

BlueBio COFUND – Training Course "Blue Bio-refinery technologies: from research to the industry with applications on products and biomaterial from algal biomass and sidestreams of fisheries and aquaculture" – Activity Report



Advanced Training course in Marine Biotechnologies "Blue Bio-refinery technologies: from research to the industry with applications on products and biomaterial from algal biomass and sidestreams of fisheries and aquaculture" 15th-18th JANUARY 2023 - University of Foggia, ITALY Image by University of Foggia

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1. Introduction

In January 2023 the advanced training course entitled "Blue Bio-refinery technologies: from research to the industry with applications on products and biomaterial from algal biomass and sidestreams of fisheries and aquaculture" was co-organised by the National Research Council (CNR Italy) and the University of Foggia (Italy), with the patronage of the European Society of Marine Biotechnology (ESMB) in the framework of the BlueBio ERA-NET Cofund. The course was hosted by the University of Foggia, Department DAFNE and STAR*Facility Centre (Italy), Foggia (Italy).

This report provides an analysis of the activities, including contents and process. It addresses methodology approaches as well as its format. Lessons learned, concluding remarks and follow-up opportunities are also tackled in this Activity Report.







2. Implemented actions

2.1. Timeline

Item	Deadline
Modality of the course, date, teachers, program,	23 rd September 2022 draft of program and
target	agenda to the BlueBio Executive Team
Call, Application form, selection criteria (DRAFT)	30 th September 2022
Announcement	18 th October 2022
Deadline for submission	30 th November 2022
Selection process	1st Dec 2022 - 7 th Dec 2022
Disclosure of selected students	9 th Dec 2022
Training course	15 - 18 th January 2023

2.2. The concept

The Blue Bioeconomy, as a part of the overall EU Bioeconomy Strategy and Circular Economy Package, offers great potential for the sustainable use of underexploited resources and connects, directly or indirectly, several sectors (e.g., fisheries, aquaculture, energy, tourism, conservation, etc.). However, the links between ocean health, impacts on resources and Blue Bioeconomy sectors still represent one of the knowledge gaps to be overcome for a "sustainable ocean economy", as recognized by the UN-Decade of Ocean Science for Sustainable Development¹.

In line with this evidence, within the EU context, the BlueBio ERA-NET Cofund project "Unlocking the Potential of Aquatic Bioresources" (www.bluebio.eu) is aimed at establishing a coordinated R&D funding scheme for strengthening Europe's position in the Blue Bioeconomy, identifying new and improving existing ways of bringing bio-based products and services to the market. To fill knowledge gaps at the crossroads of biotechnology, food production, and sustainable use of bio-resources is recognized as crucial for pursuing a sustainable exploitation of marine bio-resources and/or biomasses, considering socioeconomic impacts in several fields.

In order to support the implementation of the Blue Bioeconomy, the Strategic Agenda developed in the framework of the Euromarine Consortium Working Group on "Enhancement of Human Resources to support

¹ UNESCO-IOC (2021). The United Nations Decade of Ocean Science for Sustainable Development (2021-2030) Implementation Plan. UNESCO, Paris (IOC Ocean Decade Series, 20.)







Blue Growth sectors" (EHUSEA)² highlighted the importance of training experts in marine biotechnologies applied to different sectors (e.g., aquaculture, fisheries, seafood processing) and also identified the BlueBio ERA-NET funders' network as a potential key player able to foster and develop tools for the implementation of actions targeting human resources. In addition, training the new generation of marine biotechnologists is also among the recommended activities in support of the UN-Decade of Ocean Science for Sustainable Development³.

Considering the relevance of Human Capacity Building (HCB) enhancement for the development of the Blue Bioeconomy, in March 2021 the "Integrated advanced training course on Blue Biotechnologies, Aquatic products and Blue Bio-economy"⁴ was jointly organized in the framework of the BlueBio ERA-NET Cofund and the BlueMed Coordination and Support Action (CSA) project, hosted in Messina (Italy) by the National Research Council of Italy. Due to the pandemic limitation to events in presence, this first BlueBio initiative was held online, with very good feedback from the participants with regards to the organizational aspects, the interest for the topics tackled, the stimulating and inspiring atmosphere and finally the improved knowledge and skills.

In April 2022 an online e-coffee meeting on HCB was organized within BlueBio Task 7.3 (Annex 1), with the main objective of further promoting HCB in the BlueBio co-funded projects and identifying different forms of assistance that BlueBio ERA-NET Cofund could deliver (e.g., support for the organization of training courses, workshops, webinars, etc.), taking into account their needs and starting from the opinions expressed by the project coordinators in reply to specific questions embedded in an online survey on HCB (the summary of responses is given in Annex 2).

The outputs highlighted the interest for specialized trainings on a few specific issues: "Valorization of side streams in fisheries/aquaculture" and/or "end-products derived from algal cultivation" (from production to commercialization). Therefore, considering that the above cited topics are strictly linked each other, as they both deal with the potential use of underexploited biological resources, the final proposal from Task 7.3 was a joint training course, able to deliver the relevant horizontal information about the bio-refinery of organic biomass and to explore the specific issues by the contributions of experts at international level, with relevant examples of technology transfer from research to the industrial sector.

Specifically, the following HCB initiative was proposed:

² EuroMarine Strategic Agenda on Enhancement of Human Resources to support Blue Growth sectors, euromarinenetwork.eu/EHUSEA_Strategic_Agenda;ISSN2239-51;; <u>https://dta.cnr.it/wp-content/uploads/2020/07/2019-28 EuroMarine EHUSEA-Strategic-Agenda v2.pdf</u>

⁴ <u>https://publications.cnr.it/doc/454397; https://dta.cnr.it/dta-34-2021-bluebio-cofund-bluemed-csa-integrated-advanced-training-course-on-blue-biotechnologies-aquatic-products-and-blue-bio-economy-activity-report/</u>





³ European Marine Board (2019). Navigating the Future V: Recommendations for the Ocean Decade. EMB Policy Brief N°. 6, September 2019. ISSN: 0778-3590. ISBN: 978-94-92043-77-1. DOI:10.5281/zenodo.3465570



- <u>What</u>: a training course on "Blue Bio-refinery technologies: from research to industry with applications on products and biomaterial from algal biomass and sidestreams of fisheries and aquaculture", aimed at the promotion and development of blue careers;
- Indicative timing: December 2022-January 2023;
- <u>Proposed instrument</u>: BlueBio ERA-NET Cofund additional activities (25k€), dedicated funds (5 k€) offered by the National Research Council of Italy (Department of Earth System Sciences and Environmental Technologies: <u>https://dta.cnr.it/en/</u>), other potential opportunities (< 5k€);
- <u>Tentative budget</u>: 30-35 k€.

