Editorial

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Seaweed resources of the world: a 2020 vision. Part 4

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When the co-editors embarked on this series of four special issues, we believed 2020 would indeed be a special year, one for 20:20 vision and reflection on how global resources had changed and were being utilized for their many positive ecological and economic benefits. Indeed, the year 2020 will now go down as unprecedented in history as the year of the COVID-19 pandemic, when the world was suffering from, and in a frantic search for a vaccine and treatments against, the deadly virus. Have seaweeds and their properties been considered adequately enough in this search for sources of antiviral compounds? Several papers have been published on the antiviral properties of polysaccharides from seaweeds (Chen and Huang 2018; Pereira 2018; Pereira and Critchley 2020; Shi et al. 2017). Perhaps it is time to take a serious look at many of the phycocolloid-producing seaweeds species which might well be the source of anti-COVID compounds and, similarly, why does substantial, supporting research about the antiviral properties of seaweed polysaccharides seem to go unrecognized by the pharmaceutical community in these desperate times?

In this Vision 2020 series, we surmised that more and more people have come to appreciate and recognize seaweeds as having more desirable properties than just being lowly weeds, a nuisance, a foul-smelling and obnoxious matter being washed up on the beach! However, as an increasing body of evidence has been collated, their uses have expanded to the non-food industrial realm including their use – both potential and actual – in the pharmaceutical, biomedical, and nutraceutical industries, and as sources of products and services that benefit humankind. While these are often consumer-goods-centric applications, seaweeds are perhaps the missing link in the discussion that may well be part of the solution for the world's protection and recovery from the onslaught of global warming and climate change – by assisting to reduce excess carbon dioxide and reducing methane emissions from cattle and sheep, all whilst also providing multiple ecosystem services to the ocean.

The *Seaweed resources of the world* series of special issues for *Botanica Marina* has collected together a wide range of information into one "must-have" library resource that is not only useful to seaweed enthusiasts and scientists alike but also to the culinary artists and connoisseurs who are now starting to discover algae as the new ingredients and taste-enhancing components to their cooking menus and delicatessens.

The entire co-editorial team is very satisfied with this final part of the *Seaweed resources of the world: a 2020 vision* series. We would all like to thank again all contributors, referees and the editorial office of *Botanica Marina*, without any one of whom we would not have gone to press! The series indeed goes out with a bang. It has been an honor and privilege to collate all submissions for the entire series.

Part 4 includes an eclectic phyconomic mix. There are two quite different papers on the challenges to producing large amounts of biomass in the open sea, one from India

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and one from the Northern Atlantic region. A review of the role that seaweed feedstocks play for biofuels complements these papers. There remains much to be learned and put into practice. Part 4 continues globe-trotting and we have extensive updates on seaweed resources and their applications from South Africa, Namibia, Tanzania, Korea, New Zealand and a most welcome new contribution for Peru. These papers contain a wealth of information and there are plenty of action points to follow up on for future phycologists and phyconomists.

With publication of the final issue in the present series, we really must acknowledge that the series *Seaweed resources of the world* was first established and inspired by Professor Masao Ohno, former Director of the Usa Marine Biological Institute (Usa is a place and not reference to the USA!), Kochi University, Usa, Tosa City, Kochi Prefecture, Japan. Prof. Ohno established a Japan International Cooperation Agency (JICA) training program in marine biology for foreign researchers who came to the institute to pursue short term research projects in marine fisheries. What more fitting way to close the special Issue series is there but to honor the person behind the original *Seaweed resources of the world* book, first published in 1998 (available in parts on ResearchGate, see: https://www.researchgate.net/publication/310843733_Book_Part_3_-_1998_Seaweed_Resources_of_the_World, accessed April 27, 2020). This was a "training manual" for students sponsored by the JICA programme. That collection of articles presented the work of many of the world's established seaweed researchers and scientists from 40 different countries to provide what was then the most comprehensive compendium on seaweed resources assembled for the use of various industries, managers and practitioners of phyconomy. Professor Masao Ohno built into this book a treasure trove of knowledge on seaweed cultivation and economic value, including information not usually available to the English-speaking world. He also built a community of students and colleagues that persists to the present day with a number of his acolytes being co-editors and contributors to the present series. He also co-authored an update on seaweed resources in Japan, in Part 3, indicating that there remains much to do for phyconomy to fulfill its promise – even in Japan – where it has been practiced and perfected for so long. As a leader, he built long-lasting friendships with those he collaborated with globally. In some small way, the new series is a part of his rich legacy and a call to action to the next generations of the global, seaweed scientist community (i.e., taxonomic and ecological phycologists and phyconomists alike) who will face, and more than rise to, the challenges of increasing population, global warming and ocean acidification. Prof. Ohno's influence extends not only to his students in Japan but to those he came across in many parts of the world – from South and East Asia to the Americas – all of those who had the opportunity and the honor to work with him. The influence that "Ohno Sensei" had on his peers and students brought also with it the unexpected, widening geographical reach of important seaweed species, particularly the eucheumatoids, that are now a commonly farmed resource in tropical to sub-tropical waters, i.e., The Philippines, Indonesia, Malaysia, Sri Lanka, India, Myanmar, Vietnam, China and Japan in Asia, Brazil, Venezuela, Mexico, and some other Latin American countries, Madagascar, Tanzania (including Zanzibar) and Kenya in east Africa, and in the remote Pacific islands of Micronesia and Fiji. Although not without some ecological challenges and even the onset of some disease issues, the utilization of *Eucheuma* seaweeds opened new frontiers for rural, coastal socio-economic development and opportunities for the global seaweed industry to develop and flourish. Prof. Ohno, being a man of immense passion and dedication to the field of phycology, is also credited for developing the artificial seeding method in the cultivation of non-traditional species of seaweeds such as *Enteromorpha* (now *Ulva*) and *Monostroma* in Japan – which are recent sources of condiments for popular Japanese foods, i.e. 'okonomiyaki' and 'aosa' and 'aonori' (*Monostroma*) pastes. Similarly, he explored the use of *Halymenia* as a source of natural pigments in food applications and established a start-up to extract lectins from *Eucheuma* and *Kappaphycus* for biotech applications. At present, he is still active in the culture of edible species of *Sargassum*

Prof. Masao Ohno (ret.), former Director of Usa Marine Biological Institute, Kochi University, conducting training on seaweed culture with JICA participants. Photo courtesy of Masao Ohno.

(formerly *Hizikia fusiformis*) in Tokyo Bay. As part of his international research and development networking, Prof. Ohno traveled to many countries, meeting with local seaweed experts and industries, who have become part of his community of friends and, through online social media which he is learning to use, avidly maintaining his contacts, beyond his retirement. As a testament of Ohno Sensei's undying love for seaweeds and his continued camaraderie with colleagues, he is honored with two seaweed species bearing his name, namely *Ulva ohnoi* by Masanori Hiraoka and Satoshi Shimada and *Sargassum ohnoi* by Gavino Trono.

This series of four special issues of *Botanica Marina* is by no means complete. There are others which remain to be published. The series, as completed with Part 4, is a lasting tribute to the works and 20:20 vision of Ohno Sensei.

Now it is over to the new generation of phycologists and phyconomists, *Seaweed resources of the world 2040* beckons!

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