



Exploratory Workshop Scheme

Scientific Review Group for Life, Earth
and Environmental Sciences

ESF Exploratory Workshop on

Marine woodborers: new frontiers for European waters

Venice (Italy), 14-16 April 2013

Convened by:

**Davide Tagliapietra, Erica Keppel
and Marco Sigovini**

SCIENTIFIC REPORT

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1. Executive summary

The workshop was held in Venice (Italy) from the 14th to the 16th of April 2013 at the San Servolo Island and hosted by the VIU Venice International University. The location served both as a hotel and as a conference centre and it conveniently provided all the facilities needed at a single location. It was organized by Davide Tagliapietra, Marco Sigovini and Erica Keppel, Institute of Marine Sciences, Italian National Research Council (CNR-ISMAR), Venice, Italy). In addition to the main funding provided by the European Science Foundation (ESF), the workshop was partly supported by the CNR-ISMAR.

The workshop brought together a total of 18 participants from 9 countries (Denmark, Germany, Italy, Netherlands, Sweden, Turkey, United Kingdom together with Colombia and USA). The scientific background of the participants was quite diverse ranging from biology to archeology. The positive atmosphere of the workshop was ideal for the aim of the workshop, since all the attendees participated in the discussions in a very constructive and friendly manner. The venue of the workshop, where all the participants were accommodated, as well as coffee-breaks, meals and gala dinner, contributed to these positive synergies and the emergence of new ideas and collaborations.

The agenda of the workshop was to focus on:

- 1) bringing together experts in complementary fields that have hitherto not collaborated as a group;
- 2) identifying additional research competences that are not covered within the group of participants;
- 3) identifying, exchanging and sharing research interests for future joint leading research projects and developing application strategies;
- 4) the establishment of an international network on marine woodborers.

The participants recognised that this was a unique event as it brought together archaeologists and biologists with an interest in engaging with common questions.

The objective was to facilitate an interdisciplinary approach. The main outcomes of the workshop were the establishment of a research network aiming to coordinate scientists with an European perspective and a global view. Specific aims of such a network were to facilitate the possibility for participants to explore new research areas and future collaborations, explore potential topics for joint papers, develop research plans to be submitted to the EU or other funding agencies.

The interaction among participants also inspired meetings to come for implementing new collaborations at the interfaces between biology – ecology – archeology –chemistry – engineering.

We dedicated the first morning to introduce the discussion topics (as further specified in the next paragraph). While a full day was dedicated to the general discussion of the workshop and the follow-up activities. The introduction of the workshop was handled in a welcoming and friendly manner by the ESF representative, prof. Judit Padisák from University of Pannonia, Veszprém Hungary, who contributed very efficiently to the success of the initiative.

In the afternoon the participants were divided into three discussion tables around a specific topic according to the “knowledge café” approach. One person was chosen to lead each table acting as "rapporteur" for the following rounds and the final discussion. All attendees participated in each discussion table, switching from a table to another every half an hour so that everyone could give their contribution to every discussion topic. The method chosen proved to be effective, the discussion was fluent at each table, giving rise to many discussion points, development of proposals and ideas.

The key points arising from each table were presented to the assembly the following day by the rapporteurs.

The knowledge café and the subsequent debate lead to the identification of the gaps of knowledge in marine woodborer research and put the foundations for the elaboration of a common strategy between experts in Europe through the establishment of a research network.



The workshop has been very productive and it has met the set targets. Many colleagues were enthusiastic as they have had the opportunity to meet scientists of whom they had only knew from their published work or who only had contact by email because, belonging to different scientific disciplines hardly attended the same conferences.



The establishment of a research network on marine woodborers and the active involvement of the attendees was accepted unanimously by acclamation.

2. Scientific content of the event

The workshop put in the focal point a group of organisms that, due to their peculiar ecology, interact with any woody substrate present in the sea.

The choice of wood as habitat and food source combined with the adoption of very specific life history strategies, led to strong changes in their morphology and physiology, and the evolution of complex bacterial symbiosis.

These evolutionary modifications have put marine woodborers in direct conflict with another main user of timber in the marine environment, the humans.

