AquaVIP Gdynia summer school
Curriculum (part I)

Title	Presenter	Duration
I – Presentations & discussions		
Introductory topics		
AquaVIP project presentation in the frame of blue bioeconomy	Hanna Łądkowska, University of Gdańsk	20+10 min.
State of play: innovative technologies in aquaculture in the Baltic Sea Region countries	Konrad Ocalewicz, University of Gdańsk	45+15 min.
Impact of COVID-19 pandemic on the aquaculture and fish processing sectors	Konrad Ocalewicz, University of Gdańsk	45+15 min.
Recirculating Aquaculture Systems (RAS) - Shrimps		
Saltwater RAS: some biological, technical and economic aspects of brackish, marine and geothermal water applications	Nerijus Nika, Klaipeda University	45+15 min.
Small scale shrimp RAS system: design, operation, parameters, results	Halina Kendzierska, University of Gdańsk	45+15 min.
Aquaponics		
Aquaponics: system design, technology, applications	Adrian Bischoff-Lang, Rostock University	45+15 min.
Algae		
Macroalgae harvesting and cultivation: macroalgae in the Baltic Sea, system design, technology, and application practices in the region	Aleksandra Zgrundo, University of Gdańsk	45+15 min.
Microalgae cultivation: system design, technology, application	Marek Klin, University of Gdańsk	30+15 min.
Alternative food		
Native and non-native invertebrates from the Baltic Sea: as a food source for humans or in the future aquaculture	Urszula Janas, University of Gdańsk	45+15 min.
Worms... – about the use and benefits of worms in aquaculture	Adrian Bischoff-Lang, Rostock University	45+15 min.
	TOTAL I	App. 10h

AquaVIP Gdynia summer school
Curriculum (part II)

Title	Presenter	Duration
II – Career panel – participants' presentations		
Various topics		
Aquaculture topics of interest: in studies/research/work	AquaVIP summer school participants & Facilitators: Hanna Łądkowska, University of Gdańsk , Konrad Ocalewicz, University of Gdańsk	3 min each/ 3h in total
	TOTAL II	App. 3h
III – Laboratory practice – AquaVIP experiments		
Growth and nutritional value of *Litopenaeus vannamei* from the small-scale laboratory culture	Halina Kendzierska, University of Gdańsk	45+15 min.
Aquaponic experiment with *Litopenaeus vannamei* and macroalgae	Aleksandra Zgrundo, University of Gdańsk	45+15 min.
Aquaponic experiment with *Litopenaeus vannamei* and microalgae	Filip Pniewski, University of Gdańsk	45+15 min.
	TOTAL III	App. 3h
IV – Facilities & farms virtual tours		
Visit to the small-scale RAS laboratory	Halina Kendzierska, University of Gdańsk	15 min.
White Panther, shrimp hatchery – virtual tour	Nicola Scalise, White Panther	30+15 min.
Dąbie Hatchery, salmonid eyed eggs farm – virtual tour	Thibault Pasquier, Dąbie Hatchery	30+15 min.
K1 Trout Farm, semi RAS trout farm – virtual tour	Marcin Juchniewicz, K1 Trout Farm	30+15 min.
	TOTAL IV	App. 2h
	TOTAL	**App. 18h**

AquaVIP Gdynia summer school
I – Presentations/webinars & discussions – Introductory topics

AquaVIP project presentation in the frame of blue bioeconomy

Hanna Łądkowska,
University of Gdańsk
20 min./ 10 min. Q&A

Aim: To familiarize stakeholders and promote the objectives of AquaVIP project, blue bio economy concepts, the place of AquaVIP in the blue bioeconomy framework, outreach activities related to stakeholders.

There is a significant demand for a high-qualified personnel and knowledge in modern aquaculture. In order to develop innovative aquaculture sector and move the focus into the South Baltic region, competencies and knowledge are crucial. This is where AquaVIP has a field for action. AquaVIP project objective is to boost aquaculture labour market within the South Baltic area by fostering human resources capacity: students and companies along the aquaculture value chain through cross-border training and networking, which will result in an increased number of skilled professionals and future employees in the blue economy sector.

