



# Introduction to the proceedings of the 10<sup>th</sup> International Symbiosis Congress (Lyon, France)

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The 10<sup>th</sup> congress of the International Society of Symbiosis (ISS) was held jointly with the 3<sup>rd</sup> International Conference on Holobionts. The meeting was hosted by the French scientific community, composed of members from INSA Lyon (BF2i and MAP), University Lyon 1 (LBBE and LEM), University of Rennes (IGEPP, INRAE), and the National Museum of Natural History of Paris. The meeting took place in Lyon, the capital city of France's Auvergne-Rhône-Alpes region, from July 25<sup>th</sup> to 29<sup>th</sup> 2022, reminiscing the last symbiosis meeting held in Lyon, in 1989. Indeed, well before the ISS was founded in 1996 (Richardson 2011), Paul Nardon, Vivienne Gianinazzi-Pearson, Anne-Marie Grenier, Lynn Margulis, and David Cecil Smith welcomed at INSA-Lyon the 4<sup>th</sup> International Colloquium on Endocytobiology and Symbiosis (Nardon et al. 1990).

## 1 Challenges addressed at the meeting

Protists, animals and plants are known to establish a variety of relationships with microbes. These symbiotic associations have important ecological and evolutionary outcomes for nature and living organisms. They have enabled major evolutionary

transitions, including the emergence of eukaryotes, such as algae, that participate in global geochemical cycles (nitrogen, carbon, phosphorous), and play a crucial role in the health of plants and animals, including humans. While the pioneers of symbiosis described the first symbiotic relationships early in the nineteenth century, the huge efforts recently made to study human, animal, and plant microbiota have definitely advanced the original concept of symbiosis.

Plants and animals are now considered as an ecosystem involving a complex assembly, the holobiont (Rosenberg and Zilber-Rosenberg 2016), composed not only of the host genome, but also the genomes of a variety of associated microorganisms from which they vitally depend (Selosse et al. 2014). There was a clear benefit in uniting the 10<sup>th</sup> congress of the International Symbiosis Society (ISS) with the 3<sup>rd</sup> International Conference on Holobionts, since the two communities overlap to a great extent and share underlying theories and methodological approaches. The success of the ISS congress in Lyon strongly advocates for further association between the two organizations in the future, as well as with other dynamic organizations, such as the *Wolbachia* international community, which was well represented in Lyon.

In the era of the Anthropocene, and in the face of the global upheavals of the planet, both ecological and climatic, the challenge for this congress was to take stock of the recent progress of knowledge, but above all to assess how these interactions drive adaptation of the biosphere and offer us solutions for the future. With this in mind, emphasis was put on the development of collaborations and pedagogy by opening up the congress to students (by incentives in registration prices for PhD students, supported by the Gordon and Betty Moore Foundation, etc.), and by initiatives involving scientific mediation for the general public. These included a Street Science project, which was supported by the University of Lyon, INRAE, and la Mairie de Villeurbanne. This project was conducted by many congress organizers, along with open reporting of the conference to the public. As a result, everyone could address the above problems, pose questions and take actions where possible at their particular level.

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## 2 The meeting and activities

The meeting was a great success, and involved the participation of 330 attendees from 31 different countries. The scientific quality of the speakers was excellent and covered the issues and objectives of the meeting. The meeting site in Lyon, was at the main Congress Center of Lyon (Fig. 1A) adjacent to the Rhône River (Fig. 1B). Close to the Congress Centre there was a cluster of small restaurants where congress participants could meet for lunch or dinner, often with those doing research on a particular aspect of symbiosis (Fig. 1C). The Congress organization was excellent and included social activities, field trips and the Congress gala dinner (see below) (Figs. 2, 3, 4, 5, 6, 7).

Lectures were presented to the 330 participants (Fig. 3A) in two different theatres (Fig. 4B and C). The poster session was organized in a big Hall along with Wine and Cheese sessions (Fig. 5A and B). In additions there were excursions on one afternoon to various places of interest to visitor from other countries (Fig. 5).