Rationale, objectives of the course and target

In order to encourage Europe to assume a leadership position in the implementation of the Blue Bioeconomy, the course intended to cover gaps on the education of professional figures who can facilitate the progress along the pipeline towards the market, with special emphasis on bio-refinery technologies applied to the utilization of algal biomass and of sidestreams from fisheries and aquaculture. With this aim, the program was conceived in such way to offer the opportunity of increasing awareness about the most advanced technologies, identifying step by step the bottlenecks which slow down progress of the research results up to the market, and prospecting solutions. This objective was intended to be fostered by the adoption of a practical approach focusing on multiple aspects and case studies:

- Development of bioproducts and biomaterials from algal biomass
- Development of bioproducts and biomaterials from byproducts of fisheries and aquaculture
- Development of the innovation ecosystem enabling promising solutions to get to the market

The course was also designed to offer the opportunity of interacting with stakeholders and end-users, to create effective bidirectional interaction through knowledge and technology transfer along the production chain.

Specific objectives for the attendance of the course

- 1) Be aware of the significance of Biorefinery concept
- 2) Know the application fields, tools and opportunities.
- 3) Know the limits and identify overcoming strategies (e.g. available infrastructures).
- 4) Identify intra/interdisciplinary interaction strategies.
- 5) Know examples of best practices related to real-life experiences.
- 6) Be aware of the global market on algal biomass and sidestreams of fisheries and development trends.
- 7) Identify internship opportunities with industrial partners based on the products and services available.

Specific training credits (ECTS, *European Credit Transfer and Accumulation System*) were planned to be granted to all the attendees of the course.

In order to facilitate the attendance, no registration fees were requested to selected applicants. In addition, accommodation and local travel expenses were covered by the BlueBio ERA-NET Cofund, and a travel grant up to 370 euros was offered to all participants.







The outline of the course is given below.

Title: Advanced/High-level training course on "Blue Bio-refinery technologies: from research to industry with applications on products from algal biomass and sidestreams of fisheries and aquaculture".

Aim	Contribute to the creation of 'blue skills', filling knowledge gaps while matching market opportunities via a joint effort among the scientific community, research infrastructures and business operators		
Target	Post-docs and experienced researchers/pratictioners working/willing to work in the field of marine biotechnology		
Period and time frame	4 days, 15-18 January 2023		
Location	University of Foggia, University Campus, Foggia (Italy)		
	Features:		
	 Easy to reach by train and plane; Well connected (the closest international airport is located in Bari, connected with Foggia by train and by bus); 		
	 Availability of facilities (biotechnology laboratories, rooms for lessons, pc, monitors, microphones, etc) E-training (additional) option: on-line seminar (via GoToWebinar tool) 		
	,		
Max no. of participants	25		
Selection criteria	The selection of participants will be based on:		
	- Participation in Blue-Bio funded project		
	- Scientific background/experience		
	- Nationality		
	- Gender		
Teachers	Researchers and entrepreneurs from the BlueBio confunded projects as well as from other entities of the research and the production pipeline		
Format/Proposed activities	 Front lessons Laboratory tour 1 field visit to algal production facility 3 entrepeneurs' speeches 		





- Showcase of BlueBio granted projects
Proposed activities for the e-training -option:
- On-line lessons + Forum for discussion
- Virtual field visit
- 3 entrepeneurs' speeches
- Showcase of BlueBlo grantea projects
Based on:
 Blue Bio-refinery technologies actual trends & knowledge needs, including private sector/regulatory aspects
University of Foggia (Italy)
European Society of Marine Biotechnology (ESMB)
- N. of applicants, participants,
- Feedback of the evaluation survey
Expenses:
Tentative budget: 25 k€ Bluebio + 5 k€ CNR + additional synergies from
collaborations
- Catering & e-coffee meetings
 Venue and digital facilities [free of charge]
- Iravei & subsistence for teachers
- Travel & subsistence for students (up to £ 370)

2.3. Management: organizing and evaluation committees and communication staff

Activities were co-organized by three focus groups joined by representatives of the BlueBio COFUND project and University of Foggia (hosting Institution) and composed as follows:

Technical-Organizing Committee

- Majbritt Bolton-Warberg (BlueBio ERA-NET Cofund, Marine Institute, Ireland)
- Renata Denaro (BlueBio ERA-NET Cofund, CNR-IRSA, Italy)
- Gianna Fabi (BlueBio ERA-NET Cofund, CNR- IRBIM, Italy)
- Dennis Lisbjerg (BlueBio ERA-NET Cofund, DTU Aqua, Denmark)
- Bernardo Patti (BlueBio ERA-NET Cofund, CNR-IAS, Italy)
- Matteo Francavilla (UniFoggia, DAFNE Department, Italy)

Selection & Evaluation Committee

- Majbritt Bolton-Warberg (BlueBio ERA-NET Cofund, Marine Institute, Ireland)
- Renata Denaro (BlueBio ERA-NET Cofund, CNR-IRSA, Italy)
- Matteo Francavilla (UniFoggia, Italy)







Communication Staff:

- Sigurður Björnsson (BlueBio ERA-NET COFUND, RANNIS, Iceland)
- Hildur Ýr Þráinsdóttir (BlueBio ERA-NET COFUND, MATIS, Iceland)

2.4. The process: submission, evaluation and selection

Following the dissemination of the call for applications, whose announcement was published online on the BlueBio website on 18^{th} October 2022 (https://bluebioeconomy.eu/announcement/), the deadline for the submission was fixed on 30^{th} November 2022. The selection process extended over the period $1^{st} - 9^{th}$ December 2022.

A screenshot of the online announcement is reported below.



3-days Advanced Training course in Marine Biotechnologies (January 2023)

The course on "Blue Bio-refinery technologies: from research to the industry with applications on products and biomaterial from algal biomass and sidestreams of fisheries and aquaculture" is supported by ERA-NET Cofund on Blue Bioeconomy Unlacking the Potential of Aquatic Bioresources (BlueBio),

co-organised with the National Research Council (CNR Italy) and the University of Foggia (Italy), with the patronage of the European Society of Marine Biotechnology (ESMB), is now open for applications.

