OCEANS PAST NEWS No.6

NOVEMBER 2017

OCEANS PAST INITIATIVE

THE IMPORTANCE OF DEEP TIME

To anticipate impacts of widespread environmental change on marine ecosystems, we need **greater knowledge on long-term patterns and responses** that may be subtle, and associated with thresholds, feedbacks and/or temporal lags. In particular, comprehending the impacts of climate change on the oceans requires long-term data because it takes decades to millennia for systems to adjust to a new climatic state. Current research by the geological community is focusing on past periods of large-scale pCO_2 inputs, global warming, and related phenomena, e.g. ocean deoxygenation and acidification, to answer these questions. **These periods provide our only available analogues for the climate change**. In this issue of Oceans Past news, we consider ancient or 'palaeo' (or 'paleo') -ecological change in deep-time, and how it is helping us to understand the future ocean. The research covers hundreds to hundreds of millions of years ago, and includes the development of human civilizations and their use of ecosystems, the outcomes of a changing climate, as well as the evolution of fishes and the origin of animals that bioturbate the seafloor.

***Bryony Caswell**, Environmental Futures Research Institute*
Griffith University, Australia

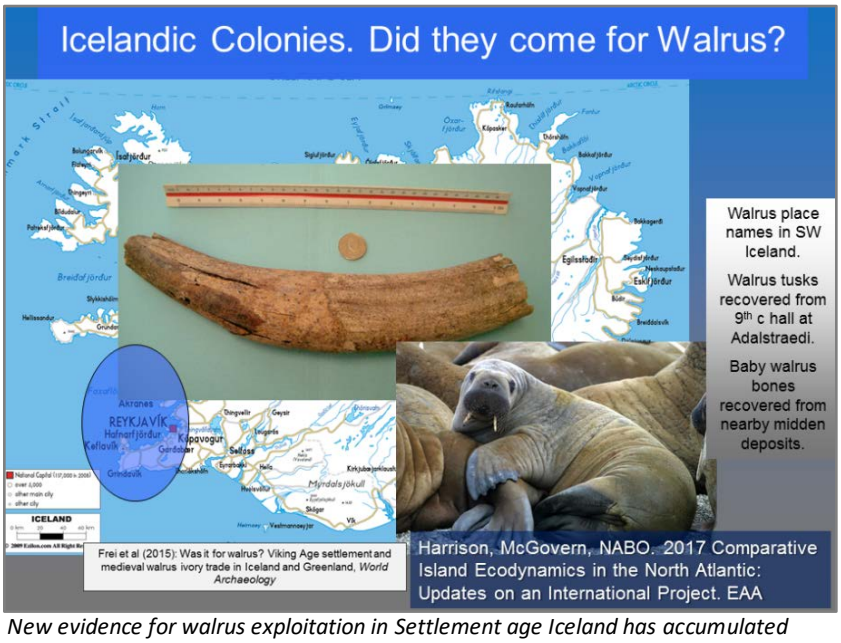
OCEANS PAST SPOTLIGHT*: PESAS

The **Paleoecology of Subarctic Seas (PESAS)**, a working group of the **Ecosystem Studies of Subarctic and Arctic Seas** (ESSAS, essas.arc.hokudai.ac.jp), includes historians, paleoecologists, paleoceanographers, and archaeologists studying the subarctic maritime regions of the North Pacific and North Atlantic. Initiated in 2014, we seek interdisciplinary syntheses of marine ecosystem dynamics and evolution, and probe a range of questions related to climate-ocean-ecology-human ecodynamics. PESAS is connected to the **North Atlantic Biocultural Organization** (www.nabohome.org/), the **IHOPE Circumpolar Network** (http://ihopenet.org/circumpolarnetworks/), and the **Society for American Archaeology's Climate Change Strategies and Archaeological Resources Committee**, as well as the Oceans Past Initiative.

