

# **COST Action FA1406 (2015-2019)**

## **WG4 (TASK 4: DEVELOPMENT OF TECHNICAL TOOLS)**

***Final Report***

*Christos Katsaros*

# WORKSHOP 1

## Macroalgal development and cultivation

### Workshop & Training School on seaweed cultivation February 15-19, 2016

Well-known Scientists meet and discuss with  
Young Researchers & Consultants & Farmers



Workshop 1 : Feb. 15-16, 2016

Title: Macroalgae development and cultivation

Place: Fisheries Research Institute ([www.inale.gr](http://www.inale.gr)), Hellenic Agricultural Organization-DEMETER, in Nea Peramos, Kavala, Greece.

Participants: More than 35 phycologists participated, including both academics and aquaculture R&D experts, from 15 different countries (Belgium, Croatia, Cyprus, Denmark, Estonia, France, Germany, Greece, Israel, Italy, Morocco, Portugal, United Kingdom, Spain, and Turkey)



# TRAINING SCHOOL 1

Seaweed cultivation  
techniques



# WORKSHOP 2

## Imaging seaweed cells and tissues




### SEAWEED IMAGING AND CELL BIOLOGY WORKSHOP AND TRAINING SCHOOL

November 12 - 16, 2018  
Station Biologique, Roscoff, France

**WORKSHOP:**  
“Imaging seaweed cells and tissues”  
12-13 November 2018  
max. 90 participants

**TRAINING SCHOOL:**  
“State-of-the-art techniques for imaging cell and tissues of macroalgae”  
14-15-16 November 2018  
max. 12 participants



SPEAKERS	
<p><b>David Domozych</b> Skidmore Microscopy Imaging Center, Biology Department, Saratoga Springs, USA</p>	<p>1. Fifty shades of green: the secret life of a charophyte 2. The cell walls of photosynthetic eukaryotes: common themes but mysteries galore.</p>
<p><b>Benedicte Charrier</b> SBR, France</p>	<p>Vesicle trafficking dynamics in brown algae: setting up FRAP in <i>Ectocarpus</i></p>
<p><b>Chikako Nagasato</b> Muroran Marine Station, Hokkaido University, Japan</p>	<p>Plasmodesmata in brown algae: structure and macromolecular transportation</p>
<p><b>Clément Laigle</b> Leica Co.</p>	<p>Light Sheet microscopy</p>
<p><b>Philippe Andrey</b> Institut Jean-Pierre Bourgin, UMR1318 INRA - AgroParis Tech</p>	<p>Image analysis and computational modelling of cell divisions in plant early embryogenesis</p>
<p><b>Thomas Torode</b> Sainsbury Laboratory, University of Cambridge</p>	<p>Biochemical and Biomechanical techniques to study the cell walls of the brown algae</p>
<p><b>Nadine Peireyras</b> BIOEMERGENCE Lab</p>	<p>3D and 4D imaging in marine metazoa embryos</p>
<p><b>Analisa Falace</b> University of Trieste, Italy</p>	<p>Scanning electron microscopy for the study of Coralline algae</p>
<p><b>Christos Katsaros</b> Department of Biology, University of Athens, Greece</p>	<p>Cell division in brown algae: More than 40 years of research</p>
<p><b>Frithjof C. Küpper</b> School of Biological Sciences, University of Aberdeen</p>	<p>Nano X-ray fluorescence tomography (SR-nXRF) for imaging element distribution at the subcellular level in algae</p>
<p><b>Catherine Reeb</b> Museum National d'Histoire Naturel (ISYEB laboratory), Paris</p>	<p>MorphoSnake: A semi-automated analysis of branched shapes</p>
<p><b>Ameressa Tsirogiti</b> Department of Biology, University of Athens, Greece</p>	<p>Ultrastructural and immunofluorescence study of the infection of brown algae by oomycetes</p>
<p><b>Hervé Rabillé</b> SBR, France</p>	<p>Mapping dynamic cell expansion</p>
<p><b>D. Saint-Marcoux</b> University Saint-Etienne, France</p>	<p>Laser capture microdissection in macroalgae: Cell-type specific transcriptome of <i>Ectocarpus siliculosus</i></p>
<p><b>Cécile Hervé</b> SBR, France</p>	<p>Cell wall biology: immunolocalisation of polysaccharides using specific probes</p>
<p><b>Kenny Bogaert</b> Department of Biology, Ghent University, Belgium</p>	<p>Maternal determination of the direction of the polarization vector in the egg of the brown alga <i>Dictyota</i> and implications of cell polarization</p>
<p><b>Bernard Kioareg</b> SBR, France</p>	<p>EMBRIC and ASSEMBLE plus: European instruments to access the marine laboratories in Europe</p>

