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**Applied Phycology**

**NEWSLETTER**



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## Message from the President

Dear ISAP Subscribers,

I hope you had a productive year as we bid farewell to 2023 and usher in the new year. I would like to thank the Newsletter Working Group led by Céline Rebours and her members Andrew Ward, Eugenia Olguin and Priya Pollard, for putting together this second issue of the ISAP Newsletter for year 2023.

I believe most of you are looking forward to the **ISAP2024 Congress** taking place from **June 16<sup>th</sup> to 21<sup>st</sup>, 2024 in Porto, Portugal**. The Local Organizing Committee has launched the conference website <https://isap2024.com/> and set up a dedicated LinkedIn page for news on the Congress <https://www.linkedin.com/showcase/101347407/admin/feed/posts/>. Thus, we invite you to bookmark and follow these pages for regular updates on this exciting triennial event.

ISAP subscribers enjoy a reduced registration fee, so don't miss out on this opportunity to gather, and meet with algae enthusiasts from various parts of the world. Travel grants to attend this Congress will be announced soon, hence do stay tune! Please help us to share news of this Congress within your network too.

I would also like to inform that the next **ISAP General Assembly (GA)** will be held on **June 18<sup>th</sup>, 2024**, during the ISAP Congress. During the GA, ISAP subscribers will exercise your rights to vote in the new Executive Committee for the 2024-2027 term to represent your voices. ISAP will announce the call for nomination of the EC members via email two months prior to the GA. We look forward to meeting all of you at the upcoming General Assembly.

### Key dates for the ISAP2024 Congress:

- Deadline for special session submission: **December 30<sup>th</sup>, 2023**.
- Deadline for abstract submission: **January 18<sup>th</sup>, 2024**.
- Deadline for early bird registration: **March 30<sup>th</sup>, 2024**.

ISAP will also be sharing important updates of the Congress on our social media platforms. These include a [Facebook page](#), [Twitter account](#) and a [LinkedIn group](#). If you have yet to explore them, I would like to urge everyone to follow or like these pages (and of course share the posts) to increase ISAP's visibility and more importantly to get the latest updates from us.

Last but not least, please look forward to the **2024 Call** for support to organize applied phycology related **training course** in the next month or two, we will be making the announcement soon.

As usual, we 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 upcoming issues of the newsletter. For further details, please contact either the Editor-in-chief of the newsletter Céline Rebours, myself or the ISAP Secretary Sze-Wan Poong whose contact details can be found at the end of the newsletter.

Wishing everyone season's greetings and a happy new year!

Warmest regards,

Qiang Hu,  
President, International Society for Applied Phycology

## Message from the Editor

Dear Colleagues,

We are delighted to present the second issue of the ISAP Newsletter for this year!

I would like to warmly thank the authors for the preparation and submission of very interesting manuscripts and my deepest gratitude for their patience during the review as well as the publication processes. I would also like to acknowledge our communication manager, Priya Pollard, and the editorial review team for their kind assistance in the preparation of this second 2023 ISAP Newsletter.

In this issue, we have two main articles, one conference report article, and views and announcements including the announcement for the 8<sup>th</sup> Congress of the International Society for Applied Phycology in the wonderful city of Porto in Portugal!

The first article, Matilde Ciani, Chiara Capelli, Giulia Daly, Roberto De Philippis and Alessandra Adessi explores the potential for bio-removal and recovery of heavy metals by the halotolerant cyanobacteria. In the second article John N. Idenyi and Jonathan C. Eya summarised the implications of using Microalgal-derived astaxanthin as a feed ingredient for the rainbow trout.

The conference report makes an extensive account of the activities conducted under the Global Algae Summit (GAS 2023) held in Kuala Lumpur (Malaysia) and a summary of the results obtained by this global meeting.

