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REPORT ON THE MEETING OF COST ACTION “APLICATIONS FOR ZOOSPORIC PARASITES IN AQUATIC SYSTEMS” (CA20125 PARAQUA), LARNACA, CYPRUS

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Abstract. This short paper reports on the meeting of the COST Action “Applications for zoosporic parasites in aquatic systems” (CA20125 ParAqua, 02.11.2021-30.10.2024) held from 4th to 7th of July 2022 in Larnaca, Cyprus. The meeting was organised by I.A.CO Environmental & Water Consultants Ltd and was an opportunity to discuss the progress of the Action, to program the activities for the next year and to undertake collaborative work for the implementation of the scientific objectives of the Action.

Key words: cross-sectoral collaboration, European network, microalgal biotechnology

COST stands for European Cooperation in Science and Technology, an EU funded program to support cross-sectoral and interdisciplinary research networks in Europe and beyond. In this context, the COST Action ParAqua, “Applications for zoosporic parasites in aquatic systems”, aims to organise and coordinate an innovative and dynamic European network, connecting academia, industry and water management authorities to advance and apply knowledge and expertise on aquatic fungi and fungi-like parasites and the relation with their hosts in natural and

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industrial systems. The Action was recently introduced on the COST News (https://www.cost.eu/aquatic-parasites-paraqua/) and more information can be found on the Action webpage (paraqua-cost.eu).

Currently, zoosporic parasites represent a major threat for microalgal biotechnology and industrial production (Carney & Lane 2014). Microalgal biotech plays an important role in the Bioeconomy Strategy and Action plan for a sustainable economy outlined by the European Commission and represent a very high potential for an economy based upon renewable resources. Like any other living organism, however, algae are vulnerable to parasitic infections. Parasitism is the most common consumer strategy (Lafferty et al. 2008), and a large number of biotic interactions are driven by parasites such as viruses, pathogenic bacteria and parasitic eukaryotes (Kagami et al. 2014, Tijdens et al. 2008). ParAqua will compile and share knowledge on the occurrence of zoosporic parasites and their relationships with hosts, elucidate drivers and evaluate impacts of parasitism in aquatic environments and algal biotech production. The aim is to implement new tools that can be used to promote better and safer production, such as methods for monitoring and early detection, or strategies of mitigating parasitic infections. But not only. ParAqua will also explore ways for valorisation of aquatic parasites for the production of essential biomolecules and advocate the importance of diversity and full ecosystem approaches to promote food web stability and resilience in aquatic systems and introduce zoosporic parasites as bioindicators for ecosystem health.

O f the 38 COST Members countries, 24 are already represented in the ParAqua Action Management Committee (Albania, Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Estonia, Finland, Germany, Hungary, Iceland, Italy, Latvia, Montenegro, The Netherlands, The Republic of North Macedonia, Poland, Portugal, Serbia, Slovenia, Spain, Switzerland, Turkey, United Kingdom), together with Israel which is a Cooperating Member and has full rights to participate in the COST action. Representatives of Romania, Czech Republic, Egypt, Azerbajan and Japan are also Action participants as Working Group Members.

Four interconnected working groups were established to organise the scientific activities: WG1, Occurrence and early detection of zoosporic diseases in natural and artificial aquatic systems (Leader Albert Rene and Co-Leaders Laura Garzoli and Andrea Tarallo); WG2, Drivers underlying the dynamics of zoosporic diseases in algal biotech and natural systems (Leader Ivana Trbojevic and Co-Leader Hans
Peter Grossart); WG3, Control strategies and valorisation of research for application (Leader Gabriel Acien Fernandez and Co-Leader Maja Berden Zrimec) and WG4, Integration and Dissemination (Co-leader Milos Stupar). Together with the Working Group, the Action Committees assure the good functioning of the Action in several aspects, including providing guidance and advice for inclusive communication within the Network (Moderators Committee Leader Bastiaan Ibelings, Co Leader Dedmer van de Waal), coordinating the scientific communication (Science Communication Coordinator Ana Gavrilovic and Co-Leader Fusun Akgul) and

oversee the good functioning of the Action Grants awarding to support the mobility of Researchers and Innovators (Grant Awarding Coordinator Kristel Panksep and Co-Leader Veljio Kisand). The Action Chair is Serena Rasconi and the Vice-Chair is Alena Gsell.

The Action is constantly growing, one of the main capacity building goals is to establish an active network of representatives from academic research, biotech and water management, where each sector brings their own experience and expertise and achieves a strong representation throughout Europe and beyond. These meetings are an important opportunity for Action Members to discuss progress and plan common activities, but also a good chance to expand the network by inviting local and external participants potentially interested to join the Action.