Spatially, the PESAS framework includes both the North Pacific and North Atlantic. These basins share atmospheric and oceanographic characteristics and processes that make comparisons informative, including geographically analogous environmental structures and variability, the same or similar marine species, and related histories of maritime oriented human communities. Temporally, we focus on four intervals: the Deglacial (18-10Ka), early through mid-Holocene (ca. 10-3Ka), late Holocene (3-1Ka), and the past millennium. Each time interval is distinct in terms of temperature, seasonality, atmospheric and oceanographic circulation, biological productivity, ecological dynamics, and unique aspects in the histories of human settlement, economy, politics and social organization. Variables related to these characteristics are partially coupled, though the relationship between them has yet to be systematically explored over the temporal and spatial scales embraced by the PESAS effort.

Each issue of Oceans Past News includes a feature article to highlight research happening in our community, as either an **Oceans Past Spotlight or as **10 Questions**, which will pose the same 10 questions to different leaders in our field. If you would like be considered for either, or to nominate a colleague or mentee, please contact Emily Klein at emily.klein04@gmail.com.*

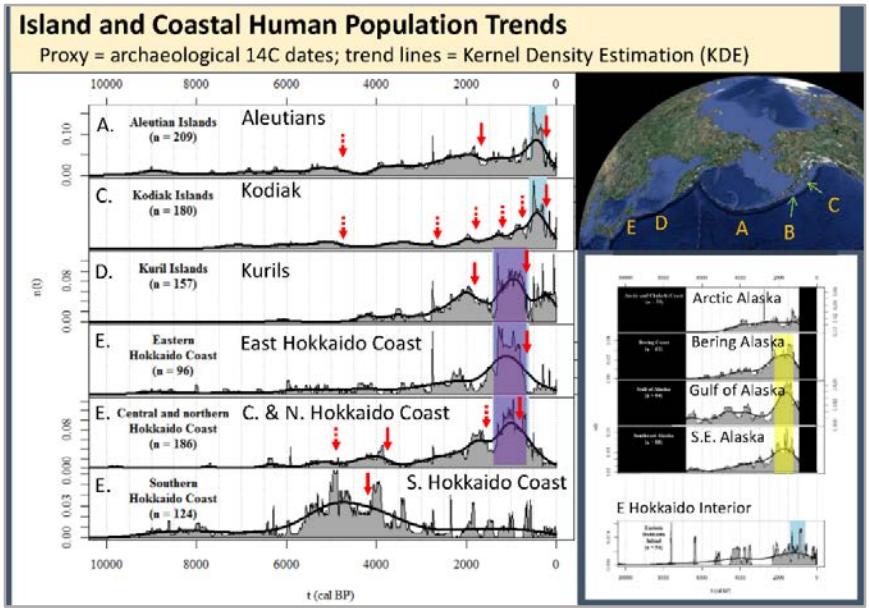
PESAS members have pursued a range of research, and our collaborations promise to advance understanding of subarctic ecosystem change in new ways. For example, **Vicki Szabo and others** in the North Atlantic Marine Mammal Project combine history, archaeology, ancient DNA, and mammalogy to reconstruct economic contributions of cetaceans and pinnipeds across premodern Iceland, Greenland, and Orkney, ca. 800–1500 CE, and **Nicole Misarti** is collaborating with **George Hambrecht and colleagues** to build on zooarchaeology and paleogenetics studies of marine taxa important to Medieval and early Modern economies. Also with Nicole Misarti, **Ben Fitzhugh and others** are exploring human and animal responses to millennial-scale climate changes across the North Pacific. Many PESAS investigations are in preparation for a special issue of *Quaternary Research*. Parallel studies from both basins and multiple locations within them are currently exploring:



New evidence for walrus exploitation in Settlement age Iceland has accumulated rapidly due to rescue excavations under modern Reykjavik. Stable Pb isotopes and aDNA offer the potential for further investigating the environmental history of Norse walrus hunting, and at least four collaborating projects are now focused on different aspects of the "white gold" producers. Modified from Harrison, et al. 2017.[1]

- millennial scale climate variability and marine primary productivity;
- sea ice, marine biology (e.g., walrus) and human economies (*see image above right*);
- paleo-stock variability of pelagic, benthic, and anadromous fish, human fisheries[2];
- social histories and human experiences in the subarctic from indigenous to expansionist economies (*below*).