<u>BlueBio ERANET COFUND</u> coordinates R&D funding scheme to strengthen Europe's position in the blue bioeconomy and addresses gaps to finally identify ways of bringing bio-based products and services to the market and find new ways of creating value from in the blue bioeconomy.

The goal of the course is to improve technological knowledge on biorefinery processes, theoretical and practical approach.

The target to address the course is PhD holders and/or experienced people in the field (priority researchers from BlueBio ERANET COFUND projects)

Official language: English

Date and Location:

16 - 18 January 2023, University of Foggia, Department DAFNE and "STAR*Facility Centre (Italy), Foggia (Italy)

Contacts:

BlueBio contacts: gianna.fabi@cnr.it; bernardo.patti@cnr.it





Candidates were evaluated based on their CVs submitted using the application form made available online. The target audience to be addressed in the course was PhD holders and/or experienced people in the field (both from Research and Industry), with priority to people involved in projects cofunded by BlueBio calls (75% of available places were reserved for them).

Twenty-five people were selected among more than 90 applicants. The majority of attendees were from 4 European countries, namely Italy, Estonia, Norway and Portugal.

The composition of candidates and selected students by gender, nationality, affiliation and involvement in BlueBio funded projects is given below.



2.5. The Programme

The programme of the training course is reported in Annex 3. It included three modules: the first one dealing on algal biorefinery, the second one focused on the biorefinery of fishery by-products, and the third one, more general, dealing on transferring knowledge "from Academia to Industry". Trainers from EU and non-EU countries were involved (Annex 4).

A practical laboratory activity actively involving the participants was implemented at the STAR* Facility Center. For this activity, the students were subdivided into five groups, each of which had to conduct a biorefinery process including three extraction steps from *Gracilaria* seaweed (see below).







addition, a seaweed show cooking event was organized on 17th January 2023 in Cagnano Varano (Foggia) to show the potential use of *Gracilaria* seaweed in the culinary field.



In the third day of the course, at the end of lectures the attendees were divided again into five groups and invited to a teamwork practise sessions, the first one dealing on biorefinery process planning and second one on HCB implementation.







The first exercise consisted of drafting a research project on biomass biorefinery in the context of the Blue Bioeconomy in around one hour, based on what learned during the first two days. Each group was then asked to present its own project in 5 minutes. The exercise was highly successful and showed an active cooperation among the members of each group. The results are showed in the picture below.



The second exercise was meant to get the opinion of participants on the actions needed to implement HCB in the field of biorefinery and in the EU context. To this aim, the five groups were asked to reply to five questions:

A) Which are, in your opinion, the most effective practices to implement HCB in research on biorefinery of products from fishery, aquaculture and seafood processing (e.g., physical training courses, online training courses, webinars / workshops on specific issues, collaborative projects, etc.)?

B) In your opinion, to which extent has the HCB activity on biorefinery applied to fishery, aquaculture and seafood processing implemented up to date at EU level, met the needs of research and industry? Are our systems for knowledge sharing in Europe good enough? – how can we improve interactions? – e.g., between North and South – what should be some of the mechanisms for this?

C) Research/Innovation projects on biorefinery often aim to develop products with a certain TRL. This involves property rights which could hamper mobility of staff and exchange of information among projects (and/or among project partners), working in the same industry. Do you have any suggestions to overcome this obstacle?

D) Do you find that your basic knowledge is sufficient in order to take advantage of the new knowledge and possibilities in advancing the blue bioeconomy? – or do you e.g., need further knowledge of other basic disciplines than your initial training (e.g., in economics, chemics, physics, genomics)?





The results of the questionnaire are reported below.



In the overall, physical training courses possibly including practical sessions (lab practice), small webinars/workshops on specific topics (e.g., specific methodologies), site visits and short-term collaborations have been highlighted as the most effective practices to implement HCB. However, these initiatives should include sessions commercially driven also involving companies, sale experts and vendors of machine to improve collaboration, communication and technology transfer between academy and industry.

Other means suggested to increase collaboration, communication and technology transfer between academy and industry are commercially driven training courses / workshops, collaborative labs, realization of pilot plants and training in pilot plants.

To improve knowledge and awareness about Intellectual Property (IP), establish bottom-up driven product development support mechanisms and developing new regulation for encouraging cooperation among industries, and encourage discussion of non-confidential information as a valuable resource as well as sharing of failure stories in order to save time and money were identified as effective ways to overcome reluctancy to share information especially from industries.

Finally, the participants recognised that there is not enough basic knowledge, however their perception was that improved collaboration and exchange with experts in the different fields would fill this gap more effectively than training courses on basic disciplines.

2.6. Feedback and lessons learned

A further individual questionnaire was circulated among the participants to get their feedback on the course. The analysis of replies showed that their expectations were fully addressed.

Most of presentations by the invited lecturers were highly appreciated, as well as the possibility of interacting with them and the quality of the laboratory facilities used for the practical experience. Also in this case, suggestions from the audience mostly regarded the possibility of enhancing the presentation of successful case studies dealing with the relationship between Academia and Industry.







Finally, all the attendees agreed there was appetite for a further edition of the course and willingness to join future training initiatives on Blue Bioeconomy. The main results of the survey are summarized in the two slides below.















ANNEX 1. Agenda of the Human Capacity Building e-coffee meeting.

BlueBio Cofund

Human Capacity Building e-coffee meeting |

agenda

Date and time: 06 April 2022, 14:00-16:00 CETMeeting venue:Video conference



Join Zoom Meeting: https://zoom.us/j/94882700844?pwd=WVdRMEdTc3ZmN2NRTWZNVDB0M1RIQT09 Meeting ID: 948 8270 0844, Passcode: 207291

Objectives: The first objective of the meeting is to promote HCB in BluBio co-funded projects. Some examples of HCB initiatives within projects will be presented, and this will pave the way for discussing about the HCB efforts already done (or planned) by the projects and their challenges, and for facilitating the exchange of best practices.

In the second part of the meeting we will also have the opportunity of considering different forms of assistance that BluBio Cofund could deliver about HCB to the funded projects (e.g. support in the organization of training courses, workshops, webinars, etc.), taking into account their needs and starting from the opinions expressed in the questionnaires by the project coordinators. Issues about communication and sharing of HCB among BlueBio projects will be also addressed.

