28 August – 5 September 2016

7th International Symposium on Extant and Fossil Charophytes, Astana, Republic of Kazakhstan

Scientific sessions

The scientific session of the 7th meeting of the IRGC occurred on 31 August to 2 September 2016 in Astana, the very young capital of Kazakhstan. The symposium was organized by Aizhan Zhamangara and vigorously supported by Sherim Tulegenov. The meeting took place in the L.N. Gumilyov Eurasian National University in a kind and almost familiar atmosphere. Up to 36 oral and poster presentations were given by speakers from 15 countries from Europe, Asia, America, and Australia filled with a wide spectrum of charophyte research. This report will try to summarize the main results of the presentations by ordering them to four main subjects: 1) Fossil charophytes - biogeographic trends & endemism, 2) Taxonomy, diversity and distribution, 3) Ecology and 4) Physiology & biochemistry.

Fossil charophytes - biogeographic trends & endemism

The IRGC president**, Carles Martín-Closas** (Spain) opened the oral presentations and spoke about the findings of Iberian endemic charophytes at the Eocene-Oligocene boundary with a few species that are exclusive from the Ebro Basin. **Alba Vicente** (Spain) won the prize of the IRGC best student presentation for her very interesting talk about cosmopolitan and endemic charophytes from the Upper Cretaceous and Lower Palaeocene. She demonstrated that extant and fossil charophytologists have similar objectives and that both are faced with intraspecific polymorphism. The presentation of **Li Sha** (China) focused on Chinese charophytes during the Cretaceous-Paleogene boundary and correlated them to the charophyte records from Europe. Taxonomy and distribution of charophytes from Kazakhstan on the boundary of Eocene and Oligocene were presented by **Aizhan Zhamangara** (Kazakhstan) identifying three stages of charophyte development in the observed period. She emphasized that Kazakhstan can serve as a connection between Europe and Asia to examine the common characteristics and differences between fossil charophytes of both continents and thus a better understanding of the evolution of charophytes. **Joe T. Hannibal** (USA) showed that the occurrence of charophytes in some French buhr millstones can be linked to specific quarry sites within the Paris Basin.

Taxonomy, diversity & distribution

Roman E. Romanov (Russia) presented in three oral and two poster presentations the current state of knowledge of charophytes from Sinai, Kazakhstan, Tajikistan, Russia and the permafrost areas of Yakutia. For the mainly desert region Sinai he confirmed 11 species and illustrated that Kazakhstan has the highest species richness among the Central Asian states - with 29 confirmed charophyte species. The most frequently collected species in Tajikistan even up to an altitude of 3800 m in the Pamir Mountains is *Chara vulgaris*. Roman E. Romanov also presented that a large number of charophytes occur in the river valleys in Yakutia. Based on detailed studies of herbaria of several universities, institutes and private collections he confirmed 46 charophyte species and updated the current knowledge of distribution and richness of charophytes in Russia. **Ingeborg Soulié-Märsche** (France) summarized the knowledge on charophyte floras from Morocco, Algeria and Tunisia and showed also that temporal waters, wadis or artificial lakes play a role for the

presence of charophyte species. She considered the idea that *Chara oedophylla* could be presented an intermediate state within the evolution of *C. vulgaris* from a monoecious to dioecious species. Based on intensive sampling from 185 localities **Freshteh Ahmadi** (Iran) improved the knowledge of the charophyte distribution in Iran and described 17 charophyte species including the new diplostichous species *Chara kohrangiana*.

Our knowledge about taxonomy and terminology about charophytes, charophyte green algae and the origin of land plants was summarized by **Adriana Garcia** (Australia) with the suggestion using the term charophyte exclusively for stoneworts and charophyte green algae or charophytic algae when referring to the clade of green algae including land plants. **Hidetoshi Sakayama** (Japan) presented the results of the first reliable transcriptome and genome sequence data obtained from *Chara braunii* and showed that many gene families hypothesized to be important in plant development are present in *Chara*. He asks for material of *C. braunii* for his phylogeographical analyses. Unfortunately, **Kenneth G. Karol** (USA) could not attend the meeting in the last moment, but Robin S. Sleith (USA) presented his work about the mitochondrial and plastid genome sequences of 15 Characeae species and showed that both organellar genomes evolved differently and told different stories about phylogenetic relationships of Embryophytes and Charophyceae.

Stephen D. Gottschalk (USA) presented an overview of the historical treatments of *Chara* subsection Willdenowia that Wood & Imahori reduced to only one species. In contrast to this, current data based on morphology, biology and a four gene phylogeny suggested the existence of more than 16 distinct species. The picture was different for phylogenetic analyses of *Chara* species presented by **Susanne C. Schneider** (Norway) indicating that morphological traits may serve as diagnostic tools for species delineation, but that they are not generally suitable for inferring genetic differentiation. That charophytes also can be listed as aggressive invasive species showed **Robin S. Sleith** (USA) in his presentation about the movement and distribution of *Nitellopsis obtusa* in North America (Fig. 1, page 33). Specimens introduced from Europe occur in habitats with high nutrients and high conductivity and show remarkably little genetic variation. For better understanding of the spread of *Nitellopsis obtusa* he is asking for material. Stephen D. Gottschalk on behalf of **Kenneth G. Karol** (USA) talked about the presence of *Lychnothamnus barbatus* in North America first documented in 2012 and discussed the question if this species is native or exotic.

