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Applied Phycology

NEWSLETTER

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Message from the President, Dr. Céline Rebours

Dear ISAP Members,

As the ISAP 2021 Conference is underway, is my pleasure to announce the publication of the first issue of the ISAP Newsletter for 2021.

The **virtual format of the ISAP conference** is now streaming and all presentations including the Q&A sessions are or will be made available 'on demand' until the **13th of August 2021**. The topic of ISAP2021 conference was chosen to reflect the change in our society and explore the benefit of algae for all humankind. Thus, I warmly encourage you to join over 400 delegates from all over the world and attend over 300 presentations.

Opening ceremony, special sessions, panel discussions, student & young researchers' week and the plenary lectures are all available online. At the ISAP General Assembly on June 15th, the ISAP Executive committee also presented the work undertaken over the past 4 years and the transformation of the governance arrangements in ISAP. We warmly thank those that participated in this meeting, the summary of which is also presented at the end of this newsletter. If you wish to know more about the new structure and governance, may I invite you to consult the ISAP guidelines.

Various networking programs such as B2B meeting, exhibition booths, and oral presentations continue to be organised to accelerate interaction among participants. You will find detailed information and the latest updates to the programme and events under the ISAP2021 conference webpage, Facebook and Instagram pages. On Instagram, we also invite all participants to share images of where you are attending the ISAP2021 conference from. When posting, don't forget to hashtag #isap2021!

During the first half of 2021, the EC members continued to prepare our society for the next triennium to sustain and grow its activities after our triennial conference. I would like to specifically thank our communication coordinator **Fiona Moejes,** our training workshop coordinator, **Roberto De Philippis** and Sponsor and Promotion coordinator, **Qiang Hu** for their remarkable efforts in streamlining these primordial activities for our society. I would like to also to express gratitude our editor-in-chief, **Sasi Nayar** for preparing another issue of the Newsletter and hope you will enjoy reading this during the mid-year break!

With the start of the new triennium of the Society, I will request you to ensure that your ISAP subscription is still current. The subscription fees are critical in ensuring the activities of the society. Membership fees support maintenance of the website, funding workshops and training programs in algal biotechnology as well as sponsoring student travel grants. We would also appreciate receiving a donation were possible. For further details please consult our webpage or contact the ISAP Treasurer **Valeria Montalescot**.

Finally, I would like to emphasize than ISAP operates solely on the volunteer work of its executive members and subscribers. This means that all subscribers can participate in various activities of the society. We would appreciate receiving your ideas, feedback on ISAP, news, and announcements of interest for ISAP subscribers. **We would also be delighted to receive articles for our 2022 issues of the newsletter.** For further details, please contact either the Editor of the newsletter or the ISAP Secretary/Treasurer whose contact details can be found at the end of the newsletter.

On behalf of the Executive committee, I wish you an enjoyable ISAP 2021 conference!

Kind regards,

Céline Rebours
President, International Society for Applied Phycology

Message from the Editor, Sasi Nayar

Dear Colleagues,

Challenging times bring about creativity and resilience in the humankind. A good example of this is the virtual congress hosted by our colleagues in Japan. No stones have been left unturned by the Local Organising Committee (LOC) together with the conference secretarial in running a fully virtual congress! They have done a magnificent job in pulling this through under some very challenging conditions. The General Assembly that I attended earlier this evening was a huge success and was seamless! What is to be appreciated is that we had delegates from almost every continent participating - except the icy continents! Let us take a moment in congratulating the LOC, the conference secretariat, and the current Executive Committee in organising a great congress!

As the Editor of the newsletter, receiving articles to compile an issue has always proved challenging. We have been very fortunate with this issue and the next in receiving all articles on time and appropriately formatted as per the guidelines. With this issue the subject diversity and quality are outstanding and hope you get as much out of this as I did. On behalf of the Editorial Team I take this opportunity in thanking those that contributed. I also thank Celine, Fiona and the editorial review committee comprising Roberto, Qiang Hu and Sammy for their contribution.

The first article in this issue is authored by M.M. Watanabe recognises the extensive historical link of algae in Japanese food culture. As the host nation of the 7th ISAP Congress, this article provides the readers an insight into a strong algae-based food culture that was impacted after the 2011 tsunami. The country is witnessing a steady decline in the consumption of algae, especially seaweeds due to concerns of radiation contamination. The positive element to this story is the resurgence of algae assisted by a government roadmap associated with the recovery in Fukushima Prefecture to promote the development of hubs and networks of clean energy technology and industry clusters. The author touches on the experience of establishing a demonstration scale facility for the production of biocrude from native microalgae grown in nutrient rich wastewater.

The second article by J. Avila-Peltroch reviews the application of protoplasts from seaweeds as a powerful biotechnological tool for genetic improvement, tissue culture and physiological studies. This fascinating article also investigates the application of protoplast technologies in seaweed for production of inoculum cultures for mass cultivation. The author takes us through the production process of protoplasts, including various cell wall lysis techniques, their isolation, cell division and growth, tissue differentiation, production of plantlets and finally transplantation to yield mature algal thallus. In addition to the historical overview, the author also covers recent advances in protoplast technologies and direction for future work.

The final article by M. Strittmatter introduces readers to a web-based portal called 'My Seaweed Looks Weird (MSLW)'. This portal enables researchers and aquaculturists to report diseases in marine macroalgae. Funded by Genialg and GlobalSeaweedSTAR. It is hoped that this multi-language portal will provide insight into morphological appearance of diseased specimens, pathogens, species, symptoms and geographical locations as well as facilitate submission of observations of 'unhealthy looking algae'.

The editorial committee is in the process of finalising issue 2-2021 of the newsletter. We expect to publish this issue by August 2021, following which the current committee will pass on the baton to the new committee. As always, please do not hesitate to contact one of us from the editorial team if you have any ideas for an article. It always helps the editorial committee to plan roll out of forthcoming issues of the newsletter when they have a bank of articles to choose from. We hope you enjoy the rest of the virtual congress and this issue of the newsletter. Best wishes and good health until the next issue!

Sasi Nayar, Editor of the ISAP Newsletter

Algae-based biocrude production and traditional algae foods in Japan

MAKOTO M. WATANABE

Algae Biomass and Energy System R&D Center (ABES), University of Tsukuba, 1-1-1, Tennodai, Tsukuba, Ibaraki 305-8572, Japan

and

MoBiol Algae Insititute Corporation, Tsukuba, Ibaraki, Japan

Corresponding author: *mwatanabe@mobiol.tech*

Introduction

This year marks ten years since the Great East Japan earthquake followed by a tsunami that severely impacted the Fukushima Daiichi Nuclear Power Station resulting in an environmental disaster. Algae-based biocrude research has progressed in connection with the reconstruction and revitalization of disaster devastated areas. Although the health benefits of regularly eating seaweed are now globally well known, the traditional diet and consumption of seaweed in Japan are now on the decline as people turn to more "westernized" food. Rumour of the possible radiation contamination of marine products, including seaweed may have accelerated the decline. This article will introduce how the involvement of algae-based biocrude research has influenced government policies pertaining to the reconstruction and revitalization of disaster-stricken areas. The article also provides an overview of how traditional algae-based food in ancient documents in Japan have contributed to Japanese food culture and health.

Great East Japan disaster in 2011

A magnitude 9.0 undersea megathrust earthquake occurred on the 11th of March 2011 off the Pacific coast of Japan at a relatively shallow depth of 32 km. The earthquake triggered a massive tsunami that impacted the east coast of Japan (Figure 1).

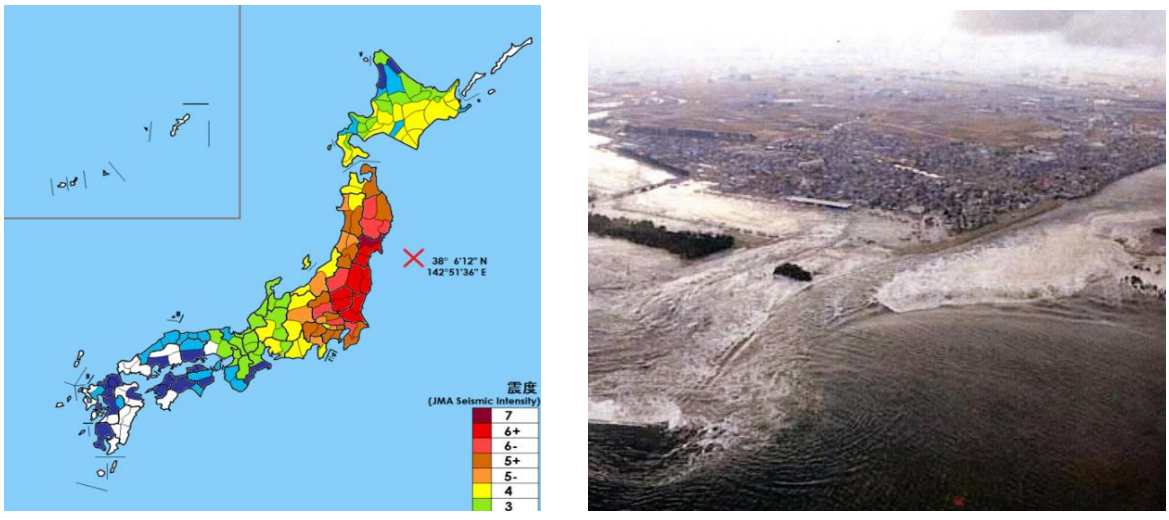

Figure 1: Great East Japan Earthquake on 11 March 2011 triggering a tsunami. Photo source: left - https://en.wikipedia.org/wiki/2011_T%C5%8Dhoku_earthquake_and_tsunami and right - https://www.jiji.com/jc/d4?p=lat216&d=d4_quake#photo2

This disaster caused 15,883 deaths, 6,145 injuries with 2,656 listed as missing. Damage to infrastructure included 129,229 totally collapsed buildings, 54,204 half-collapsed buildings, and 691,766 partially damaged buildings. The total economic damage was more than US $250 billion.

Figure 2: Damage to human life and damage to buildings. Photo source: left - https://www.afpbb.com/articles/-/3121126?pno=4&pid=18812099 *and right -* https://www.jiji.com/jc/d4?p=lat216-jlp10593029&d=d4_quake

The disaster at Fukushima Daiichi Nuclear Power Station occurred when the plant was hit by the tsunami, resulting in a meltdown of half of the plant's reactors. Altogether, 124,594 people living in the orange, yellow, and purple zones were evacuated from their homes. Monamisoma city was the most impacted.