<u> Agenda – all hours are CET</u>

- 14:00-14:10 Welcome and Introduction "Why HCB is important in BlueBio?" (Bernardo Patti)
- 14:10-14:40 Examples of HCB implementation from two funded projects
 - Digiras (Dr. Roman Netzer)
 - MedSpon (Prof. Carlo Cerrano)
- 14:40-15:10 **Roundtable discussion/ discussion in small groups** (20 minutes group discussion + 10 minute summary all together):
 - What HCB have you been doing?
 - How has it been going?
 - What can you do now, to reach your commitments?
- 15:10-15:20 Supporting Human Capacity Building in BlueBio projects: insights from the questionnaires (Bernardo Patti)
- 15:20-15:50 Roundtable discussion/ discussion in small groups (20 discussion + 10 minute synthesis):
 - How can the BlueBio Cofund assist? Which format? How might external organizations (universities, other ERA-Nets, industry) contribute?
 - Which themes?
 - Communication and sharing of HCB among BlueBio projects.

15:50-16:00 Wrap-up and final comments







ANNEX 2 - Human Capacity Building (HCB) activities in support of BlueBio funded projects – Tools and topics – Summary of responses

The following questionnaire is kindly asked to be filled out by the coordinators of projects co-funded under the first 2018 Call.

Deadline for submission of questionnaire: 18.03.2022

Would you like BlueBio cofund be in charge for the organisation of HCB events related to the needs of your project?

12 responses



If yes, which kind of HCB initiatives would you consider more effective? Make your choice for each proposed item, giving a score from 1 (less effective) to 5 (more effective).







ANNEX 3. Programme of the second BlueBio Advanced Training course

Advanced BlueBio Training course: "Blue Bio-refinery technologies: from research to the industry with applications on products and biomaterial from algal biomass and sidestreams of fisheries and aquaculture", 15th-18th January 2023, University of Foggia, Foggia (Italy).

Sunday 15th January	Monday 16th January	Tuesday 17th January	Wednesday 18th January
	Moderator: Gianna Fabi (CNR, Italy)	Moderator: Dennis Lisbjerg (DTU-AQUA, Denmark)	Moderator: Renata Denaro (CNR, Italy)
	8.45	8.45	8.45
Arrival	Welcome & Programme presentation Prof Matteo Francavilla	Wrap-up by trainees	Wrap-up <i>by trainees</i>
	Institutional greetings from Rector of University of Foggia Prof Pierpaolo Limone		
	and		
	Head of Department of Agriculture, Foods, Natural Resources and Engineering Prof Milena Sinigaglia		
	9.00		
	BlueBio ERANET Cofund Project coordinator, RCN, Norway Dr Kristin Elisabeth Thorud (by remote)		
	and		
	Task 7.3 Leader, CNR, Italy Dr Bernardo Patti		
	Module 1	Module 2	Module 3
	Seaweeds Blue-Biorefinery	Fishery and Aquaculture Biowastes Blue-Biorefinery	From Academia to Industry:





	9.30	9.00	9.00
	Green Chemistry and Biorefinery Prof Rafael Luque	Biochemical conversion of fishery bio waste into value products	BlueBio projects presentation. Constraints to reach the market (by remote)
	University of Coraoba, Spain	Prof Lene Lange	MEDSPON Project
		Bioeconomy Research & Advisor Denmark	Dr. Joachim Henjes, Alfred Wegener Institute, Bremerhaven, Germany
			BIOZOOSTAIN project
			Prof. María Guðjónsdóttir, Faculty of Food Science and Nutrition, University of Iceland, Reykjavík, Iceland
			BestBrood project
			Dr Jorge Galindo-Villegas Faculty of Biosciences and Aquaculture, NORD University, Bodø, Norway
			InEVal Project
			Dr Matthew Slater, Alfred Wegener Institute, Bremerhaven, Germany
	10.30	10.00	10.00
	Marine Based Green Chemistry Prof Matteo Francavilla University of Foggia, Italy	Unlocking the potential of crustacean waste: solvent- free, mechanochemical pathways to added-value materials Prof Audrey Moores McGill University, Canada	EU Blue Bioeconomy and Blue Biotechnologies – emerging sectors of the European Green Deal Mr Maris STULGIS Policy officer on Blue Bioeconomy, Algae and Marine Aquaculture EC Directorate-General for Maritime Affairs and Fisheries, Brussels, Belgium (by remote)
	11.30 Coffee break	11.00 Coffee break	11.00 Coffee break
	12.00 Mediterranean Seaweed biorefinery for valuable compounds and advanced materials Prof Matteo Francavilla	11.30 Shellfish conversion to advanced material Prof Giuseppe Falini University of Bologna, Italy	11.30 Technology Transfer and function of Mediterranean Innovation Alliance for Sustainable Blue Bioeconomy (MedIA-SBB)





	University of Foggia, Italy		Dr Cristian Chiavetta ENEA, Italy
	12.30	12.30-18.00	12.00
	Bio-plastic from seaweeds Dr Oystein Arlov SINTEF, Trondheim, Norway	Visit to IMTA Plant (FEAMP Research Project, UNIFG) Packed Lunch and transfer to North Gargano, Adriatic Sea	Case Studies: Fishery Biowaste industrial conversion Dr Zouhir El Marsni SEAGARDEN AS, Norway
	13.00		12.30
	Hydrocolloids from seaweeds		Biostimulants from seaweeds
	Dr Oystein Arlov SINTEF, Trondheim, Norway		Dr Valentino Russo South Agro srl, Taranto, Italy
	13.30 Lunch		13.00 Lunch
	15.00-18.00 Biorefinery Lab Activity STAR*Facility Centre - University of Foggia		14.30 Practice on biorefinery process planning based on the day- lectures Teamwork Discussion
			16.30 Feedback from participants
From 18.30 Welcome, technical details, organisation,			17.00 Final test Certification from UNIFG
programme, get together, query about expectations	18.00 End of Day 1	18.00 End of Day 2	18.00 End of Day 3
19.00 Ice breaking presentation 2' per student	Site visit (Foggia)	Site visit (Gargano)	
20.00	20.00	20.00	
Social dinner event	Social dinner event	Social dinner event	







ANNEX 4. Information on Instructors & Lessons

Øystein Arlov



Affiliation: SINTEF Industry Contact: oystein.arlov@sintef.no

Biography: Øystein Arlov is a Research Manager at SINTEF Industry, Department of Biotechnology and Nanomedicine. SINTEF is an independent, non-profit research organization in Norway working across all fields of technology. The research group Industrial and Marine Biotechnology focuses on microbial and enzymatic technology in industrial processes, biorefineries, and product development/characterization based on (marine) biomass and residual materials.