For more information please see the Phycomorph website  
[www.phycomorph.org](http://www.phycomorph.org)

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[benedicte.charrier@sb-roscoff.fr](mailto:benedicte.charrier@sb-roscoff.fr)

Venue of the workshop:  
Conference room SBR  
[www.sb-roscoff.fr](http://www.sb-roscoff.fr)



Station Biologique  
Roscoff

The meeting is organized by:  
Christos Katsaros,  
Sophie Le Panse and  
Bénédicte Charrier

Funded by:  
the COST Action FA1406

Workshop 2 : November 12-14, 2018

Title: Imaging seaweed cells and tissues

Place: Station Biologique, Roscoff, France.

Participants: More than 40 phycologists participated, including both academics and aquaculture R&D experts, from 11 different countries (Egypt, France, Portugal, Belgium, Germany, Italy, Greece, United Kingdom, Japan, Israel, and Scotland). Apart from the above, experts from companies producing specific instruments for observation and imaging of cells and tissues were invited, who gave talks and trained the young trainees



# TRAINING SCHOOL 2

## State-of-the-art techniques for imaging cells and tissues of macroalgae



# STSM (Short Term Scientific Missions)

- 12 young scientists moved to collaborating laboratories to accomplish specific experiments and/or to be trained to specific techniques

# PARTICIPATIONS to STSMs

- **Fatemeh Ghaderiardakani** to Jena, Germany (Thomas Wichard)
- **Fatemeh Ghaderiardakani** to ALGApplus, Produção, Portugal (Helena Abreu)
- **Mark Polikovsky** to Jena, Germany (Thomas Wichard)
- **Neusa Elisabete** Martins to Alfred-Wegener-Institute Helmholtz Center for Polar and Marine Research, Bremerhaven, DE (Inka Bartsch)
- **Hervé Rabillé** to University of Athens, Greece (Christos Katsaros)
- **Jessica Knoop** to ALGApplus Lda, Ílhavo, Portugal (Helena Abreu)
- **Marina Linardic** to Gent University, Belgium (Olivier De Clerck)
- **Pol Carbó Mestre** to Israel Oceanographic & Limnological Research, The National Institute of Oceanography, Haifa, Israel (Alvaro Israel)
- **Aude Le Bail** to Station Biologique de Roscoff, Roscoff, France (Bénédicte Charrier)
- **Meiron Zollmann** to NIOZ Royal Netherlands Institute for Sea Research, Yerseke, Netherlands (Klaas Timmermans)
- **Omri Nahor** to Jena, Germany (Thomas Wichard)
- **Aziz Ben Ghedifa** to University of Malaga, Spain (Felix Lopez-Figuroa)

