

A tribute to Maria Rosa Miracle

Guest Editors

A. Camacho, H. Dumont, S.S.S. Sarma, J.M. Soria and E. Vicente

PREFACE

This is a special volume of *Limnetica* in memoriam to Professor Maria Rosa Miracle. Collecting 29 invited manuscripts in tribute to Prof. Maria Rosa Miracle. She passed away on 28th May 2017 in Valencia (Spain), at the age of 72, when she was still active as Emeritus Professor at the University of Valencia. During her nearly five decades of dedication to research and teaching, she became globally a highly influential limnologist. Her lines of research in limnology paved the way for many new interdisciplinary themes, some of which can be found in this special volume.

Soon after Maria Rosa passed away, the Iberian Association of Limnology (AIL) decided to dedicate, in her honour, a special issue of *Limnetica*, the indexed journal of the Association to which she was always associated as Author, Reviewer or Editor. The present collection of papers is published in *Limnetica* in homage to Maria Rosa. Manuscripts have been contributed by various invited authors, many of whom seek answers to some of the puzzling limnological questions raised by Maria Rosa, and on the themes she liked to work on. Many of the articles have been elaborated by her former students, colleagues and collaborators, trying to address some of the unfinished products of her last few months of research activity. While collaborating with different colleagues, she left a wealth of research data which will perhaps be published in near future following her ideas and the guidelines that she has left behind.

For the present volume, manuscripts reflect diverse themes, starting from meromictic lakes, continuing by phytoplankton and zooplankton and finishing with applied limnological aspects including management of aquatic ecosystems. A second volume is in progress and, when ready, it will be combined with the present one, and a final print version incorporating all articles from both issues is expected to be released as a book by the end of 2019. More specifically, this volume of *Limnetica* contains both basic and applied limnological themes, as follows: 1. Meromictic lakes: phytoplankton ecology. 2. Meromictic lakes: methanogenic bacteria. 3. Cyanobacteria, algae and drinking water quality. 4. Phytoplankton: biogeography and taxonomy. 5. Zooplankton-phytoplankton relationships. 6. Zooplankton ecology. 7. Zooplankton: distribution, diversity and taxonomy. 8. Zooplankton: molecular taxonomy. 9. Zooplankton: environmental toxicology. 10. Zooplankton as ecological quality indicator. 11. Macrophytes. 12. Macroinvertebrates. 13. Palaeolimnology. 14. Remote sensing images for water quality studies. 15. Lake management.

This preface also contains some personal reflections from some limnologists who knew or have closely worked with Prof. Miracle, some even for more than forty years. These give us a vision of Maria's friendly relationships with other limnologists from the beginning of her research to the latest global scientific projects.

Valencia, 8th January, 2019

Guest Editors of this Special Volume of *Limnetica*
A. Camacho, H. Dumont, S.S.S. Sarma, J.M. Soria and E. Vicente



Prof. Margalef and Maria Rosa on the boat at Lake Banyoles. Ca. 1970.



Dr. Edmondson with Maria Rosa and Claudia Ricci in Gargnano during the Rotifer Symposium. 1988.

Claudia Ricci

University of Milan, Italy.

Maria Rosa Miracle, the Rotifers and I: a friendship story across Rotifer symposia

I met Maria Rosa Miracle at the first Rotifer Symposium, held in Lunz am See at the Biological Station of the Austrian Academy of Science. At that time, September 1976, both Maria Rosa and I were quite young, but while I was just a beginner in my studies on rotifers, Maria Rosa had already finished her PhD on monogonont rotifers under the supervision of Ramon Margalef, one of the brilliant ecologists of the last century. At Lunz, we shared a room at a 'bed and breakfast' not far from the Biological Station; this gave us an excellent opportunity to know each other. Maria Rosa was quite shy and did not talk much until she could feel comfortable: shortly we became friends. One of our common traits was to be late-comer, and often we risked to arrive late at the morning scientific sessions at the Biological Station. Hopefully, almost every day Alois Herzig saved us: he drove every morning to the Station and saved us from impolite delays at the meeting.

At Lunz meeting, Maria Rosa was already an experienced scientist: she was invited to give a review presentation on distribution and migration of planktonic rotifers. The whole audience appreciated the lecture: her talk was excellent, revealing a bright scientist, specialist in systematics, biology and ecology of monogonont rotifers.