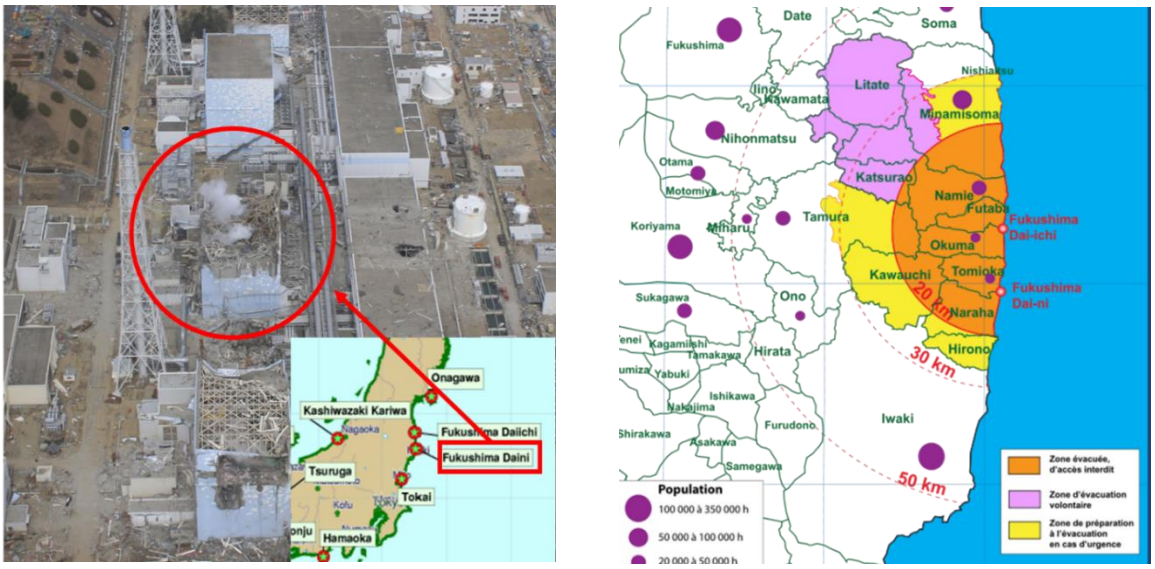

Figure 3: Fukushima Daiichi Nuclear Power Station showing meltdown of reactors and zones ordered and recommended to evacuate. Photo source: left - https://www.afpbb.com/articles/-/2821615 *and right -* https://www.qst.go.jp/uploaded/attachment/2095.pdf

Involvement of algae-based biocrude research in reconstruction of disaster devastated area

The agency of the cabinet office in the Government of Japan provided the "Basic Guideline on Energy Development for Reconstruction" on July 29, 2011. The mandate was to establish a 'Center of Excellence for Research and Development for Renewable Energy' in Fukushima Prefecture to promote the development of hubs and networks of clean energy technology industry clusters as well as to promote the establishment of several divisions of governmental institutes in Fukushima Prefecture. Based on the guidelines, the Reconstruction Agency, Ministry of Economy, Trade and Industries, and Fukushima Prefectural Government collectively launched "the Next-generation renewable energy development

program for Fukushima reconstruction and revitalization." The demo-plant system was established in Minamisoma city after the proposal on an R&D project on algae-based biocrude production was accepted.

Figure 4: Demo-plant system for algae biomass and biocrude productions installed in Minamisoma city, Fukushima Prefecture. Photo by Watanabe, 2016

However, the climatic conditions such as temperature and hours of daylight in Minamisoma are not conducive for algal cultures. The daylight hours are short, approximately 5 hours each month with temperatures <15 ℃ for most months of the year, therefore severely limiting, algal growth (Figure 5).

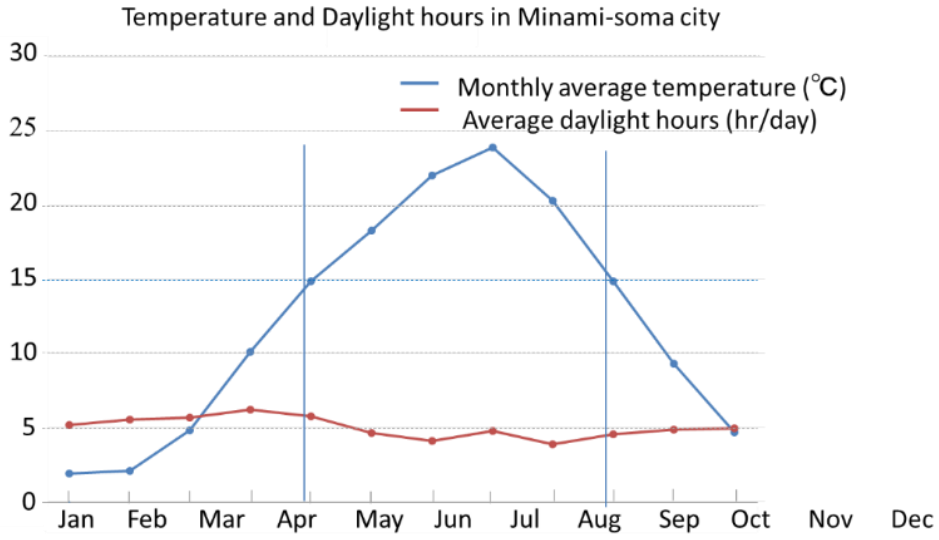

Figure 5: Monthly mean temperatures and daylight hours in Minamisoma city. Source: http://www.data.jma.go.jp/

To overcome the bottlenecks of low temperatures and low sunlight irradiance, we changed the fundamental concept for technology development; from "technology to control environmental conditions suitable for specific elite alga" to "technology to increase native common algae population adapted to the regional weather and environment." This concept change resulted in high productivity of algae with annual mean productivity of 28.1g m^{-2} day^{-1} (= 102.6 t ha^{-1} $year^{-1}$). The monthly productivity of native algae was found to be constantly high throughout the year (Demura et al. 2018; Figure 6). The biocrude production ratio in native algal polycultures was more than 40% by using Hydrothermal Liquefaction (HTL) installed in the demo-plant system in Minamisoma (Jain et al. 2019). Several publications on the engineering aspects of this pilot-scale process plant are accessible for e.g., Wibawa et al. 2018; Sasongko et al. 2018.

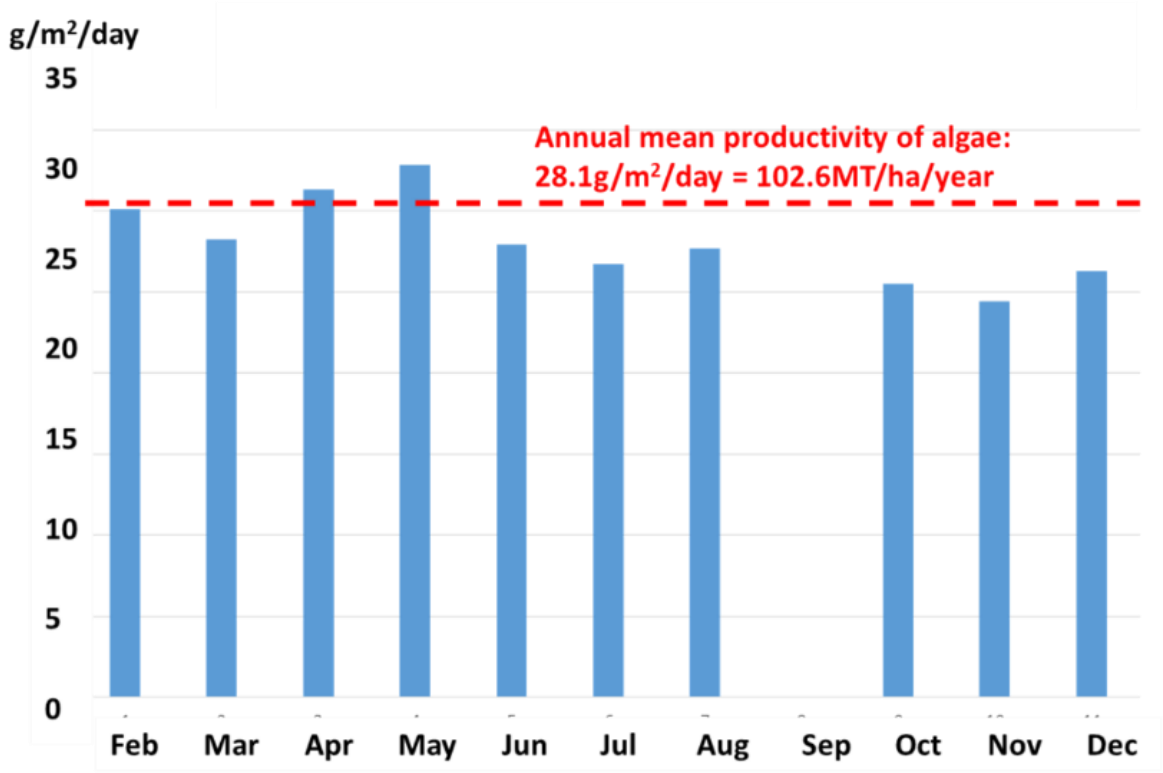

Figure 6: Monthly mean productivity of algae in the culture tank with 0.8 m water depth. Source: Demura et al., 2018

Using wastewater further improved the technology for algae biomass production.

The Kokaigawa East Sewage Treatment Center, Ibaraki Prefecture has an algae biomass production system (Figure 7). Treated wastewater was used as the primary culture medium. The algal cultures grew well throughout the year in 2 m^3 culture tanks with a mean water depth of 1.4 m. Biomass productivity of 140g m^{-2} day^{-1} (= 512t ha^{-1} $year^{-1}$) was achieved.

Figure 7: Algae biomass production system in Kokaigawa East Sewage Treatment Center. (University of Tsukuba et al, 2020).