State of play: innovative technologies in aquaculture in the Baltic Sea Region countries

Konrad Ocalewicz,
University of Gdańsk
45min./15 min. Q&A

Aim: To illustrate the state of play and trends of new solutions present in the region of the Baltic Sea: open cages, IMTA, RAS systems, aquaponics, and algae cultivation farms, and to familiarize stakeholders with the current situation and future potential.

Looking at the demand for seafood consumption in Europe, together with considering economy risks showed by the pandemic situation, aquaculture pollution, exploitation of the living resources, climate-change, quality of food from, wild stocks vs. farmed stocks, fish welfare, the sector needs sustainable solutions that which are already present or can be applied within the Baltic Sea Region. Innovative aquaculture encompasses many different production methods and target organisms.

Impact of COVID-19 pandemic on the aquaculture and fish processing sectors

Konrad Ocalewicz,
University of Gdańsk
45 min./ 15 min. Q&A

Aim: To present and discuss how pandemic situation changes aquaculture sector, costumers demand and fish and seafood processing industry.

The covid-19 has affected producers of fish, fish processing business and fish costumers. The entire pandemic situation caused several issues including health of people involved in the aquaculture sector and consumers, logistical problems (transportations, border restrictions) and problems with market access of the aquaculture products (hotels, restaurants and markets closed due to lockdown) what resulted in decline in demand for fresh aquaculture products, problems with selling of such products, problems with storage of unsold fish and sometimes decline of their prices. On the other hand, in the recent months increased popularity of processed fish has been observed. Small local aquaculture producers and fish/seafood processing plants have survived recent time quite well. Opposite has been noticed for those that based on the import/export activities.

AquaVIP Gdynia summer school

I – Presentations/webinars & discussions – Recirculating Aquaculture Systems (RAS) - Shrimps

Saltwater RAS: some biological, technical and economic aspects of brackish, marine and geothermal water applications

Nerijus Nika,
Klaipeda University
45 min. /15 min. Q&A

Aim: To familiarize stakeholders with a good practice of an innovative, sustainable saltwater RAS production by applying different source and salinity water, available in the Baltic Sea Region.

Regarding recently increasing limitations for off-shore marine aquaculture development due to its environmental impacts, one of the solutions for saltwater aquaculture is to go on-shore. Saltwater RAS technology offers an innovative, sustainable productions possibility of different fish and crustacean species, including salmonids, marine and, freshwater species. The saltwater RAS technology differs from common freshwater technology, as some additional water treatment and preparation processes are necessary. At Marine Research Institute of Klaipeda University experiments with different salinity and source water (artificial, Baltic and geothermal) are implemented to test for biological, technical and economic aspects and its advantages or limitations. At Fishery and Aquaculture Laboratory, the potential of brackish water for freshwater and euryhaline fish species cultivation is tested (on growth, harvested biomass, meat quality etc.), as it is known that some freshwater or euryhaline species perform better in brackish or marine water vs. fresh water. The other tested technology is a saltwater RAS for whiteleg shrimp cultivation. Our task is to acquire the shrimp aquaculture knowledge and optimize technology to local conditions. One of the main concerns is related to the artificial preparation of marine water, what may become a major limitation for this technology. As one of solutions, the geothermal water application to prepare artificial marine water is tested for biological, technical and economic aspects. The knowledge acquired during the testing of the new technologies is used to support new business activity and to increase competitiveness for the Lithuanian aquaculture industry.

Small scale shrimp RAS system: design, operation, parameters, results

Halina Kendzierska,
University of Gdańsk
45 min./ 15 min. Q&A

Aim: To familiarize stakeholders with a design and operation of a small-scale shrimp RAS, together with parameters and results of the experiments obtained in InnoAquaTech and AquaVIP projects, to show the potential for applications

