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Report of the Study Group on the History of Fish and Fisheries (SGHIST)

26–29 October 2009

Vlaardingen, The Netherlands

ICES International Council for the Exploration of the Sea

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Executive summary

There is a growing scientific and public interest to increase the knowledge of the long-term dynamics of marine resources and associated changes in exploitation. This calls for a thorough analysis of available historical datasets. The motivation is not only to study the population dynamics of commercial fish species *per se*, but also to gain better insight into the effects of climate change, fishing, and other anthropogenic drivers on marine organisms. Furthermore, the analysis of historical data will provide in depth knowledge of the "shifting baseline" phenomenon that greatly affects our perception of the state and potential productivity of the marine ecosystem. In this context, identification, recovery, digitization, and analysis of historical fisheries data are therefore of crucial importance. Such data can refer to tax records, commercial catch statistics, catch per unit of effort (cpue), research survey information, length and/or age compositions, biodiversity and any other sources that can throw light on marine organisms and the dynamics of fleet exploiting them before 1960.

However, historical data are usually not easily accessible for scientists in electronic format, and the digitization process may be time-consuming and expensive if not approached in an effective and structured way. Moreover, their analysis and interpretation can be complicated because of scarcity of data or gaps in time-series, spatio-temporal limitations, difficulties when interpreting cpue data with occurring technological improvement ("creep"), different measurement units, and several other possible sources of bias. These issues led to a call from the international scientific community for a tighter collaboration between "classic" fishery scientists, historians, and ecologists.

The Study Group on the History of Fish and Fisheries (SGHIST) was created following a recommendation from the 2008 Workshop on Historical Data on Fisheries and Fish (WKHIST), where it was concluded that ICES should have a role as coordinator of the historical work on marine systems. SGHIST aims to bring together scientists working on these topics to facilitate and coordinate data recovery and digitization processes, to exchange ideas, and harmonize methodologies on spatio-temporal analysis, and to discuss methods for the analysis of technological creep and the interpretation of historical time-series of cpue.

The first meeting of SGHIST was held at the Fisheries Museum, Vlaardingen, the Netherlands, from 26 to 29 October 2009 and was attended by eight scientists from six countries from Europe and North America.

A mini workshop at the Royal Library in the Hague, the Netherlands, was held on 28 October 2009. Invited experts informed SGHIST participants about data storage and cost- and time-efficient solutions for the digitization of large quantities of data from paper records (ToR c: data-storage solutions allowing access to recovered historical data). This included the preservation of historical paper records, notably the process of de-acidification of acidic paper typical of much of the 19th century. Importantly, the large-scale Sound Toll Registers project was presented, where very extensive paper records stored in Copenhagen on trade through the Sound will be stored electronically. This project will provide a 460-year time-series, and is currently being digitized through a combined Dutch–Danish collaborative effort (www.soundtoll.nl).

Progress on methods that allow long-term spatio-temporal analysis of fish population dynamics was presented by Max Cardinale (ToR e: develop methods that can be applied to historical data in order to estimate long-term dynamics). These are described in Section 4 of the SGHIST report. The methods have been successfully applied to

unravel population dynamics of turbot and plaice in the Kattegat–Skagerrak area over more than a century, including shifts in spawning aggregations. There are different ways to account for technological creep of the fishing fleet, or at least understanding the sensitivity of biomass trend to creep (ToR d: studies on historical changes in fishing technologies and fishing power).

Regional results of historical studies (ToR f) were presented through various talks. Max Cardinale showed work on changes in plaice spawning aggregations in the Kattegat–Skagerrak from 1901 to 2007. Georg Engelhard showed how, in the North Sea over the past nine decades, the flatfish species sole and plaice have shown major distribution shifts. In sole, these seem linked to climatic variations, but this apparent association has broken down in recent decades where heavy beam trawling is suspected to have had a major effect on sole distribution. In plaice, a combination of fishing, eutrophication, and in recent decades, climatic warming is hypothesized to have affected the distribution, although further analysis is required to substantiate this. Brian Mackenzie and Bo Poulsen showed research on population dynamics over 400 years of herring in the Limfjord, Denmark, a population that is small compared with herring marine populations but which was important for local communities until 180 years ago when it collapsed. It appears that a combination of fishing and suddenly increased jellyfish abundance (driven by the sudden opening of the connection with the North Sea) may have led to the collapse.

Previously during the WKHIST 2008 workshop, an inventory of available historical data had been initiated in the form of a metadatabase. The inventory was updated and extended during the SGHIST 2009 meeting (ToR a), and of particular interest was the inclusion in the metadatabase of information on Belgian sea fisheries data made by Ann-Katrien Lescrauwaet (Flemish Fisheries Institute, Belgium), which provide a relatively complete coverage of Belgium's sea fisheries activities.

The Study Group plans to hold the next meeting in Ponza, Italy, from 11 to 14 October 2010 chaired, by Bo Poulsen, Denmark and Georg H. Engelhard, UK. We have focused our Terms of Reference in line with what is now being perceived of as highest priority for this study group: a) coordinate the data recovery activities for historical information on fish, fisheries and marine ecosystems; b) develop methods that can be applied to historical data in order to estimate long-term dynamics of stocks, fishing fleets and fishing technologies, including technological creep; c) develop methods for the spatial analysis of fish and fisheries historical data; d) carry out cross-regional studies of fish and fisheries in areas that may include the North Atlantic, Mediterranean and Black Sea, focusing on the analysis of key predator species in the different ecoregions.