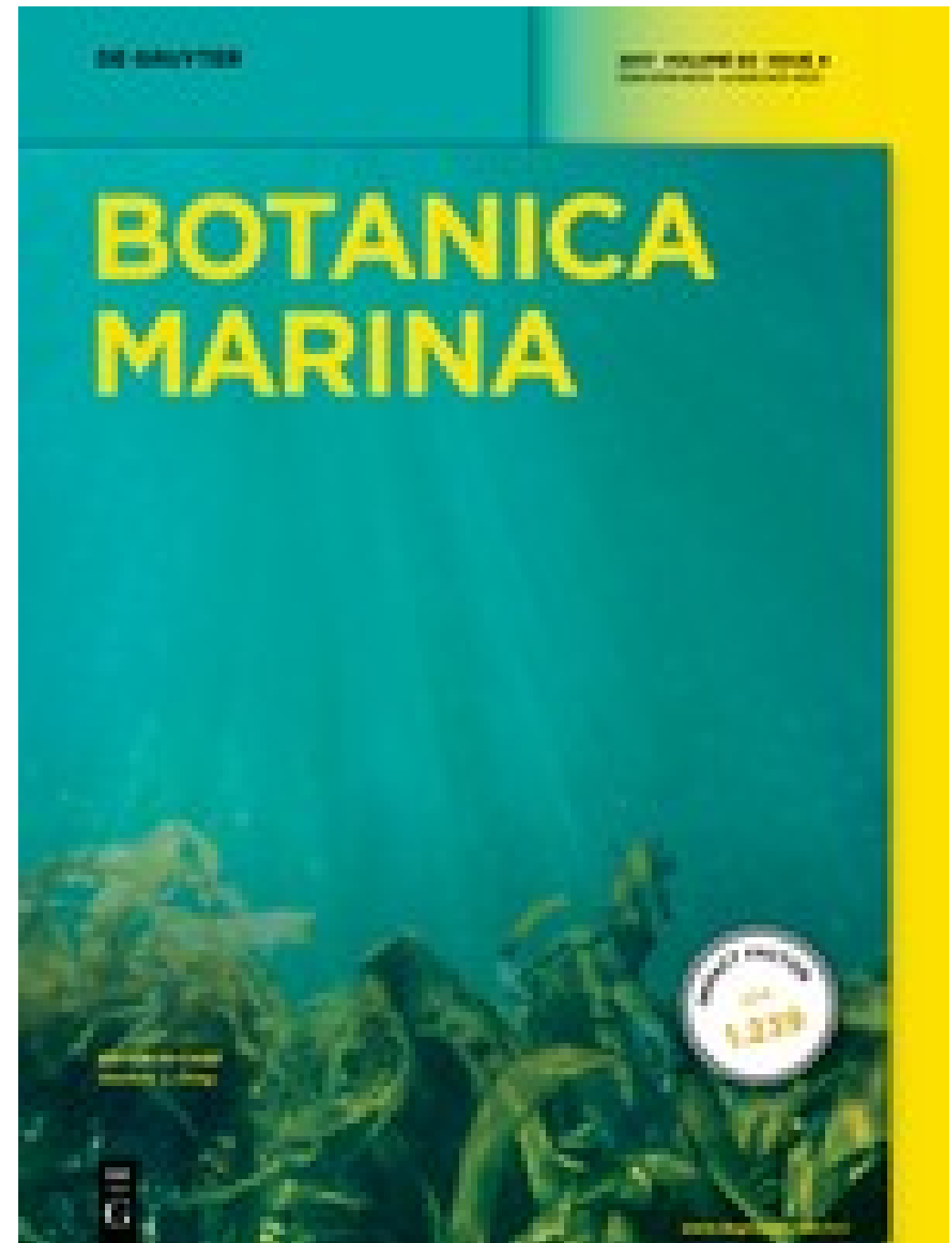
# **PUBLICATIONS**

## **Special Issue of Botanica Marina**

### **Vol. 60, Issue 2, 2017**

- Title: “Phycomorph: macroalgal development and morphogenesis”
- Issue editors: Thomas Wichard and Christos Katsaros
- [https://  
www.degruyter.com/view/j/botm.2017.60.issue-2/issue-files/botm.2017.60.issue-2.xml](https://www.degruyter.com/view/j/botm.2017.60.issue-2/issue-files/botm.2017.60.issue-2.xml)

