades of the 18th century, the total production reached 70,000-80,000 tonnes per year, or the same level seen in the first decades of the 17th century. In the first half of the 19th century, production rose to unprecedented heights reaching 200,000 tonnes in 1849.

The Dutch Republic, Norway, Sweden and Scotland each experienced phases in which they were Europe's leading producer of herring. In addition to the largest producers, however, several other herring fisheries were important at various stages during the period between approx. 1600-1850. When viewed within the framework of this 250-year perspective, the above analysis demonstrates how the Dutch herring industry – when viewed from one perspective, at least – ended up as the great loser. In the year 1600, they were the paramount producers of salted herring in Europe, whereas by 1850 they accounted for just 5% of the total amount of herring in Europe. On the other hand, though – as the analysis of the various types of organisation and technology in the various herring fisheries has shown – the Dutch high seas her-

ring fishery remained the only enduring proponent of what can be termed 'the Dutch model' of herring production. None of the many competitors in Northern Europe succeeded in building a similar fleet. Rather, the various dominant industries from the 1740s onwards were all based on more flexible, locally-based herring fisheries, requiring less capital investments.

Consumption, markets and trade

The analysis of these aspects in chapter 6 asserts that the salted herring produced by the Dutch dominated the herring trade in the 17th century, whereas Scottish, Danish and Norwegian herring featured prominently during the 18th century. In the latter half of the 18th century though, the Swedish produced Bohuslen herring rose to become the dominant export into the Baltic, while Norway and Scotland regained their status in the Baltic market during the 19th century. Price series for various parts of northern Europe offer indications of the long-term development, from which we can distil three results:

The herring prices in coastal areas were generally lower than those further inland. Secondly, there was a general trend whereby herring prices in the North Sea area and the Baltic would fluctuate in unison. Thirdly, this pattern was disrupted twice by the appearance of two periods approx. 1570-1589 and approx. 1760-1808 of very large fisheries at Bohuslen on the Swedish west coast. During these two periods, the Bohuslen herring came to dominate traffic through The Sound and thereby the Baltic trade in herring, but in neither of the two periods did the Bohuslen herring succeed in dominating the North Sea market in the same way as the Baltic markets. This is reflected in the import tables from Hamburg, where the Dutch managed to remain competitive during the last decades of the 18th century. A general decline in herring prices was observed, and comparisons between grain prices and herring prices in the German territories indicate that herring became increasingly unattractive compared to grain, in that the buying power of herring dwindled.

Next, analyses of the consumption patterns for salted herring indicated two things. First of all, the figures for consumption point towards a falling demand for salted herring, especially during the 1650-1750 period. Secondly, the consumption of herring was greater in the north eastern and central parts of Europe than in the countries surrounding the North Sea. Finally, the mercantilist policies of European states in the 18th century would have worked primarily against export-oriented producers such as the Dutch and Scottish.

In short, the trade in salted herring appears to have been highly integrated between the main area of production in the North Sea and the main areas of consumption in the Baltic and European continent. Clear proof of this can be found in the period when Bohuslen herring production rose to prominence and altered the price differentials between the North Sea and the Baltic. The

appearance of large shoals of herring at Bohuslen is a well-documented environmental phenomenon, but this chapter argues that the economic impact of the fisheries developing in Bohuslen were equally felt in the trade pattern for herring in northern Europe. The Bohuslen period at the end of the late 16th century marked the rise of Dutch supremacy in the Baltic market, while the 18th century Bohuslen period was instrumental in finishing off this era. After a phase of Swedish dominance, the salted herring from Scotland and Norway became dominant in the Baltic from the early 19th century onwards.

Fishing mortality

This brief analysis in chapter 5 examined the likelihood of a significant pre-industrial fishing effect on the North Sea herring stocks. The assumption was made that the ecosystem in which the herring lived during the early modern period is similar to the present-day North Sea ecosystem. Based on this assumption, it is unlikely that the total catch of North Sea herring impacted the North Sea herring stock biomass. This is an important result in that it means that the observed changes in herring stock fluctuations and migration patterns have environmental rather than human causes.

Stock fluctuations

The reconstruction in chapter 8 of the CPUE of the Dutch herring fishery between approx. 1600-1850 is the longest time series of CPUE ever to be constructed, thereby introducing the concept of marine environmental history into the study of pre-modern North Sea fisheries. The time series for CPUE was constructed using historical data of a highly homogenous character, facilitating the standardization of all main units of catch and effort. This, in combination with the length of the investigated period, renders the time series suitable for testing current marine biological theories on natural variations of North Sea herring against the background of a historical fishery.

From a historical point of view, this chapter suggests that historical catch rates certainly played an important part in the 250-year development and decline from prominence of the Dutch herring fishery in the mid 18th century, especially in the first half of the 19th century. In chapter 4, the catch rates in the town of Emden were analysed as part of the estimation of overall herring production in the North Sea. Despite being an entirely separate fishery, the fishers here also experienced a very steep decline between the late 18th and early 19th century.

What cannot be explained from a historical point of view is the development in CPUE between the first and second fishing trips of the fishing season. Very large fluctuations were found, suggesting almost alternating high and low points in CPUE between the first and second fishing trip.

Long-term spatial distribution of fisheries

On a methodological level, this study asserted the feasibility of using historical research techniques in reconstructing the spatial dimensions of the exploitation of a past marine environment. This was carried out in chapter 10, which also points to the historical aspects of natural variability. The fishing pattern reconstructed here can now be used to further investigate the context of current theories on the behaviour of autumn spawning herring in the North Sea as well as the fishers hunting them.

Most of the time, the observed fishing pattern saw Dutch fishers starting the season off the Shetlands, then moving gradually to the south and ending up in the area off East Anglia by November. In the 17th century, they went as far south as the English Channel in December and January. However, it was also observed that the length of the fishing season declined over the years from approx. 1745 – 1780. The results also found a significant deviation from the seasonal pattern of moving gradually north to south. In the mid-19th century, the fishers moved north and north east from September onwards, fishing on the Fladen ground in autumn. No previous historic research on the North Sea herring fisheries has ever described this fishing pattern.

19th century loss of spatial advantage

Results of these analyses of spatial variations in the success of the Dutch fishery potentially reflect the situation in other herring fisheries. With regard to the development of the Scottish herring industry, geographer James Coull has pointed to a paradox in the way in which the herring industry on the Scottish mainland rose to great European dominance in the early 1800s, whereas the Shetland-based herring industry did not pick up until the 1880s. The slow development of the Shetland-based fishery is documented in contemporary government records, since the Scots had introduced a system by which all cured herring were submitted for quality inspection. The data on cured herring forms a time series stretching from 1820 until the early 1880s, showing how – with the exception of the last few years – production peaked in at a level of some 40,000 barrels, then dropped to less than 5,000 barrels in the 1840s, increasing only slightly in the 1850s.[1]

Coull concluded that '...Shetland had a starting handicap, and even at the end of this period it is clear that most of the entrepreneurs and fishers were less fully committed to the fishery than their counterparts in the leading mainland Scottish centres.'[2] Since both fisheries exploited an equally bountiful resource, the Shetland-based herring industry was delayed in its development due to difficulties in organising the fishery in an economically sustain-

1 Coull, 'herring fishery in Shetland', p. 124.

2 Coull, 'herring fishery in Shetland', p. 139.

able fashion for more than a couple of years at a time.[3]

In 1971, historian Goodlad in also examined the issue of the declining Shetland-based catches after 1835. Although he did not overlook the socio-economic and technological aspects of the fishery, he concluded that the failure was primarily due to environmental causes. According to the fishery board, the herring fishery failed in 1839. This failure, in combination with stormy weather resulted in the worst year of fishing in living memory.[4] Historical records also state that the British herring fishery had been revived by 1822, but that the main recovery took place off the more southerly coast of Britain rather than the Shetlands. After this time, and until the 1880s, the English and Scottish based herring vessels rarely sailed to Shetland grounds for their summer fishing.[5]

In the debate on the causes of the Shetland based herring industry's failure to develop at the speed of the Scottish mainland industry, both authors observed a factor which is documented in data on the amount of cured herring. Their hypotheses for the underlying cause are based solely on qualitative evidence. Applying a combination of data on Dutch catch rates from 1600-1850 and the spatial dimension of the Dutch North Sea herring fisheries allows us to reach a definitive conclusion. The declining Dutch catch rates in the 19th century – especially on the first fishing trip of the season – support Goodlad's notion that the herring did not visit the Shetland grounds as frequently in the 1830s-1850s as they had done previously. If we view the situation from the perspective of spatial distribution, it becomes clear that the worst daily catch rates occurred at the Shetlands, whereas the areas nearer to the Scottish mainland proved more fertile. Though probably not the sole cause, this would have provided an environmental advantage in the rapid build up of the mainland Scottish herring fishery in the first half of the 19th century in comparison with the Shetland based herring industry. In addition, the Dutch high seas fishery presumably lost a comparative advantage based on their ability to operate free of geographical restraints far off the British mainland.

Fishing strategy 1) catch rates and the length of season and trip lengths

Finally, the recorded catch rates enabled an assessment of the fishing strategy applied in each season. The annual catch per boat was by and large stable, while the average length of individual fishing trips varied with the success rate of the fishery. The better the catches were, the shorter the trip. This applies to the analysis of data from the first and second fishing trip of the sea-

3 Coull, 'herring fishery in Shetland', p. 130.

4 Goodlad, *Shetland Fishing Saga*, pp. 171-175.

5 Goodlad, *Shetland Fishing Saga*, pp. 169.

son. The question of whether a fishing vessel should make one, two or three trips per year seems to be determined by how soon a ship returns from its previous trip. If a skipper brought his vessel home early from the first trip, he is very likely to have undertaken a second trip. If he came home early from both the first and second trip he is likely to have undertaken a third trip also.

Fishing strategy 2) spatial dynamics of movement
The main factors underlying the dynamics of the Dutch North Sea herring fisheries' spatial patterns can be asserted on different levels by analysing the highly detailed information from fishers' logbooks. At a seasonal level, the spatial patterns reflect an attempt to follow the migration patterns of herring in the north eastern part of the North Sea, most likely the Buchan and Dogger subpopulations. The seasonal distribution of fishing efforts was divided into a first, second and occasionally third fishing trip, but this does not seem to have played a significant role in determining the spatial pattern of fishing. On a day-to-day level, analysis of the spatial distribution of individual fishing trips has enabled an assessment of fishers' spatial responsiveness to fishing success rates. A clear day-to-day response can be seen in the correlation between the fishers' travel distance and the success of the previous nights' fishing. On average though, the fishers were not able to fully compensate for dwindling catch rates by increasing the average distances travelled per day of fishing.

Fishers' information sharing and cooperation
This study has applied economic resource theory and the results of anthropological case studies in order to discuss information sharing in a historical context while addressing distinct institutional, technological and cultural aspects. Despite the limitations to information sharing amongst Dutch North Sea herring fishers, they certainly did cooperate in managing the organisation of the fishery as well as the actual fishing operation far away from the shores of Holland. This is the first documentation based on archival studies of such a tightly organised fishery. Formal and informal systems of sharing information and monopolising the benefits of the valuable first catches of the season reveal a fishery with strong cooperative incentives to optimise catch rates. The modern economic concept of forming information sharing clubs was, at least in practice, already realised in the Dutch herring fishery between approx. 1600-1850. If any club members or free riding fishers violated the established practices, social pressure as well as measures would be applied to defend the interests of the club.

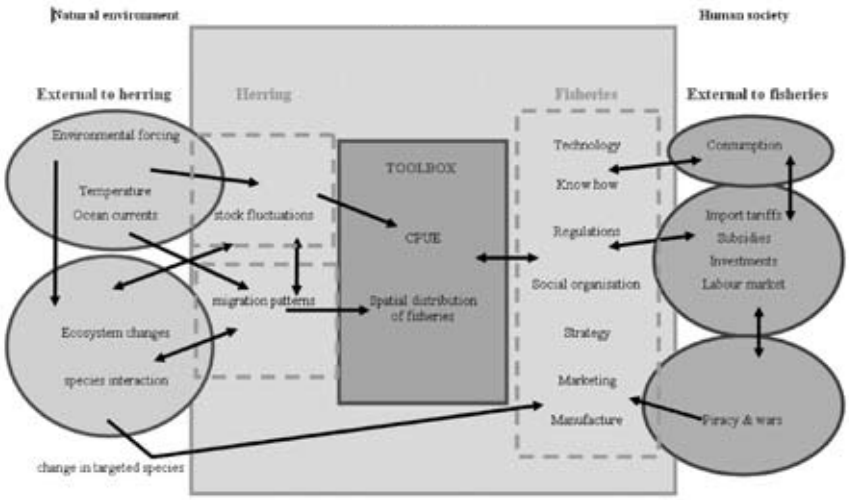
In terms of the institutional background, the *College van de Grote Visserij* facilitated a limited entry fishery, and the concept of ventjagers certainly fa-

voured cooperation amongst the Dutch fishers operating within this framework. They cooperated not just within their own town or area, but also with fishers from the rest of the Holland province. They were however, more likely to cooperate with neighbouring fishers than fishers from the other end of Holland.