Furthermore, we also would like to invite you to read in the section News and View, an update about the preparation of the 8<sup>th</sup> Congress of the International Society for Applied Phycology. The theme of the ISAP 2024 congress is “Algae 2030: Challenges and Opportunities”. More details will be posted on the [ISAP webpage](#), all ISAP social media pages and the [ISAP 2024 congress webpages](#).

Finally, we would like to invite you to follow up our announcements in the next week on our webpages and social media about the future activities of ISAP. A call for a training workshop in 2024 would be opening soon!

During this holidays period for many of us, we hope you will enjoy reading this issue of the newsletter!

As always, please do not hesitate to contact one of us from the editorial team, if you have any ideas on contributing an article in the next issue of the newsletter. **The deadline for submission is March 30<sup>th</sup>, 2024.** You will find the guidelines at the end of the newsletter.

On behalf of the 2022-2024 Editing committee of the ISAP Newsletter, I wish all the ISAP subscribers, a safe, healthy, and wealthy new year!

Kind regards,

Céline Rebours,  
ISAP Vice President and Editor of the ISAP Newsletter

## Halotolerant cyanobacteria for heavy metal bio-removal and recovery: an insight into the HMBV project

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### Abstract

Halotolerant cyanobacteria have developed several strategies to cope with high salinity, including exopolysaccharides (EPS) production. These polymers represent a potential substrate for heavy metal bioremediation. EPS contain uronic acids and other negatively charged groups such as the sulphate or pyruvate group, which may act as binding sites for positively charged metal ions, through a biosorption process. Metal properties (e.g., electronegativity and ionic radius) and the characteristics of the cyanobacteria (e.g., the surface-to-volume ratio and content/availability of the functional groups) are known to influence the biosorption process. Additionally, the presence of different metals simultaneously can affect the process. Here, we present the metal uptake by three halotolerant cyanobacteria from a multi-metal solution, in the frame of the Heavy Metal bio-recovery and Valorization (HMBV) project, funded by Cariplo Foundation (Italy).

### Introduction

Halotolerant cyanobacteria are photoautotrophic prokaryotes that inhabit hypersaline environments, including coastal lagoons, salty lakes, and salt evaporation ponds. In order to cope with harsh environmental conditions, such as osmotic stress, they have developed several cell adaptation strategies, including the production and/or accumulation of carotenoids, carotenoid-binding proteins, osmoprotectants, such as glycine betaine, cation transporters, and exopolysaccharides (EPS) (Villanova et al., 2021; Yang et al., 2020). EPS include more or less condensed fractions surrounding cells or cell groups that can be partly released and solubilized in the surrounding medium, taking the name of released polysaccharides (RPS) (Mota et al., 2022). Cyanobacterial EPS are heteropolymers with high molecular weight (up to 2MDa) and are characterized by the presence of different types of monosaccharides (up to 15). Additionally, uronic acids and other negatively charged groups such as the sulphate or pyruvate group, confer an anionic nature to these polymers (Olguín et al., 2022). This feature may provide chelating properties that can be exploited in heavy metal bioremediation. Indeed, positively charged metals can be passively biosorbed into these polymers mainly exploiting an ion-exchange mechanism, but also adsorption, complexation and precipitation processes (De Philippis et al., 2011; De Philippis and Micheletti, 2017). The biosorption process is influenced by the properties of the metal ions such as electronegativity and ionic radius, and by the characteristics of the cyanobacteria, such as the surface-to-volume ratio and content/availability of the functional groups (Micheletti et al., 2008; Mota et al., 2016). It has been shown that RPS play a key role in metal biosorption due to the presence of a high number of functional groups in these polymers (Mota et al., 2016). Thus, the exploitation of these polymers for metal removal may present several advantages, including higher efficiency and possible valorisation of the obtained metal-organic materials, due to their interesting physical-chemical properties. Nevertheless, the efficiency of the process can be strongly affected by the simultaneous presence of more than one metal in the solutions, showing a non-interactive, synergistic, or antagonistic activity due to the direct interaction between metal ions in the proximity of the binding sites or structural modification of the biosorbents after their binding (Micheletti et al., 2008; Mota et al., 2016; Sulaymon et al., 2013). Considering that more than one metal is usually present in industrial wastewaters, multi-metal systems should be taken into account to enable the scaling-up of the process at the pilot scale.