Maria Rosa attended most Rotifer Symposia, she missed three of them: the ones held in Belgium (1979), Austria (2003), and Germany (2009). Nevertheless, the results of a collaboration between Maria Rosa and Charles King were presented at second rotifer meeting, in Gent (Belgium). Compensating her absence at Gent symposium, she was very busy at the third one (Uppsala, 1983), where she arrived with a colleague (Eduardo Vicente) and a young PhD student (Manuel Serra): both are now well-known ecologists.

During June 1991, she organized the sixth rotifer symposium in a Catalan village, Banyoles, not too far from Barcelona. Adjacent to the village is a lake, Banyoles, well-known to Maria Rosa because there she had been studying zooplankton composition and movements for her PhD thesis. Year 1991 was a very busy time for Spain because of the Olympics scheduled for the following year and organized in Catalunya: even Barcelona airport was under restoration, complicating the participants' movements. On the other hand, village and Lake Banyoles were going to host the water competitions of the Olympic Games. Thus, most streets to enter and cross Banyoles village were either interrupted or deviated. Maria Rosa was so used to move around in Banyoles that she did not realize that a bus is not a car and cannot drive along narrow cross roads. As a consequence, the bus got stuck at a cross and we were suggested to walk to the monastery of Sant Esteve, place of our lodging and of the scientific meeting. Maria Rosa was so familiar with Banyoles and surroundings that, in occasion of the excursion, she and Eduardo got 'lost' while the entire group of rotiferologists was sitting in the bus waiting for them: that was the first case of 'lost organizers'. As a matter of fact, any occasion was good for Maria Rosa to water samplings and rotifer collections. As it was pointed out, no need for panic: they knew the language and could ask for instructions; actually, they did not need instructions, only time to sample.

Both Maria Rosa and I were quite regular at Rotifer Meetings, and we enjoyed the opportunities to get together on several occasions, also outside the context of the Rotifer symposia. One of the best opportunities we had was the participation in the committee to evaluate a PhD dissertation at the University of Sevilla in 1989. Ramon Margalef headed the commission. At the end of the academic duties, the whole commission was kindly invited to visit the famous *Coto de Doñana*; this provided us a unique opportunity to enjoy that beautiful and unique habitat commented by two unusual 'guides', Ramon Margalef and Francisco Garcia Novo, head of the Biology Department and a well-known plant ecologist.

During that same year, 1989, Maria Rosa came to Milan and visited our Department of Biology: after spending a few days together in the laboratory, we moved to Bormio, a touristic village high on the Italian Alps to attend a meeting of the Society of Italian Zoologists (UZI), scheduled to be held there. Ramon Margalef, too, was attending the same meeting and Maria Rosa and I could spend some time with him and his wife.

On July 1992, invited by Maria Rosa, I participated in a PhD committee at Valencia University. After the academic duties, Maria Rosa and Eduardo Vicente invited me to join a sampling campaign in the surroundings of the beautiful town of Cuenca where they had to go sampling. Although on a more touristic mood, I was happy to join them and Maria Rosa's daughter, Olga, joined the group; we all moved by car. On the first day, when night came, we were quite far from any touristic place, and neither hostel nor B&B nor hotel was around. In absence of alternatives, Maria Rosa and Eduardo decided that we could sleep in the car..., we were still 'young', then. The rest of our sampling campaign was very exciting and, for sure, more comfortable.

At the beginning of 2000, an international group of scientists studying parthenogenetic organisms built a scientific network (PARTNER = parthenogenetic organisms) the aim of which was to evidence and compare the traits of the many organisms (both animals and plants) that reproduce parthenogenetically. One of the meetings was held in Valencia, organized by Manuel Serra, Maria Rosa and their lab group. Maria Rosa attended the entire meeting, nevertheless, together with Eduardo could find the time to take me and my husband to visit unique beautiful places in the surroundings of Valencia, such as 'la Albufera', i.e. salt marshes and lagoons, that host peculiar and resistant inhabitants including many rotifer species.

Although our investigation fields differed quite much, synecology of monogonont rotifers by Maria Rosa and autecology of bdelloids by me, our scientific discussions were always interesting and fruitful to me. Our friendship, sometime with short contacts and occasional encounters, lasted until the last Rotifer meeting (Czech Republic, 2015) and later on, although with a few email messages. In fact, Maria Rosa never addressed any aspect of her private life with colleagues and the same was with me, as from my personal experience. The fact that she was sick was unknown to most of us and her death for most of us, if not everybody, totally unprepared to listen such unpleasant and sad news.

