NaTxAq

CONFERENCE
ABSTRACT BOOK
AND PROCEEDINGS

Natural Toxins

Environmental Fate and Safe Water Supply

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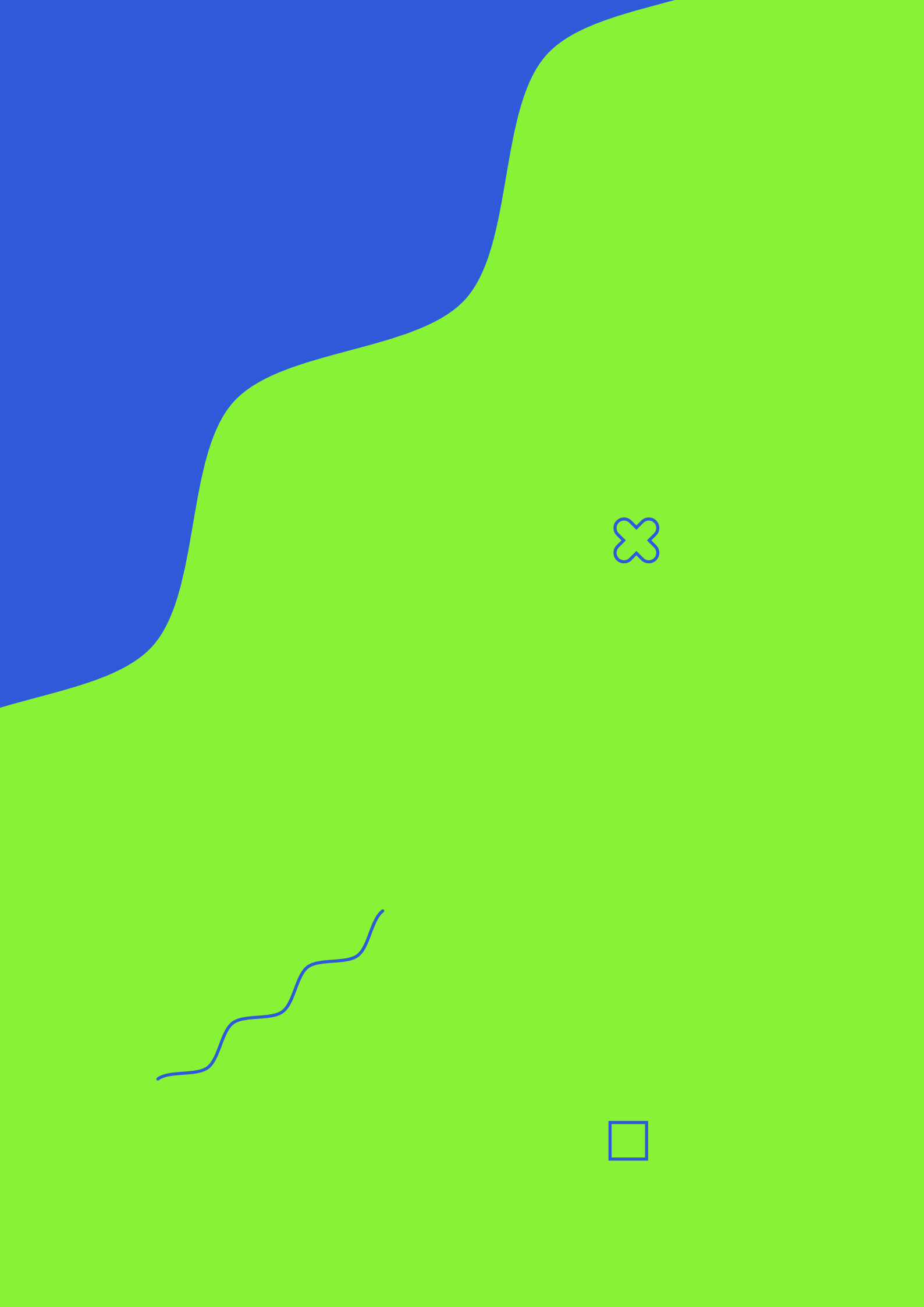
“Progress is impossible without change, and those who cannot change their minds cannot change anything.”