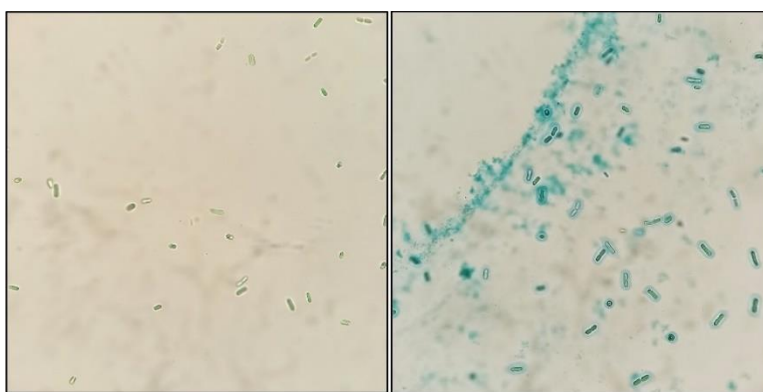
The Heavy Metal bio-recovery and Valorization (HMBV) project (<https://sites.unimi.it/hmbv/>) funded by Cariplo Foundation (Italy), aims at exploiting EPS-producing microorganisms, including cyanobacteria, for removing HM from electroplating wastewaters, converting these pollutants into organic-metallic

compounds to be exploited as biocatalysts or as high commercial-value salts, thus, allowing a zero-waste process and promoting the transition towards a circular economy. Here we compared  $\text{Cu}^{2+}$ ,  $\text{Ni}^{2+}$ , and  $\text{Zn}^{2+}$  biosorption ability from a multi-metal solution by whole cultures of three halotolerant cyanobacteria characterized by high EPS productivity.

## Methodology and results

### *Cyanobacteria and growth conditions*

Two unicellular marine cyanobacteria, namely *Cyanothece* sp. CE 4 (Genbank: OQ945752) and *Dactyloocopsis salina* sp. 16Som2 (Genbank: OQ945751), belonging to *Cyanothece* cluster III sub-cluster I of *Euhalothece* characterized by extreme halotolerance (Mogany et al., 2018), and a consortium of *Cyanothece*-like cells named VI 22M (Figure 1), were selected for their ability to produce EPS and remove Cu, Ni, Zn from single-metal solutions. The cultures were grown for one week in 1-L glass bottles with enriched seawater medium (De Philippis et al., 1993), under continuous illumination ( $200 \mu\text{mol m}^{-2} \text{s}^{-1}$ ) and insufflation of  $\text{CO}_2$ -enriched air, at constant temperature of  $26^\circ\text{C} \pm 0.5$  and  $\text{pH } 8.5 \pm 0.5$ .