The four-day hybrid conference was held in Cyprus from July 4 to 7 2022 at the Multifunctional Center for Social Activities and Welfare of the Larnaka Municipality. The Local Organiser was I.A.CO Environmental & Water Consultants Ltd, an industrial network member specialised in environmental surveys and consultancy.

The first meeting day was dedicated to the Action Management Committee, during which the Action Chair, the Working Group Leaders and the Committees Coordinators reported to the Management Committee and to Action Members the Action progress and started discussing about the goals and activities for the next year. The following days were dedicated to the WG1 and 2 workshop and meeting, during which the participants worked on the topics "Zoosporic parasites interactive database" and "Needs and solutions for zoosporic parasites detection".

Participants from a number of countries attended on site (Fig. 1a, b, c) (Bulgaria, Italy, Croatia, Poland, North Macedonia, Spain, Serbia, Iceland, France, Switzerland and Cyprus) and 33 participants attended online (Fig. 1d, e) (from Albania, Switzerland, Cyprus,
Germany, Egypt, Spain,
Estonia, Finland, France,
Hungary, Israel, Montenegro,
Netherlands, Poland, Portugal,
Serbia, Slovenia and UK).

Fig. 1. Management Committee meeting and WG1 and 2 workshop of the COST Action ParAqua (CA 20125): a, b, c - participants at the Multifunctional Center for So cial Activities and Welfare of the Larnaka Municipality, Larnaca, Cyprus; d, e - participants on the virtual session.

During the conference, a site visit was organised to the Wastewater Treatment Plant of the Sewerage Board of Larnaka (Fig. 2). The Wastewater Treatment Plant covers the Larnaca district and uses the sewage for producing two end products for reuse. Purified water is returned free of charge to farmers for irrigation purposes, and the remaining solids are compressed into pellets and used as fertiliser. First, the Plant was presented by Mr Haris Papanikolaou (Laboratory Technician) and Ms Ioanna Ioannidou (Chemical Engineer) (Fig. 2a, b), illustrating the purpose of the infrastructure and its importance to the community. After that, the participants visited the model of the infrastructure (Fig. 2c) and toured the premises and the tanks (Fig. 2d) where different stages of the treatment take place, with interesting information about the process.

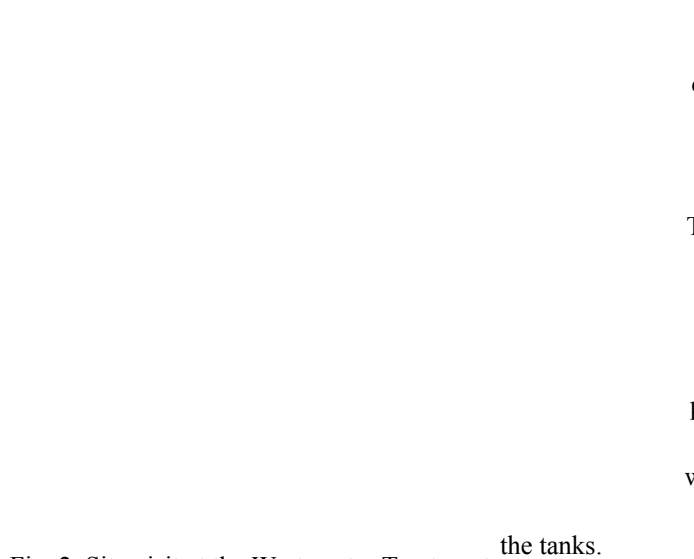

Fig. 2. Site visit at the Wastewater Treatment Plant of the Sewerage Board of Larnaka: a, b - presentation by Mr Haris Papanikolaou (Laboratory Technician) and Ms Ioanna Ioannidou (Chemical Engineer); c, d - the partici pants visited a model of the infrastructure and toured the premises and the tanks.

The following days the conference was dedicated more specifically to collaborative work on the ParAqua research coordination objectives. The first workshop day was dedicated to “Assemble and integrate all available information on occurrence and drivers of zoosporic parasites into an interactive database”. The workshop was chaired by Ilaria Rosati and Andrea Tarallo (CNR Italy), which are in charge of several management aspects within LifeWatch Italy (the Italian node of LifeWatch ERIC) and linked the Action with the prestigious European Research Infrastructure Consortium. They will coordinate the activities to collect and organise the data provided by the Action participants for the implementation of the database to gather and synthesise existing information on zoosporic parasites and make them available to the end users through a user-friendly interface. After an informative introduction about LifeWatch and the e-Science Infrastructure for Biodiversity and Ecosystem Research (Fig. 3a), the collaborative work started with a discussion on the data resources available from the members. The afternoon session was dedicated to create database templates based on the resources to be included and how these will be organised in the database interface (Fig.