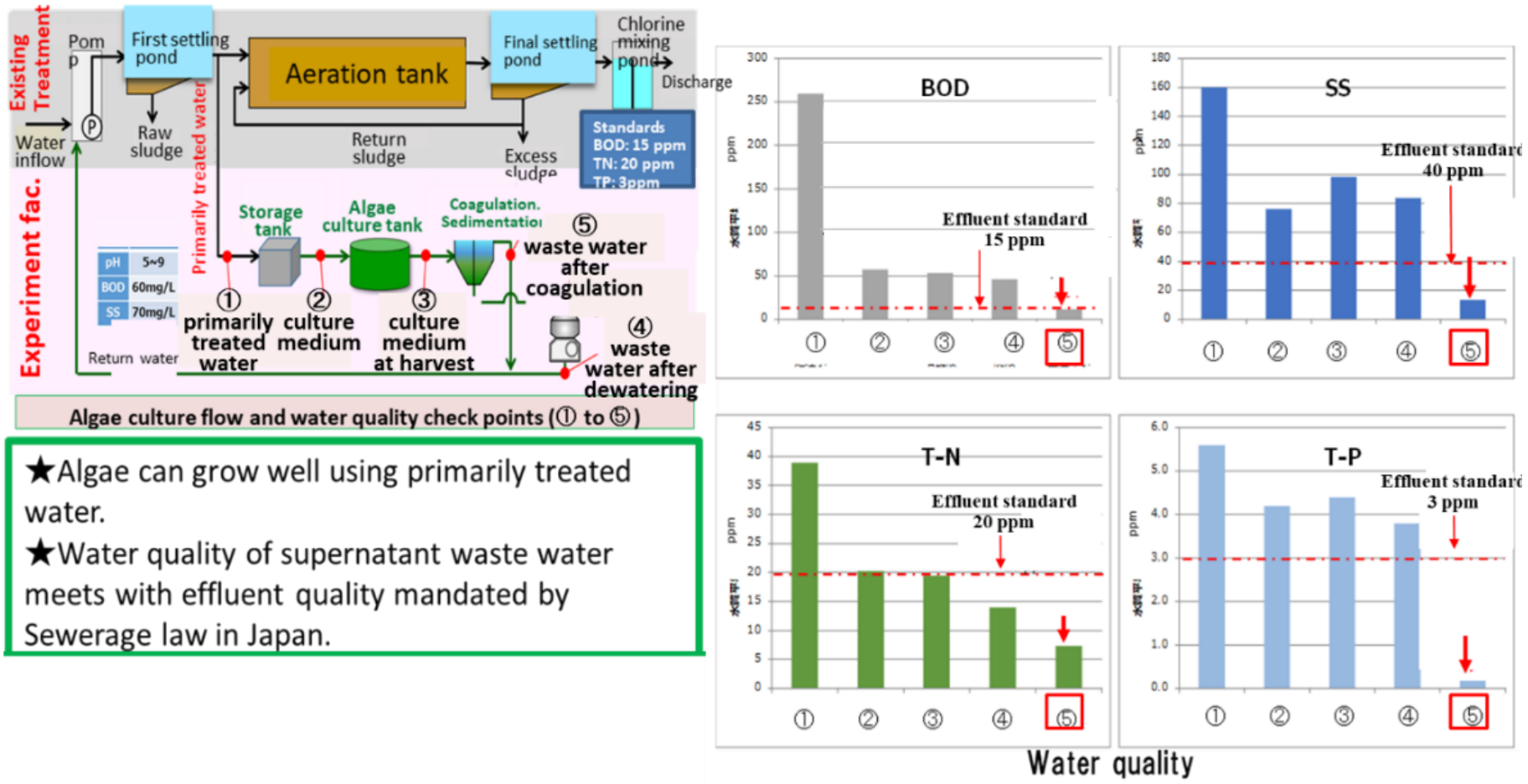

Figure 8: Purification of sewage by algae (Algae Industry Incubation Consortium, 2019).

Water quality checkpoints from culture to harvest and concentration is illustrated in figure 8 The most crucial checkpoint is the post-coagulation supernatant for algae concentration (checkpoint 5). Water quality of wastewater after harvest and concentration meets effluent quality mandated by the Sewerage Law in Japan.

Traditional algae foods in ancient documents in Japan

Japan has traditionally utilised algae as food since immemorial time. However, the traditional diet and consumption of seaweed in Japan are declining from year to year. The rumour surrounding the radioactive contamination of seaweeds may have accelerated this decline. Nevertheless, as UNESCO registered "Japanese food" as an Intangible Cultural Heritage in 2013, algae still make up a significant proportion of the modern Japanese diet. Overall, it has also increased awareness of the Japanese food culture to the rest of the world. Here, I shortly introduce traditional algae food documented in ancient scriptures in Japan.

Microalgae

There are a considerable number of microalgae that have been used as food (Table 1). *Spirulina*, *Chlorella*, and *Euglena* are now very well-known dietary supplements on the market, but Japan has long utilised *Nostoc* and *Aphanothece* as a food.

Table 1: Major microalgae that have been used as food or supplement (Aruga, 2012)

Taxa	Species	Use
Cyanobacteria	Aphanothece sacrum	Food
	Nostoc commune	Food
	Nostoc flagelliforme	Food
	Nostoc verrucosdum	Food
	Brachytrichia quoyi	Food
	Spirulina spp.	Health supplement
Chlorophyta	Chlorella spp.	Health supplement
	Dunaliella spp.	Food additive
	Haematococcus spp.	Food additive
Euglenophyta	Euglena gracilis	Health supplement

Nostoc verrucosum（Ashitsuki in Japanese）

"Ashituki" (Figure 9) appeared in a poem of Yakamochi Otomo (718～785) in "Manyoshu," the oldest surviving waka poetry in Japan, edited from the second half of the 7th century to the second half of the 8th century. He says, "Maidens are standing by the water to collect Ashitsuki."

Figure 9: Ashituki (Nostoc verrucosum) occuring naturally and as a food product. Source: left - https://takahashiryuiki.com/feature/ and right - https://shindofuji-nippon.com/supplement/1457/

Aphanothece sacrum (Suizennji-nori in Japanese):

"Suizennji-nori" (Figure 10) was first described in 1763 and has since been used as food. It was a gift to the shogunate during the Edo period. It is still a "luxury food" that can be eaten at Japanese restaurants. It's distribution on the wild has declined and was listed in 2020 as a Critically Endangered species in the 2020 Red List of Threatened Species (Ministry of Environment, Japan).

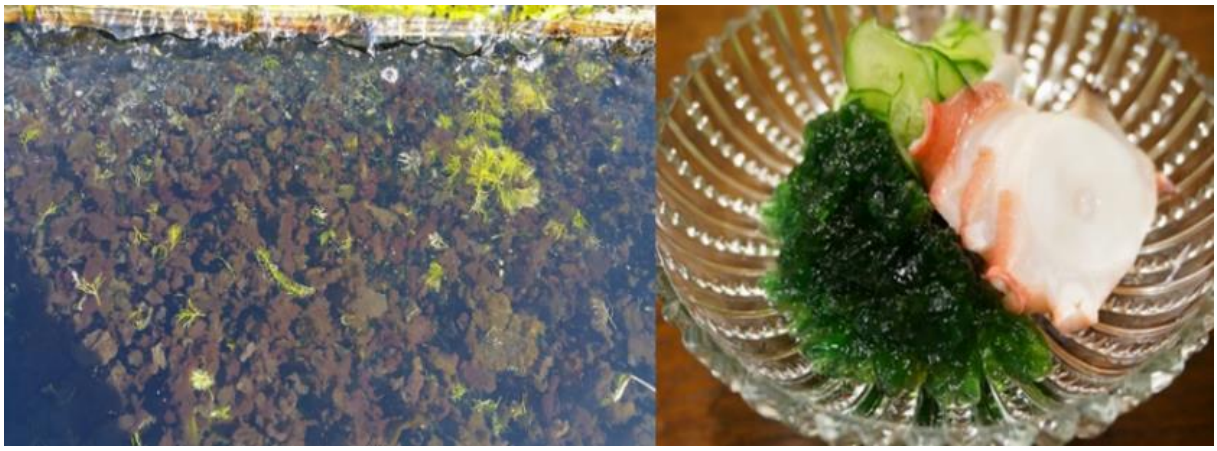

Figure 10: Suizennji-nori (Aphanothece sacrum) occuring naturally and as food. Photo source: left https://ja.wikipedia.org/wiki/%E3%83%95%E3%82%A1%E3%82%A4%E3%83%AB:Suizennjinori.jpg and right - https://readyfor.jp/projects/kansaibousakuranlotion/announcements/59806

Nostoc flagelliforme (Hassai in Japanese, Fat choy in Chinese)

"Hassai" is distributed and used as food in the local areas in Japan (Figure 11). It is a popular food product called "Fat choy" in China and is often used as a luxury ingredient in Chinese cuisine. It grows naturally

in the desert areas of the People's Republic of China. However, due to concerns of environmental destruction caused by the collection of "Fat choy," the State Council in the People's Republic of China notified the ban of collection and sale on June 14, 2000.

Figure 11: Hassai or Fat choy (Nostoc flagelliforme) occuring naturally and as a food product. Photo source: Left - https://en.wikipedia.org/wiki/Fat_choy#/media/File:Faat_choy.jpg and Right - https://pixta.jp/photo/53127668

Seaweeds

Seaweed markets

The global market of commercial seaweeds was estimated to be US $14.08 billion in 2018 and predicted to increase to US $21.1 billion by 2023. Among the main seaweeds used for human foods, market sizes of *Pyropira* (Nori), *Undaria pinnotifida* (Wakame), *Saccharina* (Konbu), and *Sargassum fusiforme* (Hijiki) are reasonably substantial. The total market size is estimated at US $5.76 billion, which is 40% of the global seaweed market in 2018 (Table 2). Although the utilisation of seaweeds in food has been declining in Japan, the global seaweed food market continues to grow.

Table 2: Japanese seaweeds for human (Mostly after Tanaka et al. 2020)

Seaweed/ Products	Species	Japanese name	Food Use	Annual Production	Value	Market size
Green	*Ulva prolifera*	Aosa	Powder	200 dry tons (2017)	US$100/kg dw (domestic)	
	Caulerpa lentillifera	Umibudou	Salad	245 wet tons (2008)	US$26/kg ww	
Red	*Pyropia* spp.					
	cultivated	Nori	Sushi roll	300,000 wet tons (2017)	US$30/kg dw	US M$2,860
	wild	Iwanori	Salad, Soup	-	US$100/kg dw	
	Gelidium spp.	Tengusa	Agar	5,000-9,000 dry tons (1950) 1,000 dry tons (2000)	US$108/kg dw(2021)[2)]	
	Gracilaria spp.	Ogonori	Agar, Salad	3,000 wet tons (2004)	US$102/kg dw (2021)[3)]	
Brown	*Undaria pinnatifida*	Wakame	Soup, Salad	91,000 wet tons (1994) 68,000 wet tons (2001) 51,000 wet tons (2017)	US$23.6/kg ww (2019)[4)] US$70.8/kg dw (2021)[5)]	US M$476
	Saccharina spp.	Kombu	Soup, Kobumaki [1)]	45,500 wet tons (natural, 2018) 32,500 wet tons (culture,2018) 2,000 dry tons from Korea/China, 2010)	US$1/kg ww (2000)	US M$2,285
	Cladoshiphon okamuranus	Okinawa mozuku	Salad	19,400 wet tons (Clado+Nema)(2018)	US$169/kg dw (2021)[6)]	
	Nemacystis decipiens	Itomozuku	Salad			
	Sargassum fusiforme	Hiziki	Simmered	175,000 wet tons (2014) (4,500 wet tons from Korea/China)		US M$143
					Total market size	US M$5,764

[1)]Rolled kelp with fish in it, [2)] https://premier-wakayama.jp/items/1075/,
[3)]https://item.rakuten.co.jp/osada2/kaisou-003 [4)]https://jpmarket-conditions.com/1462/,
[5)]https://jpmarket-conditions.com/1463/, [6)]https://jpmarket-conditions.com/14

Historical documents record seaweeds points being utilized as a currency for taxes, in courts, and as a medicinal plant. Looking at the records of the wooden tablets (Figure 12) excavated from the site of the Heijo period, for A.D. 710-794 (1311 to 1227 years ago), seaweed was used for payment of taxes.

