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Report of the Working Group on the History of Fish and Fisheries (WGHIST)

4–7 September 2017

Lysekil, Sweden



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Executive summary

Over the reporting period 2015–2017, the ICES Working Group on the History of Fish and Fisheries (WGHIST) was chaired by Emily Klein (USA) and Ruth Thurstan (UK). WGHIST is a forum for interdisciplinary research on social-ecological change in marine and fisheries systems over multi-decadal to centennial and even millennial timescales. It comprises a diverse group of researchers, including marine biologists, fisheries scientists, historians, historical ecologists, and paleoecologists from Europe and North America, as well as Australia, Russia, and South Africa.

The WGHIST Terms of Reference and progress towards them during 2015–2017 are outlined below.

- a) Use case studies to demonstrate the tangible benefit of marine historical ecology to marine policy and management

Case studies that highlighted the potential or realised benefits of marine historical ecology for informing research, management, and policy were identified from throughout the ICES region, as well as the Mediterranean, North America, Africa, and Australia. These case studies provided examples whereby historical data could be used to inform specific regional management/policies, as well as broader advice. Some of these examples have since been published in the peer-reviewed literature, presented at scientific and other conferences and meetings, or have resulted in completed and ongoing graduate research. Work under ToR (a) also led to the development of an ICES Workshop (Workshop on Integrating Historical Data into Modern Stock Assessment, WKIHSD) to be held in 2018, and identified potential knowledge gaps that could be addressed in future iterations of WGHIST. Finally, WGHIST initiated and progressed two manuscripts for peer-review under this ToR: (1) opportunities for the application of marine historical ecology, and (2) shifting baselines in global marine policy. Paper (1) also engages outcomes from ToR (c), and submission for both is expected in 2018.

- b) Ensure that quality-assured historical metadata are accessible to the science community

WGHIST worked with the ICES Data Centre to upload metadata on a diversity of historical and long-term data sources, spanning several continents and periods of time encompassing decades to centuries. The metadata currently consists of 93 unique metadata descriptors covering, among others, the North and Baltic Seas, the Northwest Atlantic, the Mediterranean, and Icelandic waters. These can be accessed via the ICES Data Portal, and they have been highlighted on the WGHIST website and in ICES presentations and communications.

- c) Integrate non-traditional methodologies and data sources to improve our knowledge base on long-term changes

ToR (c) aimed to highlight both information and the methods for employing that information that may not be commonly used by natural scientists. Members of WGHIST presented a range of such non-traditional methods and resources during this iteration of WGHIST, drawing on numerous disciplines from social sciences to history to paleoecology, to examine past ecosystems and socio-ecological trends over time. Discussions at

WGHIST meetings on these resources and methods enabled an exchange of ideas among WG members, and best practises in interdisciplinary research. These resources expand the wealth of information available, as well as the approaches possible, for contemporary research and management, in addition to providing new insights in marine systems over time. Due to overlap with ToR (a), this insight is incorporated in a manuscript for peer-review under that ToR.

- d) Address social, cultural and economic dimensions of marine ecosystem goods and services through time, with the aim to contribute to integrated ecosystem assessments.

All WGHIST meetings were attended by researchers from a range of disciplines, including history, fisheries science, social science, and ecology, which facilitated discussion on social, cultural, economic aspects, i.e. the 'human dimensions', of marine social-ecological systems. These discussions demonstrated that human dimensions are critical for understanding these systems, as well as patterns, trends, and change, through time. WGHIST has also directly engaged with ICES Strategic Initiative on the Human Dimension (SIHD), which demonstrated strong overlap in interests and goals between the groups. Also under this ToR, WGHIST members progressed a manuscript for peer-review that uses past case studies to illuminate the human dimensions of blue growth, with lessons for current and developing blue growth agendas. Submission is expected in early 2018.

The current iteration of WGHIST has highlighted several take-home messages that are relevant for the ICES and wider scientific community:

- 1) The structure and functioning of many marine ecosystems throughout the North Atlantic and beyond have been significantly altered by human activity spanning decadal to centennial timescales;
- 2) Many of these changes occurred long before routine scientific monitoring began for many systems and/or fisheries, hence present day management decisions often fail (or feel unable) to take earlier changes into account;
- 3) Historical sources exist to help us understand our past impacts upon marine ecosystems and consequently the extent of change in our seas, and these sources are becoming increasingly available to scientists, managers and policy makers;
- 4) However, interpreting historical sources and finding avenues for their incorporation into present day science and management remains a challenge, one that is best approached through interdisciplinary collaboration;
- 5) Examples of the successful application of historical data into contemporary management and policy do exist, and these examples are increasing in scope and frequency.

1 Administrative details

Working Group name

Working Group on the History of Fish and Fisheries (WGHIST)

Year of Appointment within current cycle

2015

Reporting year within current cycle (1, 2 or 3)

3

Chair(s)

Emily Klein, USA

Ruth Thurstan, UK

Meeting dates and venues

Ispra, Italy, 20–23 October 2015 (European Commission's Joint Research Centre)

Copenhagen, Denmark, 6–9 September 2016 (ICES Secretariat HQ)

Lysekil, Sweden, 4–7 September 2017 (Institute of Marine Research)

2 Terms of Reference a) – z)

- a) Use case studies to demonstrate the tangible benefit of marine historical ecology to current marine policy and management;
- b) Ensure that quality-assured historical metadata are accessible to the science community to stimulate data products including digital applications;
- c) Integrate non-traditional methodologies and data sources to improve our knowledge base on long-term changes;
- d) Address social, cultural and economic dimensions of marine ecosystem goods and services through time with the aim to contribute to integrated ecosystem assessments.

3 Summary of Work plan

Year 1 The priority for Year 1 was to 1) summarize potential and actual approaches and challenges to the application of historical marine ecology for contemporary science and management via case studies of work within WGHIST (already

initiated by Engelhard *et al.* 2016¹, which resulted from WGHIST 2011–2014); and 2) highlight the process of accessing and applying historical data to science and management questions by identifying regional-level North Atlantic case studies where historical data (both quantitative and qualitative) has already been developed and analyzed for results readily applicable to ICES Science Plan objectives (see ToR(a)). In addition, the WGHIST 2015 meeting included a Special Session on Human Dimensions, which focused on interactions of human communities with marine ecosystems through time.

Year 2 Year 2 focused on the inclusion of participants from management and policy spheres to identify areas where historical data can be explicitly incorporated into the decision-making process, and how to overcome potential challenges to doing so. To this end, WGHIST invited participants from the ICES community and beyond during the year leading up to the 2016 meeting. In addition, WGHIST furthered aims under the Special Session on Human Dimensions (Year 1), which included several WGHIST member presentations as well as a presentation from the chair of ICES SIHD. WGHIST also updated work on case studies identified in Year 1, and met with Data Centre staff to implement and review avenues for including WGHIST metadata in the ICES data portal, and discuss further digital applications of this historical resources.

Year 3 In the final year of this iteration, WGHIST members made progress on several group-authored manuscripts stemming from work related to ToR (a), (c) and (d): 1) the opportunities afforded by the incorporation of historical data into management and policy (ToR (a) and (c)), 2) lessons from history for future Blue Growth policies (ToR (d)), and 3) evidence of awareness of/actions taken to avoid shifting environmental baselines in marine policy (ToR (a)). All of these manuscripts draw upon case studies produced from WGHIST members' research and/or member expertise. It is anticipated these three publications will be submitted in 2018. Finally, WGHIST worked with ICES Data Centre staff to make historical metadata contributed by WGHIST members visible online via the ICES Data Portal. This went live in September 2017.

4 Summary of Achievements of the WG during 3-year term

WGHIST meetings were an opportunity for researchers from different disciplines and countries to discuss research and pursue new or on-going collaborations. WGHIST members span a diversity of disciplines and expertise, from fisheries scientists to historians to palaeoecologists, and employ a correspondingly wide range of data sources and methodologies. As in earlier iterations, WGHIST provided a platform to bridge gaps across disciplinary and institutional boundaries as well as the science-policy interface, and to

¹ Engelhard *et al.* (2015) ICES meets marine historical ecology: Placing the history of fish and fisheries in current policy context. *ICES Journal of Marine Science*. <https://doi.org/10.1093/icesjms/fsv219>

connect early career scientists with the larger ICES and scientific communities. All three meetings were attended by members from across the ICES region and beyond, including the Mediterranean, Australia, Africa, and Russia. Discussions were lively and productive, with multiple tangible outcomes identified and enthusiastic engagement among members participating in person and remotely. Work by WGHIST continued to forward the discipline of marine historical ecology, and place research of social-ecological systems through time in current policy and conservation contexts.

Specific achievements

- Three annual Working Group Reports (see ICES 2016² and 2017³ for earlier reports), which describe the diversity of research and collaborations by WGHIST members, placed in the context of progressing the WGHIST Terms of Reference.
- Three manuscripts are under development (anticipated submission 2018) that resulted directly from WGHIST work and collaborations made possible by this WG: 1) opportunities afforded by the incorporation of historical data into management and policy, 2) lessons from history for future Blue Growth policies, and 3) evidence of awareness of/actions taken to avoid shifting environmental baselines in marine policy.
- WGHIST chairs worked with the ICES Data Centre, incorporating WGHIST member feedback, to transfer WGHIST metadata to the ICES Data Portal. This now searchable metadata went live on the Portal just prior to the 2017 meeting, and a link⁴ to this data was added to the WGHIST ICES webpage. The ICES Data Centre team also used images proposed by WGHIST members to craft a WGHIST icon to enhance the visibility of historical metadata in the Data Portal and future digital tools.
- Member presentations at the following conferences: Oceans Past VI 2017; ICES ASC 2016; BONUS SYMPOSIUM 2017, 52nd European Marine Biology Symposium 2017, Australian Marine Sciences Association 2016; International Coral Reef Congress 2016; Oceans Past V 2015; Ecological Society of America 2015, 14th Deep Sea Biology Symposium 2015, 15th Southern African Marine Science Symposium 2014.
- Proposal for an ICES Workshop on Integrating Historical Data into Modern Stock Assessment (WKIHSD), to take place 27–31 September 2018 in Lysekil, Sweden, submitted to ICES SCICOM.
- Engagement with ICES and the wider scientific community via social media (under the hashtag #WGHIST), as well as invited pieces for ICES News, enti-

² WGHIST (2016) Interim Report of the Working Group on the History of Fish and Fisheries (WGHIST), 20–23 October 2015, Ispra, Italy. ICES CM 2015/SSGEPI:21. 44 pp.

³ WGHIST (2017) Interim Report of the Working Group on the History of Fish and Fisheries (WGHIST), 6–9 September 2016. ICES Headquarters, Copenhagen, Denmark. ICES CM 2016/SSGEPI:20. 51 pp.

⁴ Weblink to historical data within the ICES Data Portal: <http://bit.ly/2i4tADw>

tled “Charting the past to make sense of the present” (December 2015⁵) and “Changing perceptions” (May 2016⁶); the latter was selected as an ICES News Feature Article.

- The following scientific papers, popular articles, theses, and book chapters were published which benefited or resulted from discussion or collaborations developed during previous WGHIST meetings and correspondence (WGHIST member author in bold):

Alleway, H.K., Thurstan, R.H., Lauer, P., Connell, S.D. (2016). Incorporating historical data into aquaculture planning. *ICES Journal of Marine Science* 73: 1427–1436.

Bennema F.P. (*In press*). Long-term occurrence of Atlantic bluefin tuna *Thunnus thynnus* in the North Sea: contributions of non-fishery data to population studies. *Fisheries Research*. doi: 10.1016/j.fishres.2017.11.019.

Currie, J., and L. Atkinson, W. Goschen, C. Attwood. (2013). A rich bounty of historical marine data . SAEON e-Newsletter, 2 pp.

Currie, J., and G. Jones (2014). Trawling through time. *Fishing Industry News* 15: 26–27.

Currie, J. (2014). Of trawl nets, historical baselines and Gilchrist's hidden legacy. *SANCOR Newsletter* 24:5–6.

Currie, J., and S. Norman, (2015). Mission Gilchrist: Revisiting the earliest trawl surveys in South Africa. SAEON E-newsletter, 3 pp.

Danto, A. (2017). *Les sociétés littorales et leurs usages traditionnels du Watt en mer des Wadden depuis le Moyen-Âge [Coastal societies and their traditional uses of Watt in the Wadden Sea since the Middle Ages]*, M.A. thesis, S.Llinares dir., CERHIO Centre de Recherches Historiques de l'Ouest CNRS FRE 2004, South Brittany University, 202 p.

Eero, M., and H. C. Andersson, E. Almroth-Rosell, **B. R. MacKenzie** (2016). Has eutrophication promoted forage fish production in the Baltic Sea? *Ambio* 45: 649–660.

Engelhard, G.H. (2016). On the need to study fishing power change: challenges and perspectives. In: Schwerdtner Máñez K, Poulsen B (Eds) *Perspectives on Oceans Past: A Handbook on Marine Environmental History*. Springer Publishers.

Fortibuoni, T., and S. Libralato, E. Arneri, O. Giovanardi, C. Solidoro, **S. Raicevich** (2017). Fish and fishery historical data since the 19th century in the Adriatic Sea, Mediterranean. *Nature Scientific Data* 4: 170104. doi:10.1038/sdata.2017.104.

Fortibuoni, T., and O. Giovanardi, F. Pranovi, **S. Raicevich**, C. Solidoro, S. Libralato (2017). Analysis of long-term changes in a Mediterranean marine ecosystem based on fishery landings. *Frontiers in Marine Science* 4:33. doi: 10.3389/fmars.2017.00033.

Fortibuoni, T., and D. Borme, G. Franceschini, O. Giovanardi, **S. Raicevich** (2016). Common, rare or extirpated? Shifting baselines for common angelshark, *Squatina squatina* (Elasmobranchii: Squatinidae), in the Northern Adriatic Sea (Mediterranean Sea). *Hydrobiologia* 772: 247–259. doi:10.1007/s10750-016-2671-4.

