Closing Remarks of the New President of the International Seaweed Association, Professor Thierry Chopin (Canada)

The 19th International Seaweed Symposium: a turning point in the seaweed industry sector?

Dear friends and colleagues, let me first carry out my official duties as the new President of the International Seaweed Association (ISA) and pronounce a few words for this Closing Ceremony.

I would like, first, to thank Dr Yusho Aruga (Chair), Dr Masao Ohno (Secretary), the Local Organizing Committee, the sponsors and the numerous volunteers for a wonderful 19th International Seaweed Symposium (ISS) this week in Kobe. The organization was superb, the venue beautiful and the hospitality measured up to all expectations.

We had 561 participants [including a healthy number (94) of students] from 47 countries, 4 plenary lectures, 102 presentations distributed among 22 mini-symposium themes, 67 presentations in 12 contributed paper sessions, 158 posters in 4 sessions, 1 special lecture and 4 workshops. We also had, for the first time in the history of the ISSs, a very interesting concurrent International Seaweed Exhibition of 61 seaweed product companies (57 from Japan and 4 from other countries): what an eye opener for participants from around the world, especially Westerners! I hope that such an initiative will be continued in the future ISSs.

On Thursday, the five mid-symposium excursions took us to different places according to our tastes: visits to nori and wakame farms, visits to seaweed processing factories, a seaweed collection trip, a visit to the Himeji Castle and the Suma Aqualife Museum, and a visit to Kyoto. I visited the impressive Himeji Castle on Sunday and imperial Kyoto last year, so I opted for the visits to nori and wakame farms. I can tell you that the cameras were making a lot of noise when people saw these nori harvesting boats going under the nets to "mow" the precious purple material: unbelievable pictures for all our phycology courses and presentations!

The Welcome Reception was an opportunity to get re-acquainted in a nice setting. The Sakura Festival introduces us to Japanese culture and gastronomy, even if our hosts were not expecting that an unleashed group of phycologists would behave like a bunch of grasshoppers! The Symposium Banquet was again delectable and in a very warm atmosphere.

I heard that the 61 accompanying persons had a wonderful time discovering Kobe and were culturally immersed in the interesting Ikebana, Chanoyu, Origami and Shodo programmes to give them a flavor of Japanese traditions.

On Monday, the International Seaweed Association Council (ISAC) had its triennial face to face meeting. The ISA governing body conducts its business electronically in-between the ISSs to be sure that we meet again every three years, each time in very interesting and varied places. Four members of the ISAC have their mandate expiring with this ISS: Guillermo Garcia Reina, In Kyu Lee, Masao Ohno, who gave so much in the preparation of this ISS, and Dimitri Stancioff, a pillar of the ISA for so many years. To all four we express our gratitude for their commitment towards the ISA. Four new members have joined the ISAC: Iain Neish, who has been elected Vice-President, Jose Zertuche, who will be the host of the next ISS in Ensenada, Mexico, Masahiro Notoya and Jean-Paul Deveau. To all four we extend our welcome and forewarn you to be ready to roll up your sleeves!

Now, I would like to talk about a subject close to my heart: whether we are witnessing a turning point in the seaweed industry sector with the 19th ISS?

The International Seaweed Exhibition in the adjoining building showed us that the seaweed industry sector is alive and in full mutation. Interestingly, the best known component of the seaweed-derived industry is that of the phycocolloids, the gelling, thickening, emulsifying, binding, stabilizing, clarifying and protecting agents known as carrageenans, alginates and agars. The phycocolloid industry is also historically at the origin of the ISA. For many years, it dominated the content of the ISSs and their Proceedings; it was also reflected in the composition of the ISAC. We owe a lot to the phycocolloid industry for having put seaweeds on the map for the production, harvesting, processing, and management of marine resources. Many of us here owe, directly or indirectly, our careers to the phycocolloid industry.

However, this component now represents only a minor volume (1.26 million wet tonnes or 11.2%) and value (US$650 million or 10.8%) of the entire seaweed-derived industry (Chopin and Sawhney 2008). The use of seaweeds as sea-vegetables for direct human consumption is much more significant in tonnage (8.59 million wet tonnes or 76.1%) and value (US$5.29 billion or 88.3%). Three genera, *Laminaria* (or kombu), *Porphyra* (or nori) and *Undaria* (or wakame) dominate the edible seaweed market. The phycosupplement industry is an emerging component estimated at 1.22 million wet tonnes, with a value of US$53 million. Most of the tonnage is used for the manufacturing of soil additives; however, the agrichemical and animal feed markets are comparatively much more lucrative if one considers the much smaller volume of seaweeds they require. The use of seaweeds in the development of pharmaceuticals, nutraceuticals, botanicals, cosmeceuticals, and as a source of pigments, bioactive compounds, and antiviral agents, is in full expansion. Presently, that market is difficult to evaluate accurately; the use of 3,000 wet tonnes of raw material to obtain 600 tonnes of products valued at US$3 million could be an underestimation.