 ϕ ystein holds a M.Sc. and Ph.D. from the Norwegian University of Science and

Technology (NTNU), where he worked on chemoenzymatic modification of alginates for biomedical applications. His research interests at SINTEF has expanded to include biorefinery of marine biomasses (particularly brown algae) and seaweed- and biopolymer-based innovations for a variety of industrial sectors. He is the coordinator of the ongoing ERA-BlueBio PlastiSea project, and has been the SINTEF PI for >15 national and international research projects related to seaweed, marine biopolymers and biopharmaceuticals.

Title of the lesson: Bio-plastic from seaweed

Date of the lesson: 16th January 2023

Presentation/Focus of the lesson:

The main objective of PlastiSea has been to develop new bioplastic materials based on cultivated and wild harvested brown algae. Conventional plastics are made from non-renewable fossil resources and the pollution of these materials represents a global threat toward marine environments. As a result of this the need for alternative biobased and biodegradable materials is now paramount, particularly within the food sector. Bioplastic materials still face challenges with respect to low sustainability of the raw materials, low biodegradability and recyclability, high cost and non-satisfactory mechanical properties. These aspects limit the possible application areas of currently available bioplastics. Brown algae have an unrealized potential for use in materials, considering that they have an inherently high content of complex carbohydrates with good structural properties, and the fact that they can be cultivated in large scale with positive environmental effects. However, research is needed to gain an increased understanding of the usable species, and to develop a scalable biorefinery, new material formulations and production methods. As a new value chain, life cycle analyses and economic assessments are required to map possibilities and limitations for seaweed-based bioplastics.

Link to the website of the initiative/project/organization represented for the lesson: www.sintef.no/plastisea

Suggested background material:

https://www.sciencedirect.com/science/article/pii/S2211926422003228?casa_token=E2IN1B7ISG4AAAAA:yx_TPS oIY674cMOKzcvIFX0CgwFz6VHFhPypkc-uA49c3YP6BgtZ2_r4XNGLvI5C1XUK3SBPrQ https://www.sciencedirect.com/science/article/pii/S2213343721008721?casa_token=o9u1tutKVnkAAAAA:Wxfqw AB2UX5LlyoIKjxkbMTYZG8zEPLZxIVb6POI9nd8VZ2SF-63HIRJ0Th64dkB1JJBax3QNg







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Biography: Cristian Chiavetta is an Environmental Engineer graduated at the Universitiy of Bologna with a PhD on LCA of renewable energy and resource valorization as secondary raw materials. He is working at ENEA, as researcher in the Department for Sustainability. He coordinates national and international projects focusing on Sustainable Development and supports companies of the Blue Economy in eco-innovation paths through the implementation of circular economy solutions. He is the member of the board of expert on the blue biotechnologies the Cluster BIG, has been selected as circular economy expert by the Italian Ministry for the Foreign Affairs and International Cooperation (MAECI) to be part of the delegation representing Italy in the Summit of 2 Shores and provides technical supports to the Italian Ministry for Economic Development (MISE) as

advisor on the Green transition of the SMEs within the initiative of the Med platform of the industrial cooperation promoted by the Union for Mediterranean and the European Commission. He is the coordinator of the Interreg-Med B-Blue project (Building the Blue Biotechnology Community in the Mediterranean)

Title of the lesson: Technology transfer and an example of enabling framework for system innovation in the **Blue Biotech sector**: the cooperation mechanism of the Mediterranean Innovation Alliance for Sustainable Blue Bioeconomy.

Date of the lesson: January 18th 2023

Presentation/Focus of the lesson:

The presentation will give a quick overview of the system change approach and will provide the basic knowledge on the transformative innovation in order to introduce the experience done by the B-Blue project and the Blue Bio Med project in developing and launching the Mediterranean Innovation Alliance for Sustainable Blue Bioeconomy. This cooperation mechanism is aimed at supporting the organizations of the Blue Bioeconomy sectors of the Med area in the innovation development and transfer. The Innovation Alliance has been launched in order to promote the conditions enabling for promising ideas and low TRL solutions to successfully start their innovation path to the market with the ultimate goal of contributing to a systemic change. The presentation will close focusing of the main opportunities offered by Innovation Alliance to the organizations working in the blue biotech field.

Link to the website of the initiative/project/organization represented for the lesson:

- <u>https://b-blue.interreg-med.eu/</u>
- https://sostenibilita.enea.it/en
- https://bioagro.sostenibilita.enea.it/en

Suggested background material:

- file:///C:/Users/crist/Downloads/MedIA-SBB_ROADMAP_2023-2024_DRAFT.pdf
- https://www.youtube.com/watch?v=rVGoeFAW0FM&t=9s&ab_channel=SystemsInnovation





Renata Denaro





Affiliation: CNR - National Research Council of Italy Contact: <u>renata.denaro@cnr.it</u>

Biography: Renata Denaro gained her PhD in Biochemical and Biomolecular Sciences at University of Catania. She is a researcher at Water Research Institute at the National Research Council, Rome. Professor of Environmental Microbiology at University of Tor Vergata, Rome. She is author of several articles and book chapters with a special focus on bioremediation in marine environment. Member of European Society for Marine Biotechnology (ESMB), and International Marine Biotechnology Association (IMBA).

The research area is related to: 1. Marine biotechnologies (member of working group at ERANET BlueBio) 2. Structure and function of marine microbial communities in contaminated environments (scientific activity within European projects COMMODE, MAGIC-PAH 3. Ecology, genetics and physiology of bacteria specialized and generalists in the degradation of contaminants in the marine

environment, including adaptive mechanisms (enzymes, siderophores, biosurfactants) and biotic and abiotic factors that govern the self-cleaning processes in the marine environment (scientific activity within European project KillSpill). 4. Bioremediation and environmental monitoring at sea (focus on technologies and biotechnologies in situ and ex situ, biosensors built with marine bacteria, responsible of task European project BRAAVOO) At the same time, knowledge and technology transfer activities were carried out to stakeholders, also analyzing ways of interaction in international contexts (responsible for European networks CSA Marine Biotech and ERANET Marine Biotech).