George Bernard Shaw



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Proceedings of the online conference
Abstracts of presented contributions

Natural Toxins: Environmental Fate and Safe Water Supply

24th–25th September 2020

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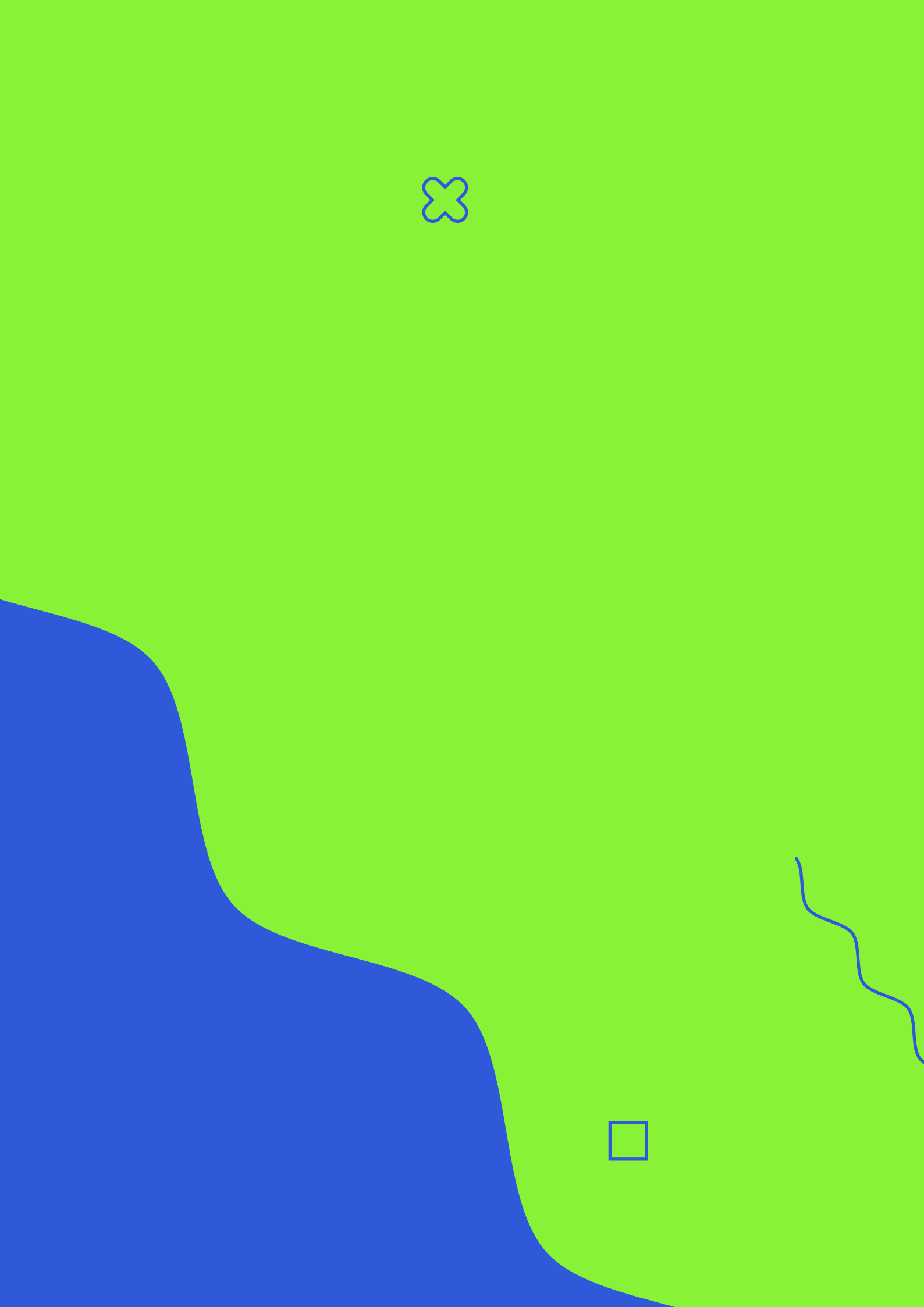
01

Introduction



Introduction

Nature is a big book to look into to understand pollutant fate and properties. Since the mid-20th century environmental chemists, biologists, toxicologist and managers have strongly improved in analysis, monitoring and understanding the distribution, fate and ecosystem and human health effects of a wide diversity of man-made pollutants ranging from polyhalogenated substances, heavy metals and PAHs to pesticides, pharmaceuticals and food ingredients.