1 Introduction

1.1 Background

Interest is growing in a long-term approach to fish and fisheries that make better use of available historical datasets. Such research is not only relevant to studies on fish population dynamics per se, but it can also improve our understanding of the affect of climate change and the long-term effects of fishing on fish stocks. This would also increase the knowledge concerning the "shifting baseline" phenomenon that affects our perception of the state of marine ecosystems and its potential productivity.

In this context, the identification, recovery, digitization and analysis of historical data are of increasing importance. The analyses of historical data are expected to give insights in the long-term trends of fish stocks and fisheries, which can be also related to changes in environmental conditions. Historical data on fish and fisheries usually refer to information on tax records, catches, catch rates, trawl survey, length and/or age composition, biodiversity and any other sources that can provide information on the dynamics of marine organisms before 1960.

However, historical data are often not readily available in electronic format and the digitization process may be cumbersome and costly. Moreover, their analysis and interpretation may be complicated owing to scarcity of data or gaps in time-series, spatio-temporal limitations, difficulties when interpreting catch per unit of effort data (cpue) in face of technological changes, different measurement units, etc.

In 2008, ICES hosted the Workshop on historical data on fish and fisheries (WKHIST) in an attempt to provide links between the marine environmental history community and the marine science community. The workshop took place at ICES Headquarters, Copenhagen from 11 to 15 August 2008 and was attended by 14 scientists from different disciplinary backgrounds.

The Study Group on the History of Fish and Fisheries (SGHIST) is the result of the 2008 workshop, where we concluded that ICES should have a role in coordinating the historical work on marine systems. SGHIST aims at bringing together scientists working on these topics to facilitate and coordinate data recovery and digitization processes, to exchange ideas and harmonize methodologies on spatio-temporal analyses, and to discuss methods for the analysis of changes in fishing power.

The work links to the History of Marine Animal Populations project that is funded under the Census of Marine Life and which aims to recover historical data sources. Several fisheries research institutes in Europe have started to make inventories of available historical information.

The 2009 meeting of the Study Group on the History of Fish and Fisheries took place in the Fisheries Museum (Visserijmuseum) in the old fishing town of Vlaardingen, The Netherlands. It was attended by nine participants from both European and North American institutions.

1.2 Terms of reference

The Study Group on the History of Fish and Fisheries [SGHIST] (Co-Chairs: Bo Poulsen*, Denmark and Martin Pastoors*[1], The Netherlands) was established and met in Vlaardingen, The Netherlands, from 26 to 29 October 2009[2] to:

a) update the inventory of historical data on marine fisheries and resources in the North Atlantic

b) coordinate data recovery programmes for historical data

c) propose data-storage solutions that will allow access to recovered historical data.

d) initiate studies on the history of fishing technologies and fishing power

e) develop methods that can be applied to historical data in order to estimate long-term dynamics.

f) carry out cross-regional comparisons of fish and fisheries in the North Atlantic.

SGHIST will report by 15 December 2009[2] for the attention of SCICOM.

1.3 Structure of the report

ToR	Description	Section
a	update the inventory of historical data on marine fisheries and resources in the North Atlantic	5
b	coordinate data recovery programmes for historical data	6
c	propose data-storage solutions that will allow access to recovered historical data.	7
d	initiate studies on the history of fishing technologies and fishing power	3
e	develop methods that can be applied to historical data in order to estimate long-term dynamics.	4
f	carry out cross-regional comparisons of fish and fisheries in the North Atlantic.	2
	Preparation for ASC 2010 theme session	8
	Recommendations	9
	References and weblinks	10

1 Martin Pastoors could not attend the full meeting. He was partly replaced as Chair by Georg Engelhard (UK).

2 The meeting date has been changed from 10–13 August 2009 to 26–29 October 2009 due to timing issues for the conveners. The report will be submitted to ACOM on 11 February 2010.

2 Cross-regional results of historical studies (ToR f)

Results on long-term analyses from a range of different geographical areas were presented. Hence it was achieved to obtain an overview of historical fisheries studies from different parts of the ICES area. However, it remains difficult to perform "true" systematic cross-regional analysis and the need was identified to identify cases where such work might be possible in future. Below cross-regional results of historical studies are presented.

Historical spatial baselines in conservation and management of marine resources

Massimiliano Cardinale[1], Valerio Bartolino[1], Marcos Llope[2], Luigi Maiorano[3], Mattias Sköld[1], Jacob Hågberg[4]

Increased knowledge of the spatial distribution of marine resources is crucial to the implementation of a true ecosystem approach to management and the conservation of marine organisms. For exploited fish species characterized by aggregation behaviour during spawning time, the identification and tracking of spawning areas is essential for a correct assessment of their productivity and population abundance. To elucidate this concept and using adult plaice (*Pleuronectes platessa*) as an example, we reconstructed, based on survey data, the past spatio-temporal distribution (1901–2007) during spawning time of this commercial fish. Historical data reveal that not only the abundance but also the former population richness was much higher than previously estimated and has declined due to protracted overexploitation during the last thirty years of the 20th century. We conclude that forecast of stock recovery to former levels of abundance neglecting spatial reorganizations might be overoptimistic and shaded by a lost memory of the past population richness. These results reinforce the importance of managing exploited marine resources at a greater spatial resolution than it has been done in the history of fishery management.