Chairperson of day 18 January 2023









Giuseppe Falini



Affiliation: Alma Mater Studiorum – Università di Bologna Contact: giuseppe.falini@unibo.it

Biography: Prof. Giuseppe Falini (GF), PhD in Chemistry, is full professor in chemistry at the University of Bologna. GF teaches general and inorganic chemistry and solid-state chemistry. He has been advisor of Master and PhD theses of several students and currently is advisor of five master students and four PhD students. Currently, the research activity of GF is mainly addressed in the fields of biomineralization and macromolecular crystallography. It can be summarized in the subjects of the the study of the calcium carbonate biominerals; the design and preparation of innovative materials from waste

marine biominerals and biopolymers. GF coordinates the biomineralization and biocrystallization laboratory. GF is co-author of about 240 scientific publications (H-index = 45) in international journals (two in Science) with impact factor. GF also wrote 5 book chapters and is inventor of 3 patents. GF has been invited to present his research activities in more than fifty international and national conferences and schools. GF has been awarded from national institutions, companies and European Community (ERC Adv).

Title of the lesson: Shellfish conversion to advanced materials

Date of the lesson: 17/01/2023

Presentation/Focus of the lesson: The lesson concerns the presentation of various synthetic strategies for the valorization of waste shells from aquaculture. The shells are formed almost entirely (> 95 wt.%) by calcium carbonate and the rest by macromolecules. The latter differentiate the shell calcium carbonate from the quarry or synthetic one. The procedures that will be presented will try to exploit the peculiar characteristics of shell calcium carbonate, the presence of the macromolecular organic matrix and the crystalline texture. Applications in the field of polymers and regenerative medicine that are underway in the BluBio-Eranet CASEAWA project will be presented, and more.

Link to the website of the project represented for the lesson: https://site.unibo.it/caseawa/en Suggested background material: chemistry, material science.







Matteo Francavilla



Affiliation: STAR*Facility Centre, Department of Agriculture, Foods, Natural Resources and Engineering, University of Foggia, Italy.

Contact: <u>matteo.francavilla@unifg.it</u>

Biography: Associate Professor in Organic Chemistry at UNIFG, Department of Agriculture Science, Foods, Natural Resources and Engineering (DAFNE); Responsible of STAR*Facility Centre, a technological hub of University of Foggia for biomass valorization; Lecturer in "Organic Chemistry", "General Chemistry" and "Biomass and Biorefinery". Laurea *cum laude* in Organic Chemistry at University of Rome "La Sapienza", PhD in Sustainable Agro-Ecosystems at

University of Foggia, Master in "Natural Organic Compounds" at University of Rome "La Sapienza". His research activity's main topics include the valorization of biomass (including algae) through extraction, purification and characterization of fine chemicals, bioactive compounds and biomaterials; Biorefinery processes; Green Chemistry applied to biomass valorization. His research interests are currently addressed towards nanoplarticles production using biopolymers as template, platform compounds, and biofuels production from aquatic and terrestrial biomass.

Title of the lesson: Marine Based Green Chemistry

Date of the lesson: January 16th 2023

Presentation/Focus of the lesson: The European algae industry is a biobased sector with a considerable potential to further develop and contribute to critical societal challenges such as the EU carbon neutrality, an innovative food system that ensures access to nutritious and sustainable food, and, ultimately, the support to a sustainable and circular European bioeconomy. The biorefinery approach (algae biofactory) is currently being investigated as a mean to increase the environmental sustainability and economic feasibility of existing conventional industrial processes. In considering the blue biorefinery concept, it is essential to focus on the sustainability aspect, which provides safety to workers and process/endproduct safety. This demonstrates the need for mild, ecofriendly and green solvents that can conveniently extract highly valuable compounds from seaweeds, providing them with high stability and further providing solutions to pollution, energy consumption and environmental deterioration. Green solvents, such as ionic liquids (ILs), deep eutectic solvents (DESs), super critical CO2 and solvents derived from natural resources (biomass derived), are finding use as "future solvents". The role of Neoteric Solvents in the Blue Biorefinery will be presented and discussed.

Title of the lesson: Mediterranean Seaweed biorefinery for valuable compounds and advanced materials **Date of the lesson**: January 16th 2023

Presentation/Focus of the lesson: The STAR*Facility Centre is a technologically advanced laboratory of University of Foggia, funded by a FP7 Research Project (STAR*AgroEnergy). It is focused on biomass valorization through a combination of chemical, thermochemical and biochemical processes with a biorefinery approach. Algae, among other biomass, represent an intriguing and challenging substrate that is studied and tested for biorefinery processes in our lab. An overview of main research results referred to cascade process for red seaweed Gracilaria gracilis conversion into high value products (algae biorefinery), will be provided and discussed.

Link to the website of the initiative/project/organization represented for the lesson: STAR*Facility Centre: https://www.facebook.com/STARFacilityCentre/ University of Foggia: https://www.agraria.unifg.it/i







Jorge Galindo-Villegas



Affiliation: Nord University, Faculty of Biosciences and Aquaculture, Department of Genomics

Contact: jorge.galindo-villegas@nord.no

Biography: Dr. Jorge Galindo-Villegas, the leader of the project is the PI of the immune-reproductive group member of the Genomics Research Group at the FBA, and an experienced EU project manager. Recently, he has participated in several large EU-granted projects Eg., TARGETFISH, SAVEFISH, EPIFISH conducting scientific and managerial duties. He is the author of several peer-reviewed scientific articles in

top cited journals E.g., PNAS, JI, FI, etc. He has edited 5 books and provide input into several chapters. Besides, at the industry level he has produced two world patents that successfully have made their way until the commercial stage. Dr. Galindo-Villegas has worked in fish biology and aquaculture for over two decades on various topics, including developmental immunity, nutrition, and health management. He is *Executive Editor* of the Journal Aquaculture (Elsevier), Associate Editor at Frontiers Media, and Editorial board member of Fish & Shellfish Immunology (Elsevier).