Programs and activities emphasized and addressed the challenge of the Anthropocene with respect to the environment. This approach resulted in symposia themes on global changes and their impact on ecosystems (e.g. *Symbiosis in Anthropocene 1: From susceptibility to*

*resilience in global change; Symbiosis ecology: from ecosystem functioning to ecological networks*), as well as on agriculture (e.g. *Symbiosis in Anthropocene 2: Symbioses for alternative agricultures; Plant holobiont: physiology, defense and applications for agriculture*), and on the marine environment (*holobionts: from littoral to deep sea*).

As in previous congresses, there was a Symbiosis Teaching Session organized by Marc-André Selosse, a tradition since the second Congress in Cape Cod in 1996. It was held in a room with tables for display (Fig. 6A). Volunteer scientists showed and explained their research model using living material (observable by naked eye or under dissecting microscope; Fig. 6B). Films, slides under microscope book(s) or images, and specific teaching methods were also displayed. The session was akin to a “living poster” session and offered no less than 15 different symbiotic models (Table 1). All the Congress attendees were intrigued by the great diversity of symbioses, experimental approaches, and observations. The success of this session makes it a hallmark of ISS congresses.

Prizes were awarded for the best post-doc talk (to Elisa Dell'Aglio, France, BF2i, University of Lyon, INSA Lyon, INRAE), the best student talk (to Sthandiwe Nomthandazo Kanyile, Germany, Max Planck Institute for

**Fig. 1** **A** The Congress Center in Lyon, France with the Rhone River on the right, the green Parc de la Tête d'Or on the left and walkways and restaurants in the background. *Copyright studiofy*. **B** The river Rhône that is adjacent to the Congress Centre, that is reachable by the foot bridge and walking trails from many hotels. *Copyright Nicolas Robin*



**Fig. 2** A and B Groups of participants enjoying a meal together in restaurants close by the Congress Centre, Lyon



Chemical Ecology), the best post-doc poster (to Miguel Ángel González Porras, Germany, Max Planck Institute für Biologie) and the best student poster (to Ana Carvalho, Germany, Max-Planck-Institute for Chemical Ecology). A poster prize sponsored by the *New Phytologist* journal, was presented for a contribution on plant symbioses (to Kevin Magne, France, Université Paris-Saclay and Université Paris Cité).

### 3 Social and outreach activities

At the congress, the organizers set up, for the first time in Lyon and Villeurbanne, a Street Science program that explained the various aspects and models of symbiosis to a large audience. This program was made available to the

public as part of the Science Festival 2021, the session being held during the congress, and also under the framework of the Science Festival 2022. The organizers of the Congress welcomed about 50 members of the general public to participate in interactive activities and get involved in speed-dating with scientists, as well as taking part in an excursion to the park “Tête d’Or” in Lyon. The public was able to discover symbioses in their daily environment and see the hidden world of interactions between living beings. The programs and interactive activities were managed by a website and a phone application. The concept of sustainable development was reinforced by avoiding goodies, tote bags, or paper documents, and offer participants an Ecocup to avoid the use of plastics during the two “Wine & Cheese” events, *i.e.* informal buffet organized during the evening poster sessions. The budget traditionally used for goodies during registration

**Fig. 3** **A** The participants at the tenth ISS Congress, group photo at the park Tête-d'Or, Lyon, France (Photo courtesy of Tomas Figura). **B** The large lecture theatre at the Congress Centre where many keynote speakers presented fascinating information on a wide range of symbiotic associations. **C** The smaller lecture theatre where many other papers were presented





**Fig. 4** A and B Two of the fifteen symbiosis teaching sessions where those attending the Congress could study at first hand topics that were outside their own field of interest



**Fig. 5** One of the excursions for ISS Congress participants, this one to visit the cave at a local Beaujolais wine maker

was fully allocated to the association “Coeur de Forêt” to plant 125 trees in the Masoala park in Madagascar. In addition, there were a number of excursions organized for participants (Fig. 4B).

The organizing committee made Congress participants aware of anti-Covid measures to avoid an outbreak during the congress. Participants were provided with surgical and FFP2 masks, hydroalcoholic gel, and an antigenic test for each participant to be used before the gala dinner. This was organized in the Palais de la Bourse (Fig. 7). Only one positive Covid test was reported before the gala dinner, and two others during the congress. The organizing committee asked all participants to inform them if they had contracted Covid-19 after the congress, but luckily none were reported.