The first demonstration facility for crustacean production in RAS in Poland has been established at the University of Gdańsk. Two white leg shrimp breeding experiments were carried out within InnoAquaTech project. Shrimps (*Litopenaeus vannamei*) were grown at 25°C and with a salinity of 28 PSU. Their nutritional value, i.e., contents of protein, fat, energy, fatty acids and soluble vitamins, protein digestibility, as well as chemical contaminants: mercury, lead, cadmium, organochlorine pesticides and polychlorinated biphenyls, were examined and compared with market shrimp species from different geographical regions. The purpose of the pilot in Pomerania was to raise the awareness of potential consumers to the fact that cultured crustaceans are characterized by a similar nutritional value to those of imported crustaceans and contain higher levels of polyunsaturated fatty acids. The facility is now further developed and used for AquaVIP experiments and demonstrations.
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AquaVIP Gdynia summer school
I – Presentations/webinars & discussions – Aquaponics & Algae

Aquaponics: system design, technology, applications

Adrian Bischoff-Lang,
Rostock University
45 min. /15 min. Q&A

Aim: To introduce the concept of the Fish Glasshouse, the combination of fish and plant production among stakeholders, to show the potential for applications.

Aquaponics refers to systems combining conventional aquaculture, breeding, fish, crayfish or shrimps in tanks with hydroponics, growing plants in water. The aquaponic system, feeds water from the aquaculture system to the hydroponic system, where the by-products are broken down by nitrifying bacteria into nitrites and then into nitrates, which are absorbed by plants as nutrients. The water is then recirculated back to the hydroponic system. Aquaponic production at Rostock University, combines African catfish breeding with plants breeding. The fish are farmed in the recirculating aquaculture systems, whereas plants are grown on fish metabolic products. The process can be monitored and processed scientifically at Rostock University, since FishGlassHouse is situated at the university campus, and then transferred to the commercial sector. Since aquaponics is considered as one of the most promising innovative and sustainable food production technology the advanced research at Rostock University has a huge potential for the aquaculture and agriculture sectors.

Macroalgae harvesting and cultivation: macroalgae in the Baltic Sea, system design, technology, and application practices

Aleksandra Zgrundo,
University of Gdańsk
45 min. /15 min. Q&A

Aim: To familiarize stakeholders with system design, technology, and application practices of various macroalgae species in the Baltic Sea Region.

There are app. 300-400 macroalgae species in the Baltic Sea. Although conditions in the Baltic are not optimal for large-scale commercial production of macroalgae for global markets, macroalgae have potential if their production is linked to ecosystem services. For example, their ability to effectively remove nutrients from the water can help with reduction of eutrophication. The lack of traditions related to exploitation and cultivation of macroalgae can also be considered as one of the factors limiting the popularization of the idea of mariculture of these organisms. In the Baltic region, macroalgae are mainly cultivated and harvested in Sweden, Denmark and Germany, which accounts for around 3% of the European production. Macroalgae production and harvesting of natural populations is also not popular in Europe and remains at a very low level. As market research indicates, macroalgae are seen as nutritionally very wealthy, being claimed as a great source of valuable compounds as polysaccharides, minerals, proteins and vitamins. Macroalgae have good publicity and good promotion – their consumption in Western cultures is in line with the increasing awareness of consumers' perceptions towards organic products and of environmentally sustainable products. Hence the increased interest in the production and consumption of high-value products from macroalgae also in the Baltic Sea region.

Microalgae cultivation: microalgae in the Baltic Sea, system design, technology, application

Marek Klin, University of Gdańsk
30 min./15 min. Q&A

Aim: To familiarize stakeholders with background information on Baltic microalgae, cultivation methods and applications.

University of Gdańsk has established a Culture Collection of Baltic Algae (CCBA) which maintains the strains of Baltic and freshwater microalgae from a wide range of habitats. The collection specializes in the Polish region but constantly includes new strains from further sources. Strains are available for research and education, as well as for the commercial use. There are numerous commercial applications of microalgae. They be used to enhance the nutritional value of food and animal feed, they can be used in cosmetics, production of pigments, lipids and their use as an additive to plant biomass for biogas production, wastewater treatment, and they play a crucial role in aquaculture and to name a few. Some strains cultivated at the University of Gdańsk will be used for removal of nutrients from the shrimp recirculating aquaculture systems (RAS) wastewaters.