Title of the lesson: Identification of broodstock performance indicators and markers to boost the aquaculture of emerging fish species

Date of the lesson: January 18th 2023

Presentation/Focus of the lesson: Appropriate broodstock management is essential for supporting reproductive function and reliable and consistent production of gametes and high-quality eggs, critical for the rapid increase in juveniles supply and turn aquaculture into a profitable industry. In all species commercialized to date, this has been the first significant challenge to overcome, and it is still so for many emerging species. The BESTBROOD project (2020 – 2023) aims to evolve biotechnologies that significantly improve broodstock management methods and enhance the reproductive performance of selected emerging species (Senegalese sole, greater amberjack, spotted wolfish, and lumpfish). All these species are in an early commercial stage, but all have shown suitability for farming, high economic value, and market demand. To create the best broodstock the project plans to: 1) develop genetic markers and bioindicators; 2) create knowledge on the best rearing conditions; 3) improve the control of the maturation cycles; 4) test hormonal therapies and artificial fertilization methods and 5) reduce dependence on wild fish for egg production. As a result, the BESTBROOD will lead to a more stable and predictable supply of high volumes of high-quality eggs to produce juveniles that meet market demands for sustainability and increase Europe's aquaculture competitiveness.

Link to the website of the initiative/project/organization represented for the lesson: https://site.nord.no/bestbrood/







Joachim Henjes



Affiliation: Alfred Wegener Institute, Helmholtz-Centre of Polar and Marine Research

Contact: Joachim.Henjes@awi.de

Biography: Joachim Henjes began his scientific career as a doctoral student and post-doc at the Alfred Wegener Institute in the Biological Oceanography Section. Here he acquired a solid grounding in the field of planktology, especially the physiology of microalgae.

JH then put this expertise into practice at Phytolutions, a spin-off from Jacobs University, where he worked as a division manager on the production of microalgae and the extraction of valuable materials and alternative energy sources on an industrial scale, among other things.

From 2014 onwards, he worked as deputy head of the Marine Aquaculture Department of the Institute for Maritime Resources IMARE. As a member of this working group, Mr Henjes was integrated into the anchor group "Aquaculture Research" (AQF) at the AWI at the beginning of 2015.

JH has many years of industrial experience in microalgae biotechnology focussing on cultivation of different microalgae as aquaculture feed, nutraceuticals and pharmaceuticals and was awarded applied projects from different funding agencies.

Title of the lesson: MedSpon - Characterization of new antibiotic principles against WHO priority pathogens of sustainable produced marine sponges for nutraceutical applications

Date of the lesson: 18th of January 2023

Presentation/Focus of the lesson:

The MedSpon project focuses on two Mediterranean sponge species: *Chondrosia reniformis* and *Axinella polypoides*. The objective of the project, based on the knowledge from mariculture, is to develop and establish aquaculture processes for target species by successfully breeding sponge fragments to serve as a source of secondary metabolites.

Considering the production of secondary metabolites can change during life cycle of the species like reproductive period and food availability, strong wild populations of target species will be studied by project partner Polytechnic University of Marche at Italian field sites to assess the optimal habitat conditions and provide information for mass production in land-based recirculation aquaculture system (RAS). Under controlled conditions in RAS different abiotic factors and types of food are tested in parallel approaches to create effective rearing conditions for bioactive contents.

It is of interest to what extent the symbionts have any influence on the production of bioactive compound. Secondary metabolites, extracted from *C. reniformis* and *A. polypoides*, are used by project partner KliniPharm for the design and progress of novel products in the field of nutraceuticals and pharmaceutics. The project focus is on antimicrobial activities of sponge extracts and novel antibiotic active principles in marine sponges against WHO relevant pathogens.

Furthermore, a screening of new sponge candidates for aquaculture with pharmaceutical potential is conducted by project partner SpongiPharm in the Aegean Sea.







Link to the website of the initiative/project/organization represented for the lesson: https://www.awi.de/forschung/besondere-gruppen/aquakultur/aquakulturforschung/projekte/medspon.html

Lene Lange, Professor, Dr.Scient. & PhD



Affiliation: LL-BioEconomy, founder and owner. A research SME in the area of Circular Biobased Economy (<u>www.ll-bioeconomy.world</u>) Contact: lene.lange2@gmail.com Biography:

Career Path

Professional career includes leading positions in both private sector and public research. After PhD & post-doc at University of Copenhagen, scientist, DANIDA Research Institute

(1978-86). 1986-2007, R&D positions Novo, NovoNordisk, NovozymesA/S, finishing in top-research-career position (Director of Research, in Molecular Biotechnology). Professor, University of Copenhagen, 2000-2010. 01.02.07 back in academia, as Head of Institute of Biology, University of Copenhagen, 2006-2008; from 01.09.08, Dean of Research and Professor in Biotechnology, Aalborg University. Campus-director, AAU Cph 2009-2013; Director of Research, Aalborg University 2012-2015. Professor, Technical University of Denmark 2015-2018. Founder & Owner of own company, "BioEconomy, *Research & Advisory*" 2018-

Academic Degrees & Titles

- 2015 Professor & Research Leader, Technical University of Denmark
- 2008 Professor in Biotechnology, Dean of Research; later Director of Research, Aalborg University, DK
- 2006 Department Head, Professor, University of Copenhagen, DK
- 2000 Professor (adjunct) at KVL, Danish Agricultural University, DK
- 1990 Dr. Scient. (= Doctor of Science), University of Copenhagen, DK
- 1985 Recognized as competent for full Professorship, Agricultural University, DK
- 1976 Ph.D. Institute for Sporeplants, University of Copenhagen, DK
- 1973 Cand. scient (M.sc.), University of Copenhagen. Major: Biology; maths, chemistry and physics

Publications, in summary, 1973-2021

> 300 peer reviewed papers, books, monographs and several patents; resulting in >5.455 citations. >3.050 after 2017. H-index 34. i10 Index 119.

Current Research: Enzyme discovery for improved biomass conversion: Generating value from crop residues and marine, agricultural and industrial sidestreams. Inventing/developing peptide- based functional annotation, CUPP, an on-line fast-track discovery of proteins, predicting function directly from sequence.