⁵ <http://www.ices.dk/news-and-events/news-archive/news/Pages/Charting-the-past-to-make-sense-of-the-present.aspx>

⁶ <http://www.ices.dk/news-and-events/news-archive/news/Pages/FEATURE-ARTICLE-%E2%80%93-changing-perceptions.aspx>

- Klein, E.S., Thurstan, R.H.** (2016). Acknowledging long-term ecological change: the problem of shifting baselines. In: Schwerdtner Máñez K, Poulsen B (Eds) *Perspectives on Oceans Past: A Handbook on Marine Environmental History*. Springer Publishers.
- Klein, E.S., Glaser, S.M., Jordaan, A., Kaufman, L., Rosenberg, A.A.** (2016). A complex past: historical and contemporary fisheries demonstrate nonlinear dynamics and a loss of determinism. *Marine Ecology Progress Series* 557, 237–246.
- MacKenzie B.R., Ojaveer, H.** (2018). Evidence from the past: exploitation as cause of commercial extinction of autumn spawning herring in the Gulf of Riga, Baltic Sea. *ICES Journal of Marine Science* (conditionally accepted, minor revision).
- McKenzie, M.** (2018). *Breaking the Banks: Representation and Reality in the New England Fisheries, 1866–1966*. University of Massachusetts Press: Amherst, Mass.
- Sguotti C., and C.P. Lynam, B. García-Carreras, J. R. Ellis, G. H. Engelhard** (2016). Distribution of skates and sharks in the North Sea: 112 years of change. *Global Change Biology* 22, 2729–2743. doi: 10.1111/gcb.13316.
- Raicevich, S., and J.-L. Alegret, K. Frangoudes, O. Giovanardi, T. Fortibuoni.** (2017). Community-based management of the Mediterranean coastal fisheries: Historical reminiscence or the root for new fisheries governance? *Regional Studies in Marine Science*. doi: 10.1016/j.rsma.2017.10.013
- Thurstan, R.H., Buckley, S.M., Ortiz, J.C., Pandolfi, J.M.** (2016) Setting the record straight: assessing the reliability of retrospective accounts of change. *Conservation Letters* 9: 98–105.

5 Final report on ToRs, workplan, and Science Implementation Plan

Here we provide the overarching progress of WGHIST on our ToRs. Full descriptions for the noted work is available in previous reports (ICES 2015, 2016), as well as in Annex 2.

5.1 ToR (a): Use case studies to demonstrate the tangible benefit of marine historical ecology to current marine policy and management

During the 2017 meeting, research presented by WGHIST members specific to ToR (a) included **Currie**, who built a replica of trawling gear used during early 20th century surveys undertaken in South African waters, to compare modern-day demersal species assemblages with assemblages recorded prior to the commencement of commercial trawling in the region. By highlighting the level of change observed in these demersal assemblages over the past century, including commercially important species, Currie's research strengthens baseline knowledge for present-day management in South Africa. **Thurstan et al.** described research undertaken in Australia to generate historical (pre-WWII) catch rates in the snapper (*Chrysophrys auratus*) fishery, and improve understanding of fishing technology changes over the last 40 years. Resulting findings are being incorporated into contemporary stock assessment models. The catch rate time series has been used to inform the year when virgin biomass is assumed, and fishing technology changes have helped standardise catch rate time series for the effects of fishing power. **Mion** highlighted the work she and colleagues are undertaking to digitize historical tagging data for the Eastern Baltic cod stock. These data will be used to estimate the growth rates of Eastern Baltic Sea cod during the 1960s–1980s, and will be developed as a baseline for more recent tagging experiments. **Orio** demonstrated through his work on the

standardization of long time series of fisheries-independent data, sourced from historical trawl surveys, that such data sources constitute a powerful tool to improve our understanding of multi-decadal dynamics of fished populations.

Case studies that do not inform specific management needs, but nevertheless present useful background knowledge for management and advice more generally, include work by **Caswell *et al.*** on using palaeoecological records to provide insights into background levels of natural variability, and **Sguotti *et al.***'s work detecting regime shifts in the marine environment. Both of these case studies demonstrate the necessity of understanding natural levels of variation as well as abrupt change over time to disentangle drivers and consequences of human-induced change in marine ecosystems.

In addition to case studies under this ToR in Year 3, other case studies were also identified as offering substantial insights regarding their application to marine management in Years 1 and 2 (see WGHIST 2015, 2016). Examples of earlier case studies include **MacKenzie and Ojaveer**, **Rijnsdorp *et al.***, and **Engelhard *et al.*** (see WGHIST 2016). All of these examples demonstrate opportunities to incorporate historical data directly into fishery stock assessment, and in some cases this is already underway. Several case studies have subsequently been integrated into a co-authored **WGHIST manuscript** (currently under the heading, "Opportunities for integrating historical perspectives into management and policy") that aims to demonstrate the opportunities afforded by the incorporation of historical data into management and policy, the non-traditional data sources that exist and ways these can be used (see ToR (c)), and the challenges that remain to integrating historical data into contemporary management and policy. This manuscript was developed and discussed over this iteration of WGHIST, and progressed during the 2017 WGHIST meeting. Submission to an international journal is anticipated in 2018.

A **second manuscript** (tentatively titled "The shifting baseline syndrome in global marine ecosystem management") for peer-review was also developed over this iteration of WGHIST, looking at the prevalence and importance of the shifting baselines syndrome in international policy documents, and whether shifting baselines is actively and effectively addressed in management. This manuscript was forwarded in the year between the 2016 and 2017 meetings, and is under development.

Given that practical application of historical data into stock assessment was outside the scope of WGHIST's Terms of Reference, and that this would also require the engagement of stock assessment expertise from outside the Working Group, WGHIST commenced discussions in 2016 on organising an ICES Workshop that would bring together stock assessment modellers and WGHIST members to explore approaches and methods for integrating historical data into stock assessment. During the 2017 WGHIST meeting, offers were made by **Max Cardinale** and Giuseppe Scarcella to lead this workshop, following the leadership of **Camilla Sguotti** since 2016. Since then, a proposal for an ICES Workshop on Integrating Historical Data into Modern Stock Assessment (WKIHSD) has been submitted to ICES, and was recently approved. The workshop is planned for 27–31 September 2018 in Lysekil, Sweden. WGHIST will continue to support this workshop by helping to identify historical time series and WGHIST members will take an active role in the workshop.

Other case studies submitted during this iteration identified substantial knowledge gaps where improving our understanding would be of particular use to contemporary management and assessment. One such gap identified by the group is our lack of understanding of historical gear and technological advancements and its impact upon fishing power/efficiency (e.g., *Rijnsdorp et al.*; *Thurstan et al.*). It was decided to target this knowledge gap during the next WGHIST iteration (see Annex 5).

5.2 ToR (b): Ensure that quality-assured historical metadata are accessible to the science community to stimulate data products including digital applications

WGHIST aimed to maintain quality metadata on historical and long-term resources, and to develop related digital tools (ToR b). Over the course of WGHIST iterations and the previous Study Group on the History of Fish and Fisheries (SGHIST), members contributed and maintained metadata on historical resources they were aware of, including resource details, state of the resource, and contacts for access. However, this metadata was not readily available to the wider scientific community. During the current WGHIST iteration, chairs worked with the **ICES Data Centre** to transfer this metadata to the **ICES Data Portal**, making it more widely obtainable to the ICES community and beyond. The resulting searchable database on the Portal was reviewed by WGHIST participants at the 2016 meeting, and members provided feedback and checked metadata quality. In the year prior to the 2017 meeting, WGHIST chairs worked with Data Centre staff to address this feedback. The metadata went live on the Portal just prior to the 2017 meeting, and a link to this metadata was added to the WGHIST ICES webpage to increase visibility. Finally, ICES Data Centre staff used images proposed by WGHIST members to craft a WGHIST icon to make historical data more readily recognisable within the Data Portal (Annex 2).

The WGHIST metadata on the Data Portal was highlighted as a good example of FAIR (Findable, Accessible, Interoperable, and Reusable) data principles at the ICES SCICOM meeting at the ASC in Fort Lauderdale, FL by Neil Holdsworth, head of the Data and Information for ICES. In September 2017, the newly launched WGHIST online metadata catalogue was advertised in ICES News.

The metadata is only the first stage in making historical information known to WGHIST more accessible and useful. Additional online digital tools have been discussed among WGHIST and with ICES Data Centre staff and future ToR have been proposed to continue the WGHIST commitment for quality-assured and accessible resources (more in Annex 5).

5.3 ToR (c): Integrate non-traditional methodologies and data sources to improve our knowledge base on long-term changes

ToR (c) aimed to highlight tools and methods for examining past ecosystems and socio-ecological trends over time that may otherwise be overlooked by natural scientists, and how the use of such non-traditional approaches and resources expand the wealth of usable resources as well as our understanding and the information available to management.

During the 2017 meeting, several non-traditional data sources and approaches were highlighted by the researchers present. *Thurstan et al.*, demonstrated how popular media

sources from the 19th and early 20th centuries have been found to be a source of historical catch rates for the East coast Australian snapper fishery. Interrogation of these sources resulted in the production of a time series 70 years in length and beginning up to 100 years prior to the formal collection of catch rate data in this fishery. This information has been provided to stock assessment modellers who are using it to inform model baseline dates and early fishery trends. Another valuable source of historical information – which is being increasingly championed by natural scientists and modellers around the world – is fishers’ ecological knowledge. **Thurstan *et al.***, also discussed the application of fishers’ ecological knowledge to stock assessment frameworks in Australia, in particular integrating information sourced from fishers on the timing and rate of uptake of new fishing technologies and their subsequent impact upon catch rates, to inform the standardisation of CPUE time series. **Sguotti *et al.***, presented research on deconstructing the drivers behind the lack of recovery in North Atlantic cod stocks using the application of regime shift theory. Her findings suggest that cod stock behaviour is non-linear, and emphasises the need for this behaviour to be incorporated into assessment alongside fishing pressure and climate change effects. In a direct engagement of previous fishing practices, **Currie** oversaw the building of trawl gear that aimed to precisely match the material and dimensions of historical trawl gear used during the early 20th century. This ensured he could more directly compare differences between historical and contemporary survey results in South African waters. **Mion’s** work with colleagues denotes the importance of insight from historical tagging studies for current similar work as it pertains to fishermen engagement and responsiveness. The paleoecological studies of **Caswell *et al.*** demonstrate how long-term patterns can be revealed, as well as their importance for understanding change and adaptation in current marine systems, especially in considering future climate change. Finally, **Hentati-Sundberg *et al.***, used path dependency to understanding how policy decisions impacted outcomes in the Swedish fishery going back 100 years, with strong implication for current and future management there. Due to overlap with ToR (a) and (d), descriptions of this work is available under Theme 1 and 3 in Annex 2.

To summarise progress towards ToR (c) across all years in this iteration, at each working group meeting participants presented their research with the aim of sharing knowledge on sources uncovered, methodological approaches applied, analyses used, and outcomes of their research. This enabled the exchange of ideas among WGHIST members and discussion of best practises in interdisciplinary research. This year’s presentations followed on from previous meetings in demonstrating that a range of sources and analytical approaches, either from other disciplines or of an interdisciplinary nature, hold great potential for improving our understanding of past ecosystems and social-ecological trends. Resulting findings thus more deeply contribute to contemporary marine science and policy understanding, and the approaches also provide novel avenues for addressing contemporary research and management questions. Initially, we envisaged the major deliverable resulting from this ToR being a multi-author manuscript. However, given the strong overlap of ToR (a) and (c) during WGHIST meetings, it was decided that the outputs from ToR (c) were best included in the manuscript being produced in ToR (a).

5.4 ToR (d): Address social, cultural and economic dimensions of marine ecosystem goods and services through time with the aim to contribute to integrated ecosystem assessments

The 2017 meeting comprised of researchers from the historical, fisheries, social, historical ecology and palaeoecological disciplines. This make-up of researchers facilitated discussion on the importance of the context within which historical data were produced, and how to ensure best practise when historical data are incorporated in assessment and/or management. More broadly, these discussions demonstrated that human dimensions are critical for understanding marine social-ecological change through time.

McKenzie presented his work into understanding the disconnect between popular perception of a New England fishery and its industrial reality. He argues that current industry representatives regularly aim to shape popular perception, thus influencing policy, by appealing to tradition and heritage, which rarely accurately reflect the industry as it stands today – or potentially how it was in the past. Furthermore, these appeals are often used to counter efforts to manage the fishery upon economic and ecological grounds, which subsequently impacts its sustainable management. McKenzie cautions that this disconnect between perceived heritage and reality is not necessarily restricted to the contemporary fishery and can exist back in time. Thus, the context in which historical data was produced should be properly understood prior to being integrated into current analytical efforts. McKenzie emphasised the role WGHIST members can play in ensuring that the social, political and cultural context of historical data is understood by those wishing to integrate the data into assessment or management frameworks.

In addition, **Hentati-Sundberg** and colleagues assessed the role of path dependency in the management and policy of Swedish fisheries over the past century. Using multiple sources of information, the researchers uncover how key actors in policy can maintain the status quo in fisheries, despite ecological and social impacts. This work again denotes the significance of policy actors in overriding ecological and even social implications of human use and the social systems and policy that drives it. Their work offers strong lessons for current and future management, and the importance of political and social context.

Discussions stemming from both works led to a group recommendation that, in a future iteration, WGHIST work to develop guidelines to establish best practice within ICES and beyond when using and/or applying historical data to contemporary advice and management (see Annex 5).

WGHIST's blue growth manuscript ("Something old, something blue, 200 years of a blue growth agenda"), which uses historical case studies to inform contemporary blue growth agendas, commenced during last year's meeting and was further progressed during the 2017 meeting, with additional case studies invited and progress made on the manuscript text. The majority of case studies have now been collated and it is anticipated that the manuscript will be ready for submission by early 2018. This manuscript directly engages the human dimensions of blue growth through time, and their importance for future success.

5.5 Broad engagement

The chairs thank all hosts for their support in providing remote access for participants who were unable to attend all three meetings this iteration in person. This allowed WGHIST members who could not join in person to attend sessions and present work, as well as the delivery of several guest presentations.

Also during this delivery period, WGHIST remained engaged with ICES and the scientific community more broadly using social media and other platforms, posting under the hashtag #WGHIST. WGHIST was also invited to contribute towards two pieces for ICES News. The first, in December 2015, was entitled “Charting the past to make sense of the present”⁷, and the second, “Changing perceptions” (May 2016⁸) was selected as an ICES News Feature Article.

6 Cooperation

Cooperation with other WG

The main focus during this iteration was on furthering WGHIST’s Terms of Reference. Therefore, cooperation with other ICES groups has been through ensuring historical metadata, and the historical ecology community, are visible to ICES members and the wider marine science community. This has been achieved through cooperation with the ICES Data Centre (digitisation of metadata), communications team (invited contributions to ICES News) and advertising and live-tweeting WGHIST meetings and progress on social media (Facebook and Twitter). It will be continued in the several manuscripts in preparation for peer review.

In addition, the 2015–2017 iteration recognized the potential for WGHIST to support the work of the ICES Strategic Initiative on Human Dimensions (SIHD). This included the WGHIST chairs’ responding to SIHD’s 2016 questionnaire regarding each group engagement in activities that integrate human dimensions, whether scientists from disciplines other than natural science are involved in the working group, and how further linkages could be made. In that response, chairs **Klein and Thurstan** highlighted that WGHIST has great potential to provide insight into how human dimensions have changed, but that the group lacks expertise in how human dimensions are currently used or expected to be used in ICES and marine policy more broadly, and that a social science perspective is lacking within the WGHIST group. This resulted in engagement with SIHD remotely at the 2016 meeting, during which the two groups’ complementary goals and opportunities for further engagement were discussed. To date, however, no specific engagement opportunities have further materialized. Pursuing this connection remains of strong interest to WGHIST, and the Chairs will continue to liaise with SIHD regarding future avenues for working together.