We are far from done and new pollutant classes emerge such as nanoparticles, plastics, and perfluorinated compounds. Broad screening programs tell us that we should pay more attention to polar, persistent and toxic compounds. Despite intensive environmental research actions over the last 80 years we are not yet in position to predict the toxicological profile of a given water sample based on measurement of known pollutants in the water. The topic for our final NaToxAq conference is yet another lesson. This is about how Nature itself produces harmful substances. During millions of years of evolution, plants, microorganisms and other organisms have developed sophisticated ways to cooperate, to compete and to defend themselves. A huge diversity of specialized natural compounds are being synthesized, covering chemical structures that will leave the organic chemist jealous. These bioactive compounds may serve as chemical weapons for the producing organism, e.g. for a plant to avoid attack by an insect. Other metabolites may serve as signal compounds, for instance for a plant to shape the biome in the rhizosphere. Many natural compounds serve as inspiration for the agrochemical and pharmaceutical industry to develop new pesticides and medicine. We do not know exactly how many of these bioactive natural compounds we have got, but numbers probably exceed 100,000. A larger fraction of the compounds are toxic to humans - and we will here term them as natural toxins. The environmental fate and toxicology of natural toxins is sparsely studied except for a few dozens of compounds. What is the load of natural toxins to the environment, what are their chemical-physical properties, how do they transfer from the organism to soils and water, how do they degrade and at which speed, do they leach to drinking water reservoirs and how do we get exposed? These and many other questions are those we will address at the conference. We are grateful for the many interesting contributions submitted to the conference to help grow this emerging field of natural toxin chemistry and toxicology. We were very much looking forward to host you at the originally planned conference in Brno, Czech Republic, in June 2020. Unfortunately, the COVID-19 pandemic has made the conference a special challenge. Great efforts are taken to transfer the conference into a successful online event. Special thanks go first of all to the RECETOX organizing team in Brno, the NaToxAq management, and the organizing committee. Your continuous enthusiasm and creativity has been a fantastic platform for developing the conference. Lean back, browse the nice book of abstracts and prepare yourself for the conference, the 24th and 25th of September.

On behalf of the organizing committee and the NaToxAq consortium,

Hans Christian Bruun Hansen
Head of NaToxAq

Overview of the NaToxAq project

Clean drinking water is crucial to human health and wellbeing. The ambition of the NaToxAq ETN network is to expand the research basis for EU's leading role in securing high quality drinking waters for its citizens. Focus is on natural toxins – a large group of emerging contaminants with unknown impact on drinking water resources. Both known toxins, like cyanotoxins, cyanogenic glucosides and terpenes and not yet explored toxins will be investigated.

Twenty leading universities, research institutions, and water enterprises will pioneer the field through joint training of 15 ESRs investigating natural toxin emission via water reservoirs to water works and consumers. The natural toxin challenge is addressed by the concerted work of the ESRs within 4 scientific work packages comprising origin, distribution, fate and remediation.

Priority toxins are selected using in silico approaches accompanied by novel non-targeted and targeted analyses to map natural toxins along vegetation and climatic gradients in Europe. Invasion of alien species, toxin emission, leaching and dissipation will be under strong influence of climate change. Data collected for toxin emission, properties and fate will be used to model effects of climate, land use, and design of remediation actions. Special attention will be paid to toxin removal at water works including development of new technologies tailored to remove natural toxins. The results will contribute to strengthening of European policies and regulation of drinking water, while new business opportunities within the fields of water supply and treatment, chemical monitoring and sensing, and the consulting sector will arise from academia-industry collaborations. The urgency of the challenge, its eminent knowledge gaps, its multifaceted and multidisciplinary nature, and the need for scientific and public awareness to be communicated by ESRs in a balanced way makes the topic ideal for a European mobility and training network.

Hans Christian Bruun Hansen
Head of NaToxAq

Words from ESRs

Since 2017 we are all on our common, yet individual journey within NaToxAq which is largely coming to an end with this conference. For all of us NaToxAq was opening a new chapter, since we were required to relocate to new places and plunged head-first into the ambitious visions of our supervisors, who came up with the innovative idea to investigate natural toxins in waters on a large scale and all different levels: new sources, new toxins, how do they travel in the environment?