A system of herring exploitation

The marine environmental analyses in the preceding chapters attempted to establish a coherent system of North Sea herring exploitation between approx. 1600-1860. Each chapter has sought to gain new insights into the interactions of historical herring fisheries and the historical natural environment in the North Sea within specific parts of the overall system. In an attempt to address the dynamics of the sum of these parts, this chapter presents an outline of the system of North Sea herring exploitation. The proposed system is illustrated by figure 11.1.

Figure 11.1
System of North Sea herring exploitation, approx. 1600-1860.



Dutch decline – hypotheses

The largest and most organized fishery in pre-modern Europe was the Dutch high sea herring fishery, de Grote Visserij, which dominated the North Sea market in the 17th century. After approx. 1650, decline set in. Over the course of the following centuries, the Swedish, Scottish and Norwegian herring producers rose to prominence on the northern European herring market. In a study by Dutch historian van Bochove it is estimated that the Dutch herring industries in total had economic deficits for most of the 250 years analysed here.[6]

But what were the dynamics behind this development? The downfall of the great Dutch herring fishery has attracted the attention of a number of historians over the last one hundred years.

Until now, five types of main hypotheses have been suggested with regards to the causes of decline. These hypotheses can now be assessed in light of the above findings.

War and piracy

The North Sea was a frequent theatre of war in the Early Modern period. The potential negative impact of these conflicts on the Dutch herring industry has been a topic for debate, at least since the late 19th century, when Dutch historian Beaujon published a political history of the Dutch fisheries. Beaujon found that by the time of the Peace of Utrecht in 1713, which saw the start of more peaceful times in the North Sea area, the Dutch herring fisheries had been hampered and broken down by the combined effects of a century-long series of wars and piracy.[7] Canadian historian Unger also proposed that the wars of the 17th century dealt decisive blows to the Dutch herring industry.[8] Recent historical research has attempted to quantify the effects of piracy. Dutch historian Adri van Vliet investigated the piracy from Dunkerque, in present-day northern France, and its impact on the Dutch herring fisheries during the 80 Years War (1568-1648).[9]

By combining overall production figures (figure 4.1) with quantifications of the number of vessels lost due to violence and warfare, we can offer some indications as to the impact of war and piracy on North Sea herring exploitation.

In 2002, Van Vliet calculated the annual number of vessels lost due to piracy over the period from 1625-1645. The greatest losses came in 1625, when

6 Van Bochove, 'De Gulden Mountain'.
7 Beaujon, *Nederlandsche Zeevisscherijen*, p. 80.
8 Unger, 'Dutch Herring, Technology', p. 279.
9 Van Vliet, *Vissers en Kapers* and *Vissers in Oorlogstijd*.

85 vessels were lost off Scotland, and again in 1635 when 124 vessels were taken by privateers.[10] These losses represent roughly 10% and 15% of the total fleet respectively. The heavy losses in 1625 coincide with a huge drop in total catches from approx. 50,000 tonnes in 1625 to just 22,000 in 1626. With regard to the even greater losses in 1635, there does not seem to have been the same immediate effect on total catches, since the total catch rose from 32,000 in 1635 to 45,000 tonnes the following year. Thus, the absolute loss in terms of the number of vessels was not necessarily reflected in the total production figures.

According to Van Vliet, the losses especially affected the southern part of the Dutch Republic. In addition to the direct loss of vessels, an increase in protection costs made the fisheries too costly. However, a recent analysis of the fisheries in the Zeeland province by Van Vliet found the fisheries to be rather more resilient to the violent perils of the sea.[11] In any case, privateering in the first half of the 17th century can only have been harmful to the herring industry.

Chapter 8 pinpoints 1652, 1666, 1670-72, 1676, 1694, 1702 and 1706-08 as years in which an unruly political situation is likely to have affected the CPUE indexation. However, this does not mean that these were the most harmful years in terms of, for instance, privateers taking herring vessels in open sea. For example, the ships taken by privateers would not feature in the landing data and thereby not bias the CPUE data. Nevertheless, the loss of ships would still affect the overall economic performance of the herring industry.

Chapter 8 suggests that the three Anglo-Dutch Wars in 1652-54, 1665-67 and 1672-74 seem to have caused bigger problems, judging from the failure to regain lost ground in more peaceful years immediately thereafter. The direct loss of ships has not been assessed in the same way for this period, but there are strong analogies between drastically declining catches and wartimes.

In 1652, 1670 and 1676 the landings from the first trip of the season were extremely bad due to the Anglo-Dutch War and Dunkerque privateers, respectively.[12] In some years the fisheries came to a complete halt, which was the case in 1666 and 1672 when only one and two herring vessels landed their catch in Schiedam. In the 1690s, the Dunkerque privateers were at their peak, and for the entire spring of 1691 the Dutch government forbade fishing in the open sea. Again, total production declined drastically.

After a peaceful interlude, war broke out again in 1702-1708; the War of

10 Van Vliet, 'Het einde van een bedrijfstak', pp. 7-16.

11 Van Vliet, *Vissers en Kapers* and *Vissers in Oorlogstijd* .

12 Beaujon, *Nederlandsche Zeevisscherijen*, pp. 75-78.

the Spanish Succession greatly impacted the Dutch herring fisheries. In 1703, around 100 herring busses fishing off the Shetlands are alleged to have been captured, burned and sank by a fleet of French warships.[13] The rest of the 1700s were relatively a peaceful period in the North Sea. The outbreak of the revolutionary wars in the early 1780s between England, France and The United States had another serious effect on the herring fisheries in the Netherlands.

There are striking parallels between the outbreak of war and heavy privateering and the periods of strong decline in the total catch of the Dutch herring industry. This mainly applies to the periods between approx. 1600-1708 and 1780-1813. However, the Dutch herring industry showed a greater overall resilience to these problems in the first half of the 17th century than it did in the rest of the period.

Institutional and technological inertia

A second explanation can be derived from Canadian historian Richard Unger's analysis of the Dutch position on the North European herring market. In his view, the Dutch herring industry excelled due to superior technology, organisation and a more effective institutional framework in the 16th century, but declined in the following century when the organisation was struck by inertia and failed to develop.[14]

Historian De Vries discards the importance of the technology factor, as the Dutch remained leaders in terms of fishing technology throughout the period.[15] The findings in the chapter on producers and production support this theory, as all the major herring producers that managed to compete successfully with the Dutch did so with inexpensive shore-based technology. Meanwhile, virtually all attempts at competing with a sophisticated Dutch style of production failed. The only exception to this rule was the herring companies in Emden in the late 18th and early 19th century, which operated successfully for more than two generations.

Moreover, analyses of the highly sophisticated fishing strategies regarding the search for fish and the efforts to fish together as a larger group highlighted aspects of the organisation of the Dutch herring fisheries that had previously been overlooked.

On the positive side, a limited entry system ensured a monopolistic status for insiders, the Dutch fishers, who gained from extensive mutual trust during joint fishing trips. Strict quality control ensured that the Dutch salted herring was regarded as the best in Europe. The know how regarding ratio-

13 Kranenburg, *De zeevisscherij*, p. 37.

14 Unger, 'Dutch Herring, Technology'.

15 Vries, *De economische achteruitgang*, p. 143.

nal fishing strategies and skills developed over generations is likely to have given the Dutch fishers an advantage, which was not easy to emulate for foreign nations setting up Dutch style herring fisheries. Even though the technological hardware was copied by several competing fishing industries, none managed to achieve longstanding success. This means that technological innovation in the North Sea fishing industries was not a major force of change in this period. Success depended on the ability to adopt the technology most suited to benefit from the relative spatial potential of the herring resources.

On the negative side, the monopolistic structure of the Dutch industry discouraged internal competition and innovation in the Dutch fishing sector. The relatively free movement of the Dutch fishing vessels enabled the fishers to adapt their operations to the success of the fisheries, but this came at a high cost in terms of investment. As previous analyses have shown, the Dutch herring industry as a whole experienced a deficit during approx. 8 of 10 years of the period between 1600-1850; enough reason, in short, for the sector to gradually contract.

More in-depth research could be conducted into the issue of institutional development and possible inertia. What sort of effect, for example, could the highly monopolistic nature of the *College van de Grote Visserij* have had on the innovation of new vessels and fishing gear? New light could also be shed on the vertical integration of investment, production, sales and distribution in the Dutch salted herring industry. However, these topics did not fall within the scope of this study.

Foreign competition

British and Dutch commentators have suggested that competition from Scotland was a third important factor in the decline of the Dutch herring fisheries.[16] The relatively high prices of prime quality Dutch herring had a potentially negative effect on competition. Another equally damaging factor could have been lack of demand on the home market due to changes in diet. Moreover, the trading policies of the North European states added to the problem, through high taxation of imported goods as well as the promotion of local industries. The rise in the number of private fishing companies in the 1760s and 1770s was often backed by government subsidies. In this period, known in economic history as the 'age of mercantilism', the herring fisheries were not exempt from a pattern whereby governments sought to promote their own national industries. None survived for long, however, which means that efforts to copy the Dutch mode of herring production did

16 Michell, 'European Fisheries' and De Vries and Van der Woude, *The first modern economy*, pp. 252-253.

not cause Dutch production itself to decline.

The production figures for salted herring show us that the most drastic phase of decline in the Dutch herring industry – the latter half of the 17th century – preceded the rise of large competing fisheries by three to four decades. It was not until the start of the 18th century that Scottish exports increased, and it was not before the 1730s and 1740s that Norwegian herring became the largest European producer. Hereafter, Bohuslen, Scotland and Norway remained the main producers throughout the period under investigation. In the analysis of this transformation of herring production, chapter 4 focused on the supply side with the demand, or consumer side, examined in chapter 6. The analysis of herring import statistics from Stettin and Hamburg outlines how the Dutch industry gradually lost its foothold in European markets.

However, when examining foreign competition as a factor in the Dutch decline, it appears that this was not a decisive issue until several decades after the start of the decline. Foreign competition in itself was hardly the prime mover. Falling demand is a more likely candidate.

Falling demand

Regarding the issue from a neo-classical perspective, it has been suggested that more lucrative investments in other sectors made the investors lose interest in the fisheries. The high prices of prime quality Dutch herring were bad for competition. A lack of demand on the home market due to dietary changes may also have played a role here. The situation was further worsened by the mercantilist trading policies of the North European, who levied high taxes on imported goods and promoted local industries.[17]

With the German States and The Baltic area constituting the principal market for European herring in the 17-19th century, it is of interest to investigate the demand for herring in those areas. In terms of the total production of salted herring in the North Sea area, the real boom towards 20th century levels occurred during the first half of the 19th century.

Having established the total production of salted herring in the wider North Sea area, it is possible to compare the supply of herring in Europe with the development of Europe's total population. This is illustrated in figure 11.2.[18] Europe's population was growing at a steady rate throughout this period, so that the amount of salted herring per capita dropped significantly. In order to put numbers to this argument, we can start by assuming that all Europeans ate an equal amount of salted herring each year. The next step is do divide the average annual production in 1600-1605 by the estimated pop-

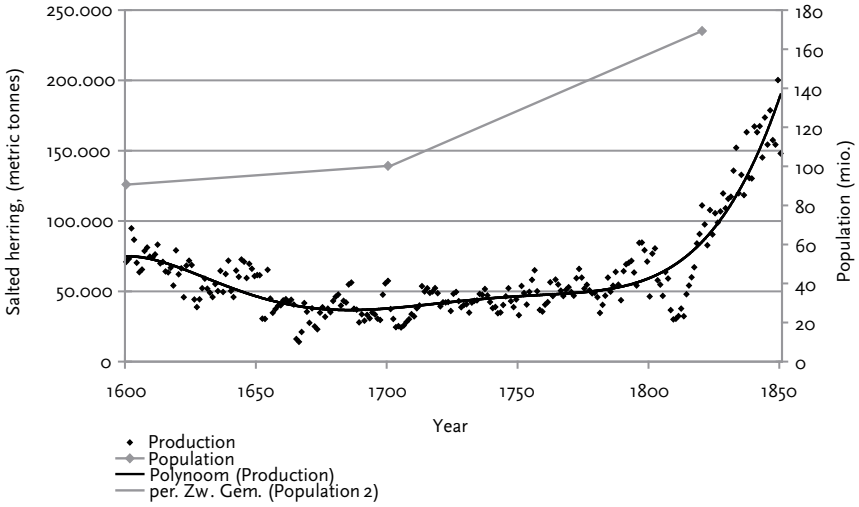
17 De Vries and Van der Woude, *The first modern economy.*

18 Population figures from: Maddison, *World Economy*, p. 232.

ulation in 1600. This results in a figure of 0.9 kg of salted herring per capita. Comparing production in the years 1696-1705 with the population around 1700 gives an average of 0.4 kg of salted herring per capita. Finally, around 1820, the ratio between European population and production of herring was 0.5 kg per capita. Over the course of the 17th century, average European consumption thus decreased by 50%, while levels appear to have stabilised during the following period of approx. 120 years. We can thus conclude that the European demand for herring must have had a highly significant impact on the transformation of the herring industry during this period.

Figure 11.2

Production of herring and the population of Europe, 1600-1850.