Figure 1

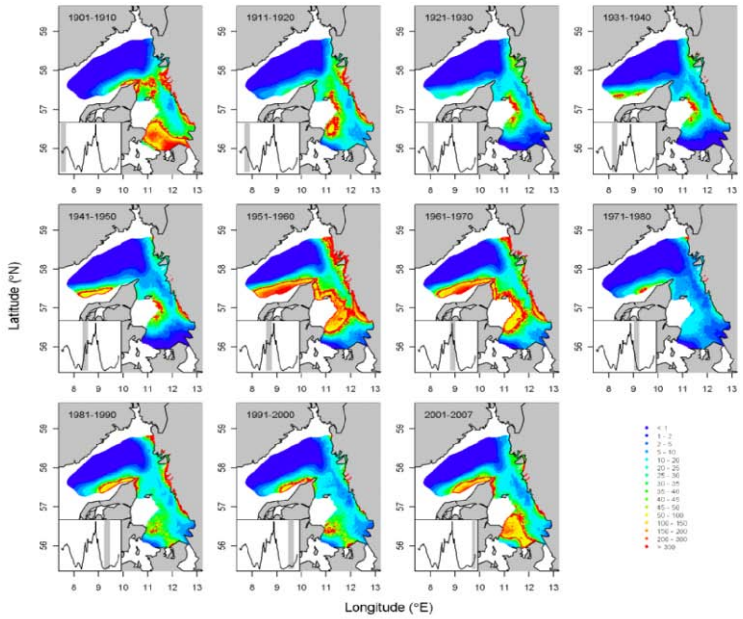

Figure 1. Distribution changes of adult plaice (in cpue (kg•h^{-1})) in the Kattegat-Skagerrak (decadal averages) estimated between January and March with indicated the spawning aggregations (i.e. hot spots areas of adult aggregation; red contours) calculated using a global threshold estimator. The trend in the spawning-stock biomass for each decade is shown in the small panel on the bottom left of each figure (from Cardinale *et al.,* 2009a).

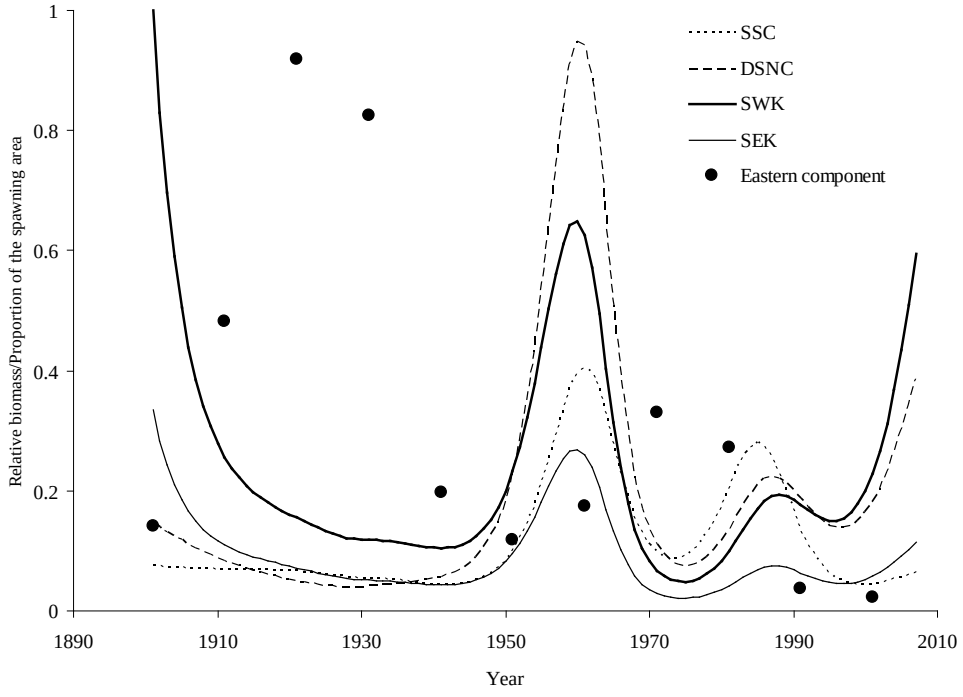

Figure 2. Historical trend of plaice adult biomass within the major areas of aggregation estimated in terms of relative biomass compared to the value in 1901 for SWK. Stock biomass is calculated integrating the predicted cpue over the estimation grid and converting kg•h^{-1} into kg•km^{-2} (see text for details). Dots indicated the proportion of the distribution area of the species occupied by the eastern component over time.

Nine decades of North Sea sole and plaice distributions

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[2] Wageningen Institute for Marine Resources and Ecosystem Studies (IMARES), IJmuiden, the Netherlands

Recent studies based mainly on research survey data suggested that within the North Sea, sole *Solea solea* and plaice *Pleuronectes platessa* have shown distribution shifts in recent decades—on average southward in the case of sole, and to deeper waters in the case of plaice. Conversely, landings data tentatively suggest a northward range expansion in sole. Various hypotheses may account for such shifts, including climate change effects and more intensive fishing effort in more southerly or shallower waters; but the relatively short time spans of datasets analysed so far (~3 decades) have complicated the disentangling of these two effects. We catalogued and digitized extensive sole and plaice catch and effort data from the British North Sea trawlers. These data cover nine decades and are spatially detailed by ICES rectangle (0.5° Latitude, by 1° Longitude). Based on these we quantify, for the first time, long-term distribution changes of North Sea sole and plaice over a period of almost a century. We interpret the findings in the light of climate change and long-term changes in fishing pressure.

The main conclusion from this study is that sole and plaice have shown major distribution shifts over the past 90 years, but these are not the result of climate change per se, but likely also of (indirect) fishing affects and eutrophication. This would not have been evident from data coming from the last 3 decades alone.