Figure 12: Left pane - Wooden tablets with the inscription of seaweeds (source: Tomizuka et al. 2011), middle pane - Engi-shiki (source: https://bunka.nii.ac.jp/heritages/detail/189306), right pane - Honcho-Shokkan published in 1697 (source: https://base1.nijl.ac.jp/~kindai/img/KGMS/KGMS-00128/KGMS-00128-05.jpg)

"Engi-shiki" was edited in the middle of the Heian period. Within it is a description of seaweed, detailing the rules of meals in the imperial court during the Heian period for A.D. 794-1185. It was recorded that

Nori such as *Pyropira*, Ao-Nori including *Monostroma* and *Ulva*, *Codium*, *Undaria*, *Eisenia*, *Gloiopeltis*, Gelidiaceae, among others have been carried to Kyoto from Tokai sea regions such as Ise, Shima, and Toumi.

The medicinal use of seaweed on people's health and well-being appeared in "Honcho-Shokkan" published in 1697 of the Edo period. It documented *Sargassum fusiforme* to improve blood circulation, and *Eisenia* curing various illnesses, constipation, blemishes, and tumors in women. There is documented evidence of 'the beneficial effect of seaweed in curing a hangover; use of *Gelidium* jelly in cooling fevers, stopping sputum, and relieving hangovers, and the utility of *Undaria* in relieving hangovers. It appears that consumption of sake caused headaches, and consumption of seaweed was an effective way to eliminating it.

Summary and Conclusions

In this article, I briefly introduced native algal communities displaying high biomass productivity throughout the year, even in the cold northern part of Japan (Minamisoma city, Fukushima Prefecture, and Kokaigawa area in Ibaraki Prefecture). Seasonal succession of native algal communities can help maintain stable biomass production by preventing pond crashes. Native algal polyculture is extremely useful for obtaining high biomass productivity even in cold temperate regions. Further, mixotrophic culture reduces the land area required for algae-based biocrude production. Algal biocrude production cost could be reduced by that comparable to the advanced sewage treatment cost by using the primarily treated water for algae culture. Ten years after the Great East Japan earthquake, the physical reconstruction of the devastated cities and towns has progressed. Further progression of algae fuel research will further progress the actualization of the Japanese government policy of making Fukushima a center for renewable energy production.

As for seaweeds, Japan has over 15 genera of economic importance utilized directly as food, ingredients in food, or raw materials to extract chemical compounds for various applications. Most species are produced through various cultivation methods that usually start in a land-based facility and are completed when seaweeds are transferred to open-sea cultivation. There are many reports on the novel, unique, or highly productive, seaweed-derived matters and/or compounds for preventing, mitigating, or recovering various kinds of diseases from ancient times in Japan; however, the development of therapeutic agents from seaweed is significantly behind, compared to microorganisms and land plants. The future of the seaweed industry in Japan is geared toward producing high-grade therapeutic and pharmaceutical products from seaweeds. The future of the seaweed industry in Japan should be accelerated toward producing high-grade therapeutic and pharmaceutical products from seaweeds incorporated with medical sectors.

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About the author

Professor Watanabe received his Doctor in Science title (botany) in 1977 at Hokkaido University, Sapporo. He joined the National Institute for Environmental Studies (NIES) in 1978, established and developed NIES-Collections of Algae and Protozoa, and became Director of Environmental Biology Division in 1997. In 2006 he became a Professor at the University of Tsukuba (UT). In 2015 he integrated the R&D skills from various faculties in UT and established the Algae Biomass and Energy System R&D Center (ABES) in the university. Accumulated knowledge and technologies in the ABES are now extending to various research fields, including fuels, chemicals, medicine, health, agriculture, and the environment. In the past, he was President of the Japan Society for Culture Collections of Microorganisms (1997-2000), Vice-President of World Federation for Culture Collections of Microorganisms (2000-2004), and President of the International Phycological Society (2010-2011). He organized the "1st Asia Oceania Algae Innovation Summit (AOAIS)" in 2010 and was a chair of IOC AOAIS until 3rd AOAIS Daejeon 2014 and invited ISAP-7 to Japan. Professor Watanabe is now President of the Algae Industry Incubation Consortium, Japan.

Protoplasts: a promising biotechnological tool for seaweed research

JOSÉ AVILA-PELTROCH

Department of Life Science, Chosun University, Gwangju 61452, Korea

***Corresponding author**: jose_avila22@hotmail.com*

Summary

Protoplasts, or "naked" plant cells, are a powerful biotechnological tool for genetic improvement, tissue culture and physiological studies. The technology has experienced a re-emergence in recent years due their utility in genome-editing and gene silencing technologies. Protoplast research in seaweeds still lags far behind land plants. There have been significant progresses on protoplast technologies for green seaweeds, where standard protocols for isolation and regeneration are accessible. This is followed by red seaweeds, where regeneration, protoplast fusion and genetic transformation have been undertaken. Finally, protoplast isolation and culture in brown seaweeds still lacks a standard protocol; however, successful regeneration of some commercially important brown algae have been achieved. This article provides an overview of protoplast technique, its uses and the state of the art of protoplast research on seaweeds.

Introduction

It is common knowledge that plant cells possess a rigid cell wall. Perhaps, this is the most important feature we remember from plant biology during our school days. Despite the crucial role of the cell wall in protection against mechanical and osmotic stress, it is also a barrier for *in vitro* manipulation, and cellular and subcellular studies. But what if we dismantle this cell wall (at least temporarily)? What possibilities would this offer to have "direct access" to the protoplasm (i.e. cytoplasm and nucleus)? And, how is that useful for basic and applied seaweed research? The following sections in this manuscript attempts to address these questions.

What are protoplasts?

The term "protoplast" refers to a "naked" plant cell, where the cell wall has been removed either by physical or largely enzymatic methods. Protoplasts are spherical in shape and their size and pigmentation vary depending on the species and the source of tissue used (Davey et al., 2005). It is important to highlight that protoplasts can also be obtained from non-photosynthetic organisms, such as bacteria (Kami et al., 2019) and fungi (Turgeon et al., 2010).

The first report of protoplast production dates to the end of the 19th century when Klercker (1892) extruded the living cell contents from sliced leaves of the water plant *Stratiotes aloides*. However, the current protocols for protoplast isolation rely on enzymes that lyse cell wall components. For example, the commercial cellulase Onozuka R-10 and macerozyme R-10 are used to hydrolyse cellulose, hemicellulose and pectin, the three primary components of plant cell walls. The enzymatic method usually results in high yields of viable protoplasts with no or minimal damage and are therefore widely used in protoplast research. Additionally, osmotically favourable conditions are necessary for stabilizing the membrane and avoiding damage or lysis of the protoplasts (Chawla, 2009).

Protoplasts are considered, at least theoretically, as totipotent cells. This means that they can re-enter the cell cycle, go through repeated mitotic divisions and regenerate a whole new organism (Eeckhaut et al., 2013). During protoplast culture, the protoplasts are able to resynthesize their cell walls, divide and regenerate under suitable culture conditions (Cove, 1979).

To establish reliable protocols for protoplast isolation, culture and regeneration, several factors must be assessed. Although a detail examination of these factors is out of the scope of this article, the most important ones are displayed in Fig. 1

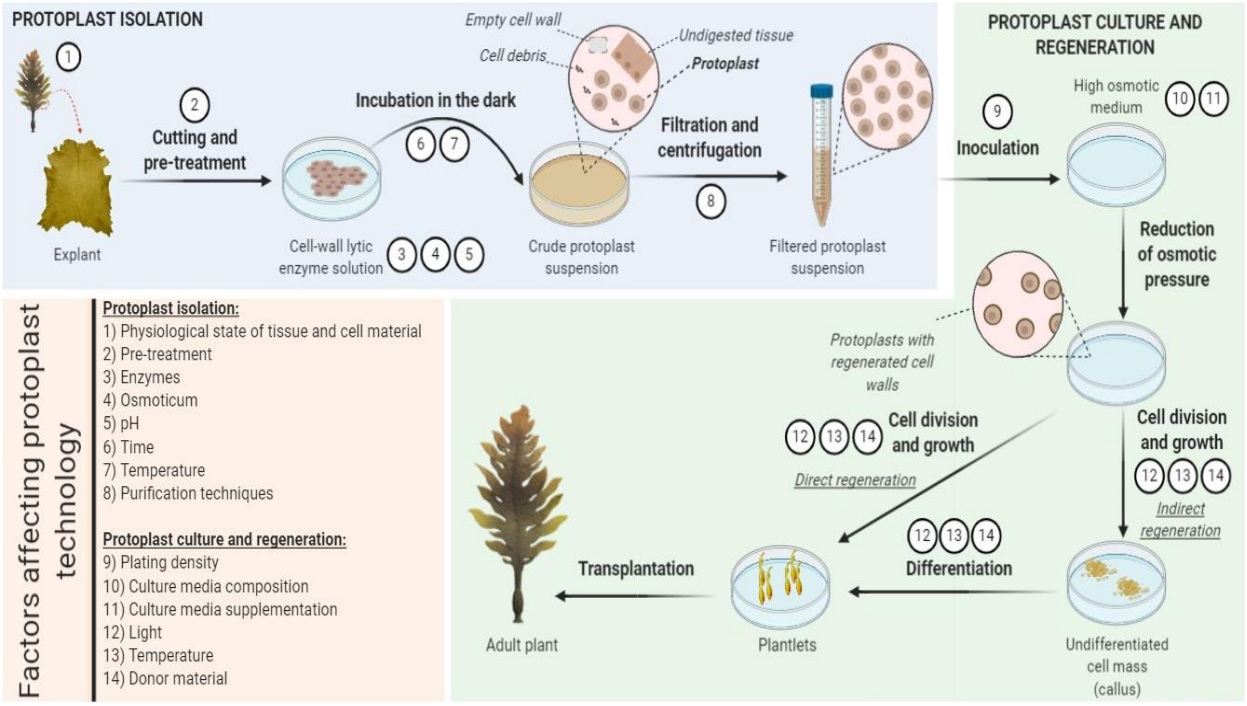

Figure 1: A schematic view of protoplast isolation, culture and regeneration in brown algae showing the main factors that affect each step.

Applications of protoplasts

As previously described, protoplasts have two main characteristics: 1) absence of cell walls, and 2) potential totipotent capacity. These features make them ideal for cellular, physiological and genetic studies, especially those related to membrane composition, cell wall formation, genetic transformation, somatic hybridization, and dedifferentiation. The following are the most common uses of protoplasts according to Davey et al. (2005):

- Somatic hybridization is one of the major uses of protoplasts. It consists of protoplast fusion of two species that carry certain characteristics (e.g. disease resistance) but cannot reproduce sexually. The idea is to generate novel plants (hybrids) with the desired characteristic(s).
- Transformation of protoplasts: Due to the fluid mosaic characteristics of the cell membrane, foreign DNA can be introduced in cells through chemical and/or physical methods. Recently, genome-editing tools, such as the clustered regularly interspaced short palindromic repeats (CRISPR)/CRISPR‐associated protein 9 (Cas9) system, have been applied in protoplasts, increasing the interest of developing protoplasts systems in plants (Lin et al., 2018).
- Proto-clonal variation: Regenerated plants from protoplasts can display phenotypic diversity. Although many of these variations affect the growth and performance of the regenerated organisms negatively, positive changes can be detected when there is enough material for screening different phenotypes.