⁷ <http://www.ices.dk/news-and-events/news-archive/news/Pages/Charting-the-past-to-make-sense-of-the-present.aspx>

⁸ <http://www.ices.dk/news-and-events/news-archive/news/Pages/FEATURE-ARTICLE-%E2%80%93-changing-perceptions.aspx>

Cooperation with Advisory structures

WGHIST does not work directly with Advisory structures, but research undertaken by WGHIST members are driven by advisory groups and processes at national and international levels, including the EU MSFD, MSP, Ecosystem-based management, Common Fisheries Policy, Blue Growth agenda and others.

Pastors presented some work that is aimed to recreate the ICES historical stock assessment and scientific advice information. Documenting stock assessments and advice is an important step towards quality controlling scientific advice procedures and evaluating the efficacy of management measures that are based on such advice. Initially the ambition is to go back to 1985 but, where possible, longer time series will be reconstructed. This work is intended to be finalized in 2018.

Cooperation with other IGOs

- WGHIST meetings in 2015 and 2016 were also held concurrently with the Oceans Past Platform (OPP), an EU-COST Initiative, due to overlaps in members, interests, and research. Cooperation here was mainly via the OPP Working Group on Trends in Production and Consumption (WG1); (See Annex 3).
- WGHIST also has a long-term collaborative relationship with the Oceans Past Initiative (OPI) on marine historical ecology at the global level. Chairs Thurstan and Klein sit on the OPI Steering and Executive Committees, respectively.

7 Summary of Working Group self-evaluation

For full Working Group self-evaluation see Annex 6.

Annex 1: List of participants

FIRST NAME	SURNAME	ISPRA 2015	COPENHAGEN 2016	LYSEKIL 2017
Floris	Bennema		Present	
Massimiliano	Cardinale			Present
Bryony	Caswell		Present	Present
Jock	Currie	Present		(Remote)
Georg	Engelhard	Present	Present	(Remote)
Tomaso	Fortibuoni	Present	Present	
Jonas	Hentati-Sundberg		Present	Present
Poul	Holm	(Remote)	(Remote)	
Peter	Jones	Present	Present	
Adrian	Jordaan		(Remote)	
Emily	Klein	Chair	Chair	Chair
Alexei	Kraikovski	Present		
Ann-Katrien	Lescrauwaet	Present	Present	
Brian	MacKenzie	Present	Present	
Matthew	McKenzie	(Remote)	(Remote)	Present
Monica	Mion			Present
Henn	Ojaveer	Present	Present	
Pere	Oliver	Present		
Alessandro	Orio			Present
Chato	Osio	Present		
Christine	Overgaard		Present	
Martin	Pastoors			(Remote)
Bo	Poulsen	Present	Present	
Sasa	Raicevich	(Remote)	(Remote)	
Adriaan	Rijnsdorp	Present	Present	
Oscar	Sagué		Present	
Camilla	Sguotti	Present	Present	Present
Robert	Thorpe		Present	
Ruth	Thurstan	Chair	Chair	Chair
Heike	Zidowitz	Present	(Remote)	
Philine	Zu Ermgassen	(Remote)		

*(Remote) indicates people who attended via Skype or Web-Ex for all or part of the meeting.

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Philine	Zu Ermgassen	University of Edinburgh	UK	Philine.Zu.Ermgassen@ed.ac.uk

*SLU: Swedish University of Agricultural Sciences

**CEFAS: Centre for Environment, Fisheries and Aquaculture Science

**IFSUA: International Forum for Sustainable Underwater Activities

Invited guests:

Ian Stewart, International Pacific Halibut Commission

Jörn Schmidt, ICES SIHD

Mark Dickey-Collas, ICES Secretariat

Periklis Panagiotidis, ICES Secretariat

Arni Magnusson, ICES Secretariat



ICES 2017. Lysekil, Sweden. Left to right: Matthew McKenzie, Ruth Thurstan, Jonas Hentati-Sundberg, Camilla Sguotti, Alessandro Orio, Emily Klein, Bryony Caswell. Missing: Monica Mion, Max Cardinale.



ICES 2016. Copenhagen, Denmark. Back row, left to right: Floris Bennema, Robert Thorpe, Christine Overgaard, Georg Engelhard, Henn Ojaveer, Camilla Sguotti, Adriaan Rijnsdorp, Bo Poulsen. Front row, left to right: Ruth Thurstan, Emily Klein, Brian MacKenzie, Bryony Caswell, Tomaso Fortibuoni, Jonas Hentati-Sundberg, Peter Jones, Ann-Katrien Lescauwat.



ICES 2015. Ispra, Italy. Back row, left to right: Ann-Katrien Lescauwat, Adriaan Rijnsdorp, Henn Ojaveer, Chato Osio, Camilla Sguotti, Emily Klein, Saša Raicevich, Brian MacKenzie, Alexei Kraikovski. Front row, kneeling, left to right: Peter Jones, Ruth Thurstan, Heike Zidowitz, Georg Engelhard, Tomaso Fortibuoni.



ICES WGHIST 2014. Copenhagen, Denmark. From front to back: Ruth Thurstan, Ann-Katrien Lescrauwaet, Camilla Sguotti, Emily Klein, Georg Engelhard, Charles Travis, and Brian MacKenzie. Photo by ICES.



ICES WGHIST 2013. Panicle, Italy. From left to right: Jonas Hentati-Sundberg, Samiya Selim, Ruth Thurstan, Emily Klein, Carlotta Mazzoldi, Tomaso Fortibuoni, Jock Currie, Georg Engelhard, and Włodzimierz and Barbara Grygiel. Photo by Ann-Katrien Lescrauwaet. Missing: Heidi Alleway and Saša Raicevich.



ICES WGHIST 2012. Ostend, Belgium. From left to right: Adriaan Rijnsdorp, Ann-Katrien Lescrauwaet, Tina Kerby, Georg Engelhard, and Poul Holm. Missing: Filip Volckaert.



ICES WGHIST 2011. Lowestoft, UK. From left to right: Valerio Bartolino, Andreas Sundelöf, Tina Kerby, Ann-Katrien Lescrauwaet, Sidney Holt, Margit Eero, Poul Holm, Bo Poulsen, and Georg Engelhard. Photo by Kieran Hyder. Missing: Colin Bannister and Wlodzimierz Grygiel.



ICES WGHIST 2010. Ponza, Italy. From left to right: Paolo Sartor, Chato Osio, Christopher Lynam, Saša Raicevich, Emily Klein, Sidney Holt, Bo Poulsen, Georg Engelhard, Tina Kerby, and Massimiliano Cardinale. Photo by Tim Holt.



ICES WKHIST 2008. Copenhagen, Denmark. Four out of 14 workshop participants: Emily Klein, Georg Engelhard, Catherine Marzin, and Stefan Claesson. Other participants included Margit Eero, Norman Graham, Einar Hjörleifsson, Brian MacKenzie, Irene Mantzouni, Henn Ojaveer, Chato Osio, Martin Pastoors, John Pinnegar, and Bo Poulsen.

Annex 2: Summaries of presented work and group discussion

Theme 1. Case studies in historical marine research: Application to management and policy, novel resources and approaches (ToR a and c)

Reconstructing ecological baselines in South Africa's trawl grounds

Jock Currie

University of Cape Town, South Africa

Understanding the state of historical fish communities and their ecosystems is critical to enable informed management of ocean spaces. Without the knowledge of historical baselines, a context to interpret current ecosystem states and change is lacking, whether the focus is population densities, assemblage compositions, or the distribution of species. This research investigated such baselines and assessed long-term change on South Africa's south coast. It was inspired by the rediscovery and digitisation of a historical dataset that sampled trawl-caught fauna prior to substantial human impact.

A government-appointed researcher, John Gilchrist, initiated trawl surveys around South Africa's coast in 1897–1904. These exploratory trawl surveys preceded and coincided with the beginnings of a commercial trawl industry. Prior to this, fishing effort had consisted of beach seining or line-fishing from small open boats or the shoreline. Therefore, these initial trawl surveys are likely to have sampled a demersal ecosystem with minimal human impacts and captured baselines that were close to pristine.

To maximise scientific value from these historical data, they needed to be compared to recent catches at the same locations. Substantial changes in trawl technology and its undefined influence on the abundance, size and species of fish caught, meant that the most accurate and meaningful comparison would be achieved by replicating historical methods and gear in a long-term repeat experiment. The aim of the project was to conduct such repeat trawl surveys and quantify how the fish communities had changed during a ~111 year period, characterised by mounting anthropogenic pressures. The historical trawl gear was carefully reconstructed using literature and photographs to ascertain the design, dimensions, materials and methods of fishing. An early 'Granton otter trawl' net was used, together with flat wooden otter boards. The historical trawl speed was estimated to be 2.6 knots.

In 2015, three sites were successfully re-surveyed from a chartered commercial side-trawler, using the replicated gear and methods. Survey results revealed that the demersal catch assemblage had transformed substantially over time, including the depletion or disappearance of previously dominant taxa. Changes included heavy depletion of kob (*Argyrosomus* spp., absent in resurveys), panga (*Pterogymnus lanarius*) and east coast sole (*Austroglossus pectoralis*), which had dominated historical catch composition. Instead, resurvey catches were largely made up of gurnards (*Chelidonichthys* spp.), horse mackerel (*Trachurus trachurus*), spiny dogfish (*Squalus* spp.), hake (*Merluccius capensis*) and white sea catfish (*Galeichthys feliceps*). Habitat preferences as well as geographic and depth distribution appeared to separate the taxa prevalent today over those dominant in the historical survey. Recent catches were made up largely of small, generalist taxa and those

that associate with unconsolidated sediments. Finally, size data showed that fish lengths had declined between periods, substantially so in certain species.

Given differences in previous and current trawl survey results, habitat preferences and the scale of geographic and depth distributions appeared to contribute towards the fate of demersal populations during a century of expanding human pressures. These factors, together with reproductive and growth characteristics and indirect trophic impacts, likely shaped the responses of demersal fish communities to fishing and other human impacts during the 111 years between trawl surveys.

As most regions lack comparable baseline data, the estimates of community change and abundance shifts on the inshore Agulhas Bank provide a rare, empirical case study of cumulative anthropogenic impacts on ichthyofauna. Besides the provision of novel historical context for current and future studies and decision-making, this work counters the erosive nature of shifting baselines in South Africa's marine environment.

Generating quantitative data from popular media and fishers' knowledge: a case study of the east coast Australian snapper (*Chrysophrys auratus*) fishery

Ruth Thurstan¹, Sarah Buckley², John Pandolfi²

¹University of Exeter UK

²University of Queensland, Australia

Archival sources

Snapper is a popular commercial and recreational fishery and is targeted throughout temperate Australian waters. Exploitation of snapper commenced many decades prior to formal government monitoring of the fishery, meaning that data for informing stock assessment models is lacking for much of the early fishery. This project interrogated archival sources dating from the mid-19th century onwards and across two east coast states, Queensland and New South Wales, with the aim to gather descriptions of early snapper fishing trips, catches and catch rates, and ideally to expand the time series of information that could be considered in the formal stock assessment process. The majority of early reports written about snapper fishing trips were collated from newspaper articles published prior to World War II. These described chartered recreational fishing activities, which was the predominant sector targeting snapper during the late 19th and early 20th centuries (Figure 1).

Quantitative data were extracted from records to produce a time series of catch rates (snapper per fisher per hour and snapper per fisher per trip). Missing data were dealt with by filling in data gaps using assumptions generated from qualitative information contained in the newspaper articles, while possible reporting bias was examined by comparing newspaper-reported catch rates with available government survey data (see ICES WGHIST 2016, 2017, Thurstan *et al.*, for more details). In total, catch rate of snapper were sourced for 504 individual charter fishing trips across Queensland and New South Wales from the period 1871–1959. A significant decline was observed for snapper per fisher per trip during this period, although catch rate remained highly variable from trip to trip. Occasional estimates of total landings of snapper per annum could also be calculated.

This information has been passed to stock assessment modellers and is of interest for informing which year the model should start from (i.e., when fishing first commenced) estimates of total catch and trends in abundance during the earliest years of the fishery.

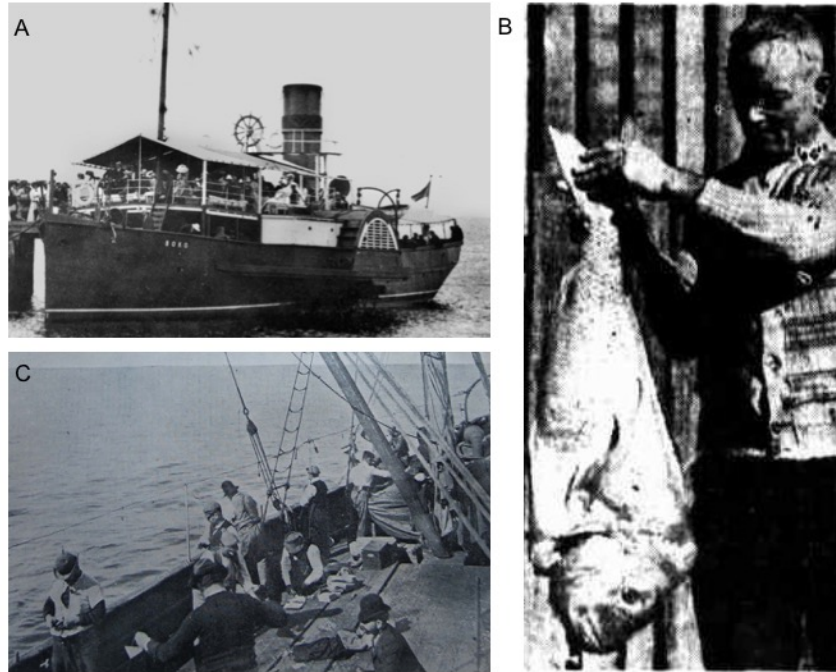


Figure 1. A) The s.s. Boko, a paddle steamer, was chartered for snapper fishing trips from Brisbane during the 1870s and 1880s (State Library of Queensland ca. 1890), B) Large snapper (24lb) landed at Peel Island in 1934 (The Telegraph, National Library of Australia) and C) Snapper fishing on-board the s.s. Tarshaw (Welsby 1905).

Fisher knowledge

In addition to interrogating archival sources, 150 snapper fishers from the commercial, recreational and charter sectors in Queensland and New South Wales were interviewed about their memories of change in the snapper fishery during their careers and/or experience of fishing. Fishers were questioned about the years when they adopted particular technology and the ways in which these technological innovations improved their fishing, including providing a quantitative estimate of change to their catch rate of snapper. These questions enabled us to generate estimates of the timing and rate of uptake of particular technologies across the sampled population, and compare these trends among the different snapper fishing sectors. In general, commercial fishers adopted technologies such as GPS and echo-sounders no more than 5–10 years prior to the recreational fishing community. Around half of the fishers who were asked to provide quantitative estimates of change to their fishing activities as a result of technology felt able to do so. The most commonly acknowledged difficulty in describing quantitative change was the introduction of multiple technologies over short periods of time, or changes in individual fishing behaviour as a result of new technologies, making it difficult to directly compare catch rates before and afterwards. Fishers most consistently felt able to quantify the impact of

GPS and electronic echo sounders, with most fishers describing increases in the number of fishing spots they knew of prior to and post-GPS use. Some fishers were also able to quantify increases in catch rates, or the percentage decrease in time spent travelling to fishing grounds.