3b).

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The second day of the workshop was dedicated to the detection methods of the zoosporic parasites and to discuss solutions for most effective, feasible and cost effective techniques for the early detection of zoosporic parasites in natural and artificial ecosystems. In the morning, the program included presentations from the Action members which provided an overview o f the current methods used for investigations on zoosporic parasites. The Action organised in May a Training School on “Detection and identification of zoosporic parasites” hosted by Hans Peter Grossart at IGB in Germany. The lectures from the Training School

Fig. 3. WG1 and 2 workshop on the database construction: a - Andrea Tarallo presents the LifeWatch infrastructure and the Data Management; b - the participants during the working session on the database implementation.

are available on the ParAqua Channel (https://www.youtube.com/channel/UC0tL1TyHqKCN8XY6IAFqtVw/playlists). The workshop was the continuation of the Training School, where participants were invited to present their experience regarding the learned methods and share feedback on their application for parasites investigations. The session started with the microscope methods, Pini Marco presented his experience in assessing parasites in algal cultures (Marco, 2022, Fig. 4a). Geza Selmeczy presented his experience with staining and video analysis (Selmeczy, 2022) and Slawek Cerbin shared his experience on apply image analysis in zoosporic parasite research and metabarcoding (Cerbin, 2022. Fig. 4b). The session continued then with a focus on molecular methods, Oliver Baric presented a nice protocol to use Next-Generation Sequencing (NGS) for identification of parasites in cultured microalgae (Baric et al. 2022, Fig. 4c) and Athina Papatheodoulou the application of DNA metabarcoding methodology in the European project Watdimon (Papatheodoulou, 2022). The sessions concluded with presentations on perspectives and applications of methods. Blagoy Uzunov presented opportunities for implementation of the knowledge acquired during the TS in Neuglobsow in Bulgarian projects (Uzunov, 2022, Fig. 4d), Milos Stupar explored ways to apply the lessons from Stechlinsee in limnological research in

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Serbia (Stupar & Trbojevic, 2022, Fig. 4e) and Jovica Leshoski shared some ideas on possibilities and prospects in a start-up lab, notably for molecular methods (Leshoski, 2022, Fig. 4f).

Two local Cyprus Government officials were invited and participated in the workshop on the techniques for the detection of zoosporic parasites, M. Lavrendios Vasiliades from the Department of Fisheries and Marine Research and M. Iakovos

Fig. 4. WG1 and 2 workshop on zoosporic parasites detection methods: a-f - presentations from the participants; g, h - collaborative writing session on the methods booklet.

Fig. 5. Impressions from the guided visit of the city: a - group picture at the Saint Lazarus church; b - details of a typical street and buildings in Larnaca; c - the medieval castle; d, e - the pottery studio and the prehistoric (3000 B.C.) cross-shaped idol symbol of the island art.

Tziortzis from the Water Development Department. The invited participants appreciated

the well organised conference and were interested to obtain more information on the topic of algae parasites to explore opportunities to apply the presented methods to their needs.

The afternoon session was dedicated to collaborative writing (Figs. 4g-h) to create a booklet of methods and techniques for end-users to conduct research on zoosporic parasites. The booklet will be published open access and will contain protocols, recommendations and practical hints on techniques for identification and quantification of parasites infections and will serve as guideline for early detection and monitoring methods.

During the meeting, the participants had the opportunity to visit the city of Larnaca with a walking tour of the downtown guided by M. Demetriou Demetris, from the Municipality tourist office. Cyprus has a long history, it is one of the oldest civilisations in the Mediterranean and its position at the crossroad of three continents made the island a unique mosaic of different cultures. The visit started at the Saint Lazarus church (Fig. 5a), founded in the 9th century, then the visit moved along the Foinikoudes promenade (Fig. 5b) to the medieval castle (Fig. 5c), built in the 12th century to protect the harbour of the town. The visit ended at the ceramics and pottery studio (Fig. 5d), where the group was able to observe some homemade exhibitions of museum replicas of the prehistoric and ancient (3000 B.C.) world of Cyprus (Fig. 5e).