The presentations were then designed so as to have an overview of the topic from the four compass points: life history strategies, biogeography, macro-microorganism symbiosis, cultural heritage. It was thus presented the "state of the art" on the main aspects of the topic. Dr. S.M. Cragg (University of Portsmouth, UK) opened the session examining the selective advantages given by different breeding patterns and larval development in teredinids. Seasonal regular breeding species were compared to species having rapid repeated gametogenic and brooding cycles. The selective benefits obtained by planktotrophic larvae, able to cross wide ocean distances, were compared to those given by pediveliger larvae ready to colonize new wood in few hours. Dr. Cragg illustrated how a combination of electron microscopy and fluorescence microscopy is used to reveal the fine functional anatomy of teredinid larvae. It followed a short but exhaustive overview of the ecology of wood-boring crustaceans with special focus on the marine boring isopods belonging to the genus *Limnoria* including recent research on epibiota supported by fine SEM images.

The presentation of Dr. L. Borges (Helmholtz-Zentrum Geesthacht, DE) offered an overview on the biogeography of wood-boring bivalves in European Seas. The distribution patterns were discussed on the light of the results of niche-based models used to predict the potential distribution of shipworms. Teredinids is a group particularly difficult to identify from morphological features. Dr. Borges highlighted, therefore, the importance of an "integrated taxonomy" combining evidence from morphology, DNA barcodes and nuclear locus sequences. The use of this integrative approach is proposed for improving taxonomic resolution between and within teredinids species.

The nature of symbiotic interactions between wood-boring bivalves and bacteria was the focus of Dr. D.L. Distel (Ocean Genome Legacy, USA). The scientist exposed current research and findings on bacterial endosymbioses found in the wood-boring bivalves. Dr. Distel illustrated how molecular approaches proved that nitrogen compounds fixed by endosymbiotic bacteria are directly transferred to the bivalve tissues. Host-symbiont interactions were outlined from both physiological and evolutionary perspectives, showing ongoing research aimed to determine the diversity within symbiont populations per se and in comparison to the diversity within shipworm populations.

Dr. D.J. Gregory (National Museum of Denmark, DK) brought the perspective and knowledge of marine archaeologists, who work actively in the protection of maritime cultural heritage. The archaeologist presented the main problems related to the impact of marine woodborers on wooden shipwrecks. The presentation was accompanied by the illustration of case studies with examples of protection techniques. The concern of the spread of the attack woodborers even in areas, where its presence was previously not recorded, such as the Baltic Sea, has been increased. Dr. Gregory has highlighted the urgent need for scientific research on protection of maritime cultural heritage in this specific field.

The discussion that followed the presentations involved immediately all the attendants, including those that deal with the engineering protection of wooden maritime structures.

The presentations were accompanied by posters displaying some specific studies and research.

3. Assessment of the results, contribution to the future direction of the field, outcome

The key goal for the gathered scientists was developing a common research strategy for marine woodborers research. The skills and interests of the group are broad, but at the same time focused on a single topic: the ecology of marine wood borers and the management / prevention of wood decay with particular emphasis on underwater cultural heritage. Unexpected additional benefits/outcomes could be hopefully gained through the interactions among the participants.

The overall conclusion of the workshop was that all the participants are strongly motivated in structuring a network. This has important consequences for both ecology and for wood conservation.

The network on marine woodborer research has, therefore, been established in Venice on April 16th 2013. All participants decided to join the network. It was also decided to contact other interested colleagues to further expand the network.

The workshop identified number of open questions that need to be addressed in the near future.

We begin to understand some physiological mechanisms of these peculiar functional group of organisms. Methods to reveal their identity and function are now being developed and should be fully exploited.

The driving factors of symbiosis should be studied and understood in light of their potential use in wood conservation; the interaction between woodborer and symbionts is not known entirely, and there are some gaps in understanding the interaction mechanisms and the significance of these interactions in biocoenotic and ecological contexts.

Molecular studies begin to help the identification of species but they have to be integrated with the morphological studies and vice-versa.