The seaweed aquaculture production (92% of the world seaweed supply) doubled between 1996 and 2004, and is estimated at 11.3 million wet tonnes, with 99.7% of the biomass being cultivated in Asia [Food and Agriculture Organization of the United Nations (FAO) 2004; 2006a, b]. Brown seaweeds represent 63.8% of the production, while red seaweeds represent 36.0%, and the green seaweeds 0.2%. The seaweed aquaculture production is valued at US$5.7 billion (again with 99.7% of the value being provided by Asian countries). Brown seaweeds dominate with 66.8% of the value, while red seaweeds contribute 33.0%, and the green seaweeds 0.2%. Approximately 220 species of seaweeds are cultivated worldwide; however, 6 genera [*Laminaria* (kombu; 40.1%), *Undaria* (wakame; 22.3%), *Porphyra* (nori; 12.4%), *Eucheuma/Kappaphycus* (11.6%) and *Gracilaria* (8.4%)] are providing 94.8% of the seaweed aquaculture production, and 4 genera [*Laminaria* (47.9%), *Porphyra* (23.3%), *Undaria* (17.7%) and *Gracilaria* (6.7%)] are providing 95.6% of its value.

Published world statistics (FAO 2004, 2006a, b), which regularly include the notation "data exclude aquatic plants" in their tables, indicate that in 2004 the top four individual species produced by the global aquaculture (50.9% mariculture, 43.4% freshwater aquaculture and 5.7% brackishwater aquaculture) were the Pacific cupped oyster (*Crassostrea gigas* – 4.4 million wet tonnes), followed by three species of carp, the silver carp (*Hypophthalmichthys molitrix* – 4.0 million wet tonnes), the grass carp (*Ctenopharyngodon idellus* – 3.9 million wet tonnes) and the common carp (*Cyprinus carpio* – 3.4 million wet tonnes). However, in fact, the kelp, *Laminaria japonica*, was the first top species, with a production of 4.5 million wet tonnes.

Because the mariculture of aquatic plants (11.3 million wet tonnes of seaweeds and 2.6 million wet tonnes of unspecified "aquatic plants" reported by the FAO) has developed essentially in Asia, it remains mostly unknown in the West, and is often neglected or ignored in world statistics—a situation we can only explain as being due to a deeply rooted zoological bias in marine academics, resource managers, bureaucrats and policy advisors! However, in 2004, the seaweed aquaculture sector represented 45.9% of the biomass and 24.2% of the value of the world mariculture production, estimated in 2004 at 30.2 million wet tonnes, and worth US$28.1 billion (FAO 2006a, b). Mollusc aquaculture comes second at 43.0%, and finfish aquaculture, the subject of so many debates, actually only represents 8.9% of the world mariculture production.

The fact that seaweeds represent close to half of the biomass of the maricultured products is often not known outside phycological circles and often comes as a surprise to many. Moreover, the mitigation potential of seaweeds is often not recognized by the rest of the aquaculture world. Phycomitigation, through the development of integrated multi-trophic aquaculture (IMTA) systems, has been rediscovered in Western countries over the last 30 years, despite the fact that this sustainable aquaculture practice has existed for centuries, especially in Asian countries, through trial and error and experimentation (Chopin et al. 2001; Troell et al. 2003; Neori et al. 2004, 2007). It is difficult to give a value to the phycomitigation industry, inasmuch as presently no country has yet implemented guidelines and regulations regarding nutrient discharge into coastal waters. As the "user pays" concept is expected to gain momentum as a tool in integrated coastal management, one should soon be able to put a value to the phycomitigation services and benefits of IMTA systems for improving water quality and coastal health. Moreover, the conversion of fed aquaculture by-products into the production of salable biomass and biochemicals used in the sea-vegetable, phycocolloid and phycosupplement industries should increase the revenues generated by the phycomitigation component.

If the environmental, economic and societal services and benefits of IMTA are properly estimated and internalized in aquaculture operations, they will represent significant incentives for the cultivation of extractive species such as seaweeds (Chopin 2008). We have to make sure that seaweeds are considered in the global economy as nutrient (nitrogen, phosphorus, etc.) credits, in a similar way as they should be for carbon credits, as the aquaculture sector moves to becoming more efficient and sustainable. We also have to make sure that seaweeds figure prominently in the present debates about energy generation and biofuel production. We now have an opportunity to reposition the value and roles seaweeds have in coastal ecosystems, in the economy and in our society. As the experts on these organisms, let us not miss that opportunity for the development of marine agronomy. It is essential for the vitality of our discipline and for the future of our students.

Just a month ago, I attended the Aquaculture 2007 Conference of the World Aquaculture Society in San Antonio, Texas. Going through the book of 1,198 abstracts, I realized that:

- 66.3% of the abstracts were dedicated to fish (8.9% of the 2004 world mariculture production),
- 15.9% to mollusks (43.0% of the 2004 world mariculture production),
- 14.2% to crustaceans (1.8% of the 2004 world mariculture production), and
- 1.6% to other aquatic animals (0.4% of the 2004 world mariculture production).

By regrouping abstracts on microalgae (0.8%), freshwater plants (0.6%), and seaweeds (0.6%), I was able painfully to reach a combined 2.0% for all these organisms, whereas seaweeds represent, as indicated above, 45.9% of the world mariculture production!

We, obviously, have a huge educational role to play to help bring a balanced ecosystem approach to aquaculture development and to “convert” the animal-dominated aquaculture world that it needs to recognize and take advantage of the services and benefits of seaweeds for their extractive functions. For that to happen, we need to attend not only phycological conferences, the comfort of which we appreciate, but also non-phycological conferences to stop “preaching” only to the “converted”. If, before the next ISS, we can all attend at least one non-phycological conference to disseminate our message of relevance in many everyday activities and global issues, we will already have achieved a lot.

In the meantime, I wish you all a safe trip back home and "Hasta la proxima" in Ensenada, Mexico, in 2010 for the 20th ISS!

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