The population of Northern Europe however, rose greatly in the period from approx. 1600-1850, preceding the increase in the production of herring. This seems to indicate that herring gradually lost its place in the common staple diet. But is it possible to document a change in diet? We must also ask what may have caused the demand of herring to fall.

There are two ways of investigating whether a fall in demand took place. Firstly, a comparison between herring prices and grain prices offers an indication of the average consumer's purchasing power. When demand falls, the relative price of herring will do the same. Though herring prices rose all across Germany in the 17th century, they fell – when viewed over the entire

1600-1850 period – in comparison to grain prices.[19] But what if the cause of this drop in prices were a surge in production, rather than a fall in demand?

In order to check this, the consumption pattern in the principal markets was examined in chapter 6. A series of snapshots from different countries showed that salted herring began to disappear from the staple diet in the North Sea and Baltic areas during the 1600-1800 period. However, the only available consistent and lengthy time series was from a hospital in central Sweden.

The hypothesis of falling demand is supported by evidence of a fall in production per capita, consumption per capita and the price differential between herring and grain.

This study has mainly focused on the interplay between production and resource availability, within the framework of the exploitation system outlined above. In economic terms, this approach is well-suited to cover the supply side of the economy, but results are limited in terms of explaining the demand side of the European fisheries sector. A similar study of the demand side would require an entirely different set of hypotheses and datasets. The early modern distribution networks for fish products require further study, as does the impact of transaction costs, the impact of infrastructure development, and the role of merchants' organisations. As a part of assessing these transport and trade oriented factors, there is also a need to examine the parallel decline of many other sectors of the early modern Dutch economy, including the loss of supremacy in the Baltic grain trade.[20] Much more research will be needed to shed light on this issue.

Declining catch rates

Declining catch rates have previously been a dark horse in historians' explanations of the downfall of the great Dutch herring industry. Dutch historian Kranenburg first suggested this explanation more than half a century ago, and a number of subsequent authors have commented on environmental changes.[21] This study, however, has been the first to present an in-depth analysis of this problem from both a temporal and spatial perspective.

Highly detailed data on catch per day per boat for each of the three po-

19 Hitzbleck, *Bedeutung des Fisches*, pp. 228-244.

20 The overall performance of the Dutch economy was most recently discussed by De Vries and Van der Woude, *The first modern economy* and Ormrod, *Rise of Comercial Empires*. The decline of the grain trade is analysed by Tielhof, *Mother of all Trades*.

21 Kranenburg, *De zeevisscherij*, pp. 43-44, Michell, 'European Fisheries', Willemsen, *Enkhuizen*, van Bochove, 'De Hollandse haringvisserij', pp. 15-16, De Vries and Van der Woude *The first modern economy*, pp. 251-253, and De Vries, *De economische achteruitgang*, p. 144.

tential annual trips has enabled the reconstruction of time series, highlighting major fluctuations over the 250-year period. This was illustrated by the analysis in chapter 8. However, a comparison of the catch rates for trip 1 with those of trip 2 and 3 found fluctuating cycles that countered one other, resulting in remarkably stable combined annual catch rates per day at sea between approx. 1600-1800. The total annual catch per boat decreased slightly in the latter half of the 18th century, and dropped quite drastically in the entire first half of the 19th century, when it remained at a level equalling less than half the CPUE of the previous two hundred years.

Chapter 10 complimented the results of the CPUE analyses insofar as it assessed the average length of the fishing season over a 250-year period. The decline of the average annual catch from approx. 1750 to the end of this century can be attributed to a gradual shortening of the herring season. Until approx. 1750, the herring season normally extended into the months of December and January, which overlapped with the normal fishing season for North Sea cod starting in winter. It is plausible to assume that the cod fisheries became relatively more attractive for the Dutch fishers from this period onwards. More knowledge of the Dutch cod fishery is needed in order to draw conclusions as to this hypothesis, but the introduction of the Hoekerbuis, a vessel type suited for both herring and cod fisheries would seem to support this theory.

In chapter 4, the virtual spatial independency of the Dutch herring industry was accounted for and compared with the shore-based, spatially restrained herring fisheries in the North Sea area. The spatial aspects of the Dutch fishery model was further fleshed out in chapters 9 and 10, which analysed the actual patterns and dynamics of movement. The results indicated a clear linear relationship between the number of days at sea and the number of days spent fishing. Moreover, the area covered per day of sailing was negatively correlated with the rate of success in fishing; the better the fishing, the less movement. The CPUE fluctuations for each of the one, two or three trips normally undertaken during one season thus seems to be a credible index for the available abundance of herring within a large portion of the North Sea.

The probable loss of *relative spatial advantage* in the 19th century outlined in the above section testifies to this. This means that although the catch rates were more or less stable in the 17th and 18th centuries, the chances are that similar spatial changes in the available abundance of herring could have affected the spatial potential of the Dutch fishery model in comparison to spatially confined shore-based fisheries.

With regards to the hypothesis of declining catch rates, it would be fair to assume that the drastic decline in catch per day at sea in the first half of the 19th century had a seriously negative impact on the development of the Dutch herring industry. During the preceding two hundred years the annual

catch rates seem to have been quite stable and could thus not have been a significant factor in this hypothesis of decline. However, past changes in the relative spatial potential could have had a negative effect on the Dutch fisheries, and the relative changes in the abundance of cod and herring might have influenced the decision to shorten the herring season from the late 18th century onwards.

Thus, changes in the natural circumstances affecting the fisheries certainly had a great impact on the downfall of the Dutch herring fisheries. With the exception of the period between 1814-1850, however, this impact manifested itself in a more indirect way than through diminishing CPUE as such.

Investments and the labour market

In addition to the five main hypotheses, two other factors deserve mentioning even if they have not provoked the same amount of interest in previous research. These two factors are the climate for investment in the Netherlands and salary levels.

A neo-classical approach to the issue yielded the explanation that more lucrative ways of investments arose in other sectors such as the whaling industry, diverting interests away from the herring fisheries.[22]

Similarly, the dynamics of the labour market and – more specifically – the salaries in the fishing sector – are worthy of more research. Historian Van Vliet has proposed that the relative wage level in the fishing sector rose in the latter 17th and 18th centuries, thus contributing to the decline in interest.[23] However, an article by Van Bochove suggests that this factor could not have had a significant effect, as the salaries in the Dutch herring industry made up more or less the same percentage of the total cost of fitting out a vessel throughout the 17th and 18th centuries.[24]

These aspects are important in terms of the development of the Dutch herring sector and deserve additional research. Nonetheless, it was beyond the scope of this study to investigate this phenomenon, which is of indirect rather than direct relevance to the interactions between fish and fishers in the system of herring exploitation. Further analyses of the workings of the Dutch capital market and labour market in relation to the fisheries would be highly interesting.

---

22 De Vries, Jan and Ad van der Woude, *The first modern economy*, pp. 266-268.

23 Van Vliet, 'sea fishery and the money-box', pp. 131-145.

24 Van Bochove, 'De Gulden Mountain'.

Conclusion

Dynamics of herring exploitation

Based on the conclusions in the current and preceding chapters, it is fair to say that the overall development was influenced by a combination of political, social, economic and environmental factors.

Politics, such as privateering and regular warfare, had a significantly negative impact on the productivity of the North Sea herring fisheries throughout the 17th century and the Napoleonic Era. In the 18th century, the more peaceful political means of mercantilist policies had a negative impact on export-oriented herring producers, and sought to promote each country's own fishing industries.

Social changes occurred throughout this period, in the shape of a changing north European diet. The demand for salted herring on the European herring market was a major force behind the overall growth in herring exploitation in the North Sea in the period between approx. 1600-1850. Demand per capita declined over the course of the 250-year period, especially between approx. 1650-1750, seemingly more so around the North Sea area than in the Baltic region.

Economic changes occurred as the main production of herring shifted from the capital intensive and tightly organised Dutch dominance towards a system of resource exploitation based on more localised, less regulated shore-based herring industries that proved most successful in Norway, Scotland and Sweden. The Dutch model of herring production was found to contain positive as well as negative institutional features compared to its North Sea counterparts.

Role of marine environment

The North Sea marine environment played a very dynamic role in the interplay between the aforementioned agents of change in the development of herring resource exploitation. The catchability of North Sea herring developed along two different lines in the period between 1600-1860.

First of all, the available annual abundance expressed as a CPUE-index was remarkably stable throughout the period from 1600-1800. However, the period of 1814-1850 saw a markedly lower level of annual catch rates than the previous period. The fisheries had an insignificant impact on stock abundance, which means the fish stock fluctuations were due to natural causes.

Secondly, the spatial distribution of the herring fisheries changed continuously throughout the 250-year period. 19th century evidence suggests that the high seas-based Dutch type of herring fisheries operating far away from home lost their relative spatial advantage over the shore-based fisheries on the Scottish mainland, since large shoals of herring swam close to the

shore, relative to the available abundance off the Shetlands. With regards to Scotland, it has not been possible to establish whether this occurred in earlier phases of relatively great activity by the shore-based Scottish herring industry. However, the North Sea area saw various shifts in terms of relative spatial advantage over time.

Environmental phenomena such as different periods of abundant large shoals of Atlanto-Scandian herring close to the shore of western Norway and the Bohuslen periods whereby North Sea herring entered the eastern Skagerack are well documented. These phenomena created the ideal preconditions for large-scale herring fisheries in western Norway and Bohuslen, allowing them to become the dominant producers of herring in the North Sea area at various times in history. This happened in western Norway in the periods between approx. 1740-1760 and approx. 1820-1850, while the Bohuslen area benefited between approx. 1765-1808. The changing spatial distribution of the dominant location of herring production in the North Sea was thus highly dependent on the environmental forces underlying the spatial distribution and stock fluctuations of herring.

Within the historical system of herring exploitation, demand for herring on the European market can thus be regarded as a major driver for the overall development of the North Sea herring industry. Within this framework, climate induced environmental forcing is assumed to be a main driver responsible for facilitating the relative spatial potential of the herring industries in the North Sea.

Dutch decline – events and conjunctures

The historical system of herring exploitation consists of interactions between a very dynamic natural system and a highly dynamic anthropogenic system. One of the most stable trends in this regard is the steady long-term decline of the Dutch North Sea herring fisheries, which has been addressed in much previous historical research. As pointed out above, several in-depth studies of the labour market, capital market, business organisation and consumption patterns remain to be conducted. Based on the knowledge available today, however, we can draw the following conclusions with regard to the long decline of the once great Dutch herring fishery. In order to highlight the main dynamics, the entire period under examination has been roughly divided into segments of approx. 50 years.

In the period between approx. 1600-1650 the Dutch herring industries were at their prime, dominating European herring production and trade. Privateering and warfare were the major obstacles in this period. Subsequently, during the phase between approx. 1650-1710 the Dutch industry suffered major blows, primarily due to the Anglo-Dutch wars and the War of Spanish Succession.

In the next period, between approx. 1710-1760, the North Sea once again became a peaceful area. Nevertheless, various challenges prevented the Dutch from achieving full post-war recovery. The gradual implementation of high tariffs on the import of salted herring in European states affected this export-oriented industry. The growing Norwegian and Scottish herring industries filled in the vacuum – especially in the Baltic market – after the contraction of the Dutch industry. A likely dynamic behind this change is an environmental shift in relative spatial potential that benefited the shore-based herring industries.

The Dutch decline continued throughout the following period between 1760-1814. The spatial distribution of available North Sea herring abundance shifted further from the Dutch area of operation during the rise of the great Bohuslen herring period, 1756-1808. Political developments such as the revolutionary wars and the Napoleonic period frequently prevented Dutch herring vessels from engaging in high sea herring fisheries during the periods between 1780-81 and 1795-1813. Meanwhile, mercantilist policies continued to impede the export-oriented herring producers, and several competing herring companies were established in the states around the North Sea in an attempt to subsidise the domestic industries.

1815-1850 was an absolute low point in the history of the Dutch herring fisheries. The catch rates were less than half of what they had been in the preceding two centuries, and Scottish as well as Norwegian herring fisheries gained a comparative spatial advantage from shifts in the spatial distribution of herring. It would be fair to say that the environmental aspects of the system had their most negative impact on the Dutch herring fisheries during this period.

Dutch decline – structural change

The demand for salted herring saw a structural decline from approx. 1650 onwards, a development that lasted at least until the end of the Napoleonic Wars. In the first half of the 19th century, society also changed rapidly in the wake of the industrial revolution. The opening of new overseas markets and improved inland transportation via railroads and canals may have helped to stabilise the per capita consumption of salted herring, but further analysis would have to be carried out to assert this theory.

In terms of fishing strategy, the shortening of the herring season from approx. 1750 onwards and the introduction of the hoekerbuis had a negative impact on the annual Dutch herring catches.

The tight organisation and stable institutional framework scarcely changed during the period under examination, and are found to have had both positive and negative effects on the industry.

Measure of success?

The dynamics of the North Sea herring exploitation system between approx. 1600-1850 have now been analysed. The long time span raises the question of how one should measure the historical success of a highly dynamic interaction between human society and the natural environment.

Fishing pressure was insignificant; from a modern sustainability perspective, the pre-industrial exploitation of North Sea herring was thus ecologically sustainable. The herring fisheries in the North Sea could not have severely affected the natural resource availability. Rather, the natural resource availability had a large impact on the fate of the herring fisheries.