The result was a list of about 100 points which deserve to be treated later, obviously with different importance. The most important areas which will be focused upon in the future are discussed below:

Table A: Systematics & Biogeography

1. How to improve confidence in taxonomic information?
2. How to improve biogeographic information?
3. Resolve life history questions.
4. Improve methods.

Table B: Marine woodborer–microorganism interactions

1. Resolving the symbiont communities.
2. Cellulose digestion.
3. Nitrogen fixation.

Table C: Protection of shipwrecks and maritime structures

1. EN275 guidelines are inappropriate, new methods for testing wood degradation need to be decided and standardised.
2. Comprehension of larval settlement and how larvae detect wood.
3. Methods for dating teredinid attack.
4. New solutions for the preservation of maritime structures.

General

1. Everyone is interested in joining a network.
2. Taxonomy.
 - a. Research websites for developing shipworm identification keys (interactive key, discover life, encyclopedia of life etc). Digitise and circulation of Turner (1972) PDF keys.
 - b. Deposit specimens and obtain vouchers numbers from museum.
 - c. Submit DNA to Ocean Genome Legacy, DNA barcoding of species.
3. Research grants for ongoing networking/funding opportunities (Horizon ESF, EU, NATO etc).
4. Find large scale time series experiment for collaboration on teredinid monitoring.

These areas should be part of the future research agenda. A detailed list of the key points that emerged during the knowledge café is posted on the provisional website of the network <https://sites.google.com/site/mww2013venice/workshop-outputs>.

To start the network activities the participants agreed on some simple but concrete follow-up actions.

a. Common samplings and experiments. A simple experiment has been proposed: the simultaneous collection of shipworm specimens from different geographic areas. Similar wood substrates will be exposed to woodborer attack using the same protocol at the field stations of the network members.

b. Setting up a website on Marine Woodborer research as a platform for the scientific community. It was proposed to use, after appropriate upgrading, the website used for the organization of the workshop. ISMAR has offered to host the website of the newly established network on its website and server.

c. Look for funding. Look for ongoing networking/funding opportunities (Horizon ESF, EU, NATO etc).

d. Bibliography. Start a common bibliographic repository.

e. Identification keys. Search websites for developing shipworm identification keys (interactive key discover life, encyclopedia of life etc).

f. Genetic. Begin to exchange specimens for genetic analysis of woodborers.

g. Setting up common protocols. The lack of standard research and assessment protocols emerged. It was therefore decided to proceed first to a survey of existing protocols, then possibly, to review them.

h. Exchange experiences and personnel. The majority of the participants were in favour of a direct exchange of knowledge, possibly through the mobility of researchers and visiting periods.

i. Special issue on Marine Woodborers. Submit a proposal for a special journal issue on Marine Woodborers in an international peer-reviewed journal.

5. Final list of participants

Michael J. Ahrens	Universidad de Bogotá J. T. Lozano, CO
Christin Appelqvist	Göteborgs universitet, SE
Charlotte Björda	Göteborgs universitet, SE
Luisa Borges	Helmholtz-Zentrum Geesthacht, DE
Simon M. Cragg	University of Portsmouth, UK
Daniel L. Distel	Ocean Genome Legacy, US
David J. Gregory	Nationalmuseet, DK
Kai Hoppe	Küstenbiologie, DE
Kristine M.L. Hutalle-Schmelzer	Georg-August-Universität Göttingen, SE
Erica Keppel	CNR-ISMAR, IT
Peter Paalvast	Ecoconsult, NL
Sabrina Palanti	CNR-IVALSA, IT
Paola Palma	Bournemouth University, UK
Reuben Shipway	University of Portsmouth, UK
Marco Sigovini	CNR-ISMAR, IT
Hüseyin Sivrikaya	Bartın Üniversitesi, TR
Davide Tagliapietra	CNR-ISMAR, IT
Ronny Weigelt	Universität Rostock, DE

6. Statistical information on participants

Age [years]	
<30	3
30-50	8
>50	7

Sex	
Females	7
Males	11

Countries of origin	
EU	
Denmark	1
Italy	4
Germany	3
The Netherlands	1
Sweden	3
Turkey	1
United Kingdom	3
Non-EU	
Colombia	1
United States	1