References

Thurstan RH, Campbell AB, Pandolfi JM (2016). 19th century narratives reveal historic catch rates for Australian snapper. *Fish and Fisheries* 17, 210–225.

Historical growth and migration of Eastern Baltic cod analysed using tagging data

Monica Mion*, Roman Motyka, Annelie Hilvarsson and Michele Casini

**Institute of Marine Research, Swedish University of Agricultural Sciences, Sweden*

Understanding the growth and mortality of fish is of crucial importance not only for analytical stock assessment but more generally for fish ecology. Growth affects age and size at maturity and interacts with recruitment, mortality and gear selectivity. Therefore, correct estimations of growth are paramount for the definition of the stock status and consequently for appropriate management.

At present, the eastern Baltic cod (*Gadus morhua*) is under the pressure of several drivers (anoxic/hypoxic zones, low prey availability, parasite infestation) and a number of adverse population developments such as low nutritional condition, a drastic decrease in mean individual size and disappearance of larger individuals indicate that the stock is in distress (Eero *et al.*, 2015). Deteriorated quality of key biological parameters for stock assessment, such as true age, in combination with changes in environmental and ecological conditions, has led to an unusual situation for cod in the Baltic Sea and the failure of the analytical stock assessment in 2014 leaving the present stock status unclear (ICES, 2014). Currently, it is unknown whether the lack of large fish is due to a decrease in individual growth rates or to the effect of size-selective fishing. Therefore, whether the stock has suffered from a decrease in productivity or an increase in fishing pressure is an open dilemma, with implications for stock assessment and fisheries management.

In this study, a large amount of historical external tagging data will be digitized from the Swedish Regional State Archives in Gothenburg and assembled in a database as part of the TABACOD project (<http://www.tabacod.dtu.dk/>). With these data, we will estimate the growth rates of Eastern Baltic Sea cod in 1960s-1980s to use as a baseline to be compared with recent tagging experiments. We will also analyse the migration routes and the connectivity of cod across the Baltic Sea seascape. The biological information gained with these analyses will contribute to the development of new analytical stock assessment models and improve the advice for Baltic cod management.

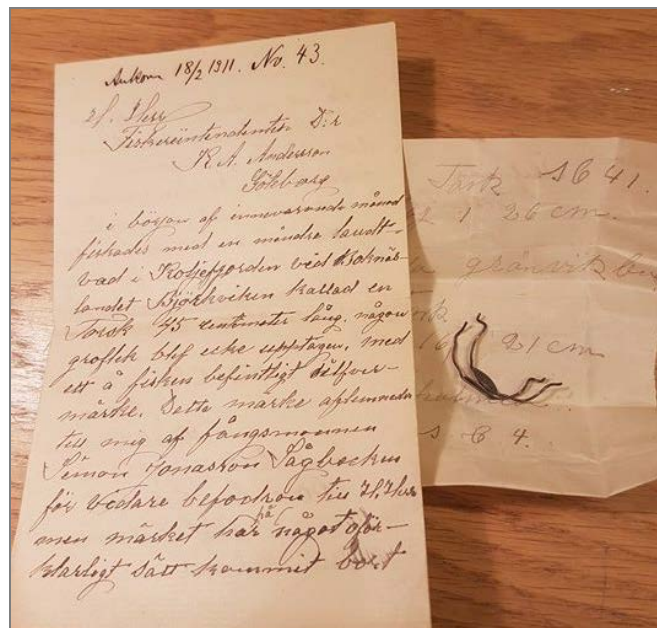


Figure. Letter from 1911 from a fisherman sending back the recapture information of a tagged cod and an example of old tags employed on the side. From the Swedish Regional State Archives in Gothenburg.

References

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Modelling indices of abundance and size-based indicators of cod and flounder stocks in the Baltic Sea using newly standardized trawl survey data

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Long time-series of standardized indices of abundance and size-based indicators are important for monitoring fish population status. This study's objectives were to (i) combine and standardize recently performed trawl surveys with historical ones, (ii) discuss ob-

served trends in abundance, and (iii) in maximum length ($L_{\max}$) for cod (*Gadus morhua*) and flounder (*Platichthys flesus*) stocks in the Baltic Sea.

Catch and individual data for cod and flounder collected during the Baltic International Trawl Survey (BITS) in ICES Subdivisions (SDs) 22–29 between 1991 and 2016 were downloaded from the ICES DATRAS database. Additionally, we compiled historical catch and individual data collected during bottom trawl surveys in the Baltic Sea carried out in the years 1928–1990 by the former Swedish Board of Fisheries (currently the Swedish University of Agricultural Sciences, Department of Aquatic Resources) and in the years 1976–1990 by the former Baltic Fisheries Research institute (BaltNIIRH; currently the Latvian Institute of Food Safety, Animal Health and Environment).

Standardization of catch per unit of effort (CPUE) from trawl surveys from 1928 to 2016 to swept area per unit of time was conducted using information on trawling speed and horizontal opening of the trawls, following the approach proposed by Cardinale *et al.* (2009).

CPUE and $L_{\max}$ data for cod and flounder stocks from 1978 to 2014 were modelled using generalized additive models (GAMs). The CPUE time series of the Eastern Baltic cod stock closely resembles the spawning stock biomass trend from the last accepted analytical stock assessment. The results obtained furnish evidence of the cod spill-over from Subdivisions (SD) 25–28 to SD 24. The CPUE trends of flounder show phases of the stocks' dynamics that were poorly known because of the short time-series available before. A drop of $L_{\max}$ in the past thirty years was evident for both species in all the stocks analysed indicating that the demersal fish community has become dominated by small individuals.

It is concluded that the standardization of long time series of fisheries-independent data constitutes a powerful tool that could help improve our knowledge on the dynamics of fished populations, thus promoting a long-term sustainable use of these marine resources.

For more detailed information please refer to Orio *et al.* (2017).

References

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- Orio, A., Florin, A.-B., Bergström, U., Šics, I., Baranova, T., and Casini, M. 2017. Modelling indices of abundance and size-based indicators of cod and flounder stocks in the Baltic Sea using newly standardized trawl survey data. *ICES Journal of Marine Science*, 74: 1322–1333.

Marine ecosystem change in deep time: Implications for current science and management

Bryony Caswell

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Caswell is conducting a multi-decadal scale study of changes in functioning in the Firth of Clyde (south-west Scotland) in relation to anthropogenic organic enrichment and de-oxygenation. Questions being addressed include: How is marine ecosystem functioning such as the provision of food for fish, impacted by enrichment and how will it change in the future? How resilient is the benthos and its functioning to perturbations? What are the timescales of disturbance and recovery? The changes that occur in enriched/deoxygenation systems can directly impact fisheries production both positively over the short term and negatively over the short and longer-term (contributing to ToR a). Historical data collected by government and/or water companies, often in the form of annual or occasional reports, can add to the story in terms of understanding how enriched benthic systems respond over multiple decades, and how they might in the future effect fisheries production of shellfish, demersal feeding fish and planktivorous fish. These effects may be both direct (e.g. mass mortality or migration of stock due to hypoxia, fitness, and health) and indirect by changing trophic pathways.

Additional research currently underway includes the application of contemporary environmental metrics that assess benthic ecosystem health – such as AMBI – to palaeoecological data, with the aim to gain insights into the natural baselines of perturbed systems. Palaeontological data are currently being compared with 2–3 decades of organic enrichment in rivers in Bilbao, Spain. In this way we address the following questions: Are our baselines for biotic indices describing the relevant and full range of natural states, and consequently, are our conclusions on present-day ecosystem changes appropriate? This work may contribute to ToR c.

Finally, during WGHIST Caswell presented work by PhD student Kochalski quantifying conflict in fisheries and how this might be used as an indicator of sustainability. This approach is based on drawing upon examples from the literature and so has the potential to be applied to historical data. It could be used to better understand the social-ecological fisheries system in the past and present, and so can contribute to ToRs b and c.

The failed recovery of Atlantic cod stocks in the context of regime shifts

Camilla Sguotti, Romain Frelat, Saskia Otto, Marie Plambech, Martin Lindgren, Christian Möllmann.

University of Hamburg, Germany

Natural systems can undergo drastic shifts and present catastrophic dynamics. These can be induced by additive effects of external and internal drivers acting on the system (e.g. fishing pressure, climate change). These sudden and catastrophic shifts are usually called regime shifts and have been documented in marine ecosystems around the world, e.g. Baltic Sea, North Sea, Eastern Scotian Shelf. These shifts are characterised by non-linear dynamics that lead the same ecosystem to have multiple configurations. Catastrophic dynamics can be detected in different types of systems, from ecosystems to organisms. In

our study, we investigate whether Atlantic cod (*Gadus morhua*) stocks have undergone abrupt changes.

Atlantic cod stocks have been exploited for centuries and have experienced dramatic collapses over the last decades (1980s, 1990s). Cod is a species not only ecologically but also economically and socially important; indeed many communities and villages have been established around cod fisheries in the past. In order to facilitate the recovery of this iconic species, drastic and unpopular management measures have been implemented, e.g. fishing moratoria in Canadian stocks. Nevertheless, the recovery of cod stocks seems slow and many stocks are currently, after 20 years of management measures, still in a depleted state. In this work we investigate the recovery status of cod stocks and the mechanisms behind it.

A meta-analysis was conducted on cod recovery based on stock assessment data of 19 stocks over its distribution area in the North Atlantic. Through a combination of multivariate analyses, and a set of recovery criteria, such as achievement of management targets, restoration of former population structures and levels of fishing mortality, we classified only 3 stocks out of the 19 as fully-recovered. We further investigated the reasons for the lack of recovery applying regime shift theory. Indeed, discontinuous behaviours can limit the recovery of the stocks due to hysteresis and lack of reversibility (two properties of regime shifts). Examining the relationship between spawning stock biomass, environmental conditions and fishing pressure we highlight the non-linear behaviours of cod stocks and the mechanisms that could have played a fundamental role in the decline and failed-recovery of these stocks. The analyses revealed that cod recovery is hindered by discontinuous behaviours and the additive effects of fishing pressure and climate change. Our results are relevant because they show how additive human and natural drivers, resulting in discontinuous systems' responses, can prevent the recovery of such an iconic species as cod, highlighting the need to incorporate these dynamics into management.

However, the detection of catastrophic dynamics is in general complicated and happens long after the regime shifts have occurred. New methods are now trying to explore original and effective ways to detect discontinuous behaviours in advance in order to be able to predict and identify potential regime shifts. This is of absolute importance since the marine systems are strictly connected to the societies using it. Historical datasets could be used to apply and test regime shifts detection methods, as well as improving our understanding of complex socio-ecological dynamics under regime-shift scenarios. Understanding these mechanisms of causation and the connectivity between the systems can be important in order to deeply appreciate the dynamics of marine systems. In particular, studying the past could help predict what could happen in the future to human communities utilizing the marine environment, and how we can potentially adapt to a series of challenges (e.g. climate change) that we are already facing.

Opportunities for integrating historical perspectives into management and policy.

WGHIST manuscript under development

Contributors: Interested WGHIST/OPP participants

It is recognised that in recent years there has been a growing global body of research examining the utility of neglected or unconventional data sources for conservation, restoration and natural resource management. WGHIST members will build upon this by conducting a review of existing research to identify knowledge gaps in the literature, then draw upon WGHIST members' experiences, in the context of these identified knowledge gaps, to highlight opportunities and methodological hurdles when attempting to integrate historical perspectives and data into management. The manuscript thus aims to demonstrate to managers through example (1) the common limitations of historical sources, (2) how these limitations can be overcome or uncertainty better accounted for, and (3) the potential gains to be made by the inclusion of such data into science and management.

The article is intended as primarily a multi-authored WGHIST and OPP WG1 product, with potential input and contributions from colleagues outside WGHIST and WG1.

The shifting baseline syndrome in global marine ecosystem management

WGHIST manuscript under development

S. Raicevich¹, T. Fortibuoni², E. Klein³, R. Thurstan⁴, J. Rice, interested WGHIST/OPP participants.

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The shifting baseline syndrome (SBS) refers to a shift over time in the expectation of what a healthy ecosystem baseline looks like, and could be determined by generational amnesia (i.e. each generation grows up being accustomed to the way their environment looks and feels, and thus they don't realize how degraded it has become over the course of the previous generation), which may affect not only common citizens, but even scientists. After Pauly (1995) defined this process, the description of historical baselines have been recognized as a key issue when understanding current ecosystem status and defining targets for marine ecosystem management, more prominently in the scientific arena.

However, at the same time, the actual use of historical baselines for management purposes have been questioned by several scholars, due to both practical and theoretical reasons. Indeed, historical baselines may refer to different ecosystem status, such as pristine (i.e. undisturbed) state, but also to sustainably or unsustainably disturbed status, depending on the timeframe of the analysis and data availability. Moreover, historical baselines may not be suitable to identify management targets, due to the occurrence of regime shifts, ecological hysteresis, or to the change in societal values that might consider a less than optimal choice for re-establishing pristine or little disturbed status. All of these may result in neglecting the use of historical baselines, in some cases lowering the ambitions of management actions and undermining the goals of sustainability.

Accordingly, there is a need to assess whether and how this influential concept has been acknowledged in current marine ecosystem based management, and assessed as a contribution to the knowledge base for management and/or to set future targets for ecosystem restoration. In this framework, a joint group of scholars belonging to WG1 of the OPP COST action, ICES WGHIST and other experts are starting an initiative to draft a review paper to assess the extent to which the SBS concept has been endorsed in current marine Ecosystem Based Management. In particular, the objective is to address:

- 1) How the concept of SBS and historical baselines has been incorporated into EBM in framing high level Ocean Policy legislation;
- 2) How SBS and historical baselines concepts are used to set future target and reference points, in relation to which ecosystem components and attributes, and in relation to what kind of indicators.

To this purpose, the group will analyse the international legislation and acts dealing with Ocean policy and Ecosystem Based Management (e.g., CBD, IUCN framework, UNCLOS, FAO EFM, MSFD), including regional sea conventions (e.g., OSPAR, HELCOM, Barcelona Convention etc.). Possibly, national legislation could be also considered, according to specific case-studies of marine ecosystem management implementation.

The process will include gathering information on the general aim of the policies (e.g. restore, preserve, rebuild, maintain, etc.), specific reference conditions mentioned (baseline; historical baseline; historical range; current status; reference condition, etc.), specific definition of target to be achieve and timeline (reference point, reference direction, reference limit, target, status, etc.), and indicators applied in case-studies (ecosystem component, metrics used, target and reference conditions used).