From the perspective of human society, the above analysis of this 250-year period demonstrates that that the Dutch herring industry ultimately lost out more than any other industry. In the year 1600, the Dutch were the paramount producers of salted herring in Europe, yet accounted for just 5% of the total amount of herring in Europe by 1850.

On the other hand, however, the analysis of the organisational structures and technologies used by the various herring fisheries has demonstrated that the Dutch high seas herring fishery remained the only enduring proponent of what can be termed 'the Dutch model' of herring production. None of the many competitors in Northern Europe succeeded in building a similar fleet. Rather, the various dominant industries from the 1740s onwards were all based on more flexible local herring fisheries, requiring less capital investment. In economic terms, this flexibility caused periods of economic boom and bust.

Past fishing in the future

This study of the exploitation of North Sea herring between approx. 1600-1850 with special emphasis on the Dutch herring fisheries is a marine environmental history. It is an attempt to combine theories of modern marine science with documentary records from the Dutch herring fisheries from the pre-statistical era. The multiple perspectives it touches upon have wide implications in at least four different directions.

First of all, the study has implications in terms of historical methodology. This study is an empirical test of potential common theoretical grounds for the humanities, i.e. the study of history and the natural sciences, in this case marine ecology. The positive outcome of the applied theories demonstrates the fruitfulness of combining the *two cultures*, which are too often viewed as being unable to communicate.

Secondly, the results are of interest to modern marine ecology, particularly with regards to studies of the North Sea herring population. The establish-

ment of a CPUE-index for an almost 250-year period can serve as a reference point for other studies on herring catch rates and stock fluctuations, both in the North Sea and within a global historical context. This would be relevant to the study of historical connections between climate change and herring, creating a firm foundation of historical ecological data with which to predict the future effects of climate change on today's herring populations. The currently available datasets on the history of North Sea herring also provide the necessary parameters with which to calculate the biomass level of North Sea herring in past ecosystems where fisheries had little effect on the ecosystem. This could reveal how herring fared in a more untouched ecosystem. Theories on species interactions between herring and cod could also potentially be tested in light of historical developments.

Thirdly, this study points to the need for further research into the history of Dutch herring fisheries, specifically on the causes for the Dutch decline. One interesting perspective would be a comparative analysis of the cost structure of competing fisheries. This could address the hypothesis that it was significantly cheaper to fish from Scotland and Norway than the Netherlands at various stages in the early modern period. Furthermore, in-depth analysis of historical market integration could take into account the resource availability discussed here.

Fourthly, the results and methodology could serve as a reference for wider historical studies of pre modern resource exploitation and other historical fisheries. The analytic framework and research tools relevant to long-term developments in CPUE and spatial patterns developed through this study could be applied to other fisheries with commercial significance over long time periods. The cod fisheries off Newfoundland are one such example.

This study makes the case for a historical system of North Sea herring exploitation in which the demands of the market serve as a major long-term driver amidst political and social changes. Within this system, the concept of *relative spatial potential* is also an important factor, while the reliance on natural variations in resource availability is highly critical in terms of the technological and economic development of the fisheries.

English summary

In short, the purpose of this study is to increase our understanding of the driving forces in pre-modern resource exploitation. Within this framework, the goal is to distinguish between human and natural impacts on the marine ecosystem through analyses of relevant sets of historical source material.
This leads to the formulation of three overarching questions.

- What were the main forces stimulating changes in the exploitation of North Sea herring in the period between approx. 1600-1860. In other words, what were the dynamics of this particular historical system?
- What was the role of the natural environment in this regard?
- What caused the long-term decline of the Dutch herring fisheries?

A marine environmental history

From the perspective of historiography, this can be considered a marine environmental history. This study is an empirical test of potential common theoretical grounds for the humanities, i.e. the study of history and the natural sciences, in this case marine ecology. The positive outcome of the applied theories demonstrates the fruitfulness of combining the two cultures, which are too often viewed as being unable to communicate.

The marine environmental analyses are aimed at helping to define a coherent system of North Sea herring exploitation between approx. 1600-1850 by testing a number of hypotheses.

It has been demonstrated that uniform sets of historical data allow for the reconstruction of long time series with regards to fishing effort and catch rates. It has also been proven that historical research can facilitate a reconstruction of the spatial dimensions of the North Sea herring exploitation pattern.

This successful outcome has made it possible to differentiate between natural and human impacts on North Sea herring.

The total extraction of North Sea herring was calculated for the period between approx. 1600-1850. It has been demonstrated that these quantities were insignificant in terms of their impact on the abundance of North Sea herring.

CPUE-indices have been applied to demonstrate how the population of

North Sea herring fluctuated over 250 years, and the high detailed historical data has made it possible to track the migration of the North Sea herring stock, both seasonally and in a decadal perspective. The observed North Sea herring stock fluctuations and migration patterns were found to be in concordance with current theory on the relationship with environmental forcing.

From a more traditional historical point of view this study has calculated the total production of salted herring in the North Sea. It also establishes the main producers of herring, and how their modes of production differentiated. Furthermore, external historical developments were found to have had an impact on the development of the herring fisheries. The European consumption pattern for salted herring was analysed, with the results pointing to a large degree of market integration and a decline in per capita demand during the 17th and 18th centuries.

In terms of fishing strategy, the tight organisation of the Dutch herring fisheries proved to be highly instrumental in the development of cooperative behaviour amongst Dutch fishers, in line with modern theory on information sharing systems. Moreover, the fishing strategies were very adaptive to the challenges posed by the herring, a species known for its vivid temporal and spatial fluctuations.

These findings allow us to answer the three questions listed above.

Dynamics of herring exploitation

The overall development of North Sea herring exploitation was influenced by a combination of political, social, economic and environmental factors.

Political factors, such as privateering and regular warfare, had a significantly negative impact on the productivity of the North Sea herring fisheries throughout the 17th century and the Napoleonic Era. In the 18th century, the more peaceful political means of mercantilist policies had a negative impact on export-oriented herring producers, and sought to promote each country's own fishing industries.

Social changes occurred throughout this period, in the shape of a changing north European diet. The demand for salted herring on the European herring market was a major force behind the overall growth in herring exploitation in the North Sea in the period between approx. 1600-1850. Demand per capita declined over the course of the 250-year period, especially between approx. 1650-1750, seemingly more so around the North Sea area than in the Baltic region.

Economic changes occurred as the main production of herring shifted from the capital intensive and tightly organised Dutch dominance towards a system of resource exploitation based on more localised, less regulated shore-

based herring industries that proved most successful in Norway, Scotland and Sweden. The Dutch model of herring production was found to contain positive as well as negative institutional features compared to its North Sea counterparts.

Role of marine environment

The North Sea marine environment played a very dynamic role in the interplay between the aforementioned agents of change in the development of herring resource exploitation. The catchability of North Sea herring developed along two different lines in the period between 1600-1860.

First of all, the available annual abundance expressed as a CPUE-index was remarkably stable throughout the period from 1600-1800. However, the period of 1814-1850 saw a markedly lower level of annual catch rates than the previous period. The fisheries had an insignificant impact on stock abundance, which means the fish stock fluctuations were due to natural causes.

Secondly, the spatial distribution of the herring fisheries changed continuously throughout the 250-year period. 19th century evidence suggests that the high seas-based Dutch type of herring fisheries operating far away from home lost their relative spatial advantage over the shore-based fisheries on the Scottish mainland, since large shoals of herring swam close to the shore, relative to the available abundance off the Shetlands. With regards to Scotland, it has not been possible to establish whether this occurred in earlier phases of relatively great activity by the shore-based Scottish herring industry. However, the North Sea area saw various shifts in terms of relative spatial advantage over time.

Environmental phenomena such as different periods of abundant large shoals of Atlanto-Scandian herring close to the shore of western Norway and the Bohuslen periods whereby North Sea herring entered the eastern Skagerack are well documented. These phenomena created the ideal preconditions for large-scale herring fisheries in western Norway and Bohuslen, allowing them to become the dominant producers of herring in the North Sea area at various times in history. This happened in western Norway in the periods between approx. 1740-1760 and approx. 1820-1850, while the Bohuslen area benefited between approx. 1765-1808. The changing spatial distribution of the dominant location of herring production in the North Sea was thus highly dependent on the environmental forces underlying the spatial distribution and stock fluctuations of herring.

Within the historical system of herring exploitation, demand for herring on the European market can thus be regarded as a major driver for the over-

all development of the North Sea herring industry. Within this framework, climate induced environmental forcing is assumed to be a main driver responsible for facilitating the relative spatial potential of the herring industries in the North Sea.

Dutch decline – events and conjunctures

The historical system of herring exploitation consists of interactions between a very dynamic natural system and a highly dynamic anthropogenic system. One of the most stable trends in this regard is the steady long-term decline of the Dutch North Sea herring fisheries, which has been addressed in much previous historical research. As pointed out above, several in-depth studies of the labour market, capital market, business organisation and consumption patterns remain to be conducted. Based on the knowledge available today, however, we can draw the following conclusions with regard to the long decline of the once great Dutch herring fishery.

In the period between approx. 1600-1650 the Dutch herring industries were at their prime, dominating European herring production and trade. Privateering and warfare were the major obstacles in this period. Subsequently, during the phase between approx. 1650-1710 the Dutch industry suffered major blows, primarily due to the Anglo-Dutch wars and the War of Spanish Succession.

In the next period, between approx. 1710-1760, the North Sea once again became a peaceful area. Nevertheless, various challenges prevented the Dutch from achieving full post-war recovery. The gradual implementation of high tariffs on the import of salted herring in European states affected this export-oriented industry. The growing Norwegian and Scottish herring industries filled in the vacuum – especially in the Baltic market – after the contraction of the Dutch industry. A likely dynamic behind this change is an environmental shift in relative spatial potential that benefited the shore-based herring industries.

The Dutch decline continued throughout the following period between 1760-1814. The spatial distribution of available North Sea herring abundance shifted further from the Dutch area of operation during the rise of the great Bohuslen herring period, 1756-1808. Political developments such as the revolutionary wars and the Napoleonic period frequently prevented Dutch herring vessels from engaging in high sea herring fisheries during the periods between 1780-81 and 1795-1813. Meanwhile, mercantilist policies continued to impede the export-oriented herring producers, and several competing herring companies were established in the states around the North Sea in an attempt to subsidise the domestic industries.

1815-1850 was an absolute low point in the history of the Dutch herring fisheries. The catch rates were less than half of what they had been in the preceding two centuries, and Scottish as well as Norwegian herring fisheries gained a comparative spatial advantage from shifts in the spatial distribution of herring. It would be fair to say that the environmental aspects of the system had their most negative impact on the Dutch herring fisheries during this period.

Dutch decline – structural change

The demand for salted herring saw a structural decline from approx. 1650 onwards, a development that lasted at least until the end of the Napoleonic wars. In the first half of the 19th century, society also changed rapidly in the wake of the industrial revolution. The opening of new overseas markets and improved inland transportation via railroads and canals may have helped to stabilise the per capita consumption of salted herring, but further analysis would have to be carried out to assert this theory.

In terms of fishing strategy, the shortening of the herring season from approx. 1750 onwards and the introduction of the hoekerbuis had a negative impact on the annual Dutch herring catches.

The tight organisation and stable institutional framework scarcely changed during the period under examination, and are found to have had both positive and negative effects on the industry.

Dansk resume

Formålet med denne afhandling er at bidrage til en øget forståelse af drivkræfterne i før-moderne ressourceudnyttelse. Herunder er det et mål at analysere en række relevante historiske kilder med henblik på at kunne skelne mellem humane og naturlige påvirkninger af et marint økosystem.
Udgangspunktet for undersøgelsen er formuleringen af tre overordnede spørgsmål.

- Hvad var de vigtigste historiske drivkræfter bag udviklingen i udnyttelsen af sild fra Nordsøen i perioden cirka 1600-1860? Med andre ord, hvordan forstås dynamikken i et bestemt historisk system af naturlige og menneskelige påvirkninger?
- Hvilken rolle spillede miljøet for den historiske udvikling?
- Hvad forårsagede det store hollandske sildefiskeris kontinuerlige tilbagegang over 200 år?

En marin miljøhistorie

Fra et historiografisk synspunkt er afhandlingen en marin miljøhistorie. Afhandlingen fremsætter et fælles teoretisk udgangspunkt for et tværvidenskabeligt studium, der kombinerer naturvidenskab og humanvidenskab, mere præcist historievidenskaben og marin økologi. Den tværvidenskabelige tilgang indikerer frugtbarheden ved at kombinere, hvad der er blevet kaldt de to kulturer. Dette sker gennem testningen af en række hypoteser, der hver især bidrager til at etablere et sammenhængende system for udnyttelsen af sild i Nordsøen. Her igennem har afhandlingen vist, at det er muligt ved hjælp af ensartede historiske data sæt at rekonstruere både lange tids serier for fangst per indsatsenhed, catch per unit effort (CPUE) i Nordsøens sildefiskerier og de samme fiskeriers rumlige mønstre. Det har tilsammen gjort det muligt at skelne mellem naturlige og humane påvirkninger af sildene i Nordsøen.