Our last encounter was in 2015 at the last Rotifer meeting in Czech Rep. During the year 2018, another Rotifer Meeting had taken place in USA: everybody would have missed Maria Rosa Miracle. Maria Rosa's and my research focused on rotifer biology and ecology, but dealing with different animal groups (monogononts for her, bdelloids for me) and under different points of view. In spite of our personal and professional differences, our friendship lasted for 40 years, sometimes with long silences, but with reciprocal pleasure at every meeting occasion; together with the entire rotiferologist community I shall miss her.

Ramesh D. Gulati

Netherlands Institute of Ecology, Wageningen, The Netherlands.

Maria Rosa Miracle, a Tribute

A lot has already been said and written about Maria Rosa Miracle since her tragic death on 28th May, 2017. I will restrict my writing about Maria Rosa's passing away to my personal meetings with her, especially since I came to know her more personally in the early 1990s. My first personal contact with Maria Rosa was in 1991 when I visited Banyoles, Spain, to participate in the deliberations of the 6th Rotifer Symposium that she organized there. Of course, I met Maria Rosa on a couple of occasions earlier but then I did not realize how important the rotifers were to the understanding of their role in the

food-chain of aquatic organisms. This was also partly because I was not interested in Rotifera as an important group of zooplankton. Therefore, the Congress in Banyoles was for me an eye opener in many respects concerning the importance of rotifers as zooplankters as well as their origin.

I had several opportunities at the Rotifer Meeting in 2015 in Ceske Budejovice, Czech Republic, to meet Maria Rosa and discuss with her some issues concerning Rotifers. I learnt a lot from this meeting with her. It was around this period that I had been also editing a Springer Book on the Ecology of Meromictic Lakes (Ecological Studies 228; Eds. Gulati *et al.*, 2017). Maria Rosa Miracle and her colleagues contributed the Chapter 8 on “Lake La Cruz, an Iron-Rich Karstic Meromictic Lake in Central Spain”. Their book chapter was of great interest to me as far as the importance of microorganisms in meromictic lakes. I vividly recall my useful discussions with Maria Rosa both on rotifers and microorganisms in such lakes.

A part of my contacts and intense interest in the works and well-being of Maria Rosa was undoubtedly due to the feed backs from my friends Nandini Sarma and SSS Sarma, in Mexico. They were great friends of Maria Rosa and worked with her at Valencia on various Spanish lakes. At the invitation of the Organizers, I was actually in Mexico, early in 2017, attending the International Shallow Lakes Meeting at Merida, Mexico, where I learnt about Maria Rosa's deteriorating health condition, although she was already seriously sick. We were also well kept informed about her health condition by Eduardo Vicente, a senior Spanish colleague of Maria Rosa who too was in Mexico attending the same Meeting at Merida. The expected happened and Maria Rosa passed away (peacefully) in the end of May 2017. It was, indeed, a very sad and tragic event but we have to accept it.

Ramesh Chandra Dalela

Editor-in-chief Journal of Environmental Biology &
Retired Professor at D.A.V. College, Muzaffarnagar, U.P. State, India.
Founder President of the Academy of Environmental Biology (India)

Prof. Maria Rosa Miracle has been an epitome of dedication and professionalism. As a teacher and researcher, she left everlasting impression in the form of work culture, ethos and discipline which will always be remembered by her students, fellow researchers and friends. Prof. Maria Rosa was closely associated with the Academy of Environmental Biology (India). She first served as Vice President of the Academy of Environmental Biology (AEB) during 1985-1987 and then as President of the Academy (AEB) for the period 1987-1990. During this period, she visited the Academy's headquarter and stayed with Dr. R. C. Dalela for about a month, visited a few places with him and delivered lectures besides presiding over the Annual Session of the AEB. Dr. Dalela fondly remembers the pleasant days that he and Mrs. Dalela spent with Professor Maria and her daughter at Muzaffarnagar, India. She also served as one of the members of Editorial Board of *Journal of Environmental Biology* for some time during 90's and was instrumental in raising the quality and standard of the Journal by her critical reviews and suggestions from time to time.

Dr. Dalela and Mrs. Dalela along with the Academy (AEB) and Journal (JEB) family wish the departed soul an eternal peace and her family the strength to bear this irreparable loss.