Fishing and jellyfish eradicate herring…180 years ago

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Herring has been commercially exploited for at least 400 years in the Limfjord, Denmark but its abundance has never been estimated for either historical or contemporary periods. Unknown spawner biomass levels and carrying capacity of the ecosystem for this species inhibits the development of scientifically based reference points for the population and for ecosystem-based management policy for the Limfjord. We develop two new estimates of herring spawner biomass for a historical period of stable fisheries (ca. 1660–1800) and estimate carrying capacity (maximum spawner biomass) of the Limfjord for herring. One estimation method is based on the retention area-spawner biomass relationship derived by Iles and Sinclair (1982) for four stocks in the North Atlantic under low-moderate exploitation. We first demonstrate that this approach successfully estimated long-term spawner biomass under moderate exploitation for seven additional herring populations in the North Atlantic. We then develop a new model including these eleven herring populations combined, and estimate Limfjord herring spawner biomass. This method suggests that spawner biomass was ca. 13,000 t, and that herring abundance in different areas of the North Atlantic is controlled by common general mechanisms and processes. The second biomass estimation method is based on analytical modelling of herring population dynamics in the Limfjord, in which a spawner biomass level is estimated that can provide long-term sustainable annual yields approximating those in the historical period (ca. 2900 t). This method estimates spawner biomass to be 11,000–19,000 t. The two independent methods produce estimates which are comparable and do not differ significantly. Given these abundance estimates, we calculate maximum carrying capacity under no exploitation to be 23,000–34,000 t. These new estimates, and in particular the area-based approach, can contribute to the development of reference fishing and biomass levels as well as sustainable fisheries and ecosystem management policies in situations where no other biomass estimates are available. Such regions include the Limfjord, Celtic Sea and Irish Sea.

Multi-decadal responses of a cod (*Gadus morhua*) population to human-induced trophic changes, exploitation and climate variability

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Abstract

Understanding how human impacts have interacted with natural variability to affect populations and ecosystems is required for sustainable management and conservation. The Baltic Sea is one of the few large marine ecosystems worldwide where the relative contribution of several key forcings to changes in fish populations can be analysed with empirical data. In this study we investigate how climate variability and multiple human impacts (fishing, marine mammal hunting, and eutrophication) have affected multidecadal scale dynamics of cod in the Baltic Sea during the 20th century. The work builds on recent reconstructions of cod spawner biomass back to the early 1920s based on commercial cpue, extended VPA and historical survey data (Eero *et al.*, 2007b; Eero *et al.*, 2007a; Eero *et al.*, 2008).

We document significant climate-driven variations in cod recruitment production at multi-annual time–scales, which had major impacts on population dynamics and the yields to commercial fisheries. We also quantify the roles of marine mammal predation, eutrophication and exploitation on the development of the cod population using simulation analyses, and show how the intensity of these forcings differed over time. In the early decades of the 20th century, marine mammal predation and nutrient availability were the main limiting factors; exploitation of cod was still relatively low. During the 1940s and subsequent decades, exploitation increased and became a dominant forcing on the population. Eutrophication had a relatively minor positive influence on cod biomass until the 1980s. The largest increase in cod biomass occurred during the late 1970s following a long period of hydrographically-related above-average cod productivity coupled to a temporary reduction in fishing pressure. The Baltic cod example demonstrates how combinations of different forcings can have synergistic effects and consequently dramatic impacts on population dynamics. Our results highlight the potential and limitations of human manipulations to influence predator species and show that sustainable management can only be achieved by considering both anthropogenic and naturally varying processes in a common framework.

(In press: Ecological Applications)

(Eero *et al.*, 2010)

3 Studies on history of fishing technology and fishing power (ToR d)

This topic was covered by Max Cardinale when presenting the standardization of cpue for long-term spatio-temporal analysis of population dynamics, where differing levels of technological creep can be accounted for. This is also described in detail in Cardinale *et al.* (2009). The ICES WKHIST report (ICES, 2008) also reports on methods for estimating long-term changes in fishing power, needed for standardization of cpue (and see Engelhard, 2008).

4 Methods for historical data analysis (ToR e)

Catch standardisation for spatio-temporal analysis of historical datasets

Massimiliano Cardinale[1], Valerio Bartolino[1], Marcos Llope[2], Luigi Maiorano[3], Mattias Sköld[1], Jacob Hågberg[4]

Generalized Additive Model

Historical data are often (if not always) characterized by a rather uneven sampling design (Cardinale *et al.*, 2009a). To account for the unbalanced sampling design between possible variables that describe fish distribution in the space and time, as for example year, month, latitude, longitude, depth or others and describe the main distributional changes of a stock over time, generalized additive models (GAMs, Hastie and Tibshirani, 1990) can be used to standardize observed catch per unit of effort (cpue; e.g. $kg \cdot h^{-1}$) (see Maunder and Punt, 2004 for a useful review on different standardization approaches). The general form of a GAM is:

$$g(m) = a + \sum_{j=1}^{p} f_j(X_j) + \varepsilon$$

where $m = E(Y/X_1, \ldots, X_p)$ is the expectation that the response variable Y is related to $a + \sum f_j(X_j)$ the covariates (X1 , ... , Xp) by the additive predictor and ε is the random error. Different distribution can be used to model cpue as for example the negative binomial, gamma, quasi-Poisson and several others (Minami *et al.*, 2007). The following is an example of an initial model formulation:

$$\text{cpue} = \beta + s(\text{long,lat}) + te_1(\text{long,year}) + te_2(\text{lat,year}) + f_1(\text{year}) + f_2(\text{month}) + f_3(\text{depth}) + \varepsilon$$