Gennem beregninger af den totale mængde af nordsøsild fanget i perioden 1600-1850 er det sandsynliggjort, at de opfiskede mængder ikke har været store nok til signifikant at kunne påvirke bestanden af nordsøsild.

Det er derfor muligt at bruge de etablerede index for CPUE til at vise naturlige fluktuationer i Nordsøens sildebestande over 250 år. Desuden har den høje opløselighed i de historiske data gjort det muligt at følge

Nordsøsildens historiske migrationsmønstre, både sæsonvist og over længere tidsperspektiver. De historiske fluktuationer i sildebestandene og deres migrationsmønstre harmonerer i høj grad med moderne teorier om miljømæssige påvirkninger af sildene i Nordsøen.

Fra et mere traditionelt historisk perspektiv har afhandlingen for det første bidraget med en beregning af den totale produktion af saltet sild i tønder i Nordsøen. Herunder har afhandlingen identificeret de vigtigste producenter af sild, samt hvordan sildeproduktionen foregik væsensforskelligt i kystbaserede fiskerier og i højsøfiskerier, som det hollandske og de forskellige forsøg på at kopiere den hollandske produktionsmåde.

Desuden viser afhandlingen, hvordan en række faktorer uden for fiskeriet havde stor indvirkning på fiskeriets udvikling. Det drejer sig både om kaperaktivitet og søkrige i Nordsøen og om udviklingen i forbrugsmønstre for saltsild i Nordeuropa. En analyse af sildehandel og de vigtigste markeder for sild viser, at der var en høj grad af intregration i sildemarkedet, og at forbruget af sild per capita aftog kraftigt igennem 1600 og 1700-tallet.

Med hensyn til fiskeristrategiens rolle for ressourceudnyttelse bidrager afhandlingen med en analyse af, hvordan den stramme organisering af det hollandske sildefiskeri fremmede en kooperativ adfærd blandt fiskerne, der svarer til moderne teorier om vidensdeling i fiskerier efter stærkt mobile pelagiske, (fritsvømmende) fisk såsom sild. Desuden viser afhandlingen, at de hollandske fiskere opererede med en stor tilpasningsevne til sildens tidsmæssige og rumlige fluktuationer. Tilsammen har besvarelsen af en række enkelthypoteser gjort det muligt at besvare de tre overordnede spørgsmål:

Drivkræfter bag udnyttelsen af nordsøsilden

Den overordnede udvikling i udnyttelsen af nordsøsilden blev påvirket af en række politiske, sociale, økonomiske og miljømæssige faktorer. Politisk set havde kapervæsen og regulære søkrige en signifikant negativ indvirkning på sildefiskeriernes produktivitet igennem hele 1600-tallet og igen i forbindelse med revolutions- og Napoleonskrigene i årtierne omkring år 1800. I løbet af 1700-tallet havde den politiske indflydelse en mere fredelig, men dog væsentlig indvirkning på fiskeriet, idet merkantilistisk handelspolitik bremsede de mest eksportorienterede producentlande, mens statslige subsidier blev en støtte for en række nye produktioner af sild.

Sociale forandringer foregik gennem hele perioden i form af en gradvist ændret diæt i Nordeuropa. Efterspørgselen på sild var en meget væsentlig drivkraft for fiskeriets generelle udvikling, og specielt i løbet af perioden 1650-1750 var der tale om et kraftigt fald i efterspørgslen efter saltet sild. Desuden var faldet tilsyneladende kraftigere i producentlandene omkring

Nordsøen, end de var i Østersøområdet.

Den væsentligste økonomiske forandring var et skifte fra en produktionsmåde domineret af det stramt organiserede og kapitalkrævende hollandske sildefiskeri hen imod et system, der var baseret på kystnært fiskeri præget af en ringe grad af regulering og stor investeringsmæssig fleksibilitet. De mest succesfulde kystnære fiskerier var i Norge, Skotland og Sverige. Hvad angår den hollandske produktionsmåde diskuterer afhandlingen betydningen af den stærke institutionalisering, som viser sig at have haft fordele og ulemper sammenlignet med de kystnære fiskerier.

Miljømæssige drivkræfter

Nordsøens marine miljø spillede en særdeles dynamisk rolle i et samspil med de oven for nævnte samfundsmæssige drivkræfter. Herunder udviklede sandsynligheden for fangst sig både over tid og rumligt i løbet af perioden 1600-1860. Set over hele fiskesæsonen var fangstraterne set gennem index for CPUE bemærkelsesværdigt stabil i perioden fra 1600-1800. I den følgende periode fra 1814-1850 var der imidlertid markant lavere årlige fangstrater. Idet fiskeritrykket var uden væsentlig betydning, må de lave fangstrater have haft naturlige årsager.

Hvad angår den rumlige fordeling af sildefiskerierne foregik der kontinuerligt forandringer i løbet af undersøgelsens approx. 250 år. Den rumlige fordeling af fiskerierne kan bedst følges i kildematerialet for 1800-tallet. Hollænderne kunne følge silden lige hvorhen, fiskeriet var bedst. Men da store mængder af sild blev langt lettere tilgængelige ved den skotske kyst end på åbent hav ved Shetlandsøerne, tyder resultaterne på, at den hollandske produktionsmåde med store fabriksskibe mistede sin relative rumlige fordel over for de skotske kystnære fiskerier.

Med hensyn til Skotland har kildematerialet ikke gjort det muligt at teste, hvorvidt der tidligere har været lignende perioder, hvor det kystnære fiskeri var relativt mere fordelagtigt end det hollandske fiskeri. Ved både Vestnorge og Bohuslens kyster er der imidlertid historiske eksempler på dette fænomen.

Således var der i perioderne, cirka 1740-1760 og cirka 1820-1850 store forekomster af Atlanto-skandiske sild ved de vestnorske kyster, som gav optimale betingelser for de store kystnære sildefiskerier, der etableredes i disse perioder. Tilsvarende kom store mængder af Nordsøsild helt ind i Skagerrak og tæt forbi skærgårdskysten ved Bohuslen og muliggjorde et stort fiskeri i årene fra 1756-1808. I alle de tre nævnte tilfælde voksede det pågældende kystnære fiskeri til at blive det vigtigste produktionssted for sild i Nordsøen. Således var foranderligheden i hvor og på hvilken måde, det var bedst at

producere sild i høj grad dikteret af de miljømæssige kræfter, der styrer bestandsfluktuationerne og den rumlige fordeling af sildene i Nordsøen. Man kan sige, at inden for det foreslåede system for den historiske udnyttelse af nordsøsild har efterspørgselen efter sild været en væsentlig drivkraft. Men de naturligt betingede forandringer i sildenes fluktuationer og rumlige fordeling er en meget væsentlig drivkraft for de forskellige sildefiskeriers relative rumlige potentiale.

Hollandsk nedgang – begivenheder og konjunkturer

Et af de mest stabile træk ved sildefiskeriernes historiske udvikling er den århundredelange tilbagegang for det hollandske sildefiskeri. Denne udvikling har tiltrukket opmærksomhed fra hidtidig historisk forskning, men denne afhandling præsenterer den første marint miljøhistoriske tolkning af fænomenet. Konklusionen kommer derfor et skridt videre end den hidtidige forskning, men det skal medgives at et fuldt dækkende svar på spørgsmålet om årsagerne til det hollandske sildefiskeris tilbagegang kræver yderligere studier. Særligt mangler vi viden om arbejdsmarkedet, kapitalmarkedet, fiskernes erhvervsmæssige organisering samt forbrugsmønstre i Nordeuropa. Ikke desto mindre, søger denne afhandling at indkredse en række svar på sprøgsmålet. Med henblik på at vurdere de forskellige naturgivne og samfundsmæssige drivkræfters indvirkning er det nedenstående inddelt, først i konjunkturelle og begivenhedsmæssige forklaringer og dernæst i strukturelle forklaringer For klarhedens skyld er de begivenhedsmæssige og konjunkturelle forklaringer inddelt i perioder af cirka et halvt hundrede år.

Den første periode cirka 1600-1650 var det hollandske fiskeris storhedstid som altdominerende producent af saltede sild i Europa. På dette tidspunkt udgjorde kapervæsen den væsentligste trussel mod fiskeriet.

I den efterfølgende periode cirka 1650-1710 gik det hollandske fiskeri stærkt tilbage på grund af kapervæsen og i særlig grad som en direkte følge af de engelsk-hollandske krige, samt Den spanske Arvefølgekrig. 1700-tallet var derimod en fredelig periode i Nordsøens historie, men årene fra 1710-1760 mistede hollænderne deres dominerende position på det europæiske sildemarked. I en række europæiske stater blev der gradvist indført høje importafgifter på saltet sild, hvilket påvirkede den eksportorienterede hollandske sildeindustri. Desuden voksede de skotske og norske sildefiskerier og kom til at dominere det store marked for sild i Østersøområdet. Det er sandsynligt, at den væsentligste drivkraft bag ved dette skifte var miljømæssig nemlig et skifte i relativt rumligt potentiale til fordel for de kystbaserede fiskerier.

I perioden 1760-1814 fortsatte nedgangen. I årene cirka 1756-1808 var det rumlige potentiale til fortsat ugunst for den hollandske produktions-

måde, men nu var det ved Bohuslen i det vestlige Sverige, at det dominerende fiskeri foregik. På den politiske arena spolerede revolutionskrigene og Napoleonskrigene det hollandske fiskeri i perioderne 1780-81 og 1795-1813. Samtidigt hermed fortsatte den generelle merkantilistiske handelspolitik til ugunst særligt for hollænderne, og desuden blev en række konkurrerende fiskerier etableret med statsstøtte i landene rundt om Nordsøen.

Perioden fra 1814-1850 var et absolut lavpunkt i de hollandske sildefiskeriers lange historie. Fangstraterne blev halverede i forhold til de foregående to hundrede år, og samtidig opnåede de skotske og norske kystbaserede sildefiskerier en stor komparativ rumlig fordel sammenlignet med hollænderne. Det kan konkluderes, at de miljømæssige udfordringer for hollænderne var mest massive i denne periode.

Hollandsk nedgang – strukturelle forandringer

En væsentlig strukturel årsag til den hollandske tilbagegang var den faldende efterspørgsel per capita, der fandt sted fra cirka 1650 og frem til afslutningen på Napoleonskrigene. I første halvdel af 1800-tallet ændredes de europæiske samfund hastigt som følge af den industrielle revolution, og efterspørgselen efter saltede sild ser ud til at have stabiliseret sig i denne periode. Det er muligvis sket som følge af en forbedret infrastruktur og gennem åbningen af nye oversøiske markeder, men det vil kræve mere forskning at svare herpå.

På et mere fiskeriinternt niveau kan det konkluderes, at fiskesæsonen i praksis blev kortere efter cirka 1750, hvilket er sammenfaldende i tid med introduktionen af den let modificerede skibstype 'hoekerbuis', der også kunne anvendes til torskefiskeri om vinteren. Dette kan forklare det samtidige fald i de årlige landinger af sild per skib til trods for at fangstraterne per havdag var stabile. Den stramme organisering af det hollandske fiskeri var en stabil institutionel struktur gennem hele perioden, som havde både positive og negative indvirkninger på udviklingen i den hollandske fiskerisektor.

Bibliography

Archival sources

Gemeentearchief Schiedam (GA. Schiedam), Gerechten van Schiedam:
Inv. no. 614-622 'Haringcertificatien, 1597-1788'.

Museum In 't Houten Huis, De Rijp:
Inv. no. 03537, 'Journaal van stuurman Klaas Moeneswerf op het buisschip Het Bruine Paard', 1848.
Inv. no. 00024, 'Rekeningboek van de haringbuis 't Bruine Paard uit De Rijp, yearly reports 1822-1846'.

National Archives, The Hague (NA). Admiraliteitscolleges, 1586-1795:
Inv. no. 1097 Journaal, 'Capt. Wassenaar', op de convoijreis naar Schotland, 1691
Inv. no. 1100 Journaal, fregath 'De Dolphijn', convoijeren na Schotland, 1692
Inv. no. 1130 Journaal, S'lands schip, 'Rossem', 1719
Inv. no. 3264 Journaal, 't Huijs te Neeck, 1710
Inv. no. 3269 Journaal, Vredehof, 1745

Nationaal Archief, The Hague (NA), Commissie van Onderzoek omtrent de regelingen der Zeevisserijen, 1851-1857:
Inv. no. 14 appendix 7; 'Overzigt van de Engelsche haringvisscherij van 1809-1852.'
Inv. no. 14 appendix 25; 'Invoer van haring te Stettin van 1824 tot 1850'.