Given the rapid pace of change in the world's climate, oceans and societies, PESAS embraces the potential of 'completed experiments of the past,' observed over multiple temporal and spatial scales, to inform future management strategies. We argue that the short time windows of much scientific instrumental and observational data are often insufficient to anticipate the range of dynamics operating on and within our marine ecosystem today. We are particularly excited to engage with OPI, and invite inquiries to develop collaborations and further a network of like-minded scientist. If interested, please contact **Ben Fitzhugh** (fitzhugh@uw.edu) or **Tom McGovern** (thomas.h.mcgovern@gmail.com).



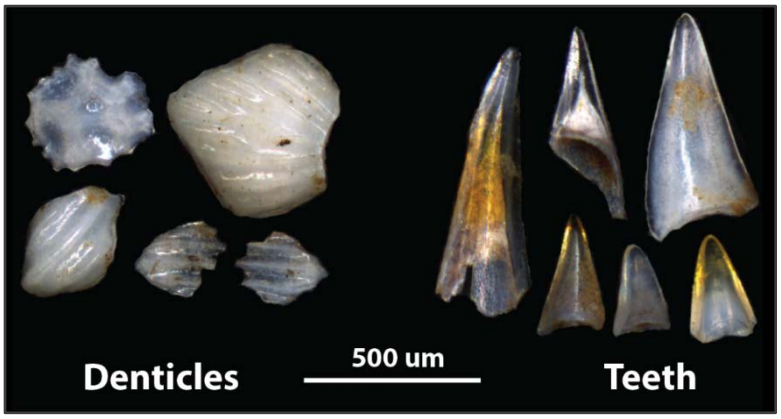
North Pacific human population estimates from the Gulf of Alaska, Aleutians, Kurils and Hokkaido based on archaeological radiocarbon data. PESAS collaborators are exploring whether patterns are related to oceanographic and ecological oscillations connected to millennial scale shifts in Aleutian Low pressure variability and/or different socio-economic conditions affecting hunter-gatherer communities. From Fitzhugh et al. 2017.[3]

[1] *Frei, K et al. (2015). Was it for walrus? Viking Age settlement and medieval walrus ivory trade in Iceland and Greenland.* World Archaeology. *doi:10.1080/00438243.2015.1025912.*

[2] *e.g. Ólafsdóttir, G. Á., et al. (2014). Historical DNA reveals the demographic history of Atlantic cod (*Gadus morhua*) in medieval and early modern Iceland.* Proc. R. Soc. B. *281(1777): 20132976.*

[3] *Fitzhugh, B. et al. (2017). Did Holocene Variability in Aleutian Low Dynamics Force Oscillations in Marine Ecosystems and Human Subsistence Harvesters? Presentation at the annual convention of the Geological Society for America. (Seattle, WA).*

RESEARCH NEWS



Example ichthyoliths, both denticles (shark scales) and teeth from the South Pacific gyre, from the Eocene (~45 million years old). Images taken by E. Sibert using the Hull Lab Imaging System at Yale University.

Fish microfossils offer exciting avenues to understand change in marine ecosystems. Understanding how fish, and marine ecosystems more broadly, may respond to anthropogenic impacts and climate change is extremely important, particularly for those who rely on fish as a food source or livelihood. Ichthyoliths, isolated microfossil fish teeth and shark scales, are preserved in nearly all marine sediments, and provide a unique resource to study fish evolution and marine ecosystem structure and function through time. Considered alongside other marine paleoproxies and fossil groups, ichthyoliths can reveal how fish, and their role in the marine ecosystem, has changed across major climate and biotic events in Earth's history, such as mass extinctions, global warming, and regional human invasion. **Elizabeth Sibert and colleagues** have developed a methodological framework to isolate and quantify ichthyoliths, preserved in marine sediments ranging from coastal coral reef rubble to deep-sea oozes, to reveal patterns of fish evolution, community structure, and productivity on timescales varying from hundreds to tens of millions of years. Using such knowledge to understand how fish responded to past perturbations and stressors can provide insight into how this important and diverse vertebrate group may change in the future. - *Elizabeth C. Sibert, Harvard University.*

Related publication: Sibert, E. C., K. L. Cramer, P. A. Hastings and R. D. Norris (2017). ***Methods for isolation and quantification of microfossil fish teeth and elasmobranch dermal denticles (ichthyoliths) from marine sediments****.* Palaeontologia Electronica ***20****(1): 1-14. http://bit.ly/2z2ijhe.*

Evidence of early bioturbation by benthic invertebrates: including trilobite resting/feeding trace, cnidarian resting traces and shallow dwelling burrows - from the Ordovician (approx. 486 million years ago), Bell Island, Newfoundland.