AquaVIP Gdynia summer school
I – Presentations/webinars & discussions – Alternative food

***Native and non- native invertebrates from the Baltic Sea:* as a food source for humans or in the future aquaculture**

Urszula Janas,
University of Gdańsk
45 min. /15 min. Q&A

Aim: To familiarize stakeholders with the potential of Baltic native and non-native crustaceans for aquaculture.

In aquaculture efforts are made to reduce fish meat use by replacing it by microalgae or krill meal. However, these alternatives are still too expensive or environmentally unsustainable. Thus, searching for species suitable for cultivation and possessing for high value feed ingredients is a new challenge which will help to reduce the environmental impact of feed production. Crustaceans or bivalve are living in most aquatic habitats and are important food items for many fish and other invertebrates. Crustaceans could be used as food for fish farming with a high market price: mainly turbot, salmonids and sturgeons or cod, in production of functional food (products with health benefits beyond their nutritional value), alive should be used in fish aquaculture for conservation projects.

Worms... - about the use and benefits of worms in aquaculture

Adrian Bischoff-Lang,
Rostock University
45 min. /15 min. Q&A

Aim: To familiarize stakeholders with the potential of worms for aquaculture.

Worms is the colloquial term for many different invertebrate animals. A total of about 57,000 different species have been described so far, which belong to different phylae, such as the flatworms (Plathelminths), nematodes (Nematoda), scratch worms (Acanthocephali), or annelids (Annelida). Common to all these worms is their similar anatomy, which is characterized by an elongated and tubular body structure and no external extremities. The size spectrum ranges from a few micrometers to a body length of about 30 meters. An increasing number of different worms are now used in aquaculture, which is simply the controlled farming of aquatic organisms to provide food and protection from disease and predators. The use and benefits of these different worms range from live food organisms for fish larvae, to the recycling of excreted and thus unused nutrients of fish and shrimp culture, to a high-quality brood stock feed to stimulate the targeted spawning of aquaculture organisms. Likewise, worms are used to mitigate the environmental impact of aquaculture.

AquaVIP Gdynia summer school
II – Career panel

Aquaculture topics of interest in studies/research/work

Participants,
3 min./presentation

Aim: To familiarize participants with the activities of co-participants, which hopefully will result in future cooperation. The feedback from presentation will also give more insight into potential interests, solutions and problems, and the ground for future AquaVIP actions.

Participants' auto presentations on aquaculture activities and potential projects related to innovative aquaculture (research or commercial): such as recirculating aquaculture practices, technologies, applications, innovations in all kinds of aquaculture productions, algae and mussels cultivation and/or harvesting, application of products coming from fish, shrimps, mussels or algae production, market (marketing and communication) experience on marketing and communication of new product coming from innovative aquaculture.

AquaVIP Gdynia summer school
III – AquaVIP experiments

Growth and nutritional value of Litopenaeus vannamei from the small-scale laboratory culture

Halina Kendzierska,
University of Gdańsk
45 min. /15 min. Q&A

Aim: To develop skills in experimental work and familiarize stakeholders with a potential of crustacean aquaculture based on combination of *Litopenaeus vannamei* and recirculating aquaculture technology (RAS).

The experiment focuses on a challenge to develop the potential of crustacean aquaculture based on combination of *Litopenaeus vannamei* and recirculating aquaculture technology (RAS). It is a follow-up of the already performed research under the Interreg South Baltic Programme project InnoAquaTech. Previous experiments on *Litopenaeus vannamei* in RAS system were carried out at the University of Gdansk within InnoAquaTech project. A report and video material on previous experiments, analysis, and results are available at: https://www.submariner-network.eu/images/Crustacean_Production_in_RAS.pdf and https://www.youtube.com/watch?v=qH62LT1vS1o. For the experiment, a system called RAS 500 is used. The system consists of two sets of inland aquaculture systems with closed water circuit – RAS. The experiment design predicts five phases: cultivation preparation, transport and placing of *Litopenaeus vannamei* shrimps in the tanks, cultivation, harvesting, and analysis.

Aquaponic experiment with Litopenaeus vannamei and macroalgae

Aleksandra Zgrundo,
University of Gdańsk
45 min. /15 min. Q&A

Aim: To develop skills in experimental work and familiarize stakeholders with a potential of algae scrubber cultivation based on combination of *Litopenaeus vannamei* and macroalgae.