National Archives, The Hague (NA); archives of De Colleges van de Grote Visserij (CGV):
Inventory no.s 387-395 "Keurboeken", registers van de te Vlaardingen aangevoerde en gekeurde haring, 1814-1821'.
Inv. no. 396 'Maasluis 11 sept 1818. Waarschuwing tegen niet behoorlijk Tellen der Netten en Vierendeels', Art. 69.
Inv. no. 381 Dagverhalen, gehouden aan boord van het hoekerschip 'Cornelia Lucia', gediend hebbende als hospitaalschip van de Groote Visscherij, 1819

Inv. no. 586 Journaal van het hospitaalschip, 'De Morgenster', 1828
Inv. no. 589 Journaal van het hospitaalschip, 'Scheepsbouwlust', 1840
Inv. no. 593 Journaal van het hospitaalschip, 'De Drie Gebroeders', 1848
Inv. no. 597 Journaal van het hospitaalschip, 'De Drie Gebroeders', 1852
Inv. no. 602 Journaal van het hospitaalschip, 'De Drie Gebroeders', 1857
Inv. no's. 626-654 'Registers van de te Vlaardingen ter keuring aangevoerde haring, 1823-1851'.
Inv. no. 675 'Rondschrijven van den hoofddirecteur van het Meteorologisch Instituut aan de reeders van de Groote Visscherij over het houden van het journaal, 1858'
Inv. no. 676 Beoordeling der Journalen van haringschepen, 1857-1858
Inv. no. 680 Journaal van het hoekerschip, 'De Jonge Aletta', 1847
Inv. no. 681 Journaal van het hoekerschip, 'Willem Beukelszoon', 1847
Inv. no. 682 Journalen van haringschepen, 'Willem Beukelszoon', 1848
Inv. no. 683 Journaal van het hoekerschip, 'De Haring en Kabeljauwvisscherij', 1848
Inv. no. 686 'Publicatie van het uitvoerende bewind der Bataafsche Republiek, houdende Ordonantien en Maatregelen, concernerende het Vangen, Zouten, Havenen, Keuren, Pakken, Ophoogen en Leggen van den Haring, enz'., (Delft, 28 July 1801).

Nederlands Scheepvaartsmuseum, Amsterdam (NSA):
Inv. no. 1994.0697 Uitkomsten verkregen uit de journalen der haringschepen. (Koninklijk Nederlands Meteorologisch Instituut, Utrecht, 1857). (De Bilt: 1857-64).
Inv. no. 5 187 'Jonge hendrik Jacob, journaal gehouden op 't hoekerschip genaamt de Jonge Hendrik Jacob loopende van 1 Junij – 22 Julij 1789'.

The Royal Dutch Meteorological Institute, KNMI, De Bilt (KNMI):
Inv. no. ABMZ0029 Journaal, 'Noordstar', 1856
Inv. no. ABMZ0029 Journaal, 'Noordstar', 1857
Inv. no. ABMZ0029 Journaal, 'Noordstar', 1860
Inv. no. ABMZ0029 Journaal, 'Noordstar', 1861
Inv. no. ABMZ0029 Journaal, 'Visschers Welvaart', 1858
Inv. no. ABMZ0029 Journaal, 'Visschers Welvaart', 1859
Inv. no. ABMZ0029 Journaal, 'Visschers Welvaart', 1860
Inv. no. ABMZ0029 Journaal, 'Visschers Welvaart', 1861
Inv. no. ABMZ0031 Journaal, 'Noordstar', 1858
Inv. no. ABMZ0031 Journaal, 'Noordstar', 1859

Inv. no. ABMZ0031 Journaal, 'Visschers Welvaart', 1862
Inv. no. ABMZ0031 Journaal, 'Visschers Welvaart', 1863
Inv. no. ABMZ0033 Journaal, 'Vlaardings Welvaren', 1856
Inv. no. ABMZ0033 Journaal, 'De Toekomst', 1857
Inv. no. ABMZ0033 Journaal, 'Volharding', 1860
Inv. no. ABMZ0033 Journaal, 'Volharding', 1861
Inv. no. ABMZ0035 Journaal, 'Volharding', 1859
Inv. no. ABMZ0035 Journaal, 'Volharding', 1862
Inv. no. ABMZ0035 Journaal, 'Volharding', 1863
Inv. no. ABMZ0035 Journaal, 'Noordstar', 1863

Stadsarchief Vlaardingen, Handschriftenverzameling:
Inv. no. 252 Scheepsjournaal van de Hoeker 'De Toekomst', 1848

Visserijmuseum/ Vlaardings Museum, Vlaardingen:
Etch, Harinck-Buisen, approx 1640-1664 by Reinier Nooms, alias 'De Zeeman' (approx 1623-1664),

Published sources

Anonymous, *The British Fishery Recommended to Parliament*, (London, 1734).
Anonymous, *Report of Herring Assessment Working Group for the Area South of 62° N*, (International Council for the Exploration of the Sea, 2005), http://www.ices.dk/iceswork/wgdetailacfm.asp?wg=HAWG
Akveld, L. M., 'Noordeevisserij', in: Broeze, F. J. A., J. R. Bruijn and F. S. Gaastra eds., *Maritieme Geschiedenis der Nederlanden*, vol. 3, (Bussum, 1977).
Alheit, J. and E. Hagen, 'Long-term climate forcing of European herring and sardine populations', in: *Fisheries Oceanography*, 6 (1997), pp.130-139.
Andersen R. and C. Wadel eds., *North Atlantic Fishermen: Anthropological Essays on Modern Fishing*, (St. John's, 1972).
Baasch, E., *Holländische Wirtschaftsgeschichte*, (Jena, 1927).
Baasch, E., 'Zur Geschichte des hamburgischen Heringhandels', in: *Hansische Geschichtsblätter*, (1906), pp. 61-100.
Bang, N., *Varetransport gennem Øresund 1497-1660* vol. I, (Copenhagen, 1922).
Bang, N. and K. Korst, *Varetransport gennem Øresund 1497-1660* vol. II, (Copenhagen, 1932).
Beattie Bogue, M., *Fishing the Great Lakes, An environmental history, 1783-1933*, (USA, 2000).

Beaujon, M. A., *Overzicht der Geschiedenis van de Nederlandsche Zeevisscherijen,* (Leiden, 1885).
Beylen, J. van et al. eds., *Maritieme Encyclopedie,* (Wageningen, 1970).
Beylen, J. van, *Schepen van de Nederlanden van de late middeleeuwen tot het einde van de 17e Eeuw,* (Amsterdam, 1970).
Beylen, J. van, 'Zelandia Descriptio. Een merkwaardige tekening van het eiland Walcheren en de Visserij op de Noordzee in de 16e Eeuw', in: *Mededelingen van Marine Academie van Belgie boek X,* (1956-57), pp. 81-114.
Bijl, A., *De nederlandse convooidienst. De maritieme bescherming van koopvardij en zeevisserij tegen piraten en oorlogsgevaar in het verleden,* (The Hague, 1951).
Binet, D., 'French sardine and herring fisheries: A tentative description of their fluctuations since the eighteenth century', in: T. Wyatt and M. G. Larraneta eds., *Long-term changes in marine fish populations,* (Spain, 1986), pp. 253-272.
Blümcke, O., 'Stettins hansische Stellung und Heringshandel in Schonen', in: *Baltische Studien,* 37 (1887), pp. 98-288.
Bochove, C. van, 'De Hollandse haringvisserij tijdens de Vroegmoderne Tijd', in: *Tijdschrift voor Sociale en Economische Geschiedenis,* 1,1 (2004), pp. 3-27.
Bochove, C. van, 'Haringvisserij in Holland, 1500-1795. Een kwantitatieve Analyse', (MA-thesis, University of Utrecht, 2003).
Bochove, C. van, 'The 'Golden Mountain': An economic analysis of Holland's early modern herring fisheries', in: L. Sicking and D. Abreu-Ferreira eds., *Beyond the Catch. Interdisciplanary approaches tot the North Atlantic fisheries, 1000-1850,* (Brill, in press).
Boon, J., *De Koopman, of bydragen ten opbouw van Neêrlands koophandel en zeevaard,* 1 (Amsterdam, 1768).
Boon, P., *Bouwers van de zee: zeevarenden van het Westfriese platteland, ca. 1680-1720,* (The Hague, 1996).
Borsboom, P., 'Het Journaal van een zeereis uit 1848 door Cornelis Kikkert (1829-1917)', in: *NETwerk,* 3 (1992), pp. 42-52.
Braudel, F., *On History,* (London, 1980).
Braudel, F., *The Mediterranean and the Mediterranean World in the Age of Philip II,* 2 vol. (USA, 1995, Engl. transl. of 2. edn., 1966).
Bringedal, T., 'Som sild i tønne. Vårsildeeksport på norske fartøy i 1856', in: *Sjøfartshistorisk Årbok,* (1998), pp. 7-159.
Bruijn, J. R., 'Dutch Privateering during the Second and Third Anglo-Dutch Wars', in: *Acta Historiae Neerlandicae,* 11 (1979), pp. 79-93.
Bruijn, J. R., *Varend Verleden. De Nederlandse Oorlogsvloot in de 17de en 18de Eeuw,* (Amsterdam, 1998).

Butcher, D., 'The Herring Fisheries in the Early Modern Period: Lowestoft as Microcosm', in: D. J. Starkey, C. Reid and N. Ashcroft eds., England's Sea Fisheries: *The commercial Sea Fisheries of England and Wales since 1300*, (Bath, 2000), pp. 54-63.

Butcher, D., *The Ocean's Gift. Fishing in Lowestoft during the Pre-Industrial Era, 1550-1750*, (Norwich, 1995)

Cabantous, A., 'Le hareng et son monde. Structures de la peche harenguière de Boulogne à Blanckenberghe (vers 1650 – vers 1830)', in: *Revue du Nord, (1986)*, pp. 47-72.

Cadigan, S. T. and J. A. Hutchings, 'Nineteenth-Century Expansion of the Newfoundland Fishery for Atlantic Cod: An Exploration of Underlying Causes', in: Holm, P., T. D. Smith and D. J. Starkey eds., *The exploited seas, new directions for marine environmental history*, (St.John's, 2001), pp. 31-65.

Campbell, R. A., 'CPUE standardisation and the construction of indices of stock abundance in a spatially varying fishery using general linear models', in: *Fisheries Research*, 70 (2004), pp. 209-227.

Cau, C., *Groot placaet-boeck, vervattende de placaten, ordonnantien ende edicten vande ...Staten Generaal der Vereenighde Nederlanden ende Staten van hollandt en West-Vrieslandt, mitsgaders vande ... Staten van Zeelandt : waer by noch ghevoeght zijn eenige placaten ...*, 9 vol. (The Hague, 1658-1797).

Christensen, A. E., *Dutch Trade to the Baltic about 1600. Studies in the Sound Toll Register and Dutch shipping Records*, (Copenhagen, 1941)

Claussøn Friis, P., *Norrige oc omliggende Øers sandfærdige bescriffuelse,* (Copenhagen, 1632)

CLIWOC *multilingual meteorological dictionary*. KNMI-publication 205, (De Bilt, 2003).

Corten, A, 'A proposed mechanism for the Bohuslän herring periods', in: *ICES Journal of Marine Science*, 56 (1999), pp.207-220.

Corten, A, *Herring and Climate, Changes in the distribution of North Sea herring due to climate fluctuations*, (Wageningen, 2001).

Corten, A., 'Northern distribution of North Sea herring as a response to high water temperatures and/or low food abundance', in: *Fisheries Research*, 50 (2001), pp. 189-204.

Coull, J. R., 'Fishery Development in Scotland in the Eighteenth Century', in: *Scottish Economic & Social History*, 21 (2001), pp. 1-21.

Coull, J. R., *The Fisheries of Europe an Economic Geography*, (London, 1972).

Coull, J. R., 'The herring fishery in Shetland in the first half of the nineteenth century', in: *Northern Scotland*, (1983), pp. 123-140.

Coull, J. R., *The Sea Fisheries of Scotland. A historical geography*, (Glasgow, 1996).

Coull, J. R., *World Fisheries Resources*, (Kings Lynn, 1993).

Csirke, J. and M. Vasconcellos 'Fisheries and long-term climate variability', in: *Review of the state of world marine fishery resources*, FAO Fisheries Technical Paper, no. 457, (Rome, 2005), ftp://ftp.fao.org/docrep/fao/007/y5852e/Y5852E00.pdf

Cushing, D. H., *Climate and Fisheries*, (Bury St Edmunds, 1982).

Cushing, D. H., 'The East Anglian Herring Fishery in the Eighteenth Century', in: *Journal de Conseil International pour l'Exploration de la Mer*, 31, 3 (1968), pp. 323-329.

Cushing, D. H., *The Provident Sea*, (Cambridge, 1988).

Cushing, D. H. and J. P. Bridger, 'The stock of herring in the North Sea and changes due to fishing', in: *Fishery Investigations*, series II 25, 1 (1966), pp. 1-123.

Dalén, L., *Den Bohuslänska Fiskelägesbygden*, (Göteborg, 1941).

Damsteegt, B. C., *Nieuwe spiegel der zeevaart*, (Amsterdam, 1942).

Degryse, R., *Vlaanderens Haringbedrijf in de Middeleeuwen*, (Antwerpen, 1944).

Doorman, G., 'Het Haringkaken en Willem Beukels', in: *Tijdschrift voor Geschiedenis*, 69, 3 (1956), pp. 371-386.

Dunlop, J., *The British Fisheries Society 1786-1893*, (Glasgow, 1978).

Dyrvik, S., *Norsk økonomisk historie*, vol. 1, (Bergen, 1979).