Burrowing worms as explosive engineers. The evolution of burrowing organisms has long been recognized as a fundamental aspect of the Cambrian Explosion of life in the oceans ~541 million years ago. In a new study, **Liam Herringshaw, Richard Callow and Duncan McIlroy** applied modern ecological criteria to assess the types of burrows preserved in the earliest Cambrian successions of Newfoundland, Canada. This research has enabled the possible impact of these tracemakers as ecosystem engineers to be assessed, and has shown that most of the major modern burrowing functional groups evolved by the earliest Cambrian. This work will be developed further in the new project, '**Worms On Film**', at the University of Hull, UK. This project will integrate geology and marine biology to explore how, when, and where vermiform organisms first began penetrating microbially bound marine substrates. These revolutionary changes in marine substrates would have had major implications for the way early ecosystems functioned e.g. to cycle nutrients throughout the marine realm. **Catherine Mascord** has been appointed as a Ph.D. student for this project, advised by Herringshaw, McIlroy, Mazik (Institute of Estuarine and Coastal Studies, Hull), and Parsons (Institute of Energy & Environment, Hull). - *Liam G. Herringshaw, University of Hull, UK.*

Related paper: L. G. Herringshaw, R. H. T. Callow, & D. McIlroy (2017). ***"Engineering the Cambrian explosion: the earliest bioturbators as ecosystem engineers****.* Geomechanics and Geology. *448. http://bit.ly/2A07Ocg/.*

Marine ecosystem resilience during extreme deoxygenation: Early Jurassic oceanic anoxic event provides clues for present day systems. During the early Jurassic (183 million years ago) pCO_2 inputs from clathrates/volcanism exceeded 4 Gt y^{-1}, and produced global temperature increases >7°C. These increases are analogous to those happening and anticipated today. To understand their implications, **Bryony Caswell and Chris Frid** investigated shifts in the ecological functioning of marine benthos using high-resolution paleontological data (100s–1000s of years) spanning a million years. Large shifts in biodiversity, body-size, and the population-size of the benthos occurred in response to ocean anoxia. Concurrent ecological impacts spanned multiple trophic levels, with changes in primary productivity impacting the macrobenthos and their pelagic predators, causing biogeographic range shifts. In addition, quantitative analyses of biological traits showed changes in core ecosystem functions and benthic-pelagic coupling. Overall, Jurassic ecosystems were functionally resilient, but ultimately functioning collapsed. Relationships between ecological change and proxies for paleoenvironmental change showed that hypoxia and primary productivity were important drivers of this collapse. Recovery from global anoxia was very slow, and connectivity, with potential sources of new recruits, was crucial. The ecosystem changes found by this work share many similarities with present-day hypoxic systems, illuminating how they may respond, and may recover.

183 million year old fossil ammonite (major predators on marine benthos) accumulation from North Yorkshire, UK that may represent a mass mortality event due to deoxygenation.

Related publication: B.A. Caswell & C.L.J. Frid (2017). ***Marine ecosystem resilience during extreme deoxygenation: Early Jurassic oceanic anoxic event.*** Oecologia, 183 (1), 275–290.

Marine archaeology offers insights on land too: Paleo-deltas and early human, environmental, and climate history. Paleo-deltas, like that of the Merrimack River in the Gulf of Maine (northeastern USA), and similar offshore submerged features offer research opportunities into early human migration and settlement, as well as valuable sources of climate and environmental data. **Stefan Claesson and colleagues** explored the value and scientific sampling potential of previously recovered specimens in the Gulf of Maine, focusing on isolated finds as indicators of submerged archaeological site preservation and as data sources about regional geomorphology, climate conditions, paleogenomics, and species extinctions in the terminal Pleistocene. These authors find submerged paleo-deltas to have deeply buried paleosols with significant preservation potential for early human and environmental history due to their depositional characteristics, and that they merit special recognition and protection from environmental and man-made activities that may impact or disturb these intact submerged landscapes. Finally, Clausson et al. note the cultural resource management implications and research opportunities of submerged environments in the northeastern US.