Algae scrubber experiments series is based on Baltic Sea water, and *Litopenaeus vannamei* culturing water (from RAS 500 experiments), and the assumption that organisms and propagules included in the water will develop into algal communities in experimental conditions. The assumption is based on wide use of “algae scrubber” systems in aquaria. The Algae Turf Scrubber was patented in 1980. A high development of algae scrubber systems for fish-keeping has been observed among amateurs. Still, there is little research in the scientific literature on the application of this system. Experiment's series will include testing the system known as "algae scrubber" using Baltic water and local organisms, testing the "algae scrubber" for culturing of *Litopenaeus vannamei* and selected strains of Ulva sp.

Aquaponic experiment with Litopenaeus vannamei and microalgae

Filip Pniewski,
University of Gdańsk
45 min. /15 min. Q&A

Aim: To develop skills in experimental work and familiarize stakeholders with a potential of microalgae application based on combination of *Litopenaeus vannamei* and algae strains.

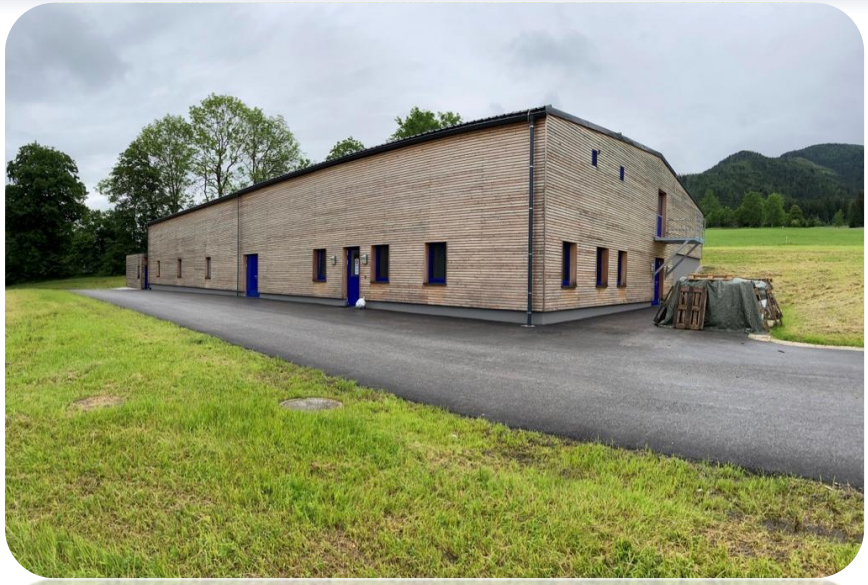
The experiment will focus on the selection of local strains – selection of strains that will grow efficiently using *Litopenaeus vannamei* culturing water as a medium. Special focus will be put on salinity and a nitrogen source influence. Biochemical characterization of biomass will be performed with the purpose to determine the possibilities of commercial use for wastewater treatment, production of pigments, lipids and their use as an additive to plant biomass for biogas production, or protein-rich biomass to be used as a feed additive. An assessment of algae growth in bioreactors and preparation of inoculum for cultivation on a semi-technical scale is planned in the further stage of the experiment, as well as the reassessment of growth rate and biochemical composition to determine the stability of biomass characteristics when changing the way algae are grown.

AquaVIP Gdynia summer school
IV – Facilities and farms virtual tours (part 1)

Virtual visit to the small-scale RAS laboratory
Halina Kendzierska, University of Gdańsk
15 min. virtual tour

Aim: To familiarize stakeholders with the technology of a small-scale laboratory RAS system and its applications.