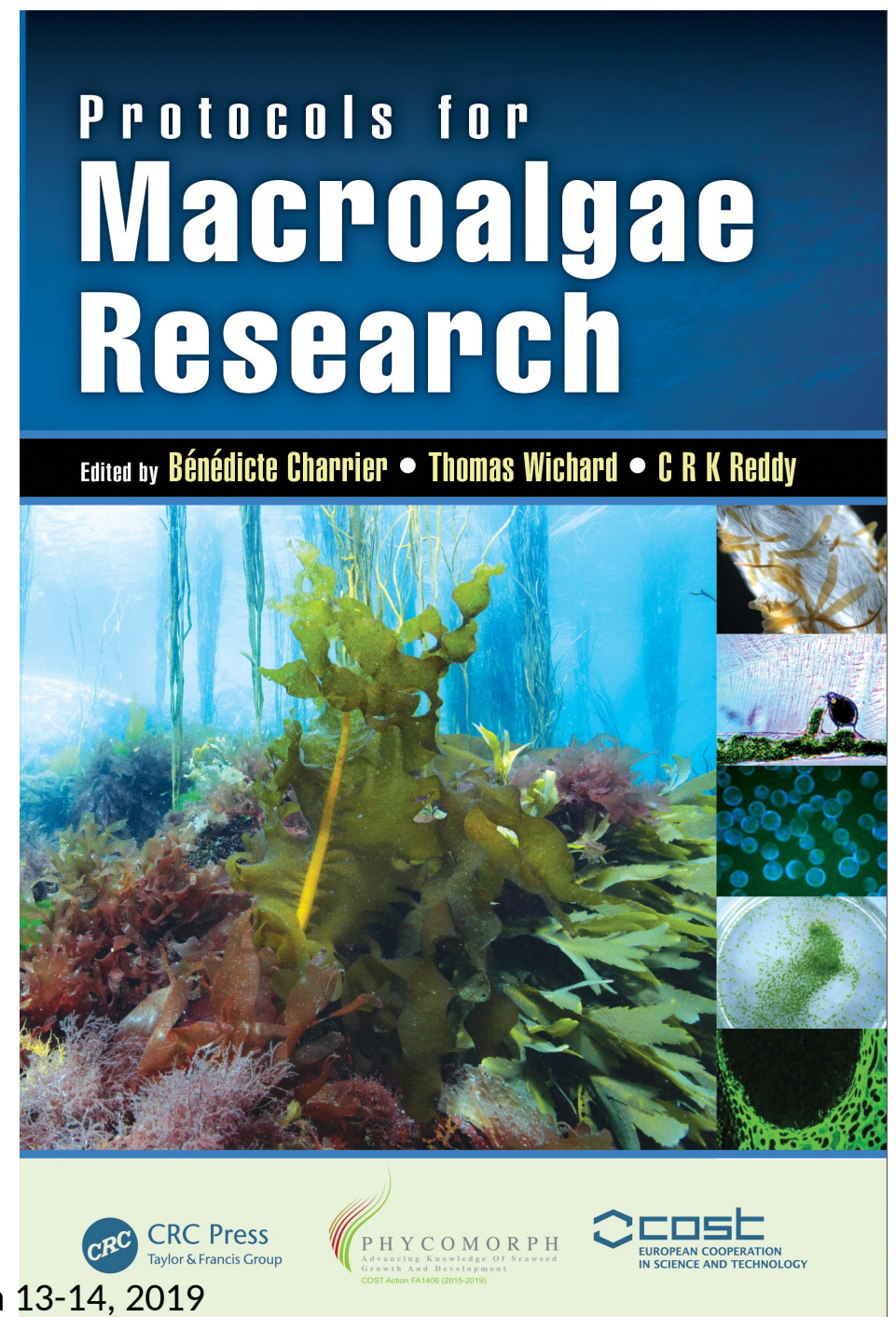
- 5 articles on Reproduction
- 4 articles on Development and Morphogenesis
- 3 articles on Techniques and applications



# PUBLICATIONS

- Book title: “Protocols for macroalgae research”
- Editors: B. Charrier, T. Wichard, C.R.K. Reddy
- CRC Press, Taylor and Francis Group. 2017

Three sections, 31 chapters



## Section I: Cultivating and preserving seaweeds

**Chapter 1 Seaweed in high-energy environments: Protocol to move *Saccharina* cultivation offshore** *Bela H. Buck and Britta Grote*

**Chapter 2 Cultivation protocol for *Saccharina latissima*** *Silje Forbord, Kristine Braaten Steinhovden, Kaia Kjølbo Rød, Aleksander Handâ, and Jorunn Skjermo*

**Chapter 3 Derivation of clonal stock cultures and hybridization of kelps: A tool for strain preservation and breeding programs** *Inka Bartsch*

**Chapter 4 Cryopreservation of macroalgae** *John G. Day*

**Chapter 5 Unraveling seaweeds bacteriomes: From field site to computer screen** *Tânia Aires, Gerard Muyzer, Ester A. Serrão, and Aschwin H. Engelen*

**Chapter 6 Heavy metal ecotoxicity on the early life history stages of macroalgae** *Pablo P. Leal and Michael Y. Roleda*

**Chapter 7 A simple protocol for a rapid and consistent production of large number of viable protoplasts from the *Ulvophyceae* species** *Vishal Gupta and C.R.K. Reddy*

**Chapter 8 Purification of sporulation and swarming inhibitors from *Ulva*: Application in algal life-cycle controlling** *Ralf W. Kessler, Taghreed Alsufyani, and Thomas Wichard*