Elsass, M. J. *Umriss einer Geschichte der Preise und Löhne in Deutschland vom ausgehenden Mittelalter bis zum beginn des neunzehnten Jahrhunderts*, vol. 2, part 1, (Leiden, 1940).

Elsass, M. J. *Umriss einer Geschichte der Preise und Löhne in Deutschland vom ausgehenden Mittelalter bis zum beginn des neunzehnten Jahrhunderts*, vol. 2, part 2, (Leiden, 1949).

Evans, R. J., *In defense of history*, (London, 1997).

Fall, R., *Observations on the Report of the Committee of the House of Commons appointed to enquire into the state of the British Fishery*, (London, 1786).

Feijst, G. van der, *Geschiedenis van Schiedam*, (Schiedam, 1975).

Fenton, A., *The Northern Isles: Orkney and Shetland*, (Tuckwell, 1997, 1. ed. 1978).

Filliaert, J., *De Compagnie van Vischvaert te Nieupoort, 1727 – 1737*, (Nieupoort, 1939).

Fossem, A. B., *Bergen Bys Historie, Borgerskapets by 1536-1800*, vol. II, (Bergen, 1979).

Frandsen, K.-E., 'Danzig's Salted Herring Trade', in: *International Journal of Maritime History*, 16, 2 (2004), pp. 145-167.

Franken, A. F., *Scheepswerven in Zeeland. Een onderzoek naar de geschiedenis en relicten van Zeeuwse scheepswerfen*, (Goes, 1996).

Fraser, R., *Review of the Domestic Fisheries of Great Britain and Ireland*, (Edinburgh, 1818).

Fréon, P. and O. A. Misund, *Dynamics of Pelagic Fish Distribution and Behaviour: Effects on Fisheries and Stock Assessment*, (Cambridge, 1999).
Fulton, T. W., *The Sovereignty of the Sea. An Historical Account of the Claims of England to the Dominion of the British Seas, and of the Evolution of the Territorial Waters: with special reference to the Rights of Fishing and the Naval Salute*, (Edinburgh and London, 1911).
Gall, J. le, 'Die Fischerei mit Treibnetzen', in: E. Le Danois ed., 'Die Französische Seefischerei', *Handbuch der Seefischerei Nordeuropas*, vol 7, 1, (Stuttgart, 1937), pp. 42-55.
Gatewood, J. B., 'Cooperation, Competition, and Synergy: Information Sharing Groups among Southeast Alaskan Salmon Seiners', in: *American Ethnologist*, 11, 2 (1984), pp. 350-370.
Gelder, H. E. van, 'Gegevens betreffende de Haringvisscherij op het einde der 16de Eeuw', in: *Bijdragen en Mededelingen van het Historisch Genootschap*, 32 (1911), pp. 1-62.
Gibson, A. J. S. and T. C. Smout, *Prices, food and wages in Scotland, 1550-1780*, (Cambridge, 1995).
Goodlad, C. A., *Shetland Fishing Saga*, (Lerwick, 1971).
Gordon, H. S., 'The Economic Theory of a Common-Property Resource: The Fishery', in: *The Journal of Political Economy*, 62, 2 (April 1954), pp. 124-142.
Grotenwold, C. A., *Die deutsche Hochseefischerei in der Nordsee*, (Stuttgart, 1908).
Hagedorn, B., *Die Entwicklung der wichtigsten Schiffstypen bis ins 19. Jahrhundert*, (Berlin, 1914).
Hahn, L., *Ostfrieslands Heringsfischereien. Unter besonderer Berücksichtigung der Geschichte der Emder Heringsfischerei in fünf Jahrhunderten 1552-1940*. (Oldenburg, 1941).
Haines, M., 'The Herring Fisheries, 1750-1900', in: D. J. Starkey, C. Reid and N. Ashcroft eds., *England's Sea Fisheries, The Commercial Sea Fisheries of England and Wales since 1300*, (Bath, 2000).
Hardin, G., 'The Tragedy of the Commons', in: *Science*, 162 (13 December 1968), pp. 1243-1248.
Hasslöf, O., *Svenska Västkustfiskarna. Studier i en yrkesgrups näringsliv och sociala kultur*, (Stockholm, 1949).
Heeringa, K. ed., *Rechtsbronnen der stad Schiedam*, (The Hague, 1904).
Hilborn, R., and C. J. Walters, *Quantitative Fisheries Stock Assessment. Choice, Dynamics and Uncertainty*, (London, 1992).
Hitzbleck, H., *Die Bedeutung des Fisches für die Ernährungswirtschaft Mitteleuropas in vorindustrieller Zeit unter besonderer Berücksichtigung Niedersachsens*, (ph.d.-thesis, Georg-August-Universität zu Göttingen, Göttingen, 1971).

Hoeven, M. van der (ed.), *Exercise of Arms. Warfare in the Netherlands, (1568-1648)*, (Leiden, 1998).
Holland, D. S. and J. G. Sutinen, 'Location Choice in New England Trawl Fisheries: Old Habits Die Hard', in: *Land Economics*, 76 (2000) pp. 133-149.
Holm, P., 'European and Native Ways of Fishing, whaling and Sealing in the Danish North Atlantic Empire, approx. 1750-1807', in: P. Holm, O. Janzen and J. Thór eds., *Northern Seas Yearbook 1995*, (Esbjerg, 1995), pp. 109-149.
Holm, P., *Kystfolk Kontakter og sammenhænge over Kattegat og Skagerrak ca. 1550-1914*, (Esbjerg, 1991).
Holm, P., A. Rosenberg, D. J. Starkey, R. Francis, T. D. Smith, http://www.cmrh.dk/hmapii.pdf, (2000).
Holm, P., 'The Bohuslen Herring. Interlude to Dutch supremacy in the European fish market 1556-1589', in: L. M. Akveld et al. eds.: *In het kielzog. Maritiem-historische studies aangeboden aan Jaap R. Bruijn bij zijn vertrek als hoogleraar zeegeschiedenis aan de Universiteit Leiden*, (Amsterdam, 2003), pp. 282-288.
Holm, P., T. D. Smith and D. J. Starkey eds., *The exploited seas, new directions for marine environmental history*, (St.John's, 2001).
Holmberg, Å., 'Perioden 1550-1880', in: E. Lönnroth ed.: *Bohusläns Historia*, (Göteborg, 1963), pp. 149-280.
Hoogendijk, A ., *De grootvisscherij op de Noordzee*, (Haarlem, 1894).
Hoogendijk, A., *Eenige Beschouwingen over 'Een nieuw leven' betrekkelijk de Nederlandsche Visscherijen*, (The Hague, 1867).
Hoogendijk, A., *Raport over de Internationale Tentoonstelling te Havre, in 1868, betreffende het Zeewezen, de Visscherijen, enz.*, (The Hague, 1870).
Högberg, S., *Utrikeshandel och sjöfart på 1700-talet. Stapelvaror i svensk export och import 1738-1808*. (Lund, 1969).
Höglund, H., *On the Bohuslän herring during the great herring fishery, Series Biology report no. 20, Institute of Marine Research*, (Lysekil, 1972).
Jackson, J., 'Historical Overfishing and the Recent Collapse of Coastal Ecosystems', in: *Science*, 293 (27 July 2001), pp. 629-637.
Jackson, J., 'Reefs since Columbus', in: *Choral Reefs*, 16 (1997), pp. 23-32.
Jenkins, K., *On "What is History?", From Carr and Elton to Rorty and White*, (Padstow, 1995).
Jenkins, J. T., *The Herring and the Herring Fisheries*, (London, 1927).
Jennings, S., M. J. Kaiser and J. D. Reynolds, *Marine Fisheries Ecology*, (Oxford, 2001).
Johansen, H. C., *Shiping and Trade between the Baltic Area and Western Europe 1784-95*, (Viborg, 1983).

Johnson, N. S., *Synergies in the commons: Information sharing in limited entry fisheries*, (ph.d.-thesis, University of Washington, 1993).
Kampen, S. C. van, *De Rotterdamse Particuliere Scheepsbouw in de tijd de Republiek*, (Assen, 1953).
Klonder, A., 'Die Nahrung der unteren und mittleren städtischen Sozialschichten der frühen Neuzeit: Preussen – Kronpolen – das Reich', in: G. Wiegelmann and R.-E. Mohrmann eds., *Nahrung und Tischkultur im Hanseraum*, (Clopenburg, 1996), pp. 349-375.
Knox, J., *A view of the British Empire, more especially Scotland; with some Proposals for the Improvement of that Country, the Extension of its Fisheries, and the Relief of the People*, vol. I-II, 3. ed., (Edinburgh, 1785).
Knox, J., *Observations on the Northern Fisheries. With a discourse on the expediency of establishing fishing stations, or small towns, in the Highlands of Scotland, and the Hebride Islands*, (London, 1786).
Kramer, R., 'De Visserij van de zijde in de eerste helft van de 19de eeuw', in: *Holland, regionaal-historisch tijdschrift*, vol.16, (1984), pp. 175-188.
Kranenburg, H.A.H. Boelmans, 'The Netherlands fisheries and the Shetland', in: D. J. Withrington ed., *Shetland and the Outside World, 1469-1969*, (Chatham, 1983), pp. 96-107.
Kranenburg, H. A. H., *De zeevisscherij van Holland in den tijd der republiek*, (Amsterdam,1946).
Ligthart, A. G., *De Vlaardingers en hun haringvisserij*, (Zaltbommel, 1966).
Lindblad, J. T., *Sweden's Trade with the Dutch Republic, 1738-1795 A qualitative analysis of the relationship between economic growth and international trade in the eighteenth century*, (Assen, 1982)
Ljungman, A. V., 'Bidrag till lösningen af Frågan om de stora sillfiskenas sekulära periodicitet', in: *Nordisk Tidsskrift for Fiskeri*, 5 (1879), pp. 257-268.
Löfgren, O., 'Resource management and Family Firms: Swedish West Coast Fishers', in: R. Andersen and C. Wadel eds., *North Atlantic Fishers: Anthropological Essays on Modern Fishing*, (St. John's, 1972). pp.83-103.
MacKenzie, B. R., J. Alheit, D.J. Conley, P. Holm, C. Kinze, 'Ecological hypothesis for a historical reconstruction of upper trophic level biomass in the Baltic Sea and Skagerack', in: *Canadian Journal of Fisheries and Aquatic Sciences*, 59 (2002), pp. 173-190.
Mackinson, S., *Representing trophic interactions in the North Sea area in the 1880s, using the Ecopath mass-balance aproach*, (Lowestoft: Centre for the Environment, Fisheries and Aquaculture Science), http://www.seaaroundus.org/report/impactmodels/NorthSea.pdf
Maddison, A., *The World Economy: A Millenial Perpective*, (Paris, 2001).
Marwick, A., *The New Nature of History, Knowledge, evidence, language*, (Ebbw Vale, 2001).

Maurstad, A., 'Fishing in murky waters – ethics and politics of research on fishers' knowledge', in: *Marine Policy*, 26 (2002), pp. 159-166.
McEvoy, A. F., *The fisherman's problem. Ecology and law in the California fisheries, ca. 1850-1980*, (USA, 1986).
McEvoy, A. F., 'Toward an Interactive Theory of Nature and Culture: Ecology, Production and Cognition in the California Fishing Industry', in: D. Worster, ed., *The ends of the earth: Perspectives on modern environmental history*, (Cambridge, 1988), pp. 211-229.
Meurs, P.A.N.S. van, *De archieven der Groote Vischerij*, (Netherlands, 1915).
Mietes, A.A., *De archieven van de colleges van de Grote Visserij, 1578-1857(1859)*, (The Hague, 1984).
Mietes, A.A., 'De Hollandse Visserijcolleges', in: *Holland, regionaal-historisch tijdschrift*, 16 (1984), pp. 166-174.
Michell, A.R., 'The European Fisheries in Early Modern Period', in: E. E. Rich and approx.H. Wilson eds., *The Cambridge Economic History of Europe*, vol. V, (1977), pp. 135-184.
Morell, M., *Studier I den svenska livsmedelkonsumptionens historia. Hospitalhjonens livsmedelskonsumtion 1621-1872*, (Uppsala, 1989).
Mulder Bosgoed, D., *Bibliotheca Ichthyologica et Piscatora*, (Haarlem, 1874).
Nall, J. G., *Great Yarmouth and Lowestoft, A Handbook for Visitors and Residents; with Chapters on the Archaeology, Natural History, &c., of the District; a History with Statistics, of the East Coast Herring Fishery, and an Etymological and comparative Glossary of the Dialect of East Anglia*, (London, 1866).
Nedkvitne, A., *Mens bønderne seilte og Jægterne for. Nordnorsk og vestnorsk kystøkonomi 1500-1730*, (Oslo, 1988).
Newell, D. and R. E. Ommer, *Fishing Places, Fishing People. Traditions and Issues in Canadian Small-Scale Fisheries*, (Canada, 1999).
Nilsson, G. B., 'Historia som vetskap', in: *Historisk Tidskrift*, 125, 2 (2005), pp. 189-207.
Nilsson, L. 'Det stora sillfisket, 1752-1808', in: E. Lönnroth (ed.), *Bohusläns Historia*, (Uppsala, 1963), pp. 281-366.
Nilsson, R., 'Postmodernism, källkritik och historieskrivning', in: *Historisk Tidskrift*, 125, 2 (2005), pp. 233-248.
Nystedt, O., Sillen i Bohuslän. *Sillen, sillfisket och sillperioderna i Bohuslän*, (Uddevalla, 1994).
Ormrod, D., *The Rise of Commercial Empires. England and The Netherlands in the Age of Mercantilism, 1650-1770*, (Cambridge, 2003).
Paludan, H., 'Cairos røde rose. Noget om historikernes kildebegreb', in: 'Findes historien – virkelig?', *Den jyske Historiker*, theme issue vol. 50 (1990), pp. 29-40.