**Figure 1: VI 22M Micrographs (40x) without (on the left) and with (on the right) EPS staining with Alcian blue 0.1%.**

### *Biosorption assays*

Harvested cultures were confined in dialysis tubing (MW cut-off 12-14 kDa, S/V  $1.9 \text{ cm}^{-1}$ , Medicell Membranes Ltd, UK) and pre-treated with deionized water and NaOH 0.1M removing the excessive salts contained in the cultivation medium to make the negatively charged binding sites available for the metal ions. The same pre-treatment was carried out with dialysis tubing only containing the culture medium (blank). Next, the confined (MW cut-off 12-14 kDa, S/V  $3.7 \text{ cm}^{-1}$ , Medicell Membranes Ltd, UK) pre-treated cultures or the blank were dipped in a solution containing  $10 \text{ mg L}^{-1}$  of Cu ( $\text{CuCl}_2$ ),  $10 \text{ mg L}^{-1}$  of Ni ( $\text{NiCl}_2$ ), and  $10 \text{ mg L}^{-1}$  of Zn ( $\text{ZnCl}_2$ ) with a ratio 1:10 (v:v, biosorbent and metal solution, respectively) and maintained under continuous agitation at  $25^\circ\text{C}$ ,  $\text{pH } 5.0$ . Three replicates were set for each condition. After 24 h the dialysis tubes were removed and residual metals concentration in the solutions was determined by ICP-OES (iCAP 7400 ICP-OES Analyzer, Thermo Fisher Scientific, US) following the method APAT CNR IRSA 3020 Man 29 2003. The specific metal uptake was expressed as  $\text{mmol of metal g}^{-1} \text{ DW}$ . Biomass dry weight (DW,  $\text{g L}^{-1}$ ) was determined by filtering cell suspension after the pre-treatment on pre-weighed  $0.45 \mu\text{m}$  filters and drying the filters at  $105^\circ\text{C}$  for 4 hours.

The effect of metal or cyanobacteria strain on metal adsorption was analyzed with two-way ANOVA and Tukey's multiple comparisons test at the 5% significance level with GraphPad Prism 7.0.

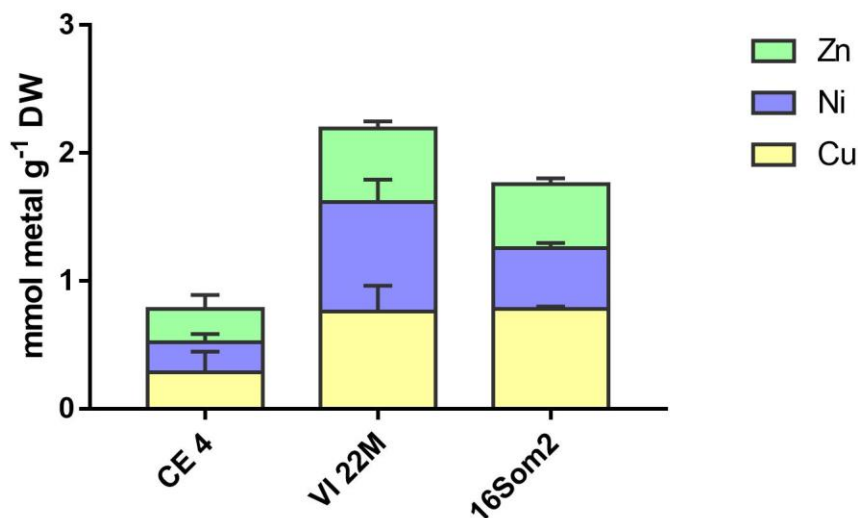
## Results and discussion

Three cyanobacterial cultures were adopted as biosorbents in a three-metal solution. The pH of the cultures after the basic pre-treatment was  $10.1 \pm 0.2$ . Thus, HCl 0.2M was added during the biosorption assay to decrease the pH of the metal solution within its optimal range for biosorption process. NaOH has been described as very effective desorbing agents, since, by an ion exchange mechanism,  $\text{Na}^+$  replace the positively charged ions derived from the culture medium that are bound to the negatively charged binding

sites of the EPS (Mota et al., 2016). Here, we found a positive effect of the basic pre-treatment on VI 22M and 16Som2 compared to our previous data obtained adopting HCl as desorbing agent.

As shown in Figure 2, the consortium (VI 22M) revealed the maximum total metal uptake (2.19 mmol metal g<sup>-1</sup> DW), 64% and 20% higher than CE 4 and 16Som2, respectively. VI 22M and 16Som2 showed a statistically significant higher Cu uptake compared to CE 4 ( $p \leq 0.01$ ), while VI 22M showed also a statistically significant higher Ni uptake compared to CE 4 ( $p \leq 0.001$ ).