Where cpue is the stock biomass, β is a constant, s is an isotropic smooth, tei are tensor product smoothers, fi are natural cubic splines and ε is an error term. The interaction between latitude and longitude is modelled through an isotropic smooth as suggested by Wood (2006). For the interactions between year and latitude and between year and longitude (i.e. spatio-temporal interactions) a tensor product smoothing function is recommended (Wood, 2006). This approach is preferred when product covariates have different unit scales as it allows for a different amount of smoothness along the two axes (Wood, 2006). The spatio-temporal interactions are included to account for changes in the spatial distribution of the stock during the time period

analysed. Full and reduced models are usually compared through a backward stepwise regression approach based on both statistical significance and generalized cross validation (GCV; Wood, 2006). In order to simplify the interpretation of the results, the maximum number of knots should be limited, as for example for the smooth effect of month and depth and for the interaction between latitude and longitude (see the Appendices in Cardinale *et al.*, 2009a, b for further details).

Reconstructing historical spatial distribution

The final GAM model is used to obtain cpue estimates over a regular grid. Calculated cpue over the grid can be then converted into density (e.g. $kg \cdot km^{-2}$) considering the bottom swept-area that corresponds to 1 hour of trawl (see the Appendices in Cardinale *et al.*, 2009a,b for further details). Estimates are then integrated over the whole grid to calculate yearly biomass over the entire area included in the grid. Estimation of the annual biomass over the entire grid area represents an effective way to appropriately weight different areas, reconstruct biomass trend for the entire study period and extract the year effect from the model (Beare *et al.*, 2005), also under spatial-temporal interaction (Maunder and Punt, 2004).

Spawning aggregation analysis

Hot spots as for example aggregation of spawning or juvenile fish, are spatially explicit, in that they are detected at geographic locations and may be mapped. Definitions of hot spots may be based on thresholds that are spatially global or spatially local. Spatially *global* definitions compare the value for a given observation with those in the complete dataset. In contrast, spatially *local* definitions involve comparing the value for a given observation with locations in the vicinity of the observation (Nelson and Boots, 2008). For example, a spatially *global* estimator or threshold can be applied to predicted density data that can be used to identify the main spawning areas of a stock. The threshold is usually calculated using the 85^{th}, 90^{th}, 95^{th} or 99^{th} percentile of the overall predicted density distribution at the beginning of the time-series. In the case historical data, the choice of the percentile is a compromise between the likely large variation in stock size during the time-series and the need to individuate persistent areas of adult aggregation after decades of exploitation and usually reduced biomass. All areas with fish density above this value can be assumed to be spawning aggregation. Spatially *local* estimator can also be used although those are much more computationally intensive than global ones (Nelson and Boots, 2008).

5 Update of inventory of historical data (ToR a)

The inventory of historical data are contained in the spreadsheet SG*HIST 2009 data inventory.xls* which is available on the SGHIST Internet page. It is an updated and extended version of the data inventory carried out during the ICES WKHIST 2008 workshop. In particular, details on extensive Belgian fisheries statistics have been included, kindly provided by Ann-Katrien Lescrauwaet (Flanders Marine Institute, Belgium). The Belgian data are of special interest as they cover the Belgian fleet and its activities and are rather complete, when compared to fisheries datasets for many other fishing nations.

6 Coordination of data recovery programmes (ToR b)

Brief update on Defra project MF1108 "One-hundred Years of Change in Fish and Fisheries"

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Cefas has unique historical fisheries data covering a timespan of over 100 years. Such data are highly valuable for examining climate change impacts, impacts of fisheries, pollution, and other anthropogenic drivers, on marine organisms and may also help in a better understanding of the "shifting baseline" phenomenon. Despite uniqueness, most pre-1970s data have not been digitized yet and a clear need was identified for such historical data to become accessible to scientists. These considerations led to the initiation of Defra project MF1108 "One-hundred Years of Change in Fish and Fisheries".

Aim 1 of the project is to digitize Defra commercial fisheries "Statistical Charts", covering the years 1913–1981, except war years. These charts provide spatially detailed data on catches, effort, and cpue by fish species and fishing fleet. Based on these, studies on the long-term shifts in fish distribution in relation to climate and fishing will be made possible (and have been commenced already for North Sea sole and plaice). Moreover, research on long-term changes in the trawl fisheries themselves, and in the spatial distribution of effort will also be achievable.

Aim 2 of the project is to make an inventory of the historical research survey data, covering 1890s-1970s. This refers to surveys carried out by Cefas and its predecessor (Directorate of Fisheries Research), mostly in the North Sea but also in the Irish Sea, north and west of Scotland, and in the Barents Sea. Based on the inventory, (prioritized) subsets of surveys are digitized (with an initial focus probably on the 1950s–1960s). Based on such survey dataset, changes in biological characteristics in fish populations and species compositions in relation to climate and fishing will be examined.

Figure 3. Number of Cefas surveys, inventory by Nick Goodwin (2001).

It should be noted that the Defra project was much inspired by ICES WKHIST 2008. The workshop reinforced our plans to try to make best use of extensive Cefas/Defra datasets. WKHIST brainstorming underlined a thriving scientific interest in long-

term changes in fish and fisheries; showed a will for concerted efforts; and confirmed the importance of studying long-term, historical changes in fish and fisheries.