After the successful meetings, the ParAqua participants continued and expanded networking experiencing traditional Cypriot culinary delicacies. Eating in Cyprus is serious business, and usually you can see Cypriots gathered around a table with a couple of plates called meze to snack on. With a rich history, the island has seen a variety of influences, all of which add to the local gastronomy. Halloumi is probably Cyprus' most famous product that is produced by combining a mixture of goat's and sheep milk, before being set with rennet. This is an unusual practice due to the absence of acid-producing bacteria in any part of the process, a standard for most dairy products. Halloumi's high melting point means it can be easily fried or grilled, and is less often served cold. Beside Halloumi, traditional Cypriot foods include souvlakia (grilled meat kebabs), sheftalia (grilled pork), afelia (pork marinated in coriander), cous-cous with Greek yoghurt, pitta bread. kolokasi (root vegetables), different fish dishes, lamb, artichokes, chickpeas, olives and many more...

Fig. 6. Part of various meze dishes - a, b.

Fig. 7. Self-exploration of Cypriot food on the first night upon our arrival (a). With help of hosts and meeting organisers, I.A.CO, we are getting familiar with rich Cypriot cuisine (b, c).

In order to taste all these delicacies in a few days, the best way is to order Cypriot traditional meat or fish meze, what could consist of as many as 30 tasting plates (usually 20+) designed for sharing (Figs. 6a, b). These are savoury dips and vegetables and a wide variety of fish and meat dishes prepared in several different ways. And of course, these great meals go well with ouzo, local wine or local bear.

This is how we started the exploration of Cypriot food on the first night upon our arrival (Fig. 7a). Our hosts and meeting organisers, colleagues and friends from I.A.CO, organised the conference Gala Dinner and helped us in the next days to become even more familiar with this rich cuisine (Figs. 7b, c).

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests regarding the publication of this article.

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References

Baric O., Radocaj T., Vardic I. & Gavrilovic A. 2022. The use ofNext-Generation Sequencing (NGS) for identification of parasites in cultured microalgae. Workshop of the COST Action ParAqua - Applications for zoosporic parasites in Aquatic Ecosystem (CA20125), Larnaca - Cyprus, July 6, 2022.

Carney, L.T. & Lane, T. W. 2014. Parasites in algae mass culture. - Front. Microbiol. 5: 278. https://doi.org/10.3389/fmicb.2014.00278

Cerbin S. 2022. Beginner's impressions on applying metabarcoding and image 55

analysis in zoosporic parasites research. Workshop of the COST Action ParAqua - Applications for zoosporic parasites in Aquatic Ecosystem (CA20125), Larnaca - Cyprus, July 6, 2022.

Lafferty, K. D., Allesina, S., Arim, M., Briggs, C. J., De Leo, G., Dobson, A. P., & Thieltges, D. W. 2008. Parasites in food webs: the ultimate missing links. - Ecol. Lett. 11: 533-546.

Leshoski J. 2022. Identification of zoosporic parasites, possibilities, and prospects in a start-up lab. Workshop of the COST Action ParAqua - Applications for zoosporic parasites in Aquatic Ecosystem (CA20125), Larnaca - Cyprus, July 6, 2022.

Kagami, M., Miki, T. & Takimoto, G. 2014. Mycoloop: chytrids in aquatic food webs. - Front. Microbiol. 5: 166.

Marco P. 2022. Lesson from the Training School Microscopy session to assess parasites in algal cultures. Workshop ofthe COSTAction ParAqua - Applications for zoosporic parasites in Aquatic Ecosystem (CA20125), Larnaca - Cyprus, July 6, 2022.

Papatheodoulou A. 2022. Project Watdimon- DNA metabarcoding methodology for European benthic diatoms. Workshop of the COST Action ParAqua - Applications for zoosporic parasites in Aquatic Ecosystem (CA20125), Larnaca - Cyprus, July 6, 2022.

Selmeczy G. 2022. Experience at the TS: staining and video analysis. Workshop of the COST Action ParAqua - Applications for zoosporic parasites in Aquatic Ecosystem (CA20125), Larnaca - Cyprus, July 6, 2022.

Stupar M. & Trbojevic I. 2022. Could the lessons from Stechlinsee be applied in further limnological research in Serbia? Workshop of the COST Action ParAqua - Applications for zoosporic parasites in Aquatic Ecosystem (CA20125), Larnaca - Cyprus, July 6, 2022.

Tijdens, M., Van De Waal, D. B., Slovackova, H., Hoogveld, H. L. & Gons, H. J. 2008. Estimates of bacterial and phytoplankton mortality caused by viral lysis and microzooplankton grazing in a shallow eutrophic lake. - Freshwater Biol. 53: 1126-1141.

Uzunov B. 2022. Implementation of the knowledge acquired during TS in Neuglobsow in Bulgarian projects. Workshop of the COST Action ParAqua - Applications for zoosporic parasites in Aquatic Ecosystem (CA20125), Larnaca - Cyprus, July 6, 2022.

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