ICES workshop on: Integrating historical data in stock assessment models (WKIHSD)

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During the last WGHIST meeting the idea of a workshop between WGHIST members (i.e. historical ecologists, historians, etc.) and stock assessment experts and modellers was developed with the aim to integrate historical data within current stock assessment models. WGHIST has collated a high amount of data that is of primary interest for stock assessment scientists and could add valuable information on commercial stocks, especially surrounding biomass reference points. However, historical data are often difficult to handle due to multiple factors, such as fragmentation of the time series, standardization of the data etc. Therefore, collaboration between historical ecologists and stock assessment experts appears promising in order to integrate historical data within current stock assessment models and highlight their importance.

To favour the organization of this workshop, different activities have been carried out during the last months. First of all, a template to collect the metadata for potential case studies has been created and circulated among WGHIST members. A total of 11 case studies have been collated, ranging from the North Sea, the Baltic Sea to the Mediterranean Sea and the seas in front of South Africa. Secondly, stock assessment experts and scientists have been contacted and their willingness to participate to the workshop has

been investigated. Finally, the workshop has been presented to SCICOM of ICES where it gained support.

During this year meeting (2017) we finalized the workshop idea. A total of 6 case studies have been selected for the workshop. The next steps include: decide the workshop venue and dates, contact the WGHIST members that have proposed the selected case studies to verify if he/she is still willing to participate and finally contact stock assessment scientists to be possibly involved in the selected case study. The workshop is expected to contribute in defining best practice on how historical data can be integrated into assessment models and help to understand stocks dynamics and aid to the management of commercial stocks around the globe.

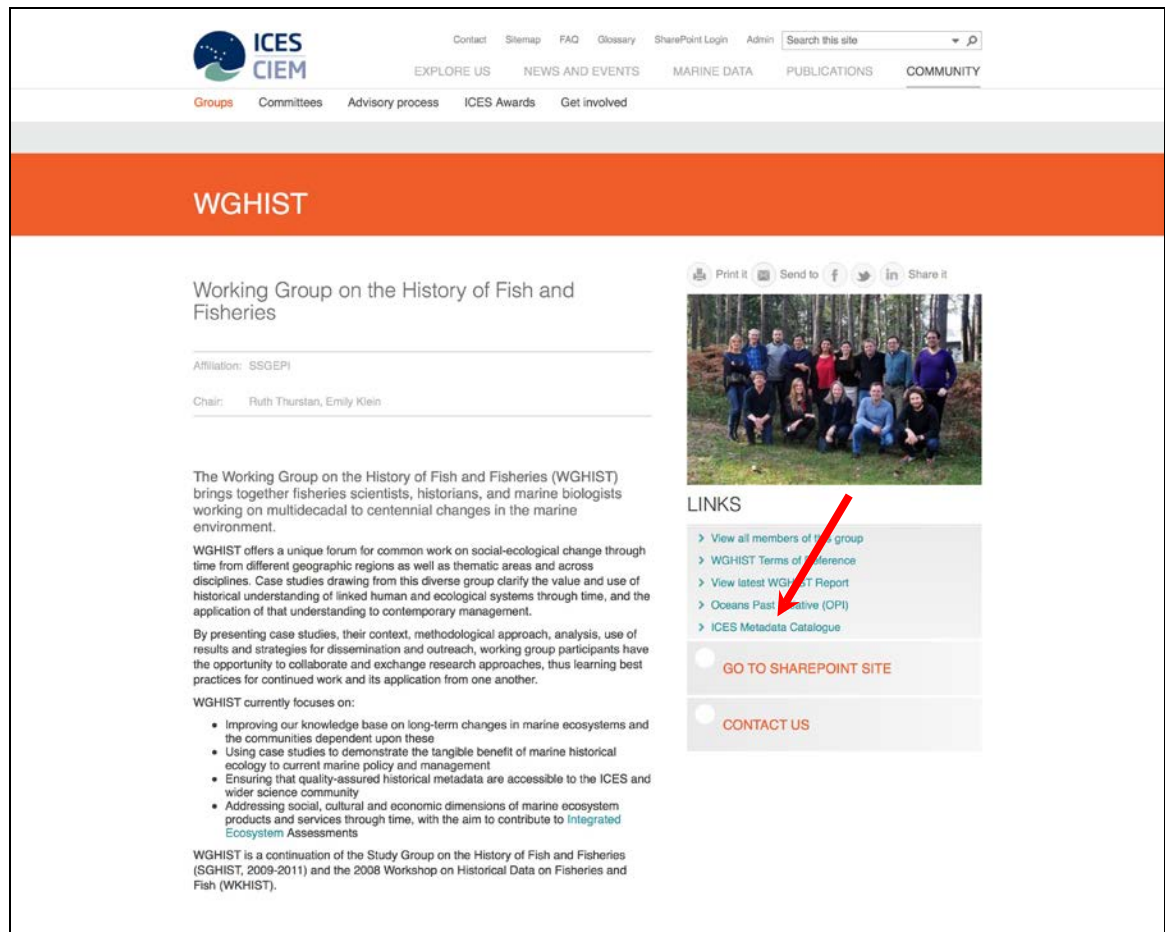
Theme 2. Data rescue, digitization, and future development (ToR b)

Update on WGHIST metadata on historical sources and digital tools

WGHIST members and ICES Data Centre

During this iteration, WGHIST worked with members of the ICES Data Centre to transfer metadata files of historical datasets held by WGHIST members to an online portal, thereby increasing the visibility and accessibility of such data for the wider ICES community.

During the 2017 meeting the final metadata catalogue of WGHIST-held data was unveiled. WGHIST metadata description are now available and searchable online. Metadata are able to be added/updated by anyone who holds historical data that they think may be of interest and useful to the wider scientific community. Quality control of the submitted data is conducted by the WGHIST chairs. A common historical icon (see below) is attached to all WGHIST metadata, allowing it to be readily recognized.



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WGHIST

Working Group on the History of Fish and Fisheries

Affiliation: SSGEPI

Chair: Ruth Thurstan, Emily Klein

The Working Group on the History of Fish and Fisheries (WGHIST) brings together fisheries scientists, historians, and marine biologists working on multidecadal to centennial changes in the marine environment.

WGHIST offers a unique forum for common work on social-ecological change through time from different geographic regions as well as thematic areas and across disciplines. Case studies drawing from this diverse group clarify the value and use of historical understanding of linked human and ecological systems through time, and the application of that understanding to contemporary management.

By presenting case studies, their context, methodological approach, analysis, use of results and strategies for dissemination and outreach, working group participants have the opportunity to collaborate and exchange research approaches, thus learning best practices for continued work and its application from one another.

WGHIST currently focuses on:

- Improving our knowledge base on long-term changes in marine ecosystems and the communities dependent upon these
- Using case studies to demonstrate the tangible benefit of marine historical ecology to current marine policy and management
- Ensuring that quality-assured historical metadata are accessible to the ICES and wider science community
- Addressing social, cultural and economic dimensions of marine ecosystem products and services through time, with the aim to contribute to [Integrated Ecosystem Assessments](#)

WGHIST is a continuation of the Study Group on the History of Fish and Fisheries (SGHIST, 2009-2011) and the 2008 Workshop on Historical Data on Fisheries and Fish (WKHIST).

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LINKS

- > View all members of this group
- > WGHIST Terms of Reference
- > View latest WGHIST Report
- > Oceans Past Initiative (CPI)
- > [ICES Metadata Catalogue](#)

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Figure: Screenshot showing link (red arrow) to ICES Metadata Catalogue from WGHIST webpage.
Direct link: <http://www.ices.dk/community/groups/Pages/WGHIST.aspx>.

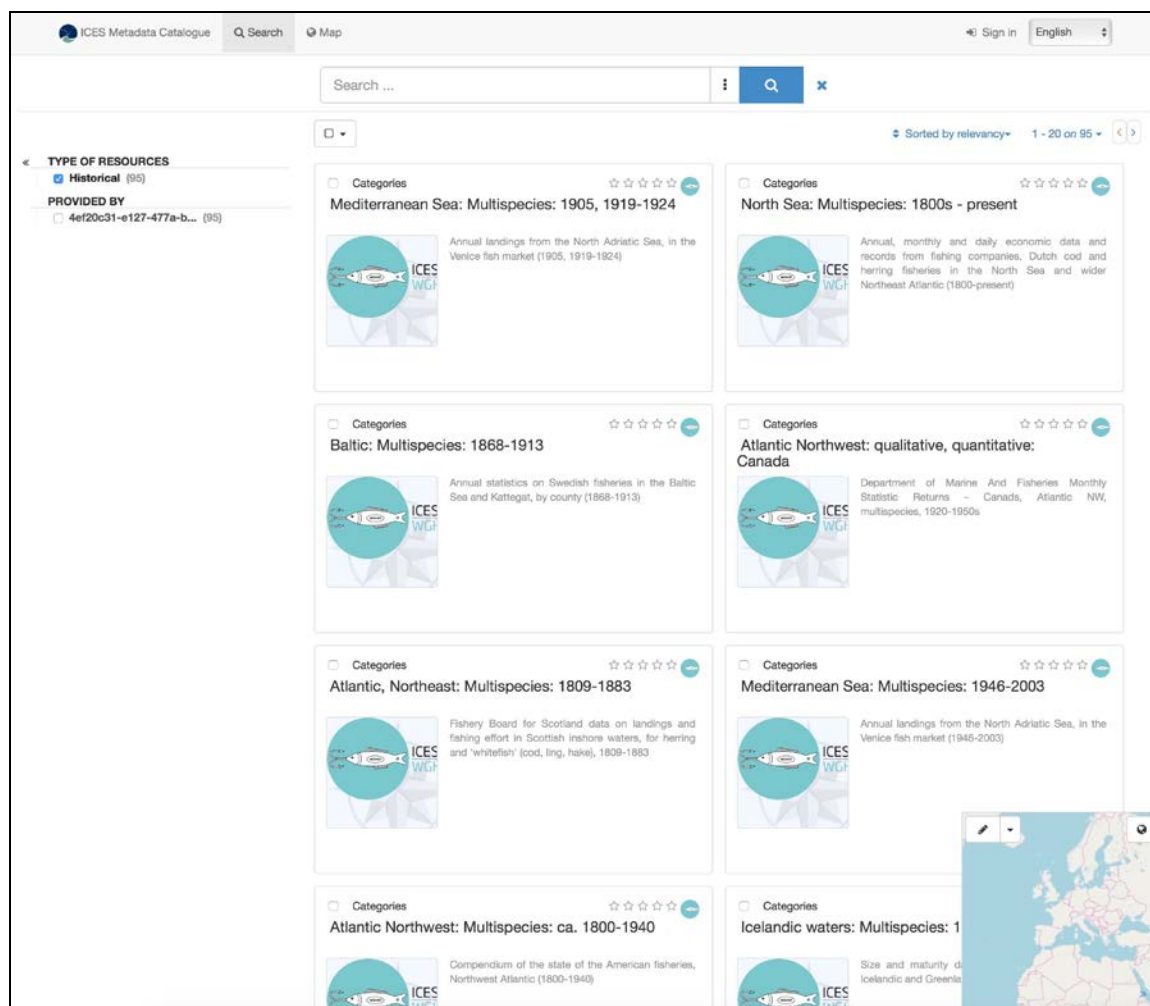


Figure: Screenshot of ICES Metadata Catalogue with WGHIST metadata files listed. Direct link:

http://gis.ices.dk/geonetwork/srv/eng/catalog.search#/search?facet.q=type%2Fhistorical&resultType=details&fast=index&_content_type=json&from=1&to=20&sortBy=relevance

The screenshot displays the ICES Metadata Catalogue interface. At the top, there is a navigation bar with 'ICES Metadata Catalogue', a search bar, a map icon, and a sign-in button. Below the navigation bar, a 'Back to search' button is visible. The main title of the page is 'Mediterranean Sea: Multispecies: 1905, 1919-1924', with a note indicating it was 'Updated: a year ago'. The 'Metadata information' section is prominently displayed, featuring a 'Download metadata' button and a table of metadata fields. To the right of the metadata table, there is an 'Overview' section with a circular logo containing a fish and the text 'ICES WGHIST'. Below the overview, there is a 'Provided by' section with a globe icon, and a 'Share on social sites' section with icons for Google+, Twitter, Facebook, LinkedIn, and Email. A 'Rating' section with five stars is also present.

Metadata Standard Name	wghist
Long Title / Description	Annual landings from the North Adriatic Sea, in the Venice fish market (1905, 1919-1924)
Region	Mediterranean Sea
Record Type	Landings
Data Source	D'Ancona U. Dell'influenza della stasi peschereccia del periodo 1914-18 sul patrimonio ittico dell'Alto Adriatico. R. Comitato Talassografico Italiano
Species or Taxonomic groups	Multispecies
Title species	Multispecies
Aphia_ID according to the World Register of Marine Species "WoRMS"	
number of species reported	102
Type of observation	Landings of the Venice fish market
Span of years	1905, 1919-1924
Temporal resolution	annual
Fishing region	North Adriatic Sea
Marine Regions ID according to www.marineregions.org	Northern Adriatic Sea; Gulf of Venice
Country of landing	Italy
Spatial resolution	harbor
Data owner/data provider	Istituto Superiore per la Protezione e Ricerca Ambientale (ISPRA)
Contact Person	Tomaso Fortibuoni: tomaso.fortibuoni@isprambiente.it
Policy	Access by request
Link	
Status	["digitalized"]
Notes	The data were recovered from local libraries and archives and digitalized
First Date	
Last Update	

Figure: Screenshot of ICES Metadata Catalogue with detail from an individual WGHIST metadata file. Direct link: <http://gis.ices.dk/geonetwork/srv/eng/catalog.search#/metadata/5d3eb81b-4418-471b-ad15-c2df283c7918>

Theme 3. Social, cultural, and economic dimensions of marine ecosystems through time (ToR d)

The importance of placing historical data in its proper context: highlights from a 19th century New England fishery

Matt McKenzie

University of Connecticut, USA

New England fisheries scholars often identify 1905, the year the first steam trawler was launched in the region, to mark the beginning of New England's fisheries industrialization. Analysis of late nineteenth century Gloucester vessel ownership patterns and crew nativity, as well as studies of the horizontal integration and subsequent indictments of

Boston's haddock trawl vessel owners, however, highlight that mechanization and industrialization are not necessarily the same process.

Fishing vessel lists and memorials to lost vessels reveal two important features in Gloucester's schooner fishery between 1866 and 1908. First, following the repeal of salt subsidies, Gloucester's schooner fleet consolidated into fewer and fewer hands as competing firms struggled to vertically integrate to dominate the market. This pattern mimics closely management decisions taken by other heavy industries bucking the boom and bust economic cycles wracking the US economy throughout the period. Second, published memorials reveal a vast majority of those working on Gloucester's schooners were not American born; another pattern consistent with other American heavy industries at the time. Canadian born fishermen made up roughly 90% of the crews working aboard Gloucester vessels, while Americans made up a similar proportion of vessel owners. While still propelled by sails, and still fishing from dories, Gloucester's fishery after 1866 was managed toward profit maximization and market domination just like many modern American industries.