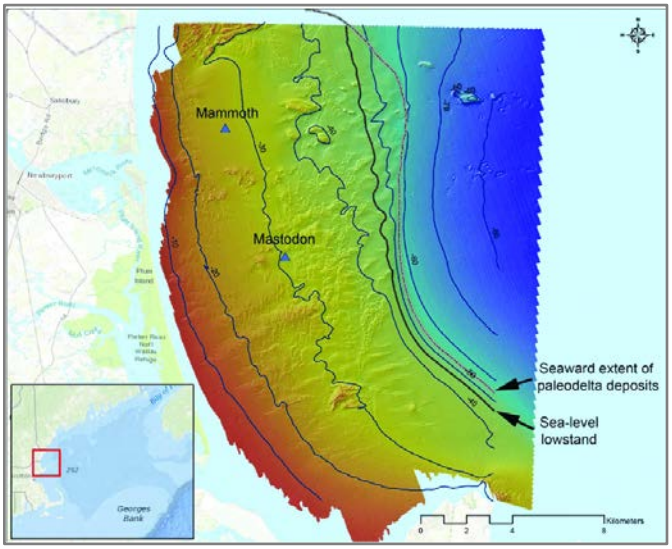


Fig. 1 from Claesson et al. Bathymetric map of the inner continental shelf of northeastern Massachusetts (Barnhardt et al., 2009), showing the extent of the Merrimack River paleo-delta approximately 7 km offshore the current coastline (gray dashed line).

Related publication: S. Claesson, S. Baleka, M. Hofreiter, & C. Widga (2017). **The contribution of Late Pleistocene megafauna finds to submerged archaeology and the interpretation of ancient coastal landscapes.** *Journal of Archaeological Science: Reports.* http://bit.ly/2gXvZn0.

COLLABORATIONS

New collaboration funded to study human communities across the Atlantic: The European Programme MSCA-RISE has recently funded a researcher's exchange project, "**CONCHA: The construction of early modern global Cities and oceanic networks in the Atlantic: An approach via Ocean's Cultural Heritage**". Connecting 11 partner institutions from Europe, Africa and the Americas, CONCHA's main goal is to address the different ways port cities developed around the Atlantic from the late 15th and early 18th century in relation to differing global, regional, and local ecological and economic environments. The project is chaired by Prof. **João Paulo Oliveira e Costa** and coordinated by **Cristina Brito** (CHAM-NOVA FCSH, UAc, Lisbon, Portugal), and is directly linked to the objectives of the UNESCO Chair The Ocean's Cultural Heritage (http://www.cham.fcsh.unl.pt/ext/catedra_eng/index.html). Funding supports CONCHA for 4 years, during which several research, education and scientific dissemination activities are planned.

RESOURCES

From the archives to the web: Historic data on biodiversity provide the context for present observations and allow the study of long-term changes in marine populations. **Tomas Fortibuoni and colleagues** aimed to identify, rescue, digitize, describe, and perform the quality control of historical data on fish and fisheries for the Adriatic Sea (Mediterranean) from the beginning of the 19th century onwards, and to make the resulting standardized datasets freely available online to end-users. These datasets on fish and fisheries cover the last two centuries and encompass a wide range of resources, from qualitative observations to standardized scientific monitoring. They consist of three groups: (1) early naturalists' descriptions of fish fauna, including information (e.g., presence, perceived abundance, size) on 255 fish species for the period 1818–1936; (2) historical landings from major Northern Adriatic fish markets (Venice, Trieste, Rijeka) for the period 1902–1968, Italian official landings for the Northern and Central Adriatic (1953–2012) and landings from the Lagoon of Venice (1945–2001); (3) trawl-survey data from seven surveys spanning the period 1948–1991 and including Catch per Unit of Effort data (kgh−1 and/or n h−1) for 956 hauls performed at 301 stations. The integration of these datasets has already been demonstrated as useful for analyzing historical marine community changes over time, and its availability through an open-source data portal will facilitate future analyses in the framework of marine historical ecology. It is available via Nature's Scientific Data, a peer-reviewed open-access journal: "**Fish and fishery historical data since the 19th Ce in the Adriatic Sea, Mediterranean**", **www.nature.com/articles/sdata2017104**.