The RAS-500 has been specifically designed and installed for the purpose of cultivating shrimps in closed recirculating aquaculture system and to carry out experiments which determine how different factors in various combinations effect survival, basic physiological processes, protein content and weight gain of the pacific white shrimp. Simultaneously data for the recommendation of the facility set up and shrimps' cultivation are collected and processed. RAS-500 consists of 3 separate tanks: water preparation tank, main unit (containing: electric cabinet, electronic cabinet, mechanical filtration, protein skimmer, UV and ozone sterilization, biological chamber, heating, filter sump, aeration) and a shrimp tank. There are two sets of the equipment specified and the sets differ in the biological filtration systems. Biological filtration in RAS 1 is typical wet/dry filtration (trickle filter). Biological filtration in RAS 2 is based on fluidized media fully submerged in the water column. Both systems are used simultaneously. The two sets work independently. It allows us check both filtration systems.

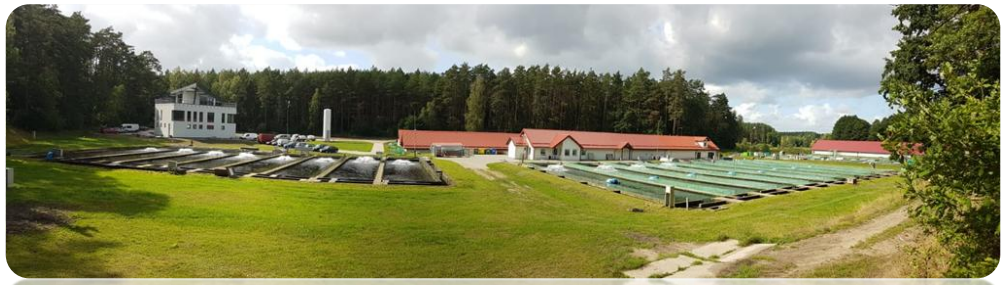


White Panther, shrimp hatchery – virtual tour
Nicola Scalise , White Panther
30 min. virtual tour

Aim: To familiarize stakeholders with the production of white shrimps in the recirculating aquaculture system

Surrounded by imposing mountain ranges and picturesque landscapes, the White Panther, Austria mountain shrimp enjoys its life deep down in the fresh water of the Almbach, in the heart of Austria. The shrimp farmed in the recirculating aquaculture system (RAS) gets species-appropriate husbandry without the slightest use of chemicals as well as varied, healthy feed that is perfectly matched to the various stages of development. Due to the extensive care and sustainable breeding, guarantee shrimp meat of the highest quality is guaranteed.

AquaVIP Gdynia summer school
IV – Facilities and farms virtual tours (part 2)



Dąbie Hatchery, salmonid eyed eggs farm – virtual tour

Thibault Pasquier, Dąbie Hatchery

30 min. virtual tour

Aim: To familiarize stakeholders with the production of salmonid eyed eggs by an innovative and sustainable method

Dabie Hatchery is one of the world leading company in the production of salmonid eyed eggs. The company is successfully exporting 4 different species to almost 40 countries. In order to supply their clients all the year round, there is a production of eyed eggs every week which requires indoor and outdoor facilities. The conditions to produce eyed eggs differ from the standard growing farm where fish is grown for human consumption. Therefore, the Dabie fish farms have been especially designed to meet their requirements. The farms are using the concept of RAS with a limited water inlet. The water treatment steps implemented in the farms are innovative and unique. Producing eyed eggs also requires a skilled team to control not only the process of growing fish but also the process of spawning, fertilization and incubation. The market requires the most resistant and fast-growing fish and to do so, Dabie Hatchery is constantly investing on the genetic of its brood stock.

K1 Trout Farm, semi RAS trout farm – virtual tour

Marcin Juchniewicz , K1 Trout Farm

30 min. virtual tour

Aim: To familiarize stakeholders with the production of trout in an innovative, semi RAS system

A lot of time and many ideas were so far invested into the planning and construction of the K1 Trout Farm, Poland, which is largely automated in order to reduce the ecological impact of the production and improve the fish welfare. The plant uses an air system, ensuring a vertical water circulation, a continuous current of stream water, aeration and separation of suspended solids from the fish water via a unique sediments collection system. Furthermore bioreactors are implemented for water biofiltration. The last step for water purification is an application of an integrated multi-trophic aquaculture system. As the result the bi-products are a biological fertilizer and filtered water is redirected into the stream. The farm is already a good example of a synergy between ecology and economy, still it has new investment plans ahead to improve both its productivity and sustainability.