Fishing in the past: Historical data on sea fisheries for Belgium

Data sources, data management and data integration to reconstruct historical time-series on the composition and value of landings of sea fisheries in Belgium

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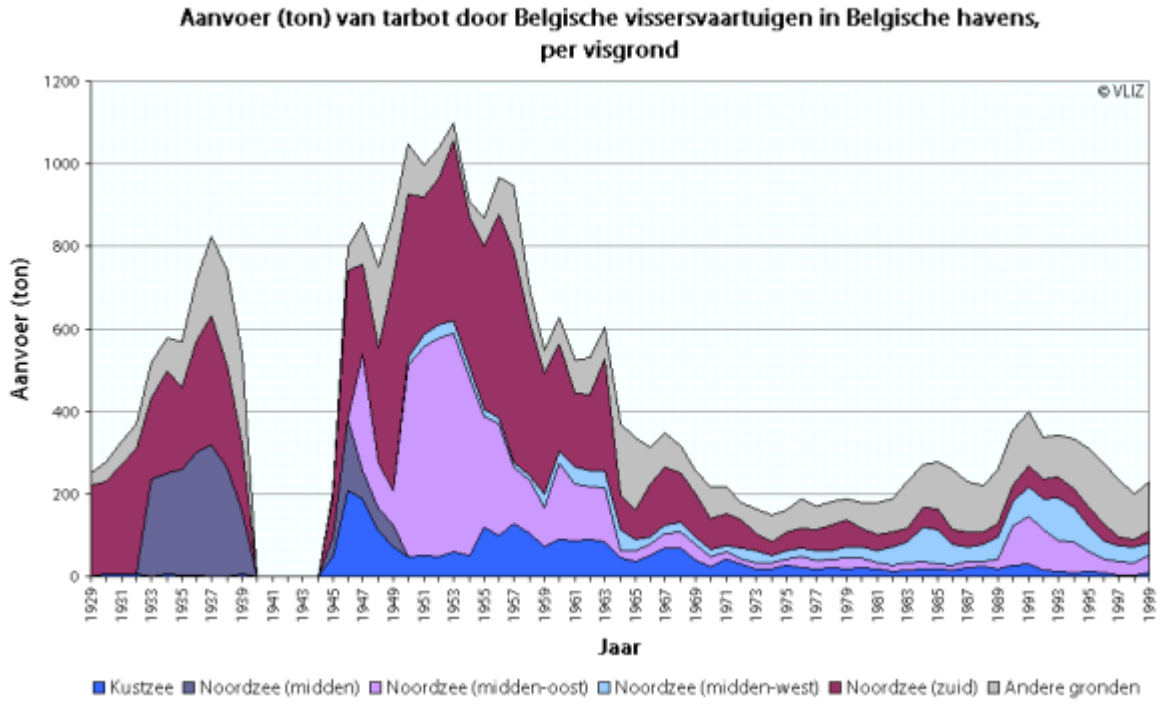
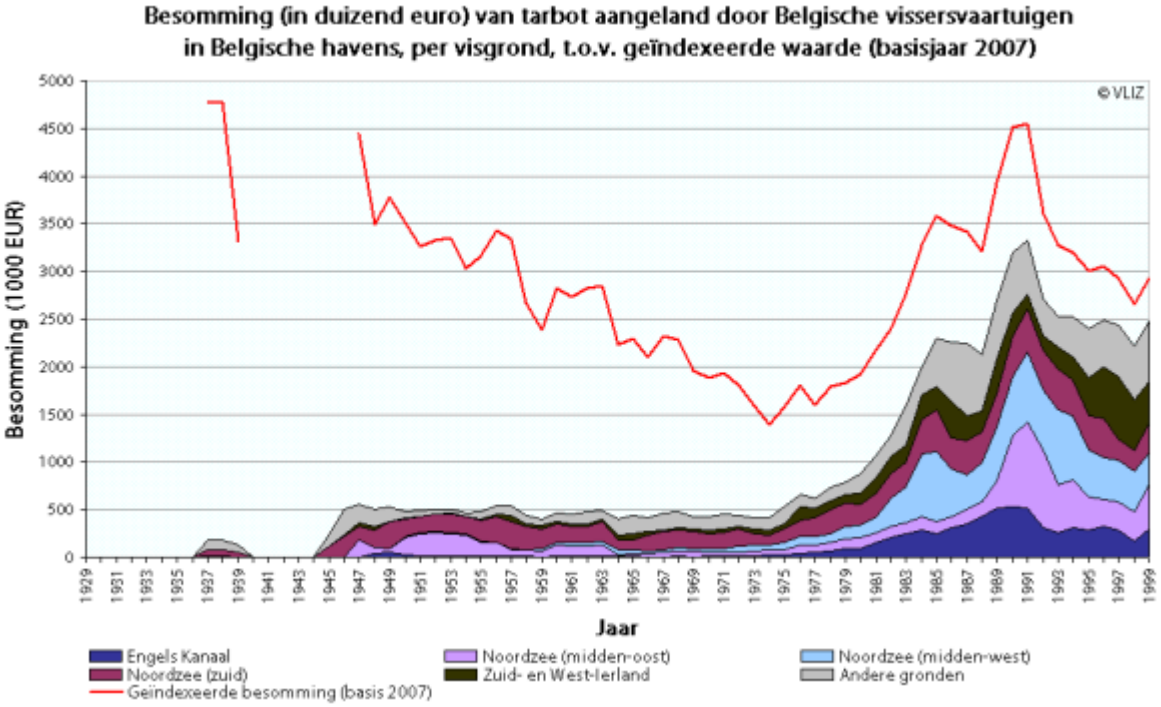
[2] Marine Biology Section, Ghent University (Belgium)