Singaraju S.S. Sarma

National Autonomous University of Mexico (UNAM)

Prof. Maria Rosa Miracle achieved international recognition and as a result was asked to serve in leadership roles outside of her native country. Beginning in the early 1980s she was closely associated with Academy of Environmental Biology (India) (AEB). She served as Vice-President of the Academy

during 1985-1987 and then became President for the period 1987-1990. During this time, she visited the Academy and contributed to the proceedings edited by R.C. Dalela, S. Kant, and S. Vahra (1988). In fact, the Editor-in-Chief of JEB, Dr. R.C. Dalela fondly remembers the pleasant days that he spent with Prof. Maria Rosa and her daughter together with Prof. Eduardo Vicente. Prof. Maria Rosa with her students also published a key article on the effects of insecticides on ecotypes of the rotifer *Brachionus plicatilis* (JEB; Vol. 7(4): 259-275, 1986). This paper is still being cited (Mills *et al.*, 2017 *Hydrobiologia* 796(1): 39-58). This important research was one of the first to show that different ecotypes of *B. plicatilis* respond differentially when subject to environmental stress. We now know that *B. plicatilis* is actually a cryptic species complex consisting of as many as 15 species (Mills *et al.*, 2017). Thus honouring her by dedicating this special volume is a token to express our gratitude for her services and contribution, not only for the AEB, but also for the entire community of limnologists.

My association with Prof. Maria Rosa dates to 1991 when she organized the prestigious 6th International Rotifer Symposium, which was held in Banyoles (Spain). It was only possible for me and other young scientists from developing nations to attend this meeting because Prof. Maria Rosa waved all costs associated with my participation. Since the late 1990s, my wife, Prof. S. Nandini, I met Prof. Maria Rosa in many international events such as Symposia on Rotifera, Cladocera, Copepoda, SIL, etc. Our research collaboration grew strongly in recent years. For example, during last five consecutive summers, we carried out various experiments on zooplankton feeding ecology, predation, and ecotoxicology at her laboratory. This productive collaboration has already resulted in several publications with a few more in review or in preparation for submission. Prof. Maria Rosa was also keen to deliver a key note address on Spanish hypertrophic lagoon, Albufera of Valencia at the 9th Shallow Lakes Meeting in February 2017 (Merida, Mexico). Unfortunately, by this time her health began to deteriorate considerably and thus she could not attend the meeting, although Prof. Eduardo Vicente delivered the invited talk of their joint work on Albufera at this meeting. As a researcher, Prof. Maria Rosa's contributions are numerous; as a mentor to her students she was indispensable; as a friend she was a delight to be with.

Eduardo Vicente and Antonio Camacho

Department of Microbiology and Ecology & Cavanilles Institute for Biodiversity and Evolutionary Biology. University of Valencia, Spain.

Professor Maria Rosa Miracle, limnologist. In memoriam

Maria Rosa Miracle was born on 2nd June 1945 in Barcelona. She studied at the University of Barcelona where she was awarded with her BSc (honours, 1968) and PhD (*cum laude*, 1974) degrees. As a former PhD student of Prof. Dr. Ramón Margalef, she conducted field work on Lake Banyoles (Girona, Spain) studying for several years the seasonal succession, distribution and patchiness of zooplankton. After completion of her PhD dissertation, she spent a two-year research stay at the University of California, Davis, with Dr. Charles Goldman as supervisor.

Upon returning to Spain, she spent several years, until 1979, at the University of Barcelona as Associate Professor, developing mainly two projects financed by Research Scholar Government Public Works: the “Study on Pyrenean Lakes” and a “Study on the Spanish Mediterranean coastal lagoons”. In 1979 she went to the Department of Zoology, Oregon State University, Corvallis, invited by Dr. Charles King, to participate in the project “Rotifer population dynamics, experimental laboratory studies on survival”. At the end of 1979 she joined the University of Valencia as Senior Professor of Ecology, setting up the Limnology Research team there, and occupied the prestigious *Chair on Ecology* in 1981, following her academic activity until her retirement by September 2015. Thereafter, she continued as Emeritus Professor at the University of Valencia.

For more than forty years, Maria Rosa Miracle was a tireless and unflagging worker, completely devoted to research and teaching activities. She served as the Head of the Ecology Department at the University of Valencia between 1981-1987 and 2003-2010, as the President of the Academy of Environmental Biology, India from 1987 to 1990, and as the President of the Iberian Limnological Association from 1994 to 2002. Maria Rosa was also Associated Editor of five international scientific journals.

Prof. Miracle supervised more than 20 PhD students and many of them are now university professors, including three currently Chair Professors on Ecology. In addition, three of former PhD students are now scientists working at research centers in Germany, one in France and one more at *Colegio de la Frontera Sur* in Mexico. Also, three of them teach at secondary schools, and others work as environmental managers on public or private entities. She also supervised more than 20 Master theses. Prof. Miracle had a passion for teaching and was revered by her students.