Advances in seaweed protoplast research

Seaweeds, like plants, possess a rigid cell wall composed of cellulose. In addition to cellulose, cell walls of seaweeds also possess other components that make them complex (Reddy et al., 2008). For example, the cell walls in brown algae (Phaeophyceae) are mainly composed of alginates and fucoidans (Kloareg and Quatrano, 1988). From this perspective screening of commercial enzymes, crude extracts or enzymes

isolated from organisms that hydrolyse cell walls presents a unique research opportunity contributing to the study of protoplast isolation from seaweed tissue (Reddy et al., 2008).

Unlike land plants, protoplasts from seaweeds do not require plant growth regulators for regeneration. Advances in protoplast regeneration in seaweeds significantly lag behind land plants. Factors such as temperature or plating density have been tested in protoplast cultures. However, other factors need to be examined. As an example, spectral quality of light is known to affect protoplast regeneration in land plants and the moss *Physcomitrella* but has not been evaluated for marine multicellular algal protoplasts (Jenkins and Cove, 1983; Compton et al., 2000). Also, polyamines, a low molecular weight aliphatic amine is reported to affect morphogenesis and development in seaweeds, have not been assessed in protoplast cultures (Kumar et al., 2015).

Protoplast research in marine macroalgae dates to 1979, when Millner et al. (1979) isolated protoplasts from the green seaweed *Ulva intestinalis* using a combination of driselase and pectinase. Since then, enzymatic methods have gained popularity in seaweed protoplast research, although mechanical lysing techniques continue to be used for coenocytic forms, such as Bryopsis (Kim et al., 2001). Till date, protoplast isolation and regeneration has been accomplished in at least 89 seaweed species (Reddy et al., 2008). A summarised list of key references on seaweed protoplast research can be found in table 1.

Table 1: Key references for research on seaweed protoplasts

Phylum/Class	Reference	Title	Publication
General	Kaladharan (1998)	Protoplasts - a powerful tool in genetic manipulation of commercial seaweeds.	Proceedings of the First National Seminar on Trends in Marine Biotechnology. 83-88 pp.
	Reddy et al. (2008)	Seaweed protoplast: status, biotechnological perspectives and needs	Journal of Applied Phycology 20: 619-632
	Baweja et al. (2009)	Seaweed tissue culture as applied to biotechnology: problems, achievements and prospects	Phycological Research 57: 45-58
Chlorophyta	Kim et al. (2001)	Life without a cell membrane: regeneration of protoplasts from disintegrated cells of the marine green alga *Bryopsis plumosa*	Journal of Cell Science 114: 2009-2014.
	Gupta et al. (2012)	Detection of epigenetic variations in the protoplast-derived germlings of *Ulva reticulata* using methylation sensitive amplification polymorphism (MSAP)	Marine biotechnology, 14: 692-700.
	Gupta and Reddy (2018)	A simple protocol for a rapid and consistent production of a large number of viable protoplasts from the Ulvophycean species	Protocols for Macroalgae Research. CRC Press, Boca Raton. 129-138 pp.
	Gupta et al. (2018)	Marine macroalgal nursery: A model for sustainable production of seedlings for large scale farming	Algal Research. 31: 463-468

Phylum/Class	Reference	Title	Publication
Phaeophyceae	Benet et al. (1997)	Protoplast regeneration from gametophytes and sporophytes of some species in the order Laminariales (Phaeophyceae)	Protoplasma 199: 39-48.
	Matsumura et al. (2000)	Mariculture of *Laminaria japonica* (Laminariales, Phaeophyceae) using protoplast regeneration	Phycological Research 48: 169-176.
	Matsumura et al. (2001)	Successful sporophyte regeneration from protoplasts of *Undaria pinnatifida* (Laminariales, Phaeophyceae)	Phycologia 40: 10-20.
	Coelho et al. (2012)	Isolation and Regeneration of Protoplasts from *Ectocarpus*	Cold Spring Harbor Protocols. doi: 10.1101/pdb.prot067959.
Rhodophyta	Mizukami et al. (1995)	Culture and development of electrically fused protoplasts from red marine algae, *Porphyra yezoensis* and *P. suborbiculata*	Aquaculture 132: 361-367
	Dipakkore et al. (2006)	Production and seeding of protoplasts of *Porphyra okhaensis* (Bangiales, Rhodophyta) in laboratory culture	Journal of Applied Phycology 17: 331-337.
	Takahashi et al. (2010)	Isolation and regeneration of transiently transformed protoplasts from gametophytic blades of the marine red alga *Porphyra yezoensis*	Electronic Journal of Biotechnology 13: 8-9
	Huddy et al. (2015)	Regeneration of whole plants from protoplasts of *Gracilaria gracilis* (Gracilariales, Rhodophyta)	Journal of Applied Phycology 27: 427-435

Green seaweeds

Studies on protoplast from green seaweeds have been mostly undertaken on *Ulva* and *Monostroma*. A well-established protocol for protoplast isolation was recently described by Gupta and Reddy (2018) for Ulvophycean species using only cellulase "Onozuka" R-10. Protoplasts obtained from *Ulva* usually regenerate into normal plants, although other abnormal morphologies (e.g. cell clumps) can occur. Due to this regeneration ability, Gupta et al. (2018) used protoplasts from *U. lactuca* as seedlings for large scale farming. Epigenetic studies have shed light into the regeneration pathways in green algae, and protoplast fusion between *Ulva* and *Monostroma* have been successfully accomplished (Gupta et al., 2012, 2015). Undoubtedly, protoplast research in green seaweeds has witnessed most progress compared to red and brown seaweeds.

Brown seaweeds

In 1984, Saga and Sakai (1984) reported for first time protoplast isolation from a brown seaweed *Saccharina japonica* using a crude enzyme solution from the sea urchin *Strongylocentrotus intermedius*.

Till date most protoplast studies have been focused on kelps due to their commercial importance. *Undaria pinnatifida* is the most researched species, followed by *Macrocystis pyrifera*, *Saccharina japonica* and *Laminaria digitata* (Reddy et al., 2008). However, unlike green seaweeds, most of the protocols in Phaeophyceae involves the use of non-commercial enzymes, which make them expensive, time consuming and with low reproducibility. Protoplast regeneration has been successfully achieved in filamentous forms and in only two kelp species, *U. pinnatifida* and *S. japonica* (Matsumura et al., 2000, 2001). Protoplasts from brown algae have been used in physiological and cellular studies, as well as in expressed tag sequences analysis (Reddy et al., 2008). Also, whole plant regeneration in *U. pinnatifida* and *S. japonica* might indicate that protoplasts could be used for clonal propagation in kelps (Matsumura et al., 2001).

Red seaweeds

The work of Tang (1982) in *Phycocalidia suborbiculata* (formerly *Pyropia suborbiculata*) started protoplast research in red seaweeds. He isolated protoplasts using a combination of cellulase "Onozuka" R-10 and a mixture of enzymes from the digestive system of the sea snail *Lunella coronata*. Most isolation reports have been focused on *Pyropia*/*Porphyra* and *Gracilaria* due to their economic importance with some protocols relying only on commercial enzymes. Protoplast culture and regeneration studies are prevalent in several species of *Pyropia*/*Porphyra* (Reddy et al., 2008). This has led to the use of protoplasts as an alternative culture method in this genus (Dipakkore et al., 2005). Whole plant regeneration reports in more complex forms such as *Gracilaria* spp. are scarce (Huddy et al., 2015). Protoplast fusion has been accomplished between *P. suborbiculata* and *Neopyropia yezoensis*, and between the later and the green seaweed *Monostroma nitidum*. Physiological and cellular studies have been undertaken with protoplasts from *Chondrus crispus*, *Grateloupia sparsa* and *Palmaria palmata* (Reddy et al., 2008). Also, protoplasts from *N. yezoensis* have been used as a system for transient expression of a β-glucuronidase reporter gene (Takahashi et al., 2010).

Conclusions

Major progresses in protoplast research have been done in red and green seaweeds, the latter having reliable protocols for protoplast isolation and regeneration. Methods for brown seaweeds rely on non-commercial enzymes or crude extracts that represent a major drawback. Establishing standard protocols with commercial enzymes, such as in *Ulva* spp., are needed in order to progress further on protoplast studies. Regeneration of complex forms are also necessary, as well as, exploring new factors during protoplast cultures, such as light spectra or polyamines. Given all this, protoplast research represents a promising approach for seaweed studies and manipulation.

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My seaweed looks weird: A participative web portal to report algal diseases

MARTINA STRITTMATTER

Scottish Marine Institute, Oban, United Kingdom

***Corresponding author**: Martina.Strittmatter@sams.ac.uk*

Cultivated and wild macroalgae are constantly exposed to a variety of microorganisms including pathogens. Whereas macroalgal diseases have gained more and more interest during the last decade, information about disease symptoms and the identity of the pathogens causing them is still scarce.

In order to further the current knowledge of macroalgal diseases, we have set-up a web portal, **My Seaweed Looks Weird (MSLW)**, within the framework of the two projects Genialg (EU H2020) and GlobalSeaweedSTAR (UKRI, GCRF), where everybody can submit observations of 'unhealthy looking algae' displaying possible symptoms of disease like spots, holes, galls etc (Figure 1).