Time series on landings of sea fisheries in Flanders were reported at least as early as 1767 for herring, salted cod and "fresh fish". Structurally embedded reporting on landings and the economic value of these landings in Belgium (Flanders) started in 1929; however data were not available in the public domain or digitally. Based on this systematic reporting available from disperse data sources, a standardized and integrated time-series was reconstructed at the lowest taxonomic level and spatial scale,. The resulting database covers the period 1929–1999 on a detailed level by species (41), by port of landing in Belgium (4) and in "foreign ports", by fishing area of origin (31).Recent data are available digitally from the Flanders Fisheries Service Reported landings covered by the database (1929–1999) amounted to 3.1million tonnes, of which 2.8million (91%) were landed in Belgian ports and 0.2million tonnes in "foreign ports" with an additional 20,256tonnes in Dunkerque and Gravelines (France) during World War II. The total value of these landings amounted to €2,278million which recalculated to account for inflation (reference year 2007) represented €6,075million. The most important species in terms of landings were cod and herring (respectively 17% and 16% of total landings). In terms of indexed value, sole (31%) and cod (15%) were the most valuable species (1929–1999). Close to 73% of all landed species originated from 5 fishing areas: Coastal waters (shallow waters off Belgium, northern France and the Netherlands), the southern North Sea, the Iceland Sea, and the central North Sea East and central North Sea West. 20% of all landed species originated from the shallow coastal waters. The southern North Sea and the Icelandic waters follow closely with 17% and 16% respectively. The coastal waters contributed nearly 60% of all landed pelagic species and 55% of all landed "molluscs and crustaceans" reported for the period 1929–1999. The integrated database broadens our historical view on fisheries, underlining the decline in landings since reporting started in Belgium. It allows further analysis of this decline by particular species and fishing grounds provides a wider historical component of sea fisheries in ecological science and fisheries management. Data, graphs, maps and other products based on the HiFiDatabase are available from:

http://www.vliz.be/EN/Figures_Policy/Figures_Policy_Belgian_Sea_Fisheries





Figures: (Above): Historical trend of landings of turbot by Belgian fisheries in Belgian ports, by fishing area of origin. (Below): Historical trend of value of landings (in Euro) of turbot by Belgian fisheries in Belgian ports, by fishing area of origin, and total value corrected for inflation (values 2007).

7 Data storage solutions (ToR c)

A mini-workshop was held at the Royal Library (Koninklijke Bibliotheek), The Hague, The Netherlands on Wednesday 28 October 2009, about data recovery programmes currently ongoing, and best practices on digitization and data storage. This was attended by SGHIST participants, and there were moreover three invited experts:

- Andrea Langendoen (Koninklijke Bibliotheek) , The Netherlands
- Daniel Benden (database expert Wageningen IMARES), The Netherlands
- Siem van der Woude (Tresoar, involved in Sound Toll Register project), The Netherlands

Andrea Langendoen reported on the conservation and preservation of books and documents, and the often painstaking methods required to preserve historical documents. This is particularly relevant to old, handwritten documents as kept at libraries. It may include the de-acidification of paper that is too acid and that may also contains lignin (ground wood paper), which otherwise eventually will yellow and weaken and become vulnerable to tearing. Eventually, this kind of paper will become brittle to such an extent that it can no longer be used. The problem is paramount in 19th and 20th century paper, and notably in the common pocket book and in newspaper; as a general rule, books and documents dating from before the 1800s do not need de-acidification.

Siem van der Woude reported on the Sound Toll Register (STR) project (www.soundtoll.nl), or short, STR-online. This is an online, electronic database of the complete Sound Toll registers. Digitisation has started in March 2009 and is scheduled to be completed in 2011.

The Sound Toll Registers are the records of the toll of the king of Denmark levied on the passage of ships through the Sound, the strait between Denmark and Sweden. They form one of the great serial sources of early modern history of Western Europe. Sound Toll Registers are kept by the Danish National Archives (Rigsarkivet) Copenhagen, and have been preserved for about 300 of the 360 years from 1497 till 1857, when the Sound Toll was abolished (with a virtually uninterrupted time-series from 1574 to 1857). The Sound Toll Registers contain information on about 1.8 million passages. For each of these, the shipmaster, his town of residence, port of departure and (from 1660s onwards) port of destination, composition of cargo, and due toll per commodity are available. Thus, the STR forms the main measuring point of commodity transport between northern and southern Europe. This provides vital information on trade, transport, production, consumption in Europe. It can also inform about the origins, lives and economic activities of a host of shipmasters. From ca. 1580 on the majority of the passing shipmasters were from the Netherlands. In particular, during the 18th century the shipmasters from Friesland outnumbered their colleagues from the other Dutch provinces. See www.soundtoll.nl for further information.

Because of the enormous size of this source, systematic studies are hard to realize. Two Danish historians, Nina Ellinger Bang and Knud Korst, published in the years between 1906 and 1953 seven volumes with edited, partly aggregated information from the Danish Sound Toll Registers (N. E. Bang en K. Korst, Tabeller over skibsfart og vaeretransport gennem Oeresund 1497–1783 [seven volumes] (Copenhagen and Leipzig 1906–1953; also available online through above website). However, the Sound Toll Register project is the first attempt to digitize all individual records. This would

enable scientists to use the Sound Toll register's information to the full extent, including data on fish trade.