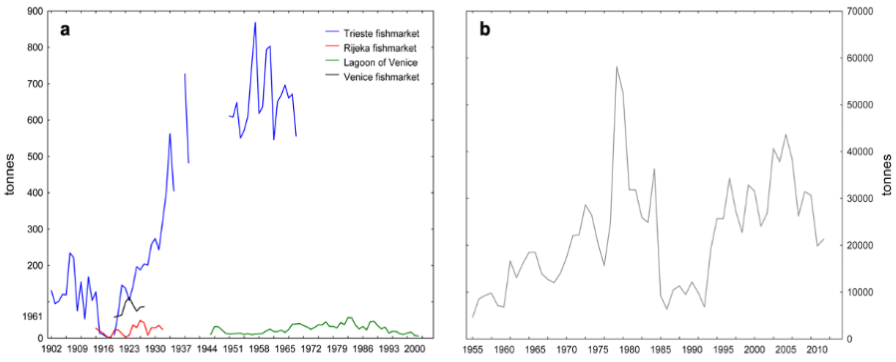


*Fig. 2 from Fortibuoni et al.: Example of landings available by species, in this case two sources of data for European anchovy (*Engaulis encrasicolus*).*

OPPORTUNITIES

New Bedford Whaling Museum opens search for new President and CEO. This is the rare opportunity to take the helm of the **New Bedford Whaling Museum,** a vibrant and healthy organization founded in 1903, and steer it into the future. More information is available at https://koyapartners.com/search/president-ceo-11/, and those interested can apply at https://koya.refineapp.com/jobPosting/apply/1821. To suggest potential candidates, please contact **Anne McCarthy & Erin Reedy**, leads for the search via Koya Leadership Partners, at koyachicago@koyapartners.com.

Doctoral opportunity in medieval and early modern nautical charts: PhD scholarship open with the European Research Council project "MEDEA-CHART", in the Faculty of Sciences at the University of Lisbon in Portugal. The project focus on the origin, technical evolution and use of the medieval and early modern nautical charts. Applications should be emailed to medea-chart@ciuhct.org by **26 November 2017**. Further details at **http://bit.ly/2zwbIcF**.

NEW PUBLICATIONS

Armstrong, C. G. et al. (2017). **Anthropological contributions to historical ecology: 50 questions, infinite prospects.** *PLOS ONE*. https://doi.org/10.1371/journal.pone.0171883.

Braje, T. J, & T. C. Rick, P. Szpak, S. D. Newsome, J. M. McCain, E. A. Elliott Smith, M. Glassow, S. L. Hamilton (2017). **Historical ecology and the conservation of large, hermaphroditic fishes in Pacific Coast kelp forest ecosystems.** *Science Advances*. 3(2). doi: 10.1126/sciadv.1601759.

Caswell, B. A., & C. L. J. Frid (2017). **Marine ecosystem resilience during extreme deoxygenation: the Early Jurassic oceanic anoxic event.** *Oecologia*, 183 (1), 275–290.

Claesson, S. & S. Baleka, M. Hofreiter, & C. Widga (2017). **The contribution of Late Pleistocene megafauna finds to submerged archaeology and the interpretation of ancient coastal landscapes.** *Journal of Archaeological Science: Reports.* 15: 290.298. https://doi.org/10.1016/j.jasrep.2017.08.007

Erlandson, J. M. (2017). **Coastlines, marine ecology, and maritime dispersals in human history.** In *Human Dispersal and Species Movement*, N. Boivin, R. Crassard, & M. Petraglia *eds*. Cambridge University Press. pp 147-163.

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

Herringshaw, L. G., & R. H. T. Callow, & D. McIlroy (2017). "**Engineering the Cambrian explosion: the earliest bioturbators as ecosystem engineers**. *Geomechanics and Geology*. 448. https://doi.org/10.1144/SP448.18.