Finally, the organizing committee would like to warmly thank the invited speakers and all the participants for the quality of their presentation and for the interactive atmosphere they were able to cultivate during this meeting. Positive interactions also dominated in the audience! In addition, we thank the various sponsors for their support that allowed the smooth running and presentation of the wonderful lectures and discussions that were the outcome of this congress. In conclusion, the organizing committee would like to thank the INSAVALOR company for the help they provided with registration and advising participants, the high quality of their management and for monitoring of the congress activities. We thank all the contributors and look forward to the next congress that will take place if all goes well in Melbourne in 2025 under supervision of Linda Louise (Environmental Microbiology Research Initiative, University of Melbourne): we can't wait to meet all the symbiosis community again there.

We also would like to inform our symbiosis community that the executive committee (EC) of the ISS has been re-elected late of September 2022. The new team is now composed of Aziz Heddi (President), Sharon Doty (Vice-President, Education 1), Irene Newton (Vice-President, Education 2), Manju Gupta (Vice-President, Website), Erik Hom (Treasurer), and Elizabeth Heath-Heckman (Secretary). The EC is seeking for at least two Student Representatives, and warmly encourage students to get in contact with the committee for this purpose.

#### The organizing committee:

Federica Calevro, Anna Zaidman-Rémy, Rita Rebollo, Abdelaziz Heddi: BF2i (INSA Lyon, INRAE)  
 Laurence Mouton, Natacha Kremer, Fabrice Vavre: LBBE (University Lyon1, CNRS)  
 Claire Valiente-Moro: LEM (University Lyon1, CNRS)  
 Fabrice Not, François Lallier: AD2M (University of Sorbonne, CNRS)

**Fig. 6** **A**, wine tasting during the evening session. **B** Selected cheeses and breads to accompany the wine tasting



**Fig. 7** The Congress gala dinner at Palais de la Bourse, where the congress participants enjoying an evening in historic surroundings, and a wonderful meal

Marc-André Selosse: ISYEB (Muséum National d'Histoire Naturelle of Paris and Institut Universitaire de France)

Jean Christophe Simon, Christophe Mougel: IGEEP (University of Rennes, INRAE)

Feteh-El-Zahare Haichar: MAP (INSA Lyon, University Lyon1, CNRS)

#### Invited speakers:

Bruno Lemaitre, Switzerland

Fabrice Not, France

Forest Rohwer, USA

Gabriele Berg, Austria

Irene Newton, USA

Jillian Peterson, Austria

Joel Doré, France

Joel Sachs, USA

Kevin Foster, UK

Marc-André Selosse, France

Margaret McFall-Ngai, USA

Martin Kaltenpoth, Germany

Michael Khul, Denmark

Nancy Moran, USA (visioconference)

Paola Bonfante, Italy

Purificación López-García, France

Ute Hentschel, Germany

**Table 1** Symbiotic displays during the Symbiosis Teaching Session in Lyon France

Marc-André Selosse	Symbiotic mites in domatia of temperate trees
Fabrice Not & Johan Decelle	The Planktomania project
Michael Middlebrooks	<i>Elysia viridis</i>
Luca Borgato & David Richardson	Lichens
Emmanuelle Botte	Sponge bacterial symbioses
Daniel Wipf & Véronique Gruber	Legume nodules
Daniel Wipf & Véronique Gruber	Arbuscular mycorrhizas
Doron Pinko	Kleptoplasty and symbioses in foraminifera
John Burns, William Burgess, Baptiste Genot & Cory Bishop	The Salamander-alga symbiosis
Ehsan Kayal	Zombifying <i>Amoebophrya</i>
Remi Petrolli, Liam Laurent, Tomas Figura & Benoît Perez-Lamarque	Orchid mycorrhizas and ectomycorrhizas
Hasna Boubakri & Katharina Pawlowski	Actinorrhizas
Anna Michalik, Piotr Łukasik & Michał Kolas	Bacterial symbioses in planthoppers
Sarah Zauner	Symbiotic lucinids
Xavier Bailly	<i>Synsagittifera roscoffensis</i>

**Sponsors:****References**

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