As indictment records reveal, Boston's fresh fish market actors followed similar trends, this time using total control of Boston's single fish pier to extort kickbacks from fishing vessels seeking to sell in the city. From those illegal payments, Boston's fish dealers amassed substantial surplus capital they then used to drive out competition, leverage lopsided from the city in the construction of the Boston Fish Pier, and eventually, drive up fish prices during World War I. These profits also allowed for the construction of the first steam-powered dragger, F/V *Spray*, in 1905, and four more otter trawlers before the war.

In both cases, industrialization—a term historians define as a redefinition of previous relationships between labor, management, the productive process, and natural resources, took place without the application of machinery to that productive process. While still using old methods, Gloucester fleet owners and Boston fish dealers made decisions upon new expectations of profitability, industrial consistency and continuity, and power over workers and captains. These new attitudes began long before mechanization, and need to be considered as such.

Relationships between public perception and industrial realities also shaped management. Following the war, otter trawling expanded, and soon dominated the vast majority of New England's landings. Persisting romantic popular visions of Gloucester's schooner fishery, however, masked the industry's industrialization and mechanization. As biologist William C. Herrington published warnings to the industry to cease targeting juvenile haddock, using declining LPUE figures to support his case, most New Englanders continued to see their fisheries as timeless, artisanal, anti-modern, and sustainable.

The disconnect between popular perception and industrial realities continue to frame the region's understanding of its fisheries. Recent fisheries disputes reveal how appeals to tradition and heritage take front stage in public responses to quota cuts, marginalizing the groundfish fisheries' dire biological condition and overcapitalization. Such a disconnect has shaped historian's views, too, as no long term historical study yet has tackled the region's fisheries past following 1905.

Understanding the meaningful differences between industrialization and mechanization, as well as divergences between public perception of the fisheries and their industrial realities, represents an important filter to engage and integrate historical data into current analytical efforts. More broadly, this study highlights the need to properly understand the context from which date emerge, the debates and discourses that produced them, and the concerns of the people and ecosystems which they describe.

Path dependency in social–ecological systems: Swedish fisheries policy, subsidies, and 100 years of over–fishing

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Path dependency has been put forward as theoretical explanation for persistent overexploitation of natural resources, but clear empirical evidence is lacking. We explore the role of path dependency in natural resource management by empirically studying a 100-year evolution of Swedish fisheries. We rely on three main types of original longitudinal data collected for the period 1914 - 2016: (1) fishery policy documents, (2) subsidies granted to the fishing industry, and (3) catch and fishing fleet data. We uncover four pieces of evidence suggesting the existence of a path dependent dynamic. First, despite increasing insights on the vulnerability of fish stocks to overexploitation, national policy goals in relation to fisheries remained surprisingly constant, continuously promoting incompatible goals of economic, social and environmental prosperity. Second, the same policy instruments were used over long periods but was motivated differently based on the prevailing economic situation in the fishing sector. Third, actor constellations within the fisheries policy sub-system were remarkably stable over time. Fourth, neither political regime changes nor macro- economic variables (GPD, industry production) could explain observed temporal variation in subsidy levels. We conclude that key policy actors have managed to form an “iron triangle” and thereby maintained status quo in the system despite clear and ongoing degradation of the resource base. Substantial reform is needed to change incentives structures and promote a sustainable and resilient system trajectory.

Something old, something blue: 200 years of a blue growth agenda

WGHIST contributors

Blue growth is an umbrella concept currently promoted by both national and international policy frameworks, including the EU and FAO. Overarching goals include balancing the equitable growth and accessibility of marine economies with environmental sustainability and protection of habitats and ecosystem services. Central to successfully balancing these goals is the clear need to address social-ecological relationships between people and ocean resources. Despite the more recent use of the term “blue growth”, these goals associated with it have historical corollaries going back centuries into the human use of marine resources. Understanding how social, environmental, and ecological drivers interacted to determine the success or failure of management and policy with such goals through time offers important insights for contemporary blue growth initiatives, including ways forward and lessons learned. Here, we assess examples from history

where these overarching goals were successfully balanced, and where they failed, exploring the major drivers of success or failure over time.

Aim: While implied, blue growth initiatives do not clearly state how success of these goals depend and are influenced by social, political, and economic aspects of human systems, and their interaction with ecological systems. Looking through time, we aim to leverage this history to understand how elements of blue growth were developed in the past and their outcomes, thereby informing contemporary marine policy targets within the blue growth context. Given current focus, we pay particular attention to the integration of socio-economic dimensions and the ways in which human systems in turn impact management and policy outcomes.

Approach: To review historical practice/behaviours/policy (find historical analogies) and explore what lessons can be learned for contemporary management/policy, using FAO's blue growth initiative as a contextual framework.

Key message: By looking at how historical governance initiatives have shaped the nature of human interactions with the marine environment, we can learn lessons for blue growth, with particular insight into the interface between human and ecological systems.

Annex 3: Collaboration with Oceans Past Platform (OPP)

EU COST Action on Oceans Past Platform

Henn Ojaveer: Vice Chair of the COST Action

The Action aims to measure and understand the significance and value to European societies of living marine resource extraction and production to help shape the future of coasts and oceans. The Integrative Platform will lower the barriers between human, social and natural sciences; multiply the learning capacity of research environments; and enable knowledge transfer and co-production among researchers and other societal actors, specifically by integrating historical findings of scale and intensity of resource use into management and policy frameworks. The oceans offer rich resources for feeding a hungry world. However, the sea is an alien space in a sense that the land is not. Fishing requires skills that must be learnt, it presupposes culinary preferences, technical ability, knowledge of target species, and a backdrop of material and intangible culture. The Action asks when, how and with what socio-economic, political, cultural and ecological implications humans have impacted marine life, primarily in European seas in the last two millennia. The Action calls on historians, archaeologists and social scientists as well as colleagues from the marine sciences to engage in dialogue and collaboration with ocean and coastal managers. The Action will develop historical descriptors and indicators for marine and coastal management.

OPP consists of the following five Working Groups:

- WG1: Trends in Production and Consumption (see below)
- WG2: Coastal settlements (aim to pool and enhance existing knowledge regarding four critical issues that combines demographic, economic and environmental dimensions)
- WG3: Aquaculture (aim: to collect and develop knowledge on aquaculture's impact on ecosystem goods and services and distribution of social and economic costs and benefits over time, as well as on the shifting perceptions and management of aquaculture)
- WG4: Changing values (economic and cultural) of marine life to society (aim: by documenting the changing relationship of society and marine life to develop a comparative
- trans-disciplinary and integrative understanding of the human-ocean system and overall changes in society)
- WG5: Gendered seas (aim: to understand how men and women have used, governed, and changed their marine environment over time)

The most relevant to WGHIST is Working Group 1. The aim of the WG1 is to use archaeological, historical and more recent catch history information to establish integrated trends in exploitation of key marine species through linking:

- trends with technological development
- trends with societal developments such as colonialism, past & present policy measures
- the role of marine science insights for production and consumption

WG1 has the following topical focus areas:

- i) Multi-centennial fishery and consumption of charismatic species: case study of tuna in the Mediterranean Sea;
- ii) Historical ecology of commercial demersal species: case study in the North Sea, incl. spatial trajectories, fleet/gear dynamics, development and testing of indicators;
- iii) Forage fish (such as herring, stickleback) in various marine ecosystems over different time-periods: centennial-scale exploitation and consumption trends, technology development, assessment of trajectories of fishing power;
- iv) Conspicuous marine consumption: case study of oysters in European northern seas since the 15th century.

In addition to the four topical focus areas, WG1 also:

- i) Develops methods to synthesize the quantitative and qualitative historical evidences to reconstruct changes in exploited populations and ecosystems over time (lead: Adriaan Rijnsdorp)
- ii) Facilitates the collection and inventory of open data sources through standardization of protocols (lead: Ann-Katrien Lescrauwaet)
- iii) Makes explicit how Marine Historical Ecology can guide management (lead: George Engelhard)

Geographic focus areas:

Based on the research interests of participants and also considering the data/information availability, the following areas were considered as a primary focus: North Sea, Baltic Sea and the Mediterranean Sea

Countries involved:

Representatives of the following countries participate in WG1 activities: Australia, Belgium, Denmark, Estonia, France, Great Britain, Germany, Ireland, Italy, Netherlands, New Zealand, Russia, Sweden and USA.

Annex 4: Internal recommendations

- 6) WGHIST continues to contribute to the understanding of marine social-ecological systems through time, with specific reference to human dimensions, policy advice, and increased visibility and accessibility of novel and non-traditional resources and approaches. This includes the role of WGHIST in providing leadership on the development of resources and translating research into advice, and this will be continued in the proposed next iteration.
- 7) WGHIST recommends continuing collaboration with members from ICES Strategic Initiative on the Human Dimension to highlight ways in which social and economic data can be integrated into ICES advice. Additional engagement with other working groups on issues of human dimensions, such as the Working Group on Social and Economic Dimensions of Aquaculture (WGSEDA), is also recommended.
- 8) WGHIST recommends continued liaison with the ICES Data Centre to develop new digital tools and ways in which the WGHIST metadata and other long-term resources can be integrated into the ICES website and made available and visible to the science community. WGHIST further recommends developing connections with other WGs (e.g. ICES DIG) that can assist on this aim and connects historical data with other resources. Finally, WGHIST recommends that ICES consider ways it can encourage institutions more broadly to make their archived data more digitally accessible for the wider community.

Annex 5: WGHIST resolution 2018–2020

The **Working Group on the History of Fish and Fisheries** (WGHIST), chaired by Ruth Thurstan, UK, and Emily Klein, USA, will work on ToRs and generate deliverables as listed in the Table below.

	Meeting dates	Venue	Reporting details	Comments (change in Chair, etc.)
Year 2018	4–8 September	Brest, France	Interim report by 1 December	
Year 2019	early Sept 2019	TBC – possibly University of Exeter, Penryn, UK	Interim report by 1 December	
Year 2020	early Sept 2020	TBC – possibly ICES HQ, Copenhagen, Denmark	Final report by 1 December	

ToR descriptors

ToR	Description	Background	Science Plan topics addressed	Duration	Expected Deliverables
a	Collection and assembly of metadata on marine social-ecological systems through time, and further development of data products and best practices that encourage the use of these resources.	Data from WGHIST supports the development of tools for marine living resource management and provides data to the global community via the ICES Data Centre. In addition, WGHIST can work with ICES Data Centre to identify opportunities for promoting and facilitating access to and the digitization of historical and archival resources housed by other institutions. WGHIST can also develop guidelines for the use of and best practise in using long-term/historical data in research and management.	10, 27, 31	All years	Digital products, such as indexing WGHIST metadata on the ICES Spatial Facility. Guidelines on best practice within ICES and beyond when using and/or applying historical data to contemporary advice and/or management.
b	Review outcomes of WKIHSD meeting and peer-reviewed research from the historical	ICES Overviews present an opportunity to increase the visibility of available historical data via brief summaries that include key aspects of specific	10	All years	Overview text, suitable for inclusion in ICES Overviews (in a comparable format to Trends in Non-Indigenous Species), on key historical

	ecology community, and from these consider preparing brief overviews of key historical information for submission to ICES Ecosystem and/or Fisheries Overviews.	ecoregions/fisheries (e.g., historical pressures, year of commencement of significant fishing activity, historical landings, historical distribution of fishing/other activities compared to today). WGHIST proposes to submit information, based upon the outcomes of WKIHSD and peer-reviewed research from the historical ecology community, on a number of ecoregions and/or fisheries in a form similar to 'Trends in Non-Indigenous Species', for consideration for inclusion in ICES Overviews.			activities and data available on ecoregions and/or fisheries.
c	Evaluate changes in marine ecological and social-ecological systems through time via cross-disciplinary collaboration, and demonstrate the importance of this knowledge for contemporary science and management.	The interdisciplinary nature of WGHIST, with expertise in marine ecology, fisheries biology, historical ecology, palaeoecology, social and environmental history, offers a unique forum for conducting research into marine social-ecological systems and the scale, direction and drivers of social-ecological change through time.	1, 6, 10, 14	All years, culminating in year 3	Submission of (1) manuscript reviewing the development of major fishing technologies through time, and the ecological, social and/or cultural changes facilitated by these innovations; and/or (2) manuscript on the benefits and challenges of cross-disciplinary collaborative work.
d	Continue to use non-traditional data sources and approaches for advancing our knowledge of change and dynamics in marine ecological and social-ecological systems through time.	Several members of WGHIST work with unconventional resources and approaches, and are well versed in using interdisciplinary methods to extract non-traditional data and interpret trends over long (decadal to centennial) periods of time.	27	All years, culminating in year 3	Submission of manuscript or alternative (WGHIST report) on non-traditional methods, approaches (e.g. empirical dynamic modelling, time series analysis), their outcomes and application (e.g., data poor fisheries).

Summary of the Work Plan

Year 1	In Year 1, WGHIST will work with the ICES Data Centre to explore the opportunities for developing data products that encourage use of and enhance the visibility of historical and long-term data (ToR a). Work on the proposed manuscripts (ToRs c, d) will also commence during the Year 1 meeting, as will identification of historical data/literature for the ecosystem overviews (ToR b). Potential areas of interest already identified by WGHIST members for ToRs c and d include: quantifying changes in ecosystem services over time, detailing fishing technology change and cumulative
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impacts upon fishing efficiency, and invoking cross-disciplinary knowledge to expand our understanding of linked social-ecological system change through time. Post-meeting work will involve soliciting contributions from the wider WGHIST membership list and continued development of manuscripts. WGHIST will also support WKIHSD with data resources and expertise (ToR a).

The WGHIST 2018 meeting will also re-establish links with the ICES SIHD and other WG with expertise relevant to WGHIST aims, through invitation of SIHD and WG Chairs to the WGHIST meeting, whether in person or remotely, and by the WGHIST Chairs remaining in communication with SIHD and other WG throughout the year. These efforts aim to strengthen cross-disciplinary ties and enhance communication and learning among ICES WGs. Links with external groups (e.g. Oceans Past Initiative) will also be maintained to enhance interdisciplinary learning and collaboration.

Year 2 and 3 In years 2 and 3 WGHIST will continue to develop digital tools for historical metadata, explore opportunities for improving the accessibility of historical data for use by the scientific community, and develop protocols for best practise when using historical data, potentially in collaboration with the ICES Data Centre and other WGs. While these tools will be finalised in year 3, it is our hope that progress will be ongoing throughout years 1 and 2, including the provision of digital updates to the ICES community during this time. If so, this will afford WGHIST members and the wider ICES community multiple opportunities to make use of these tools and feedback to the Chairs and Data Centre on these tools, thus enabling the tools to be improved over this iteration.

Years 2 and 3 will also see progress on the proposed manuscripts and ecosystem overviews, and the WGHIST chairs will work to maintain and enhance connections with SIHD and other relevant WG, as above. Year 2 will forward manuscript and guidelines in our ToRs, which will be circulated among WGHIST members in between the meetings. This circulation may include scientists and practitioners with targeted expertise outside WGHIST. In both years, specific research from WGHIST will be used to expand this work. Deliverables will then be completed in Year 3.