Title of the lesson: Sustainable Valorization of the Blue Biomass

Date of the lesson: 17.01.2023

Presentation/Focus of the lesson:

Sustainable valorization of the Blue Biomass: Through bioprocessing (using microbes and/or microbial enzymes) upgrading fish-processing cut-offs, shrimp shells and seaweeds. Resulting in an entire spectrum of higher value products. With positive impact on climate, food security, health, biodiversity, environment, livelihood and economic development

Link to the website of the initiative/project/organization represented for the lesson:







• Suggested background material: *Lange et al., 2020:* Opportunities for Seaweed Biorefineries. Introductory chapter "Sustainable Seaweed Technologies", Elsevier

Audrey Moores



Affiliation: McGill University Contact: <u>audrey.moores@mcgill.ca</u>

Biography: Audrey Moores is a Full Professor of Chemistry, co-lead of the Materials group of the McGill Sustainable Systems Initiative (MSSI) and associate director of the Facility for Electron Microscopy Research (FEMR) at McGill University. She serves as an associate editor for *ACS Sustainable Chemistry & Engineering*. In 2020 she became a member of the College of New Scholars, Artists and Scientists of the Royal Society of Canada, which is the junior body of the equivalent to a Canadian Academy of Science. In 2021 she received the Canadian Chemistry and Chemical Engineering Award for Green

Chemistry. With her group, she focuses on sustainable solutions for nanoparticles and biopolymer synthesis as well as catalyzed reactions, with an interest in waste biomass valorization, earth abundant starting materials and high atom economy. She is leading a Quebec-funded project geared towards the scale up of the valorisation of crustacean waste valorisation by mechanochemistry.

Title of the lesson: Reinventing solventless chemistry: New opportunities for the valorization of crustacean waste **Date of the lesson**: January 17th 2023

Presentation/Focus of the lesson: In this lesson, students will be introduced to notions of mechanochemistry and aging. We will then cover a few examples of how mechanochemistry can be used effectively for polymer functionalization and its advantages. We will then zoom in on the question of crustacean waste as a source of value added products and the challenges of its valorization. We will talk as well about the Canadian and Quebec context for these questions. From there, we will review some of the work on the use of mechanochemistry and aging for the extraction of chitin from crustacean waste and its conversion into chitosan. We will also open up at the end towards opportunities in the world of chitin and chitosan nanocrystals and their potential applications.

Link to the website of the initiative/project/organization represented for the lesson: https://www.mooresresearch.org/

Suggested background material:

J. L. Vidal, T. Jin, E. Lam, F. Kerton, A. Moores, "Blue is the New Green: Valorization of Biomass from Marine Waste", *Curr. Res. Green Sustainable Chem.* **2022**, 100330. https://doi.org/10.1016/j.crgsc.2022.100330







Matt Slater



Affiliation: Alfred Wegener Institute Contact: mslater@awi.de Biography: Matt is the head of Aquaculture Research at AWI and is lucky enough to work with a great team of scientists developing sustainable aquaculture solutions for the blue bioeconomy. His main area of research interest has always been sea

the blue bioeconomy. His main area of research interest has always been sea cucumbers and their uses in remediation of marine sediments. This interest has expanded to many other species and topics over the past 20 years.

Title of the lesson: Echinoderm Value Chains

Date of the lesson: 18.01.23

Presentation/Focus of the lesson: Making sea urchins, seastars and sea cucumbers valuable marine resources in Europe, opportunities and challenges.

Link to the website of the initiative/project/organization represented for the lesson: <u>https://www.awi.de/en/science/special-groups/aquaculture/aquaculture-research/projects/ineval.html</u>







Maris Stulgis



Affiliation: Policy Officer Blue Bioeconomy, Algae and Marine Aquaculture, European Commission, DG Maritime Affairs and Fisheries (DG MARE),

Contact : Maris.Stulgis@ec.europa.eu

Biography: Maris Stulgis finished 5-year university level studies in the Kaliningrad State Technical University and has obtained a diploma in Water bioresources and aquaculture. Before joining the European Commission he worked for 10 years in Latvian national administration in environment protection and fisheries control policies development and implementation. As a Policy Officer in DG MARE, Maris dealt with fisheries control policy development and implementation (e.g.

development of new control technologies, leading the group of EU inspectors monitoring EU rules implementation in the Baltic and North Sea countries), fisheries data management, worked with marine pollution, biodiversity, environmental policies files. As from 1/10/2020 Maris deals with the Blue Bioeconomy, Algae and Marine Aquaculture.

Title of the lesson: EC driving forward EU Blue Bioeconomy and Blue Biotechnologies – emerging sectors of the European Green Deal

Date of the lesson: 18 January 2023

Presentation/Focus of the lesson:

The emerging blue bioeconomy and biotechnology sectors look at groups of marine organisms and biomass that until now often have been ignored for commercial exploitation. This includes microorganisms (microalgae, bacteria and fungi), algae, invertebrates (e.g. starfish, sea cucumbers, sea urchins), jellyfish as well as fish and seafood waste. The blue bioeconomy turns aquatic biomass into food, feed, nutraceuticals, pharmaceuticals, cosmetics, energy, packaging etc. **Blue biotechnology** is the application of science and technology to living aquatic organisms for the production of knowledge, goods and services (OECD, 2016). The most notable sector of the EU Blue Bioeconomy is algae sector. European Commission has consequently elaborated and adopted a pioneering <u>communication</u>⁵ to unlock the potential of algae in the European Union. The Communication proposes 23 actions, implementation of which will lead to a more harmonized governance and legal frameworks, improved business environments, increased social awareness and acceptance of algae and algae-based products by European consumers, and close the knowledge, research, and technology gaps.

Links to the websites of the organization represented for the lesson:

The Commission's Directorate-General for Maritime Affairs and Fisheries is responsible for the policy area of fisheries, the Law of the Sea and Maritime Affairs. Directorate A drives forward EU Integrated Maritime Policy and Blue economy. It aims to support and stimulate the creation of jobs, growth and investment to unlock the economic potential of the sea. Relevant links:

Oceans and Fisheries Maritime Forum European Algae Stakeholders Platform

Suggested background material: Blue economy report 2022 EU Blue Bioeconomy report 2020 and EU Blue Bioeconomy report 2018

⁵ Press release







Zouhir El Marsni



Affiliation: R&D Department Contact: +4745520855 <u>zouhir.el.marsni@seagarden.no</u> Biography: PhD in chemistry and R&D leader with Seagarden AS company

Title of the lesson: Fishery Biowaste industrial conversion
Date of the lesson: 18th January 2023
Presentation/Focus of the lesson: In the presentation I will talk about our company history and business explaining how we use a rest of raw materials from seafood for to produce food for human consumption.

Suggested background material: <u>www.seagarden.no</u>