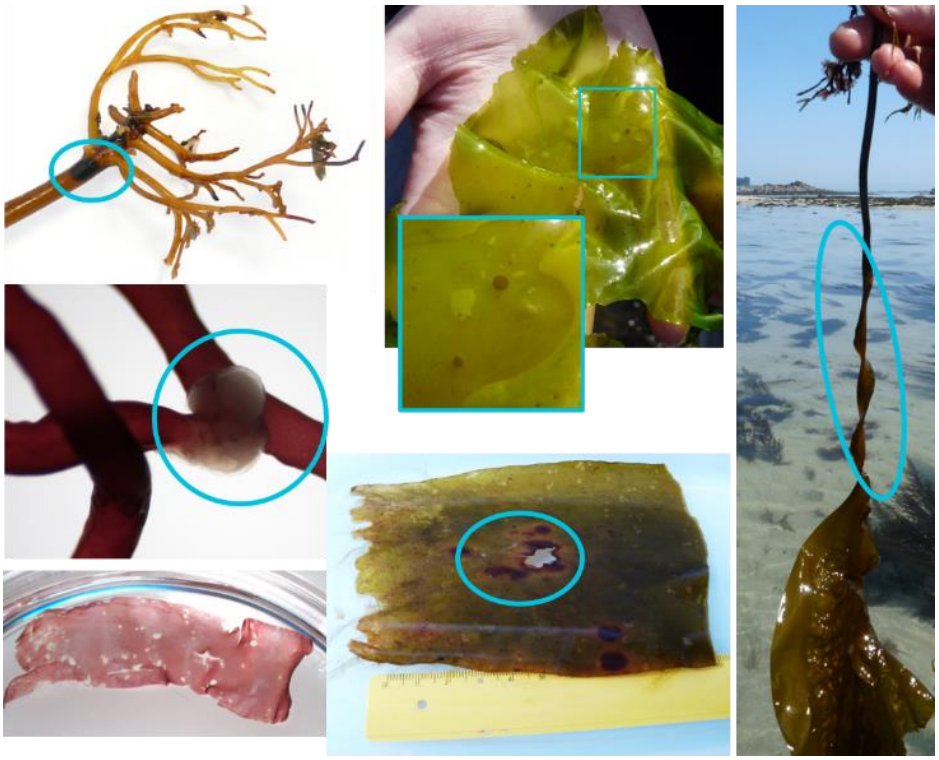


Figure 1: Morphological changes displaying possible disease symptoms

This portal, which has been set-up in English, Spanish and Portuguese, can be accessed under https://globalseaweed.org/?page_id=902. We kindly ask to provide some information related to your observation of the unhealthy alga, like algal species, observed symptoms, location of the observation etc which is treated confidentially, if required. Furthermore, it is possible to submit image material to support such observations. We also encourage your submissions of physical samples for which we will provide an in-kind analysis via microscopy and potentially barcode sequencing to obtain more specific information about the identity of the putative pathogen causing those disease symptoms.

The overarching objective of this participative MSLW web portal is gather a maximum of information about algal diseases worldwide and, with the permission of the contributor, make them accessible in an open-access repository which is currently under construction.

Please, also visit our website for some examples and case studies and help us to spread the word about the MSLW web portal.

You can also contact us under mslw@sams.ac.uk for any question and we will be happy to receive your submission of diseased macroalgae.

Minutes of the virtual General Assembly of the International Society for Applied Phycology

The ISAP GA was held in the auspices of the 7th ISAP Congress, Japan on the 15 June 2021.

Meeting commencement: 11:05 CEST
Conclusion: 14:00 CEST

- 12 panelists (including 2 ISAP Japan2021 secretary)
- 25 attendees at commencement
- 34 attendees at 50 minutes from commencement
- 31 attendees 1 hour after commencement
- 31 attendees at commencement of voting

List of attendees is archived and will not be publicly shared for GDPR reasons. Attendees who would not like their names to be archived may email to applied.phycologysoc@gmail.com.

1. Agenda

Opening introduction - Céline Rebours

Rules of communications - Céline Rebours

1. **Validation of Agenda** - Céline Rebours
2. **Presentation of the 2017-2021 ISAP activities**
    a. History of ISAP and presentation of the new administrative structure of the ISAP – Céline Rebours
    b. Process adopted for the creation of the foundation and its functioning – Valéria Montalescot
    c. Presentation of the handbook - Céline Rebours
    d. New website and modernizing the subscriber's management - Valéria Montalescot
    e. Newsletter - Sasi Nayar
    f. Young scientist activities - Leila Ktari
    g. 2017-2021 workshops and presentation of the new online format - Roberto De Philippis
    h. 2017-2021 Sponsorship/Promotion working group activities - Qiang Hu and Vitor Verdelho Vieira
    i. Dissemination - Fiona Moejes
    j. Attribution Grants - Céline Rebours and Vitor Verdelho Vieira
    k. Financial Report – Valéria Montalescot
3. **ISAP 2020 awards** – Céline Rebours
4. **Presentation of the candidates for the 2024 ISAP Congress** – Qiang Hu
5. **Presentation of the EC nominees list and opening of the election. Presentation of the online system to vote** - Céline Rebours
6. **Amendments to the bylaw and ratification of the amendments**. Please see enclosed to the GA meeting call the suggested amendments. Presentation of the online system to vote - Céline Rebours

7. **Change of the ISAP fees** - Céline Rebours

8. **Other topics**: All subscribers can send suggestions to the agenda up to 48h before the GA

2. Summary of the meeting

No objections to the agenda.

Panelists went through the presentation of each section. No comments to the activities or sections presented.

Amendment of articles: President Céline Rebours explained modalities of voting. Each article amendments were presented before voting. Three minutes were allocated for each poll. Results of voting number (among attendees) and voting results after each voting poll were presented.

All articles were validated with at least 97% of votes. See details below.

Changes in fees: Two minutes were allocated for each poll. All changes have been validated with at least 86% of votes. One subscriber asked about where to find DAC countries list which has been made available by Valeria.

3. Minutes

Opening introduction - Céline Rebours (CR)

- CR welcomed all delegates and explained that the term of the EC had been extended by an year due to the postponement of the congress due to COVID19 pandemic.
- CR explained that only those that registered for the conference would have access to the GA as per the 2014 by laws.
- CR explained the agenda point by point.

Rules of communications - Céline Rebours

CR explained how the zoom system works and the process of asking questions either through the chat feature, or during Q&A or by raising the 'virtual' hand in zoom.

1. **Validation of Agenda** - Céline Rebours
   - CR solicited any comments on the agenda. There were no comments from the floor.

2. **Presentation of the 2017-2021 ISAP activities**

   a. Historic of ISAP and presentation on the new administrative structure of ISAP– Céline Rebours
   - CR explained that the current structure of the society is based on members who pay a membership fee electing an EC comprising 18 members. The EC then elect the President, who in turn appoints a Treasurer/Secretary.
   - CR then explained the issue of the legal status with the constant changing of the headquarters with each President/Treasurer taking office. This resulted in disruption of activities, higher costs, legal risks, and low visibility. CR and ISAP EC members worked on a solution to have a permanent headquarters that allow board members to be from any country.
   - CR explain the structure of the Supervisory Board and the 3 positions within the Supervisory Board and the link with ISAP EC.

   b. Procedure adopted for the creation of the foundation and its functioning. – Valéria Montalescot (VM)

- VM explained the way the Office Bearers selected the Netherlands and how they came up with the structure of the supervisory board as a way to have a permanent headquarters that will not disrupt the original functioning of ISAP.

c. Presentation of the handbook - Céline Rebours
- CR explained the work done with the handbook as a legacy for next EC and a shorter version for ISAP subscribers to help everyone understand how the society works. She explained that difference between full version and the subscriber's version was the omission of sensitive data that came under the purview of GDPR.

d. New website and modernizing subscriber management - Valéria Montalescot
- VM explained the reasons of moving to WildApricot platform that facilitates better subscriber management and enables features reserved to subscribers.

e. Newsletter - Sasi Nayar (SN)
- SN explained about the newsletter and how the Editorial team developed guidelines for authors and has managed to have at least 2 issues per year. He also mentioned the registration of the newsletter with the National Libraries of Australia (NLA) for the issue of an ISSN number.

f. Young scientist actions - Leila Ktari (LK)
- LK presented activities targeting Young scientists. Participation to Algae week of one of our young EC members to promote activities of ISAP to the young applied phycology community.
- CR added that it was very important to try and connect with the Young Algaeneers Symposium, the proposal to develop more activities to engage with the younger generation and to get them to engage with the society, as they are the future of the society.

g. 2017-2021 workshops and presentation of the new online format - Roberto De Philippis (RdP)
- RdP presented the working group and the importance of training courses focused on biotechnology and applied phycology.
- Two training courses were organized in 2019 and 2020 that included theory, practical hands-on and fieldwork,
- RdP explained the challenges to move online content and deliver the practical topics through videos. A final training webinar will be organized in September 2021 supported financially by GSSTAR.
- CR commented that ISAP EC is regularly announcing calls for activities such as training workshops or webinars or the conference in 2024. CR added that everyone linked to a research institution and specially based in a DAC listed country is welcome to apply. She invited the subscribers to follow up with the next EC.

h. 2017-2021 Sponsorship/Promotion working group - Qiang Hu (QH) and Vitor Verdelho Vieira
- QH presented the working group and the core of the sponsorship program.

i. Dissemination - Fiona Moejes (FM)
- FM presented the work done on the communication side since she started to help with this component a year ago. The aim for now is to send news by email twice a week and add dissemination on Facebook and LinkedIn. She hopes that the next EC will comprise more

young scientists to bring in new ideas and contribute to the website updates and dissemination.

j. Attribution Grants - Céline Rebours and Vitor Verdelho Vieira.

- CR thanked EABA, GlobalSeaweedSTAR and AIIC whose contributions helped in funding 52 grants to participate in the virtual conference.

k. Financial Report – Valéria Montalescot

- VM presented the financial summary detailing income and expenditure of the ISAP Foundation bank account (ING Bank) since the account was opened in July 2019 until the 22 May 2021 (see table 1 below) which has then been audited by a subscriber external to the EC.
- The expenditure falls into 3 categories, viz., costs associated with maintenance of the webpage, registration of ISAP as a foundation, and other ISAP activities. Cost incurred have followed an approval process with either a subcommittee organizing activities or a consultative process involving the EC prior to undertaking the expenditure. Once approved, the expenditure was validated by the Office Bearers.

Table 1: ISAP Financial summary 1 July 2019 to 22 May 2021

Summary per categories	date 22-05-2021	Incomes - euros	Expenditure - euros	Balance (euro)
Incomes total - 21 MAY 2021		**17,633.39**		**€ 8,944.79**
Nantes congress memberships	22/07/2019	11,867.00		
Memberships since Aug 2019 by wire transfer		1,320.00		
Memberships since Aug 2019 by online payment (paypal)		2,375.56		
Membership - other (reimbursement VMontalescot)		25.00		
Sponsorship for ISAP2021 student grants - EABA		1950.00		
Others - bank fees due to ISAP foundation		95.83		
Summary per categories	date 22-05-2021	Incomes - euros	Expenditure - euros	Balance (euro)
Expenditures - total - 21 MAY 2021			**€ 8,688.60**	
Outreach - ISAP Young Scientists				
Reimbursment to SAMS for the invitation of A. Kazbar to the Algae Week and Young Algaeneers Symposium held in Oban in May 2018. A. Kazbar as representative of the ISAP Young Scientists			**€ 1,242.91**	
Total Workshops -			**€ 3,834.42**	
2nd Payment Tunisia - 2018 - Advanced by C.Rebours and reimbursed			€ 1,086.14	
1st payment Mexico 2019 - paid by wire transfer from ING ban account			€ 1,370.11	
2nd payment Mexico 2019- paid by wire transfer from ING ban account			€ 1,378.17	
Expenses related to ISAP registration in the Netherlands			**€ 1,145.49**	
Notary - Advanced by C.Rebours and reimbursed			981.1	
Chambre de commerce registration fee - Advanced by C.Rebours and reimbursed			53.05	
Legalization of documents - advanced by V. Montalescot and reimbursed			111.34	
Expenses related to websites (may 2019-Sep 2021)			**€ 2,074.21**	
Wild Apricot - website Sept20 to Sept21 advanced by VM and reimbursed			£ 866.54	
Wild Apricot website Aug19 to Sept21 - advance by VM and reimbursed			£ 1,022.59	
Old website costs - WIX May 2019 to Oct2019 - advance by VM and reimbursed			£ 156.66	
Domain website - Webics - May2018 to May 2019			€ 28.42	
Expenses bank fees (aug 2019 to May 2021)			**€ 391.57**	
Expenses - bank transfer fees (aug 2019 to May 2021)			£ 161.00	
Expenses - bank transfer fees (aug 2019 to May 2021)			£ 167.57	
Expenses related to temporary bank account			£ 63.00	

Functioning costs related to the website:

- WIX website: costs pertaining to the functioning of the old website that ceased operating in October 2019 after the content was transferred to the new website hosted by Wild Apricot.
- Webbics: costs associated with the maintenance of the domain www.appliedphycologysoc.org
- WildApricot: costs associated with the transfer to the new website. The proposal to transfer to this website platform designed specifically to host websites of various associations and facilitate membership management was received favourably by the EC and the Office Bearers (Celine Rebours, Roberto de Philippis and Hu Qiang).