Supporting information

Priority	The value of historical marine ecology for evaluating current ecosystem health and providing appropriate baselines is now well published. In addition, understanding social-ecological system change has great potential for greater appreciation of both the system resilience and how they may change in the future. Scientific Scope: WGHIST 2018–2020 will focus on operationalizing historical data for current scientific questions and management needs. In particular, this iteration of WGHIST will emphasize increasing the visibility and accessibility of historical data to ICES and the wider scientific community, and conducting interdisciplinary research that improves our understanding of social-ecological change through time and the impacts these changes have had, and continue to have, upon fisheries provision.
Resource requirements	WGHIST will continue consultation with ICES Data Centre staff. Future Data Centre staff attendance will be an asset to WGHIST, but if this cannot be achieved in person, remote connections worked well during the previous iteration and will be leveraged. WGHIST co-chairs will also be contacting SIHD chairs to discuss their interest and ability to attend future meetings, again either in person or

	remotely. Any assistance ICES can provide for supporting remote access to meetings is greatly appreciated.
Participants	WGHIST predicts attendance of 8–15 group members and guests each year. These will include ecologists, historians, social scientists, economists, policy experts, data analysts working in or connected to historical marine ecology. In addition, we will invite guests in contemporary management and policy, and in the social sciences, who may participate remotely.
Secretariat facilities	None in 2018 or 2019. Meeting rooms and ability for participants to access the meeting at ICES HQ remotely in 2020.
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	WGHIST will actively seek out connections within ACOM for the application of historical ecology work into scientific advice (e.g. stock baselines, change through time, context for IEAs, etc).
Linkages to other committees or groups	Direct support of WKIHSD. Potential links to ACOM, EPDSG, HAPISG, IEASG, SIHD as well as WGBIODIV, WGBFAS, WGECO, WGMARS, WGMIXFISH, WGRMES, WGSAM, DIG and WGSEDA, depending on interest and availability of committee and group members to join in person or remotely.
Linkages to other organizations	There is interest for the European Commission in regards to MSFD baseline development as well as Integrated Ecosystem Assessments. Participants in the Oceans Past Initiative (OPI) will also be interested in our work and outcomes, and WGHIST will promote connections with this group. Finally, WGHIST has an international participation beyond ICES member countries, including Australia, South Africa, and Italy.

Annex 6: WGHIST self-evaluation 2015–2017

1. Working Group Name

Working Group on the History of Fish and Fisheries (WGHIST)

2. Year of appointment

As Working Group, current iteration: 2015, for the 3-year period 2015–2016–2017

3. Current Chair(s)

Ruth Thurstan (UK)

Emily Klein (USA)

4. Venues, dates and number of participants per meeting

(1) **Ispira, Italy: 20–23 October 2015**, 20 participants (of which 2 participants engaged remotely and 3 more via correspondence), in addition to an invited member from ICES staff, see 2015 report for details.

(2) **ICES HQ, Copenhagen, Denmark: 6–9 September 2016**; 22 participants (of which 5 participated via remote access), plus 5 invited members from ICES staff and other organizations, see 2016 report for details.

(3) **Lysekil, Sweden: 4–7 September 2017**; 13 participants (of which 4 participated via remote access).

5. WG Evaluation. If applicable, please indicate to which of the research priorities (and sub-priorities) of the Science Plan to which the WG make a significant contribution

6. Investigate linear and non-linear ecological responses to change, the impacts of these changes on ecosystem structure and function and their role in causing recruitment and stock variability, depletion and recovery.

10. Develop historic baseline of population and community structure and production to be used as a basis for population and system level reference points.

27. Identify knowledge and methodological monitoring gaps and develop strategies to fill these gaps

WGHIST contributes to several of ICES' science priorities (most relevant are listed above), and will continue to do so in the future if the next iteration is approved. WGHIST focuses on understanding marine social-ecological patterns and change through time, specifically concentrating on how people impact, and are in turn impacted by, marine ecosystems and the marine environment. This has specifically addressed both linear and nonlinear responses and dynamics (6 above). Resulting knowledge illumi-

nates historical baselines and how past ecosystems/communities were structured, as well as how these systems change and adapt, and what aspects lead to improved resilience (6 and 10). This work, as well as the sources and methods deployed to analyse non-traditional datasets from which much of this information is gathered, also directly contributes to (27). Finally, the research of WGHIST and its members directly engages the human side of marine social-ecological systems, and therefore also speaks to patterns and change in human communities and the ecosystem goods and services people value through time. Collectively, WGHIST therefore supports other science priorities more indirectly, and has potential to supply foundational insight for effective IEA development.

6. WG evaluation. In bullet form, list the main outcomes and achievements of the WG since their last evaluation. Outcomes include publications, advisory products, modelling outputs, methodological developments, etc. *

- WG Reports: 3 annual reports identifying and describing a diversity of case studies from 4 different continents that addressed (1) the application of Marine Historical Ecology (MHE) to policy and management, (2) novel and non-traditional data sources and analytical approaches, and (3) the human dimensions of marine social-ecological systems through time;
- Publication of WGHIST metadata inventory on the online ICES Data catalogue. This metadata describes relevant datasets available for further research, covers a wide geographic range (North Sea, NE Atlantic, NW Atlantic, Mediterranean Sea, Baltic Sea, Pacific Ocean and Southern Ocean), and is now widely accessible to the ICES community and beyond;
- Presentations at international conferences: Oceans Past VI (2017, Portugal), ICES Annual Science Conference (2016, Latvia), BONUS SYMPOSIUM: Science delivery for sustainable use of the Baltic Sea living resources (2017, Estonia), 52nd European Marine Biology Symposium (Slovenia, 2017), Australian Marine Sciences Association (2016, New Zealand), International Coral Reef Congress (2016, Hawaii), Oceans Past V (2015, Estonia); COST-OPP Conference, Chioggia, Italy (2016); Ecological Society of America (2015, USA).
- Oceans Past Special issue in *ICES Journal of Marine Science*: "Oceans Past V: Multidisciplinary Perspectives On The History Of Human Interactions With Life In The Ocean" (introduction and 6 papers: <https://academic.oup.com/icesjms/issue/73/5>).
- Publications and popular articles by WGHIST members (WGHIST support or feedback acknowledged; names of WGHIST members in bold):
 - **Alleway H. K., and R. H. Thurstan**, P. R. Lauer, S. D. Connell (2016). Incorporating historical data into aquaculture planning. *ICES Journal of Marine Science* 73, 1427–1436.
 - **Bennema F. P.** (*In press*). Long-term occurrence of Atlantic bluefin tuna *Thunnus thynnus* in the North Sea: contributions of non-fishery data to population studies. *Fisheries Research*. DOI: 10.1016/j.fishres.2017.11.019.

- **Currie, J.**, and L. Atkinson, W. Goschen, C. Attwood. (2013). A rich bounty of historical marine data . SAEON e-Newsletter, 2 pp.
- **Currie, J.**, and G. Jones (2014). Trawling through time. *Fishing Industry News* 15: 26–27.
- **Currie, J.** (2014). Of trawl nets, historical baselines and Gilchrist's hidden legacy. SANCOR Newsletter 24:5–6.
- **Currie, J.**, and S. Norman, (2015). Mission Gilchrist: Revisiting the earliest trawl surveys in South Africa. SAEON E-newsletter, 3 pp.
- **Eero, M.**, and H. C. Andersson, E. Almroth-Rosell, **B. R. MacKenzie** (2016). Has eutrophication promoted forage fish production in the Baltic Sea? *Ambio*, 45: 649–660.
- **Engelhard, G. H.** (2016) On the need to study fishing power change: challenges and perspectives. In: Schwerdtner Máñez K, Poulsen B (Eds) *Perspectives on Oceans Past: A Handbook on Marine Environmental History*. Springer Publishers, pp 89–101.
- **Engelhard, G. H.**, and R. H. Thurstan, **B. R. MacKenzie**, H. K. Alleway, R. C. A. Bannister, M. Cardinale, M. W. Clarke, J. C. Currie, T. Fortibuoni, P. Holm, S. J. Holt, C. Mazzoldi, J. K. Pinnegar, S. Raicevich, F. A. M. Volckaert, E. S. Klein, A.-K. Lescrauwaet. (2016). ICES meets marine historical ecology: Placing the history of fish and fisheries in current policy context. *ICES Journal of Marine Science*, 73(5): 1386–1403. *Editor's Choice article*.
- **Fortibuoni, T.**, and S. Libralato, E. Arneri, O. Giovanardi, C. Solidoro, **S. Raicevich** (2017). Fish and fishery historical data since the 19th century in the Adriatic Sea, Mediterranean. *Nature Scientific Data* 4, Article number: 170104. doi:10.1038/sdata.2017.104.
- **Fortibuoni, T.**, and O. Giovanardi, F. Pranovi, **S. Raicevich**, C. Solidoro, S. Libralato (2017). Analysis of long-term changes in a Mediterranean marine ecosystem based on fishery landings. *Frontiers in Marine Science* 4:33. doi: 10.3389/fmars.2017.00033.
- **Fortibuoni, T.**, and D. Borme, G. Franceschini, O. Giovanardi, **S. Raicevich** (2016). Common, rare or extirpated? Shifting baselines for common angelshark, *Squatina squatina* (Elasmobranchii: Squatinidae), in the Northern Adriatic Sea (Mediterranean Sea). *Hydrobiologia* 772: 247–259 (10.1007/s10750-016-2671-4).
- **Fortibuoni, T.**, and F. Aldighieri, O. Giovanardi, F. Pranovi, M. Zucchetta (2015). Climate impact on Italian fisheries (Mediterranean Sea). *Regional Environmental Change* 15(5): 931–937 (10.1007/s10113-015-0781-6).
- **Klein, E.S.**, and R. H. Thurstan (2016) Acknowledging long-term ecological change: the problem of shifting baselines. In: Schwerdtner Máñez K, Poulsen B (Eds). *Perspectives on oceans past: a handbook of marine environmental history*. Springer Publishers, pp11–30.

- **Klein E.S.**, and S. M. Glaser, A. Jordaan, L. Kaufman, A. A. Rosenberg (2016). A complex past: historical and contemporary fisheries demonstrate nonlinear dynamics and a loss of determinism. *Marine Ecology Progress Series* 557, 237–246.
- **MacKenzie B.R., and H. Ojaveer** (2018). Evidence from the past: exploitation as cause of commercial extinction of autumn spawning herring in the Gulf of Riga, Baltic Sea. *ICES Journal of Marine Science* (conditionally accepted, minor revision).
- **McKenzie, M.** (2018). *Breaking the Banks: Representation and Reality in the New England Fisheries, 1866–1966*. University of Massachusetts Press: Amherst, Mass.
- **Sguotti C.**, and C.P. Lynam, B. García-Carreras, J. R. Ellis, **G. H. Engelhard** (2016). Distribution of skates and sharks in the North Sea: 112 years of change. *Global Change Biology* 22, 2729–2743. doi: 10.1111/gcb.13316.
- **Raicevich, S.**, and J.-L. Alegret, K. Frangoudes, O. Giovanardi, **T. Fortibuoni**. (2017). Community-based management of the Mediterranean coastal fisheries: Historical reminiscence or the root for new fisheries governance? *Regional Studies in Marine Science*. DOI: 10.1016/j.rsma.2017.10.013.
- **Thurstan, R.H., Buckley, S.M.**, Ortiz, J.C., Pandolfi, J.M. (2016). Setting the record straight: assessing the reliability of retrospective accounts of change. *Conservation Letters* 9: 98–105.
- WGHIST recognizes the importance of leveraging online platforms and social media for sharing research done within the group and by its members. WGHIST used Twitter to share (with permission) research and discussion during meetings, and was invited to contribute twice to the ICES News blog, including a News Feature Article (“Changing perceptions”, 4 May 2016, <http://www.ices.dk/news-and-events/news-archive/news/Pages/FEATURE-ARTICLE--changing-perceptions-.aspx>).
- To apply the abundant reservoir of historical data to current fisheries science approaches directly, the WGHIST members worked to set up a dedicated workshop towards this aim. This activity resulted in submission of the resolution on WKIHSD (Workshop on Integrating historical data into modern stock assessment) to ICES.
- In April 2018, the COST Oceans Past Platform (OPP) and WGHIST will be holding a joint workshop on investigating changing fishing technologies and impacts of technological innovation through time, funded by the EU COST Action.

7. WG evaluation. Has the WG contributed to Advisory needs? If so, please list when, to whom, and what was the essence of the advice.

The majority of WGHIST’s Terms of Reference (ToR) do not focus directly on the delivery of specific advisory needs for ICES. Broadly, WGHIST’s main contribution is **improving the quality and expanding the breadth of information** available to the research commu-

nity by informing on past ranges of marine ecosystem variation, conditions, and structure through time. Knowledge gained from WGHIST can be applied across a broad spectrum of policy and management measures and contribute to the sustainable management of marine resources.

WGHIST also provides **a bridge connecting research across disciplines** to better understand interconnected marine ecological and human systems. It engages researchers from a range of backgrounds, including historians, archeologists, palaeoecologists, modellers, ecologists, biologists, policy officers, and others. As a result, WGHIST research demonstrates **effective cross-disciplinary work**, and offers examples across a range of **non-traditional sources and analytical approaches**.

Due to this multidisciplinary nature, WGHIST can **directly address human dimensions** (e.g. economic value and sectors, cultural identity and values, ecosystem goods and services, societal and political change, changes in management and policy as well as those in gear and technology), and how these have changed over time. This insight is of increasing importance in contemporary management and policy, such as for the development of integrated ecosystem assessments (IEAs). WGHIST reports have highlighted case studies that exhibit ways to assess human dimensions for inclusion into policy and management.

In addition to these broader outcomes, specific contributions to management and policy advice are listed and described in the WGHIST reports, which are purposefully organized around case studies to exemplify how marine historical ecology approaches can inform or facilitate management and policy. WGHIST has also reported on the broader utility of historical data in providing reference conditions, such as understanding ecosystems prior to industrial fishing, and the timing and socio-economic drivers of observed changes.

8. WG evaluation. Please list any specific outreach activities of the WG outside the ICES network (unless listed in question 6). For example, EC projects directly emanating from the WG discussions, representation of the WG in meetings of outside organizations, contributions to other agencies activities.

Australia and the United States:

1. Conference presentation, "ICES Working Group on the History of Fish and Fisheries 2015–2017". Oceans Past V, Tallinn University, Tallinn, Estonia, May 2015.

Australia:

1. Invited presentation, "Assembling archival data on the east coast snapper fishery". Fisheries Research and Development Corporation Project No. 2015–216, Steering Committee presentation and discussion, Sydney, July 2017.
2. Conference talk, "Exploring trajectories of change in an inshore recreational fishery". Oceans Past VI, Sesimbra, Portugal, May 2017.