8 Preparation for ASC 2010 theme session

The group has proposed a Theme session at the ASC 2010 (or ASC 2011): **"Linking the history to the present: understanding the history of fish, fisheries and management."** Convenors (still to be confirmed): Andy Rosenberg, Martin Pastoors, Henn Ojaveer, Max Cardinale, and Bo Poulsen. The theme session would follow-on from the HMAP conference on Oceans Past (26–28 May 2009, Vancouver, http://hmapcoml.org/oceanspast/). The theme session would link the results from the historical studies with the work carried out in several of the advisory functions of ICES. It would also provide a common interface where historical scientists, ecosystem scientist and fisheries scientists could meet to exchange results that can improve the understanding of the long-term dynamics of marine ecosystems.

9 SGHIST Terms of Reference for the next meeting

The **Study Group on the History of Fish and Fisheries** (SGHIST), chaired by Bo Poulsen, Denmark and Georg H. Engelhard*, UK, will meet in Ponza, Italy, 11–14 October 2010 to:

a) coordinate the data recovery activities for historical information on fish, fisheries and marine ecosystem

b) develop methods that can be applied to historical data in order to estimate long-term dynamics of stock, fishing fleet and fishing technologies, including technological creeping

c) develop methods for the spatial analysis of fish and fisheries historical data

d) carry out cross-regional comparisons of fish and fisheries in the North Atlantic, focusing on the analysis of key predator species in the different ecoregions.

SGHIST will report by 15 November 2010 for the attention of the SCICOM Committee.

Supporting information

Priority	The activities of this Group will improve the understanding of the long-term changes in fish stocks productivity and structure of the marine ecosystems. Consequently these activities are considered to have a high priority.
Scientific justification	There is growing interest in historical data on fish and fisheries and the past marine ecosystem in general. The interest is on the discovery, recovery, digitization and analysis of historical data. The analysis of historical data are expected to give insight in long-term historical trends in fish stocks and fisheries which can be related to exploitation and long-term changes of the marine environment. The work links to the History of Marine Animal Populations project that is funded under the Census of Marine Life and which aims to discover historical data sources. Several fisheries research institutes in Europe have started to make inventories of historical information and the workshop is intended to bring these initiatives together. WKHIST 2008 and SGHIST 2009 have recommended that a project should be set up to recover the historical information that has been collected by marine research institutions and zoological museums around the North Atlantic and the Mediterranean. SGHIST will oversee that project. SGHIST will link with methodological experts to advance the methodologies for analysing historical data including methods for using meta-information from different areas.
Resource requirements	No specific requirements
Participants	The Group should be attended by some 15 members and guests. Attendance from the Mediterranean countries is foreseen.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to advisory committees	Linked to ICES proposal for the digitization, analysis and interpretation of plankton data for pre-1914 ICES sampling in the north sea and adjacent waters.

Linkages to other committees or groups	There is a very close working relationship with all the groups of the Fisheries Technology Committee. It is also very relevant to the Working Group on ecosystem Effects of Fisheries, and several ICES working/study groups on effects of climate change and other human impacts on marine populations and ecosystems
Linkages to other organizations	Census of Marine Life / History of Marine Animal Populations

10 References and links

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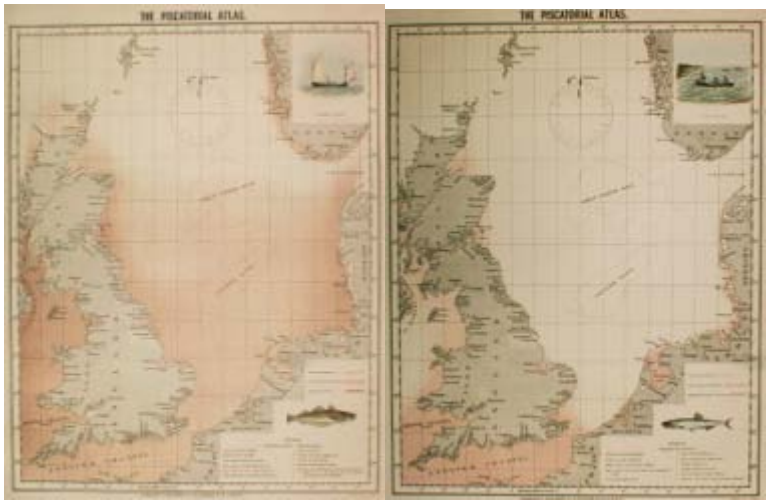
Links supplied by Jan van de Voort, Fishery Museum, Vlaardingen, The Netherlands

Provided are links to several examples of historical fishery resources such as maps, charts, tables, statistics which indicate the type of information available for recovery and interpretation.)

The Fisheries Exhibition Literature (London Fisheries Exhibition 1883): http://www.archive.org/details/fisheriesexhibi05unkngoog

The Olsen Piscatorial Atlas: what species were fished in the North Sea more than 100 years ago? http://www.vliz.be/EN/Marine_Library&id=183



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Some French historical sources: http://cnum.cnam.fr/RUB/fcata.html, http://cnum.cnam.fr/fSER/8XAE583.html

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Fisheries statistics 1880: http://books.google.nl/books?id=tU0LAAAAIAAJ&pg=PA128&dq=fisheries+statistics+1880+reports&lr=&num=20&as_brr=1#v=onepage&q=&f=false

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http://math.clarku.edu/huxley/SM5/fish.html

Annex 1: Participants

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