Costs related to the registration of the ISAP as Foundation in the Netherlands and opening of a permanent bank account:

- The decision to create permanent headquarters in the Netherlands was received positively by the EC with the final decision undertaken by the Office Bearers Celine Rebours, Roberto de Philippis and Qiang Hu.

Cost related to the ISAP activities:

- Participation of A. Kazbar to the Algae Week and Young Algaeneer Symposium 2019 was approved by the Young Scientists sub-committee and validated by the Office Bearers.
- Funding allocated to the training workshop was approved by the EC. The selection of the best candidates (Tunisia and Mexico) was undertaken by the Training Workshop sub-committee and expenses validated by the Office Bearers.

3. **ISAP 2020 awards –** *Céline Rebours*

CR explained the organization related to the best posters, best talks, distinguished applied phycologist and outstanding contribution to the ISAP awards.

4. **Presentation of the candidates for the 2024 ISAP Congress –** *Qiang Hu*

The call for expression of interest to organise the next ISAP congress in 2024 is still open. QH invited subscribers to apply for the next congress and assist in disseminating the call.

5. **Presentation of the EC nominees list and opening of the election. Presentation of the online system to vote -** *Céline Rebours*

CR explained that normally only people that attended the GA can vote. But that will change as one of one of the amendments is to open the election process online to all subscribers, including the current election.

Note from point 6: The amendment was accepted and therefore all subscribers would be given access to the poll to elect the next EC members.

6. **Amendments to the bylaw and ratification of the amendments. Please see enclosed to the GA meeting call the suggested amendments. Presentation of the online system to vote -** *Céline Rebours*

CR explained modalities of voting. Proposed amendments to each article was emailed to the subscribers before the GA. Subscribers sent back their amendments/comments to the bylaws to EC prior to the GA. The revised amendment was then presented at the GA prior to voting. Three minutes were allocated to vote on each ammendment. Results of number of votes and the voting

results provided at the end of each poll. All ammendments were validated with at least 93% of positive votes. See table 2 for the poll report from Zoom:

7. Change of the ISAP fees - *Céline Rebours*

CR explained that an increase in membership fees will facilitate more activities that will help the society grow.

Student fee should not be changed to encourage recruitment of younger generation. New categories adapted to DAC listed country was presented.

All changes have been validated with at least 86% of votes (table 2). One subscriber asked about the source of DAC countries list. List was made available by Valeria in the chat room and can also be accessed at: https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/DAC-List-ODA-Recipients-for-reporting-2021-flows.pdf

Table 2: Poll report from Zoom with poll questions pertaining to amendment of By-Laws and changes to subscription fees

No.	Question	Number of Votes	Yes		No	
1	Do you validate the changes made to article 1? Yes/No	35	34/35	97%	1/35	3%
2	Do you validate the changes made to article 2? Yes/No	35	34/35	97%	1/35	3%
3	Do you validate the changes made to article 3? Yes/No	32	31/32	97%	1/32	3%
4	Do you validate the changes made to article 4? Yes/No	33	33/33	100%	0/33	0%
5	Do you validate the changes made to article 5? Yes/No	31	31/31	100%	0/31	0%
6	Do you validate the changes made to article 6? Yes/No	32	32/32	100%	0/32	0%
7	Do you validate the changes made to article 7? Yes/No	31	31/31	100%	0/31	0%
8	Do you validate the changes made to article 8? Yes/No	32	32/32	100%	0/32	0%
9	Do you validate the changes made to article 9? Yes/No	32	32/32	100%	0/32	0%
10	Do you validate the changes proposed in amendment 10? Yes/No	30	30/30	100%	0/30	0%
11	Do you validate the changes proposed in amendment 11? Yes/No	30	30/30	100%	0/30	0%
12	Do you validate the changes proposed in amendment 12? Yes/No	31	31/31	100%	0/31	0%
13	Do you validate the 1 year subscription for the **DAC countries**	28	27/28	96%	1/28	4%
14	Do you validate the 3 years subscription for the **DAC countries**	29	29/29	100%	0/29	0%
15	Do you validate the increase of the 1 year subscription for the **corporate** subscribers? Yes/No	28	26/28	93%	2/28	7%
16	Do you validate the increase of the 3 years subscription for the **corporate** subscribers? Yes/No	25	24/25	96%	1/25	4%
17	Do you validate the increase of the 1 year subscription for the **ordinary** subscribers? Yes/No	28	26/28	93%	2/28	7%
18	Do you validate the increase of the 3 years subscription for the **ordinary** subscribers? Yes/No	25	24/25	96%	1/25	4%

8. Other topics: All subscribers can send suggestions to the agenda up to 48h before the GA.

In consideration that there being no further issues to discuss, the President thanked the subscribers for sending in their amendments/comments to the bylaws and for joining the GA. The General Assembly formally closed at 14:00 CEST.

Valeria Montalescot
Treasurer-Secretary of the International Society for Applied Phycology
Oban, June 17th 2021

News and Views

The 7th International Society of Applied Phycology Congress (ISAP2021) is currently underway!

Registering for ISAP2021 will give you access to a variety of live sessions as well as **over 230 presentations** and so much more - so don't miss this chance to learn of the current state of applied algal research accessible from your laptop.

You can still register for the conference by clicking here. Registration will stay open until 13 August 2021.

Please visit the ISAP2021 website for more information.

Important timelines

Registration deadline (standard):	**13 August 2021**
Call for submissions to the Journal of Applied Phycology special issue	**15 October 2021**

Organized by:

ABES 筑波大学 University of Tsukuba euglena AIIC Algae Industry Incubation Consortium JAPAN

Conferences and Events

MARE Conference People & the Sea XI, 28 June – 2 July 2021; online

This conference aims to reconcile two seemingly opposing uses of the oceans: exploitation and conservation, in the same way as was intended with the use of 'sustainable development'. The concept also seems to promise that there still is a new, not yet reached frontier for economic expansion. With the theme "Limits to Blue Growth?", MARE would like to contribute to the United Nations Decade of Ocean Science for Sustainable Development.

Further information: https://www.marecentre.nl/wp-content/uploads/MARE-2021-Call-for-papers.pdf

2nd edition of the Conference Lipids in the Ocean, 5 – 8 July 2021 in Aveiro, Portugal

This event will be a great opportunity for researchers, students and stakeholders to share their knowledge, expertise and new ideas on marine lipids and advance our knowledge on the study and potential applications of these biomolecules.

Further information: http://lipids2021.web.ua.pt/

Aqua Nor, 24 – 27 August 2021 in Trondheim, Norway

Since 1979, Aqua Nor has been an important international meeting place for the aquaculture industry, and it is today the world's largest aquaculture technology exhibition. During Aqua Nor, numerous seminars, mini-conferences, lectures, debates and presentations are held. During the exhibition, visitors and exhibitors alike can participate in various social events both during the day and in the evening. The conditions are perfect for meeting old friends as well as new contacts and customers in an informal setting.

Further information: https://www.aquanor.no/?lang=en

Seagriculture 2021, 15 – 16 September 2021, online

The Seagriculture conference gathers top speakers, who will share their know-how within seaweed for feed, food, offshore cultivation, biorefinery of seaweed and much more. Don't miss this unique opportunity to network with colleagues from all over Europe within industry and research.

Further information:
https://seagriculture.eu/?utm_campaign=seagri1906&utm_source=enormail&utm_medium=email

EABA Webinar: Biorefineries for Algae Biomass, 23 September 2021, online

The participants will have a vision about what is algae biorefinery and what is the current status with input about the present key players and emerging projects. In recent years, ever-increasing socio-economic awareness, and negative impact of excessive petrol consumption have redirected the research interests towards bio-resources such as algal-based biomass. In order to meet current bio-economy challenges to produce high-value multiple products at a time, new integrated processes in research and development are necessary. Though various strategies have been posited for conversion of algal-based biomass to fuel and fine chemicals, none of them has been proved as economically viable and energetically feasible. Therefore, a range of other bio-products needs to be pursued. In this context, the algal bio-refinery concept has appeared with notable solution to recover multiple products from a single operation process.

Further information: https://algaeworkshops.org/algae-workshops/biorefineries-for-algae-biomass/

Aquaculture Europe 2021, 4 – 7 October 2021, Madeira (Portugal)

Aquaculture has a clear place in securing food production in Europe and presents "Oceans of Opportunities" for development and investment if given the political and social licence to expand and develop, with public awareness/acceptance of its role. Aquaculture Europe 2021 will explore those oceans from the unique island that is Madeira.

Further information: https://www.aquaeas.org/Meeting/AE2021

Oceans of Knowledge 2021: Climate Change and the Ocean, 26 – 27 October 2021, London (UK) + online

Oceans of Knowledge 2021 will provide an important opportunity to meet and network with delegates from government, academia and industry, representing multiple disciplines and sectors concerned with understanding, mitigating and adapting to a changing climate. Outputs from the conference will be used to generate a summary report drawing together the three themes, informing follow on workshops and supporting peer reviewed publications.

Further information: https://www.imarest.org/events/category/categories/imarest-conference/oceans-of-knowledge-2021-climate-change-and-the-ocean

AlgaEurope 2021, 7 – 9 December 2021, online

Algae have become a multi-billion sector in terms of biotechnology development that is expected to grow rapidly, providing valuable goods and services in multiple applications. In spite of centuries of scientific and commercial interests, the term "algae" has no taxonomic meaning. In the light of rapidly growing business interests associated with the term algae, a clear, simple definition of algae is not only required, but essential for developing the necessary standards, regulatory and legal issues.