Sibert, E. C., & K. L. Cramer, P. A. Hastings, R. D. Norris (2017). **Methods for isolation and quantification of microfossil fish teeth and elasmobranch dermal denticles (ichthyoliths) from marine sediments**. *Palaeontologia Electronica* 20(1): 1-14. https://doi.org/10.26879/677.

Yasuhara, M., & D. P. Tittensor, H. Hillebrand, B. Worm (2017). **Combining marine macroecology and palaeoecology in understanding biodiversity: microfossils as a model.** *Biological Reviews*. 92(1):199-215. doi:10.1111/brv.12223.

ANNOUNCEMENTS: PLEASE PARTICIPATE

Overcoming objections: harnessing the full potential of historical research for marine policy development. Have you encountered objections that your work is not required, relevant, or lacks evidential foundation for application in management and policy, despite the increasing literature demonstrating its potential? A new **OPI** project aims to survey the community on these objections, and which have been the greatest hurdles to advancing research or having findings accepted by fisheries managers and policy makers. The survey will be posted on the OPI website (http://oceanspast.org/index.html) for you to download, complete, and return. The study team, led by **Alison MacDiarmid and Gesche Krause**, will collate the range of objections encountered, explore their validity, recommend robust rebuttal arguments where warranted, and provide advice. Results will be presented at the 2018 **Oceans Past VII** conference in Bremerhaven, and published in the conference proceedings. Your participation is essential to the success of this study! Please watch for emails, check the website, and help spread the word once the survey is live.

ANNOUNCEMENTS: CONFERENCES

Oceans Past VII in Bremerhaven, Germany, 22-26 October 2018: Please join the community for Oceans Past VII, "**Tracing human interactions with marine ecosystems through deep time: implications for policy and management**." Knowing the past is vital for developing a vision of the future. The oceans and inshore seascapes of the world are rapidly changing, and understanding the human and marine ecosystem forces, trajectories and responses – sometimes over centuries or millennia – is vital for their informed management. Understanding, quantifying, and predicting humanities interactions with the world's coastal seas and oceans requires examination of our practices of consumption, transportation, extraction and pollution, as well as our values and governance systems. The conference aims to bring together the vast knowledge pool of two decades of marine historical ecology and environmental history to inform the policies of the Anthropocene. Oceans Past VI welcomes researchers, practitioners, policy-makers and students of all disciplines under the unifying view of our oceans as networks of social-ecological or coupled human-nature systems. If you have an interest in the history of human interactions with life in the ocean and implications for policy and management, this is the 2018 conference you must attend. For more information, please visit *https://www.awi.de/conferences/opp7*.

Sustaining the Seas: Fish, Oceanic Space and the Politics of Caring. University of Sydney, Australia. 11-13 December 2017. *Conveners are particularly interested on historical perspectives; marine historical ecologists and environmental historians are encouraged to attend. http://www.sustainablefishlab.org/sustaining-the-seas-conference/*.

The University of Toronto's Centre for Comparative Literature's 28th Annual Conference, **The Ocean and the Seas/L'océan et les mers**, will be held on the unceded territory of the Huron-Wendat and Petun First Nations, the Seneca, and most recently, the Mississaugas of the Credit River, at the University of Toronto, on February 23 and 24, 2018. More information at *https://complitconference2018.wordpress.com/*.

International Conferences on Environmental Humanities, **"Stories, Myths, and Arts to Envision a Change."** Alcalá de Henares, July 3-6, 2018. More information at *http://www.institutofranklin.net/en/events/international-conference-on-environmental-humanities/*.

CONTACT

Oceans Past News is a quarterly newsletter that aspires to both unite and inform the worldwide community interested in historical perspectives of marine social-ecological systems by providing insight into the wide-ranging and excellent work being done and the resources available. If you would like to propose work for OPN in the future, please contact our editors, **Emily Klein** (emily.klein04@gmail.com) or **Cristina Brito** (escolademar@gmail.com).

*The next Oceans Past News will be out mid-January 2018. We **warmly welcome submissions** through the end of 2017.*

RESOURCES

The Oceans Past News Archive is available online: **http://oceanspast.org/newsletter.html**
More on the Oceans Past Initiative: **http://oceanspast.org/index.html**
We are also on Facebook: **https://www.facebook.com/groups/122288493384/**