How much raw water can I safely drink? How about treated water? For us students, however, the first questions often were: what is bracken? A fern and toxic?! What does "toxic" mean? I should solve all this in just three years?!

The ducklings plunged into the water (Fig. 1) started to swim – it went surprisingly well! We stumbled, were stuck, were desperate and had to "prioritize" – yet here we are: a group of 16 – mature, proud ducks. Over the past years, we met on many occasions and we were very much looking forward to have this final get-together of our "NaToxAq family" (Fig. 2) in Brno this summer, right before parting our ways and waddle into new adventures – be it in science or other fields. The past years were certainly also filled with lots of fun excursions, laughter, new friends, numerous valuable experiences, and a lot of exciting science! We think we can speak for all of us in thanking the whole NaToxAq family for this special time, but also our close friends and families for supporting our choices and ambitions. Further, we want to thank you, the participants of this conference, for allowing us to share the outcomes of the past years with you and learn more about your natural toxin research in exchange. It is a privilege to be able to do so, even in these rather difficult times and the still rather uncommon online format. We hope you will enjoy the meeting and gain new insights into the fascinating field of natural toxin research!

Barbara Kubíčková and Carina Schönsee

ESR representatives

FIGURE 1

Ducklings ready for the jump.

Photo by K. Kirkensgaard, 2019.

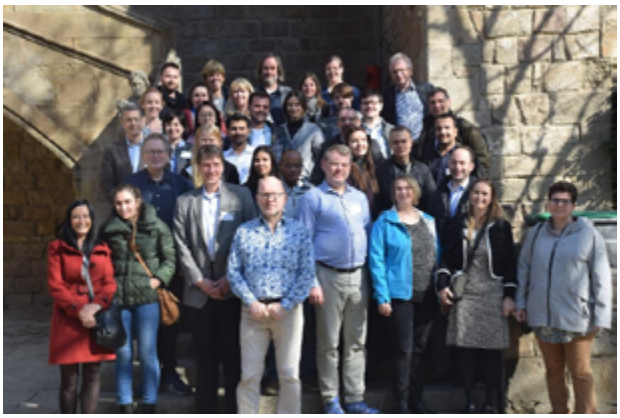


FIGURE 2

The NaToxAq consortium.

Photo by K. Kirkensgaard, 2019.

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Tools to manage cyanobacteria agglomerations in freshwater ecosystems

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Increase of water temperature and eutrophication processes accelerate harmful algal blooms in freshwater ecosystems. If point sources of pollution are controlled in many European Union countries, the diffuse pollution of phosphorus and nitrogen compounds from agricultural land is still a challenge for the management. Undoubtedly, the primary goal is to cease pollution and block access to water ecosystems. However, the urgent measures are also necessary to be applied to already deteriorated lakes that suffer from harmful cyanobacteria blooms, especially those ecosystems which are used for the drinking water supply and recreation. Harvesting of cyanobacterial agglomerations can contribute in reducing of nutrient load and cyanotoxins concentrations from water bodies. Restoring water quality and biological health of a particular aquatic ecosystem allows to prevent cases of intoxication via recreation, diminish costs of drinking water treatment and ensure safe water for consumers. The project AlgaeService for LIFE - LIFE17 ENV/LT/000407 (2018-2023), proposes to use a system of tools to manage water quality and cyanobacterial blooms in freshwater ecosystems. Particularly, two technologies will be applied to harvest agglomerations of cyanobacteria in aquatic ecosystems of different size. The efficiency of harvesting of cyanobacteria using the specialised prototype with conveyor type system will be tested in lakes and ponds in 2020. Another prototype-harvester equipped with centrifugation system will operate in large water bodies, such as the Curonian Lagoon. Moreover, remote sensing methods, such as satellite images and images of unmanned aerial vehicle, will be applied to define timing and target area of cyanobacteria agglomerations for efficient operation of prototypes. The ArcGIS application “Mark a blooming water body”, the interactive map with marked blooming locations and the questionnaire are available on the project website (http://algaeservice.gamtostyrimai.lt/). This tool encourages state institutions and society to contribute in filling the database of blooming water bodies and raises public awareness on issues related to harmful cyanobacteria blooms.

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