Parmentier, J., 'The Asian challenge. The socio-economic influence of the Ostend East India trade in the Southern Netherlands', in: L. M. Akveld, F. R. Loomeijer and M. Hahn-Pedersen eds., *Financing the Maritime Sector proceedings from the Fifth North Sea History Conference*, Rotterdam 1997, (Esbjerg, 2002), pp. 285-308.

Ploeg, J., 'Speurtocht naar Haringbuizen', *Mededelingen van de Nederlandse Vereniging voor Zeegeschiedenis*, 25 (1972), pp. 25-32.

Poldervaart, A., 'Het konvooi tot bescherming van de haringvloot onder leiding van kapitein Cornelis van Brakel in 1710', in: *NETwerk*, 14 (2003), pp. 7-18.

Pons, G., '*De bakens verzet. En analyse van de hollandse pekelharingvisserij met kielschepen in de periode 1814-1885', (ph.d.-thesis, University of Utrecht, 1996).*

Poulsen, B., 'On the impact of Environmental Disasters: The Limfjord Herring Fishery before and after the Storm of 1825', in: D. J. Starkey and M. Hahn-Pedersen eds., *Bridging Troubled Waters. Conflict and Co-operation in the North Sea Region since 1550. Proceedings from the 7th North Sea Conference*, Dunkirk 2002, (Esbjerg, 2005), pp. 287-304.

Poulsen, B., 'The Impact of the Breach of Agger Tange in 1825 on the Limfjord Fisheries: An Environmental History', (Unpublished MA-thesis, University of Southern Denmark, 2002).

Poulsen, B., 'The Renaissance Sea – Perceptions in Danish and Norwegian Topography', in: *International Journal of Maritime History*, 14, 2 (2002), pp. 284-292.

Poulsen, R. T., 'An environmental history of North Sea ling and cod fisheries, 1840-1914', (unpublished, Ph.D.-thesis, University of Southern Denmark, 2005).

Ravier, C. and J.-M. Fromentin, 'Long-term fluctuations in the eastern Atlantic and Mediterranean bluefin tuna population', in: *ICES Journal of Marine Science*, 58 (2001), pp. 1299-1317.

Robinson, R., 'The Impact of the Fisheries on North West European Economies', in: D. J. Starkey and M. Hahn-Pedersen eds., *Concentration and Dependency. The Role of Maritime Activities in North Sea Communities, 1299-1999.* (Esbjerg, 2002).

Robinson, R., 'The Line and Trawl Fisheries in the Age of Sail', in: D. J. Starkey, C. Reid & N. Ashcroft eds., *England's Sea Fisheries, The Commercial Sea Fisheries of England and Wales since 1300,* (Bath, 2000).

Robinson, R. N.W., 'The English Fishing Industry 1790-1914: A Case Study of the Yorkshire Coast', (Ph.D. thesis, University of Hull, 1984).

Rohdenburg, G., *Hochseefischerei an der Unterweser. Wirtschaftliche Voraussetzungen, struktureller Wandel und technische Evolution im 19. Jahrhundert und bis zum Ersten Weltkrieg,* vol. 43 of *Veröffentlichungen aus dem Staatsarchiv der Freien Hansestadt Bremen,* (Bremen, 1975).

Röhlk, F., Schiffahrt und Handel zwischen Hamburg und den Niederlanden in der zweiten hälfte des 18. und zu begin des 19. Jahrhunderts, in: *Vierteljahrschrift für sozial- und Wirtschaftsgeschichte*, beihefte 60 (Wiesbaden, 1973).

Rogers, J. and E. Thorold, *A History of Agriculture and Prices in England*, 7 vol. (Oxford, 1866-1887, repr. Vaduz, 1963)

Sahrhage, D. and J. Lundbeck, *A history of fishing, (Germany*, 1992).

Saxo Grammaticus, *Saxos Danmarkshistorie*, translated by Peter Zeeberg from latin manuscript: Gesta Danorum, (Gylling, 2000)

Schippers, A. W., *De standplaatsfactoren der groote Haringvisserij*, (Vlaardingen, 1927).

Shammas, C., *The Pre-industrial Consumer in England and America*, (Oxford, 1990).

Sharp, G. D., 'Future climate change and regional fisheries: a collaborative analysis', in: *FAO Fisheries Technical Paper*, no. 452, (Rome, 2005), http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/006/Y5028E/Y5028E00.HTM

Sicking, L., *Zeemacht en Onmacht, Maritieme Politiek in de Nederlanden, 1488-1558*, (Amsterdam, 1998).

Sicking, L., 'Protectiekosten en winstgevendheid van de haringvisserij in de Nederlanden: de teelt van 1547', in: *NETwerk*, 11 (2000), pp. 9-19.

Smith, T. D., *Scaling Fisheries, the science of measuring the effects of fishing, 1855-1955*, (Cambridge, 1994).

Smout, T. C., *Scottish Trade on the Eve of the Union 1660-1707*, (Edinburgh, 1963).

Snow, C. P., *De to kulturer*, (København, 1966 translated from 2. ed. 1964).

Solhaug, T., *De norske fiskeriers historie*, 1815-1880, vol. I-II, (Drammen, 1976).

Solhaug, T., 'Vårsildfiskeriet på Vestlandet 1808-1873', in: *Norveg*, 22 (1979), pp. 57-72.

Southward, A., G. T. Boalch and L. Maddock, 'Fluctuations in the herring and pilchard fisheries of Devon and Cornwall linked to change in climate since the 16th century', in: *Journal of Marine Biological Assessment*, 68 (1988), pp. 423-445.

Starkey, D. J. and M. Hahn-Pedersen eds., *Concentration and Dependency. The Role of Maritime Activities in North Sea Communities, 1299-1999*. (Esbjerg, 2002).

Starkey, D. J., C. Reid & N. Ashcroft eds., *England's Sea Fisheries, The Commercial Sea Fisheries of England and Wales since 1300*, (Bath, 2000).

Struijs, M. A., M. P. Zuydgeest and D. van Os eds., *Om een bevaeren schip te maecken. Geschiedenis van de Vlaardingse scheepswerfen*, (Vlaardingen, 1997).

Tielhof, M. van, *The 'Mother of all Trades'. The Baltic Grain Trade in Amsterdam from the Late 16th to the Early 19th century*, (Leiden, 2002)
Tillema, J. E., *Ontwikkeling van de Nederlandsche haringvisscherij in den loop der eeuwen,* (Rijswijk, 1917).
Toresen, R. and O. J. Østvedt, 'Variation in abundance of Norwegian spring-spawning herring (Clupea haringus, Clupeidae) throughout the 20th century and the influence of climatic fluctuations', in: *Fish and Fisheries*, 1 (2000), pp. 231-256.
Tracy, J., 'Herring Wars: The Habsburg Netherlands and the Struggle for Control of the North Sea, approx. 1520-1560', in: *Sixteenth Century Journal*, 24, 2 (1993), pp. 249-272.
Unger, R., 'The Netherlands herring fishery in the later Middle Ages: The false legend of Willem Beukels of Biervliet', in: R. Unger, ed., *Ships and Shipping in the North Sea and Atlantic, 1400-1800*, (Great Yarmouth, 1997).
Unger, R. W., 'Dutch Herring, Technology, and International Trade in the Seventeenth Century', in: *The Journal of Economic History*, vol. XL, nr.2, (1980), pp. 253- 279.
Veen, D.J. van der, 'Een zozeer te niet gegane bedrijfstak'. De economische ontwikkeling van de Noordzeevisserij (1800-1940)', in: *Holland, regionaal-historisch tijdschrift*, 16 (1984), pp. 143-155.
Verbrugge, L., 'Die belgische Seefischerei' in: *Handbuch der Seefischerei Nordeuropas*, vol. 7, 3 (Stuttgart, 1932), pp. 1-39.
Vermaas, J. C. en M. C. Sigal, *De haringvisscherij van 1795 tot 1813*, (Vlaardingen, 1922).
Vestergaard, T. A., 'Hemmeligheden ved fiskeriet. At finde ud af hvad man ved i Danmark', in: K. Hastrup and K. Ramløv eds., *Kulturanalyse. Fortolkningens forløb i antropologien*, (Viborg, 1989).
Villiers, P., 'La flotte de pêche dans l'activité de Boulogne a la veille de la revolution', in: P. Villiers and C. Pfister eds., *La Pêche en Manche et mer du Nord XVIII – XX siecle, Proceedings of Colloqium at Boulogne-sur-Mer 18.-21. mai 1995*, (Boulogne-sur-Mer, 1998), pp. 57-78.
Vliet, A. van, 'Het einde van een bedrijfstak. De Opstand als een verklaring voor de neergang van de (haring)visserij in de Nederlanden', in: *NETwerk*, 13 (2002), pp. 7-16.
Vliet, A. P. van, 'The sea fishery as an opportunity for investment in the Dutch Republic or The relation between the sea fishery and the money-box', in: L. M. Akveld, F. R. Loomeijer & M. Hahn-Pedersen eds., *Financing the Maritime Sector, Proceedings from the Fifth North Sea History Conference* Rotterdam 1997, (Esbjerg, 2002), pp. 131-145.
Vliet, A. P. van, 'Vande affslagh vande zouten visch ende haringh de Zierikzeese visafslag en vismarkt', in: *Kroniek van het land van de zeemeermin (Schouwen-Duiveland)*, (2004), pp. 5-18.

Vliet, A. P. van, Vissers en Kapers. *De zeevisserij vanuit het Maasmondgebied en de Duinkerker kapers, (ca. 1580-1648),* (The Hague, 1994).
Vliet, A. P. van, *Vissers in Oorlogstijd. De Zeeuwse zeevisserij in de jaren 1568-1648,* (Middelburg, 2003).
Voort, J. P. van de, 'De mazen van net en wet: schielen, spanen en maaswijdtemeters', in: *Maten & Wegen: orgaan van de Vereniging van Verzamelaars van Maten en Gewichten*, (2002).
Vries, J. de and A. van der Woude, *The first modern economy: success, failure, and perseverance of the Dutch economy, 1500-1815*, (Cambridge, 1997).
Vries, J. de, *De economische achteruitgang der Republiek in de achttiende eeuw,* (Leiden, 2. edn. 1980).
Walpole, S., *The British Fish Trade*, (London, 1883).
Wätjen, H., 'Zur Statistik der holländischen Heringsfischerei im 17. und 18. Jahrhunder', in: *Hansische Geschichtsblätter*, 37, (1910), pp.129-186.
Wieringen, R. W. van, ed., W.C.H. Staring, *Maten, Gewichten en Munten van vroeger en tegenwoordig*, (Schoonhoven, 1902).
Willemsen, R., *Enkhuizen tijdens de Republiek*, (Hilversum, 1988).
Wilson, J. A., 'Fishing for Knowledge', in: *Land Economics*, vol. 66, 1, (February 1990), pp. 12-29.
Worster, D., 'Appendix: Doing Environmental History', in: D. Worster ed., *The ends of the earth: Perspectives on modern environmental history*, (Cambridge, 1988), pp. 289-307.
Ypma, Y. N., *Geschiedenis van de Zuiderzeevisserij*, (Amsterdam, 1962).

Electronic resources:

Bochove, C. van, Database Hollandse haringvisserij 1500-1795, (Amsterdam 2004). http://www.iisg.nl/research/haringvisserij.xls

Geometry functions for Microsoft Excel, http://nmml.afsc.noaa.gov/Accessibility/AccessExcelGeoFunctions.html

'Historical prices and wages', (database of the International Institute of Social History, Amsterdam, NL) http://www.iisg.nl/hpw/brenv.xls

Online encyclopedia, Wikipedia; http://en.wikipedia.org/wiki/Mercantilism and http://en.wikipedia.org/wiki/Historiography

Glossary of economics; http://www-personal.umich.edu/~alandear/glossary/m.html

Formula for calculating distance between two navigational points. http://www.experts-exchange.com/Databases/GIS_GPS/Q_20383758.html

Conversion from navigational points to distance in kilometres, miles and nautical miles. http://www.wcrl.ars.usda.gov/cec/java/lat-long.htm

Söderberg, J., Prices in Stockholm 1539-1620, http://www.iisg.nl/hpw/data.html (electronic database of International Institute of Social History, Amsterdam, NL).

Zanden, J. L. van, data supplied by Jan de Vries, Jan Pieter Smits and Arthur van Riel, 'The prices of the most important consumer goods, and indices of wages and the cost of living in the western part of the Netherlands, 1450-1800', in: Prices and Wages, (electronic database of International Institute of Social History, Amsterdam). http://www.iisg.nl/hpw/brenv.xls