3. Invited presentation, "Establishing ecological and cultural baselines in the Queensland oyster fishery". National Shellfish Reef Restoration Network meeting, Bribie Island, Nov 2016.
4. Invited presentation, "Assembling archival and fisher knowledge data on the east coast snapper fishery". Fisheries Research and Development Corporation Project No. 2015–216, Steering Committee presentation and discussion, Brisbane, Nov 2016.
5. Conference talk, "Uncovering social and ecological changes in recreational fisheries using popular media". ICES Annual Science Conference, Riga, Sept 2016.
6. Conference talk, "Examples of the effects of interactive drivers from historical data", Thurstan plus WGHIST member research. ICES Annual Science Conference, Riga, Sept 2016.
7. Conference talk, "Engaging resource users to identify social and ecological changes in Australia's coral trout fishery". 13th International Coral Reef Symposium, Honolulu, Hawai'i, Jul 2016 (Symposium organiser and speaker).
8. Conference talk, "Archival records reveal a century of diminishing returns for recreational fishers". Australian Marine Sciences Association, Wellington, New Zealand, Jul 2016.
9. Invited presentation, "Historical insights into the east coast snapper fishery". Fisheries Research and Development Corporation Project No. 2015–216, Steering Committee presentation and discussion, Brisbane, Nov 2015.
10. Conference talk, "Using historical media to provide insights into a popular recreational fishery". Oceans Past V, Tallinn University, Tallinn, Estonia, May 2015.
11. Popular article: Record catch. State Library of New South Wales Magazine. 2016.
12. Popular article: Conservation innovations: What can we learn from old fishing tales? Wildlife Australia. 2016.

Denmark:

1. Invited talk, "Biodiversity Variations and Processes in Semi-Enclosed and Estuarine Seas", COST-OPP Conference on Historical Ecology of Semi-Enclosed Basins: Past, Present and Future of Seas at Risk, Chioggia, Italy, October 2016.

Italy:

1. Conference poster, "Historical data on fish and fisheries in the Adriatic Sea (Mediterranean)". (52nd European Marine Biology Symposium, Piran, Slovenia, September 2017)
2. Conference talk ("La pesca in Adriatico e la rappresentazione scientifica: dai naturalisti dell'800, ai biologi del '900, agli approcci ecosistemici del nuovo millennio") Com'è cambiata la pesca a Chioggia: percezione e analisi scientifica. Chioggia, Italy, June 2017.
3. Keynote address, "Ignore historical data and miss the boat: role of past information on quantitative analysis of marine resources" Oceans Past VI, Sesimbra, Portugal, May 2017.
4. Conference posters, "Analysis of Long-Term Changes in a Mediterranean Marine Ecosystem Based on Fishery Landing" and "Reconstructing the dynamics of

small pelagics in the Adriatic Sea over more than a century (1902–2014)”. Oceans Past VI, Sesimbra, Portugal, May 2017.

5. Conference presentations, “Scientific expeditions in the Adriatic Sea suggest long-term changes in size of exploited species” and “Historical data on fish and fisheries in the Adriatic Sea (Mediterranean)”. Oceans Past VI, Sesimbra, Portugal, May 2017.
6. Conference presentation, “Analysis of Historical Landings of European Anchovy (*Engraulis encrasicolus*, Linnaeus, 1758) in the Gulf of Trieste (Northern Adriatic Sea, Mediterranean)”. COST-OPP Conference on Historical Ecology of Semi-Enclosed Basins: Past, Present and Future of Seas at Risk; Chioggia, Italy, October, 2016
7. Invited talks, “Community-based management in Mediterranean coastal fisheries: historical reminiscence or the root for new governance?” and “Analysis of Historical Landings of European Anchovy (*Engraulis encrasicolus*, Linnaeus, 1758) in the Gulf of Trieste (Northern Adriatic Sea, Mediterranean)”. COST-OPP Conference on Historical Ecology of Semi-Enclosed Basins: Past, Present and Future of Seas at Risk; Chioggia, Italy, October, 2016.
8. Conference presentation, “Analisi dei dati storici di pesca dell’acciuga (*Engraulis encrasicolus*, Linnaeus, 1758) a Trieste”, 47th Congresso della Società Italiana di Biologia Marina, Turin, Italy, June 2016.
9. Conference posters, “Adriatic selachians extinctions revisited” and “The three big “experiments” in the northern Adriatic sea: ecological lessons and management implications of the fishing interruptions determined by three twentieth century wars”. Oceans Past V, Tallinn University, Tallinn, Estonia, 2015.

South Africa:

1. Conference presentation, “A century of change in South Africa's inshore trawl communities: 1903/1904 vs 2015.” Oceans Past VI, Sesimbra, Portugal, May 2017.
2. Conference poster, “Manila and tar: South Africa's first survey trawl gear, 1897–1904.” Oceans Past VI, Sesimbra, Portugal, May 2017.
3. Conference presentation, “Trawl impacts in South Africa: benthic habitats and long-term change.” 14th Deep Sea Biology Symposium, Aveiro, Portugal, August–September 2015.
4. Conference presentation, “A century of change: comparison of historical and recent trawl survey records.” 15th Southern African Marine Science Symposium, Stellenbosch, S. Africa, July 2014.
5. Conference presentation, “Trawling investigations around South Africa, from ‘pristine’ (1897–1906) to the present.” CEFAS Seminar Series, Lowestoft, UK, October 2013.

Sweden:

1. Invited lecture, “Fisheries and fisheries management – long term change”. Swedish Agency for Marine and Water management, fisheries section, October 2017 (80 participants).

2. Conference presentation, "Path dependency in social-ecological systems: Swedish fisheries policy and 100 years of over-fishing". 3rd Global Resilience conference, Stockholm, August, 2017.
3. Invited lecture, "Swedish fisheries in a long term perspective". Swedish Agency for Marine and Water management, fisheries section, October 2016 (80 participants).

United Kingdom:

1. Invited guest lecture, "Using historical approaches to explore long-term change in marine ecosystems". Plymouth University, Environmental Sciences department, UK, November 2017 (~40 attendees).

United States:

2. Invited guest lecture, "In a dynamic world, how do we understand and manage complex marine systems?", including long-term change in the Gulf of Maine ecosystem. College of William & Mary, Mathematical Biology department, Williamsburg VA, November 2017 (~25 attendees).
3. Invited talk, "Beyond catch statistics: Uncovering resilience and change in Gulf of Maine coastal herring", and engagement with ecologist, social scientists, historians, and others at the *Laws of Herring* Workshop. Maine Historical Society, Portland, ME, October 2017 (17 participants).
4. Presentation of research involving understanding long-term change in marine ecosystems to interested non-governmental organization (Pew Charitable Trusts), May 2016 (20–30 attendees).
5. Invited online webinar, "A complex past: Exploring nonlinear dynamics in fisheries". NOAA OneScience seminar series, November 2016.
6. Conference presentation, "Nonlinear dynamics and spatial structure of coastal social-ecological systems". Oceans Past V, Tallinn University, Tallinn, Estonia, 2015.
7. Conference presentation, "Beyond catch statistics: Uncovering resilience and change in a marine social-ecological system". Ecological Society of American, Baltimore, MD, August 2015.
8. Invited guest lecture, "Applying the past: How do we use historical data?". Columbia University, New York City, New York, February 2015 (class of 20 students).
9. Quarterly production of Oceans Past News, an international newsletter, co-edited by Dr. Emily Klein, ICES WGHIST Chair.

In addition to outreach activities, WGHIST has created new networking and collaboration opportunities between researchers and institutes.

- **Emily Klein** (NOAA/Farallon Institute) and **Ruth Thurstan** (University of Exeter) – published book chapter: "Acknowledging long-term ecological change: the

problem of shifting baselines.” In: Schwerdtner Máñez K, Poulsen B (Eds). *Perspectives on oceans past: a handbook of marine environmental history*. Springer Publishers, 2016, pp. 11–30.

- **Matt McKenzie** (University of Connecticut), **Ruth Thurstan**, **Emily Klein** – Collaboration on interdisciplinary project underway.
- **Bryony Caswell** (Griffith University), **Emily Klein**, **Ruth Thurstan plus WGHIST members** – Collaboration on joint manuscript underway.
- **Brian MacKenzie** (DTU Aqua), **Teresa Romeo** (ISPRA, Advanced Institute of Environmental Protection and Research, Laboratory of Milazzo, Sicily, Italy). On-going collaboration including joint manuscript on historical coastal swordfish bycatches and COST OPP visit in March 2016.
- **Jonas Hentati-Sundberg**, **PhD study, leading to thesis**: 2015. SEA CHANGE – “Social-ecological co-evolution in Baltic Sea fisheries”. Doctoral thesis, Stockholm University, Stockholm, Sweden.
- **Danto, A., M.A. study leading to thesis**: 2017. *Les sociétés littorales et leurs usages traditionnels du Watt en mer des Wadden depuis le Moyen-Âge [Coastal societies and their traditional uses of Watt in the Wadden Sea since the Middle Ages]*, M.A. thesis, S.Llinares dir., CERHIO Centre de Recherches Historiques de l'Ouest CNRS FRE 2004, South Brittany University, 202 p.

Many WGHIST members are also actively involved in the COST Oceans Past Platform (OPP) Action (2015–2018), and two of the three meetings were held jointly with those of OPP. This further encouraged engagement across platforms and supported collaborative endeavors.

Several WGHIST members have played a role in the global Oceans Past Initiative (OPI) (<https://www.tcd.ie/history/opi/>), and in convening the Oceans Past VI conference (<http://www.escolademar.pt/oceans-past-vi/>) and planning the Oceans Past VII conference (<http://oceanspast.org/oceanspastvii.html>), both of which are ICES co-sponsored symposia. A WGHIST Chair (Emily Klein) also edits the Oceans Past News, a quarterly online publication supported by OPI (<https://www.tcd.ie/history/opi/news.php>).

9. WG evaluation. Please indicate what difficulties, if any, have been encountered in achieving the workplan.

The workplan was generally achieved in accordance with the established ToRs. Each of the WGHIST meetings provided opportunities for discussion of case studies, data products, non-traditional methods and resources, and the human dimensions of marine systems. However, the following main challenges or points of attention are raised:

- a) **Attendance.** WGHIST is dependent on member time and resources, sometimes supported by a members’ institution or, in many cases, by the members’ personal resources. Overall, attendance increased during this iteration, and this was bolstered by providing remote access at all three meetings for members unable to attend in person. In addition, in two of the three meetings, travel resources were augmented by EU COST funds that supported travel to the OPP meeting (held

jointly) for members from EU member states. Despite the benefits of COST funding during this iteration, WGHIST membership is global so this opportunity was not open to all WGHIST members. Moreover, COST funding is limited to a 4-year timeline, so will not be available for future meetings. Despite these issues, half of all attendees in the first two meetings and all attendees of the final meeting of this iteration attended used their own resources, which attests to the enthusiasm of research community members. Being aware of this, the WGHIST chairs have aimed (and will continue to aim) to maximize attendance by highlighting the WGHIST annual meeting as an opportunity to progress joint manuscripts and enhance collaborative opportunities, in addition to the agreed ToRs.

- b) **Diverse membership.** WGHIST members constitute a diverse group in terms of skills, approaches, resources, and objectives, which is a strength of WGHIST the group aims to leverage towards its ToRs. However, irregular or discontinuity in attendance (for reasons given in (a) above), meant that expertise varied somewhat at each meeting. While it is critical WGHIST maintain its multidisciplinary nature, over-emphasizing a particular expertise (e.g. modeling), topic (e.g. MSFD indicators for descriptors 1, 3 or 4), or geographical area, can limit the engagement of the WGHIST members in the room, and under-exploit or undervalue their skills and knowledge.
- c) **Completion of manuscript deliverables.** Forwarding papers from concept to completion was a slow process due to the range of members and the ability to maintain momentum between meetings, which is even trickier when not everyone can attend each year due to limitations on financial support or time.
- d) **Broad engagement:** WGHIST aims to engage more widely with the ICES community, and indeed the 2015–2017 Workplan outlined this goal more specifically in several areas. However, engagement was challenging in practice, most likely because it was even more difficult for scientists not WGHIST members to find time and financial support for a meeting they are not yet personally or professionally invested in.

10. Future Plans. Does the group think that a continuation of the WG beyond its current term is required? (If yes, please list the reasons)

Yes.

The work of WGHIST has demonstrated and potential value for informing management and policy within ICES and more broadly. This is especially true for understanding the human dimension of marine systems and applying that insight to novel approaches for ICES' stated mission, 'to provide information, knowledge and advice on the sustainable management of human activities affecting, and affected by, marine ecosystems'.

WGHIST also directly addresses Goals 1 and 2 under the Science pillar of the ICES Strategic Plan: 1) Develop an integrated, interdisciplinary understanding of the structure, dynamics, and the resilience and response of marine ecosystems to change; and 2) Understand the relationship between human activities and marine ecosystems, estimate pressures and impacts, and develop science-based, sustainable pathways. As social-ecological systems are dynamic and changeable, both of these goals require information

on the structure and functioning of marine ecosystems and reliant human communities through time. The interdisciplinary make-up of WGHIST members further provides opportunities to understand baselines, dynamics, interactions and drivers in these linked systems over time to progress integrated ecosystem understanding and cross-disciplinary collaboration.

Specifically, in a future iteration, WGHIST proposes working with the ICES Data Centre to make historical data more visible and accessible to the ICES community, including the development of new digital tools and via enhanced links with other institutional holders of archival data that may be of use to ICES science and/or stock assessment. A future WGHIST iteration also plans to expand knowledge via interdisciplinary research on topics that will be of both tangible and strategic interest to ICES, including quantifying changes and drivers of ecosystem service delivery and condition over time, and mapping spatial-temporal patterns in fishing technology advances and the impacts of such advances upon fishing efficiency.

11. Future Plans. If you are not requesting an extension, does the group consider that a new WG is required to further develop the science previously addressed by the existing WG. (If you answered YES to questions 10 or 11, it is expected that a new Category 2 resolution will be submitted through the relevant SSG Chair or Secretariat)

n/a see question 10

A new Category 2 resolution is submitted together with this self-evaluation.

12. Future Plans. What additional expertise would improve the ability of the new (or in case of renewal, existing) WG to fulfill its ToR?

- Continued engagement with the ICES Data Centre, and a partnership with ICES Data and Information Group (DIG), especially as WGHIST looks to encourage and support the digitization of archived resources under its next iteration.
- Continued effort is needed to connect WGHIST with other WGs interested in (1) the use of novel resources and analytical methods, and (2) bringing the human dimension to bear on management and policy decisions for future sustainability. To this second point, WGHIST hopes to further deepen its connection with ICES SIHD, and to develop a relationship with WGSEDA on the human dimensions of aquaculture (WGSEDA has expressed an interest in working with WGHIST in their 2017 Report).
- As in previous iterations and due to changes in OPP funding, the chairs renew their commitment to stimulating active participation and interaction, and attendance to the meetings, as this is a critical driver of output in this group.

13. Future plans. Which conclusions/or knowledge acquired of the WG do you think should be used in the Advisory process, if not already used? (please be specific)

- see above (questions 6 and 7)