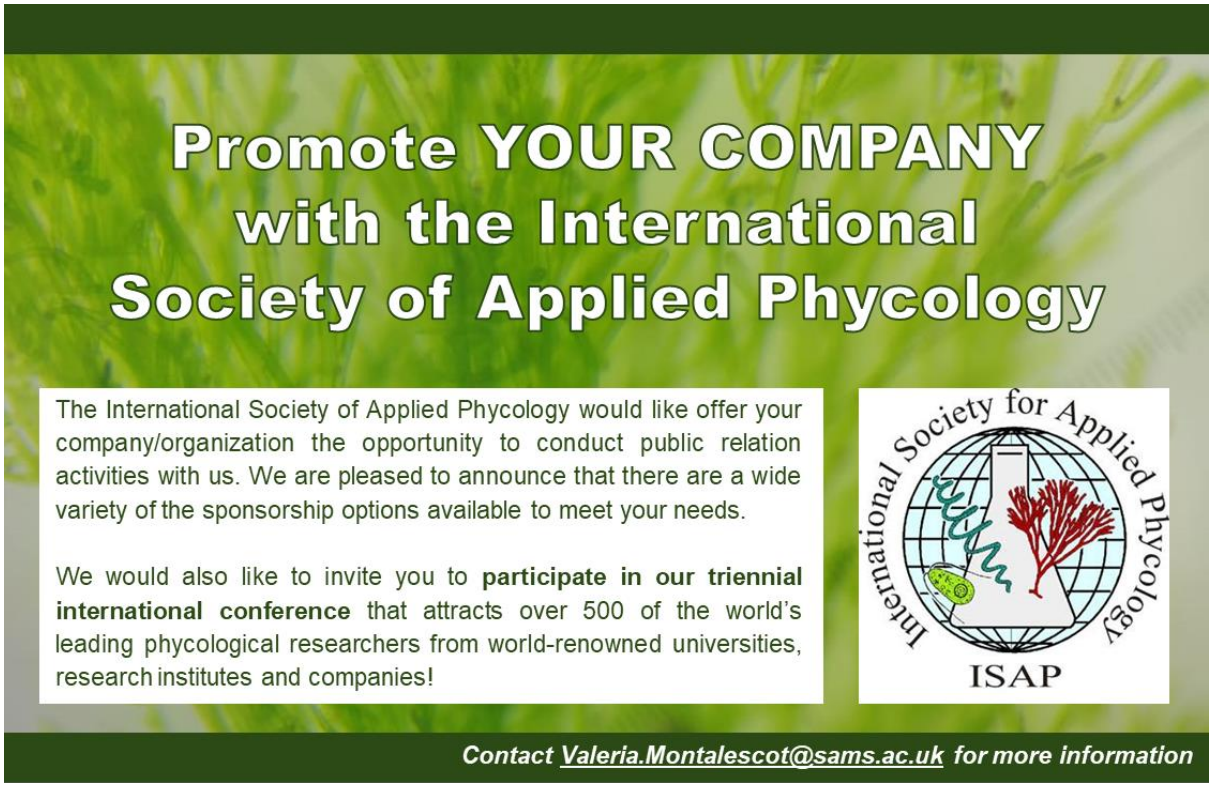
Further information: https://algaeurope.org/

The 24th International Seaweed Symposium (ISS2022) February 13th – 18th 2022, Hobart, Tasmania (Australia)

The International Seaweed Association (ISA) is an international organisation dedicated to the encouragement of research and development of seaweed and seaweed products. Their mission is to promote applied phycology on a global basis, and to stimulate interactions among researchers, industrialists and government representatives in all relevant institutions, organisations and industries and in all countries. The 2022 Symposium is being hosted by the University of Tasmania's Institute for Marine and Antarctic Studies on behalf of ISA.

Further information: https://www.iss2022.net/

Please note that most countries may also have national conference attendance and grants – please look at national institutions in your respective countries for these opportunities



International Society for Applied Phycology (ISAP) Newsletter Article Submission Guidelines

Contributing an article to the ISAP newsletter

Members or non-members of ISAP are welcome to contribute articles, news clips or announcements to the newsletter. We do particularly encourage undergraduate and graduate students to contribute.

Past issues of the newsletter

Archives of the newsletter can be accessed on our website:
https://www.appliedphycologysoc.org/newsletters

Frequency of publication

Biannual.

The audience

The newsletter is read by about 600 members of the ISAP who are applied phycologists from universities, research institutes, industry, policy makers and other algae enthusiasts. It is also read by those who frequent our Facebook and LinkedIn in page where the newsletter is uploaded. The newsletter can also be accessed through National Library of Australia (NLA), as part of the agreement for the issue of the ISSN number.

Type of articles

We solicit and publish technical articles pertaining to applied phycology from any type of ecosystem. Each issue typically comprises two articles, one on microalgae and the other on macroalgae.

Other types of contributions may include announcements pertaining to conferences, workshops, symposia, training courses and events, project updates, book reviews as well as review of technology and services.

Article formatting

All submissions should be in **MS word (.doc or .docx) format typically of 250 – 2500 words**. Word files should be named with the surname (family name) of the corresponding author e.g., Camello.docx.

Please format your article in plain font ideally using **Times New Roman, font size 11**. Please bold titles and italicize sub-titles. Use appropriate symbol font for units. Please avoid the use of excessive space between characters or words. ISAP newsletter adopts metric unit of measurement. Scientific names should be in full, with genus and species in italics.

The manuscript should be organized as follows

- Title
- Author list with affiliation and corresponding author
- Summary or Abstract
- Main body of the manuscript
- Conclusions and/or recommendations
- Acknowledgments (optional)
- References
- Tables (optional)
- Figures (optional)
- Figure captions (optional)

Title
Typically **100 characters**, in bold.

Authors and affiliation
Each article should list all authors with their first name and middle name abbreviated. Superscripts may be used to indicate the institutional affiliation of the authors. An asterisk symbol is used to highlight the corresponding author and their contact email ID. For e.g.,

N.V. Thomas[1], K. R. Roman[2] and A. R. Camello[3*]
[1]Affliation of first author with institutional address
[2]Affliation of second author with institutional address
[3]Affiliation of third author with institutional address

*Corresponding author: camello.a@aad.gov.au

Summary or Abstract
A summary or abstract, typically **100-150 words** should summarize what the article is about and the salient findings.

Main body of the manuscript
The articles must be written in plain English with the broad objective of conveying technical information that can be understood by non-specialists and members of the public. Technical jargon should be avoided. Figures and tables may be cited in the main body of the manuscript but must not be embedded. Similarly, in-text citation of references must be adopted. In-text citations should follow the author-year format. For e.g., (Roberts and Emilio, 2003).

Conclusions / Recommendations
No more than 50 – 100 words with closing opinion with recommendations for further work.

References
Citations need not be extensive and may be restricted to pertinent reviews or those applicable to the subject matter. Only literature cited in the main body of the manuscript should appear in the reference list. The citations should be listed **alphabetically and chronologically**. The format adopted by the newsletter is as below:

Journal article
Thomas, P.A. and Oscar, M.A. 2005. Culture of *Nannochloropsis gaditana* in bubble column reactor. Journal of Applied Phycology 134: 31-38.

Book
Whatman, C.F. 2008. Pond water quality. CRC Press, Boca Raton, FL, USA. 455p.

Book chapter
Michaelis, M. 2008. Bacterioplankton in aquaculture ponds. 48 -52pp In: Pond water quality, Whatman, C.F. (Ed.). CRC Press, Boca Raton, FL, USA.

Report
Roman, H.G. and Pete, G.S. 2012. Seaweed cultivation in ponds. Report no. RD12/0208-1. Environmental Protection Authority, Canberra, ACT, Australia. 80p.

Tables
Small, concise tables that complement the data in the text are encouraged. Tables may be created using the word table tool. Tables must **be submitted separate to the main manuscript** and must contain the tile.

Photos / Figures / Images / Line art
Photos or image files should be of high resolution (typically >300dpi), in colour or Black and white (B&W) and should be supplied in **.jpg** or **.tiff** or **.png** format. Up to 15 figures or images can be included with each article. Image or photo files should be labelled with the surname (family name) of the corresponding author followed by the Figure number for e.g., **McTierFigure1.jpg**

Figures or photographs used in the manuscript should have in-text citation. Please do not embed photos or images into the main body of the manuscript. Figure legends or captions should be in word format with the description of each of the figure used. The photographs or figures used must be original and must have been taken by one of the co-authors. If not, the owner, the source of the photograph or figure must be acknowledged.

Copyrights and ownership

All materials submitted must belong to the authors. If not, contribution from other parties must be clearly acknowledged in the article. The corresponding author takes all responsibility pertaining to compliance with copyrights and permission to publish the material, when an article is submitted to the newsletter for publication.

Submitting an article

If the complete submission, that includes the manuscript, tables and figures, are <10Mb we encourage the corresponding author to attach the manuscript and the supporting files to an email message and email to the Editor at sasi.nayar@sa.gov.au. If the files are too large to be communicated over email, please let the Editor know. We will then create a secure folder on OneDrive and share it with you for the files to be dropped and shared with the Editorial team.

ISAP Contacts and Officers

President: Dr. Céline Rebours
Møreforsking AS
Postboks 5075, Larsgården, 6021 Ålesund, NORWAY
E-mail: celine.rebours@moreforsking.no
http://www.moreforsk.no/

Vice President (Outgoing President): Prof. Roberto De Philippis
Department of Agrifood Production and Environmental Sciences (DISPAA)
Florence University, Piazzaledelle Cascine 24; I-50144 Firenze, ITALY
Tel.: +39 0552755910
E-mail: roberto.dephilippis@unifi.it
http://www.dispaa.unifi.it/

Vice President (President-elect): Dr. Qiang Hu
Institute for Advanced Study
Shenzhen University
Shenzhen, Guangdong
CHINA 518060
Tel.: +86-138-1140-6745
E-mail: huqiang@ihb.ac.cn

Secretary/Treasurer: Dr. Valéria Montalescot
Global SeaweedSTAR
Scottish Association for Marine Science
Oban, Argyll PA37 1QA, UK
Tel.: +44 1631 559205
E-mail: applied.phycologysoc@gmail.com

Editor, ISAP Newsletter: Dr. Sasi Nayar
Algal Production Group
South Australian Research and Development Institute - Aquatic Sciences
2 Hamra Avenue, West Beach, SA 5024, AUSTRALIA
Tel.: +61 8 8429 0785
E-mail: sasi.nayar@sa.gov.au
http://pir.sa.gov.au/research

Communications Coordinator & Social media administrator: Dr. Fiona Moejes
Director of Programmes
The Mawazo Institute
Nairobi, KENYA
Tel: +254 706 156 951
E mail: fiona.moejes@mawazoinstitute.org
https://mawazoinstitute.org/