Ecology

Intensive sampling and measuring of water chemistry data around New England and New York allowed investigations of species richness using multivariate analyses and species distribution models by **Robin S. Sleith** (USA). Conductivity or pH constrains species in different ways indicating that conservation efforts should try to protect a wide range of habitats. **Hendrik Schubert** (Germany) analysed the occurrence and distribution of charophytes in Chile, demonstrating that ionic composition caused differences in the distribution patterns of *Chara* and *Nitella* species, except *C. braunii* which was found under ionic compositions similar to *Nitella* species. **Sara Calero** (Spain) studied the short life cycle of a parthenogenetic population of *Chara canescens*. In response to the fluctuating habitat and the annual character, she found that *C. canescens* only has a reproductive cycle of 5 months and that the size of oogonia depends on the position of the whorl. In her next presentation Sara

Calero analysed the phenology of three charophyte species demonstrating that temperature seems to be a key factor in the regulation of the reproductive pattern. Additionally, she reported that increased salinity negatively affected the sexual reproduction of *Chara hispida*, by delaying the reproductive onset, shortening its reproductive period and decreasing the frequency of oospore production. It seemed that salinity promotes the presence of long-stalked antheridia. The response of charophytes from shallow water bodies to global warming was presented by **Maria A. Rodrigo** (Spain) showing that stressors like temperature, salinity, nitrate concentration, UVR etc. interact and that the charophyte responses to climate change differ not only among species but show also intra-specific differentiations. The seasonal dynamics of primary production of charophytes was analysed by **Kaire Torn** (Estonia) demonstrating that during mild winters *Chara tomentosa* is not only able to exist, but also to produce. **Elisabeth Lambert** (France) analysed the vegetation of saltmarshes from the French Atlantic coast and demonstrated that *Tolypella salina* occurs only in habitats with regular drying periods combined with changing salinities from brackish to hypersaline. A Polish-German project for the protection of charophyte lakes of Lubuskie voivodship (Poland) and Brandenburg (Germany) regions was presented by **Andrzej Pukacz** (Poland) demonstrating that light conditions and proportions between forests and industrialized areas in the catchment basin are the key factors for the charophyte occurrence and species richness.

Analyses of subfossil charophyte oospores in the littoral part of the Curonian Lagoon were presented by **Zofija Sinkevičienė** (Lithuania). She showed that viable oospores were concentrated mainly in the upper sediment layers, which partly can be explained by biological peculiarities of charophytes and hydrodynamic activities in the estuarine lagoon. **Petra Nowak** (Germany) analysed the recent macrophyte community of Baltic coastal waters in relation to the diaspore reservoir in the sediment and its regeneration potential showing that the diaspore bank could play a role for regeneration and conservation of coastal water ecosystems. The presentation of **Anja Holzhausen** (Germany) focused on the dormancy and vitality of oospores. Pre-treatment with cold temperatures as well as desiccation can be identified as condition to break the dormancy. The vitality of oospores can be detected with 2,3,5 - Tri-phenyltetrazoliumchlorid.

Physiology and biochemistry

Mary J. Beilby (Australia) improved our knowledge about the signaling of charophyte cells under salinity stress and showed that Ca2+ in Characeae action potential (AP) comes not only from the internal stores but also from out-side and formation of inositol triphosphate (IP3) is probably involved in that process. In her second presentation Mary J. Beilby answered questions about the reaction of proton pumps and H+/OH- channels participating in the pH banding pattern under salinity stress and showed that the latter ones can be blocked by 1 mM ZnCl2. **Allan R. Chivas** (Australia) analysed the low molecular-weight compounds within the thalli of charophytes and demonstrated that *Chara* has a remarkable organic chemistry, spanning the range of all marine algae and terrestrial higher plants whereas *Lamprothamnium* behaves as other submerged and floating-leaf aquatic plants. **Margarete Kalin** (Canada) showed that charophytes can provide a solution for the removal of certain contaminants (e.g. uranium, radium) from alkaline mine waste effluents. With apical growth and basal decay, charophytes can stabilize sediments and facilitate bio-mineralization processes. During her second presentation

Margarete Kalin provided a summary of the concentrations of elements in effluents of mining waters and in the biomass of charophytes growing abundantly in effluent lakes or ponds showing that the relationship between the elemental concentrations in the water and that in the biomass are remarkable.

Anja Holzhausen and Petra Nowak

(Germany)