**Chapter 9 Preparation of axenic cultures in *Ulva* (Chlorophyta)** *Gianmaria Califano and Thomas Wichard*

## **Section II: Chemical composition**

**Chapter 10 Biochar production from seaweeds** *Loretto Contreras-Porcia, Matvas Araya, Elizabeth Garrido-Ramvrez, Cristian Bulboa, Jean Pierre Remonsellez, Javier Zapata, Camila Espinoza, and Jorge Rivas*

**Chapter 11 Identification and quantification of laminarins in brown algae** *Angelika Graiff, Wolfgang Ruth, and Ulf Karsten*

**Chapter 12 Determination of carbohydrate composition of macroalgae** *Wouter J.J. Huijgen, E.M. Cobussen-Pool, B.F. van Egmond, and J.W. van Hal*

**Chapter 13 Quantification of proteins in seaweeds** *Carl Safi, Jelle van Leeuwen, Yvette Telleman, Nicole Engelen-Smit, Lambertus van den Broek, and Paulien Harmsen*

**Chapter 14 Comprehensive phytohormone quantification in the red alga *Pyropia yezoensis* by liquid chromatography–mass spectrometry** *Takakazu Matsuura, Izumi C. Mori, Yoko Ikeda, Takashi Hirayama, and Koji Mikami*

**Chapter 15 Total phenolic content and antioxidant capacity analysis of seaweed biomass**

*Xiaoru Hou, Randi Neerup, and Anne-Belinda Bjerre*

**Chapter 16 Extraction of phycocyanin and phycoerythrin pigments** *Stewart William Beattie, Michèle Morancais, Paul D  l  ris, Jo  l Fleurence, and Justine Dumay*

**Chapter 17 Quantification and localization of reactive oxygen species in marine macrophytes** *Manoj Kumar, Loretto Contreras-Porcia, Nirali M. Kumar, and Peter J. Ralph*

**Chapter 18 Metabolomics of intra- and extracellular metabolites from micro- and macroalgae using GC–MS and LC–MS** *Constanze Kuhlisch, Gianmaria Califano, Thomas Wichard, and Georg Pohnert*

**Chapter 19 Preparative extraction of exometabolites from seaweed surfaces** *Florian Weinberger*

**Chapter 20 Disruption-free solid-phase extraction of surface metabolites from macroalgae** *Emilio Cirri and Georg Pohnert*

## Section III: Cellular and molecular characterization

**Chapter 21 The immunodetection and *in situ* imaging of cell-wall polysaccharides in brown algae** *Amandine Siméon, Delphine Duffieux, Cécile Hervé, Sophie Le Panse, Paul Knox, and Thomas Torode*

**Chapter 22 Atomic force microscopy based analysis of cell-wall elasticity in macroalgae** *Thomas Torode, Marina Linardic, J. Louis Kaplan, and Siobhan A. Braybrook*

**Chapter 23 Dynamic and microscale mapping of cell growth: Case of *Ectocarpus* filament cells** *Hervé Rabillé, Bernard Billoud, Elodie Rolland, and Bénédicte Charrier*

**Chapter 24 Actin fluorescent staining in the filamentous brown alga *Ectocarpus siliculosus*** *Hervé Rabillé, Maria Koutalianou, Bénédicte Charrier, and Christos Katsaros*

**Chapter 25 Cryofixation of brown algae for transmission electron microscopy** *Chikako Nagasato, Christos Katsaros, and Taizo Motomura*

**Chapter 26 Probing the subcellular topography of seaweeds: Transmission electron microscopy, immunocytochemistry, and correlative light microscopy** *Sandra C. Raimundo and David S. Domozych*

**Chapter 27 Coralline algae preparation for scanning electron microscopy and optical microscopy** *S. Kaleb, G. Alongi, and A. Falace*

**Chapter 28 Extraction of high quality RNA from brown algae for transcriptomic analysis** *Sandra Heinrich*

**Chapter 29 Induction of sexual reproduction in *Spirogyra* cultures for laser capture microdissection of gametes and zygotes** *Denis Saint-Marcoux and Jane A. Langdale*

**Chapter 30 Cloning and expression strategies for the postgenomic analysis of brown algae** *Agnès Groisillier*

**Chapter 31 Polyethylene glycol-mediated transformation in the green macroalga *Ulva mutabilis* (Chlorophyta): A forward genetics approach** *Jens Boesger, Michiel Kwantes, and Thomas Wichard*