Maria Rosa was Principal Investigator or participant in over 20 highly competitive Spanish funded research projects, over 10 European or International Projects, and 18 technical studies and reports. She authored or co-authored more than 200 indexed scientific articles, 21 books or book-chapters, and organized 16 International Congresses or Workshops. She also authored over 250 Abstracts or Extended Abstracts in Congresses and Symposia.

This was just a numerical summary of forty years of professional activities. In addition to study many of Spanish lakes (mainly karst lakes), wetlands and lagoons, she also visited and studied aquatic ecosystems in many other countries, collaborating with some of the most reputed limnologists around the world. Among others, she shared research with Prof. Henri Dumont (Ghent University, Belgium), actively participating in a limnological expedition to the Algerian and Tunisian Sahara in 1976, as well as in a study of primary production in marginal lakes associated with River Niger in 1993. She performed several research stays at the Windermere Laboratory (Freshwater Biological Association, UK) with Dr. Bland Finlay, to study the microaerophilic and anoxic environments in 1983, and also conducted some electron microscopy studies of ciliates and bacteria at the oxic-anoxic interface of stratified lakes in 1992. She also conducted joint research with Prof. Peter Tyler on the interfaces and chemoclines in the stratified marginal lakes of Gordon river in Tasmania in 1987, and pursued in the Protistology Laboratory, Deakin University (Warrnambool, Australia), to perform a Limnological study of stratified deep areas in the Hopkins estuary. With Prof. Wayne Wurtsbaugh, she performed a research stay in the Utah State University, Logan, USA, studying the eutrophication of the Farmington basin in the Great Salt Lake in 2002. With Dr. Keve Kiss, of the Hungarian Academy of Sciences, she developed an Spain-Hungary integrated project for plankton studies from 2005 to 2007. Most recently, with Dr. Victor Alekseev of the Russian Academy of Sciences, she jointly lead a study on the taxonomy of the cyclopid copepods of confusing identification by comparison with specimens from the type locality in 2011, and also conducted a study of microcrustaceans at the shoreline of the Lake Baikal and wetlands near Irkutsk in 2012.

Similarly, reputed senior scientists have visited Maria Rosa's laboratory to study, among others, the plankton of Albufera de Valencia and other shallow lakes in the Mediterranean coast, including many of the above-mentioned co-workers but also Prof. Brian Moss (UK), Prof. Manuel Elías (Yucatan-Mexico) and Profs. S.S.S. Sarma and Nandini Sarma (UNAM-Mexico). Another limnological area of her interest was the stratified lakes near Arcas, doing a common project with Dr. Finlay, as well as the karst area of river Guadazaon polje, conducting a project with Prof. Wurtsbaugh in both Lake El Tejo, and in the internationally well-known meromictic Lake La Cruz (both systems in Cuenca, Spain), that was also visited several times by her with other senior scientists such as Dr. Jakob Zopfi and Prof. Raymond Cox in addition to those already mentioned as collaborators.

All her scientific and academic achievements were only possible through her lively and passionate attitude towards the challenges of the new, the uncommon and the unknown, with a desire and disposition to increase knowledge on extreme or rare environments wherever they might be encountered, seeking those inland waters, lakes, wetlands in Europe, Eastern Asia, America or Africa even getting to the

barely reachable Saharan or fluvio-marginal lacustrine waters at the Niger Delta.

The incorporation of Professor Miracle as faculty member of the University of Valencia led the starting point of the Limnology school at this University, which over the years became the second relevant school in this area, inspired by that initiated by Professor Dr. Ramón Margalef at the University of Barcelona, of which Dr. Miracle was part, fifty years ago, as a PhD student. The impact of the limnologists trained in the research team of Prof. Miracle is reflected in the academic, scientific and professional development of the PhD students trained under her supervision.

In addition to her achievements in Academia, the most remarkable feature about her character is that she was a hard worker and a very good and gentle person. Maria Rosa was all her life a great supporter of Spanish Limnology and will be missed by her colleagues and all those who interacted with her. Being a very shy person, science was her life, but her two sons, Dicky and Dani, and her daughter, Olga, were her love. Those that valued her as a person and as a scientist will miss Maria Rosa.



Great Salt Lake: Maria Rosa is sampling zooplankton in Great Salt Lake (USA). Ca. 2002.



Next to a doline after sampling Lake La Cruz. From right to left, Prof. Raymond Cox, Jennifer Thompson, Dr. Amelia Rotaru, Javier Soria, Prof. Miracle, Dr. Nicole Posth and Dr. Simon Poulton. 2014.