Generally, cyanobacteria have shown higher affinity towards Cu, compared to Ni and Zn (Micheletti et al., 2008). Nevertheless, only 16Som2 culture pre-treated with NaOH as desorbing agent highlighted this behaviour.



**Figure 2: Specific Cu, Ni, Zn uptake (mmol g<sup>-1</sup> DW) from a three-metal solution by CE 4, VI 22M, 16Som2. Data are shown as mean  $\pm$  sd (n=3).**

## Conclusions

Despite a basic pre-treatment can positively or negatively affect metal sorption depending on the strain and the metal, it can be exploited for the treatment of metal-containing wastewaters characterized by acid pH to reach the optimal value required for the biosorption process. Further studies with industrial wastewaters are needed to assess the feasibility of cyanobacteria-based biosorption in applicative conditions. The use of confined systems easily promotes the recovery of biosorbent-bound metals, while the valorisation of these “hybrid” materials is challenging to enable a circular economy system.

## Acknowledgments

The research was supported by Fondazione CARIPLO-Circular Economy 2020 project num. 1069-2020 “Heavy Metal Bio-recovery and Valorization-HMBV” (<https://sites.unimi.it/hmbv/>).

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## Microalgal-derived astaxanthin enhances rainbow trout vibrant color and nutrition

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### Abstract

Astaxanthin, a powerful carotenoid pigment produced by microalgae, plays a significant role in the commercial production of rainbow trout (*Oncorhynchus mykiss*). As rainbow trouts are incapable of producing astaxanthin on their own, they must obtain it from their food. Astaxanthin derived from algae sources has gained substantial attention as a natural and highly effective dietary supplement for rainbow trout, mainly due to its origins and outstanding antioxidant properties. We described the importance of incorporating microalgal-derived astaxanthin into rainbow trout diets and evaluate its effects on growth, pigmentation, immunity, and overall health. There are many benefits associated with Astaxanthin for human health, including its role as a potent antioxidant, anti-inflammatory agent, skincare enhancer, eye disease preventative, and immune system booster.

### Introduction

Astaxanthin, a carotenoid pigment derived mostly from algae, is attributed to rainbow trout's colorful pinkish-orange coloration (Ytrestøyl et al., 2015). Through their diet, rainbow trout acquire astaxanthin, a potent antioxidant that accumulates in their tissues (Surai, 2002).

Astaxanthin is a red-orange pigment belonging to the carotenoid group that contains potent antioxidant properties and protects cells from oxidative damage caused by free radicals or reactive oxygen species (ROS) (Surai, 2002). The rainbow trout does not produce astaxanthin, but obtains it from their diet. A rainbow trout in the wild consumes a variety of organisms, such as algae, insects, and small fish, which are rich in astaxanthin (Gammone et al., 2019). Astaxanthin-rich diets are often used in aquaculture to promote the optimal growth, health, and coloration of rainbow trout (Ytrestøyl et al., 2015).

Astaxanthin obtained from algae contributes substantially to rainbow trout's vibrant color. When rainbow trout consume astaxanthin-rich food or prey, the pigment is absorbed through the gut, where it accumulates in tissues such as the skin, muscles, and adipose tissue (Ytrestøyl et al., 2015). Therefore, rainbow trout display their characteristic pinkish-orange coloring.

An indicator of the health and quality of rainbow trout is their coloration intensity. Several studies have demonstrated a direct correlation between dietary astaxanthin levels and the intensity of coloration. In contrast to rainbow trout fed diets that contain low levels of astaxanthin, rainbow trout fed diets high in astaxanthin display more vibrant colors (Kalinowski et al., 2019). This vibrant coloration is desirable in the aquaculture industry, as it enhances the market value and consumer appeal of rainbow trout products.

### *Microalgal species and astaxanthin production*

Algae synthesize astaxanthin as a protective mechanism in response to environmental stresses, such as high light intensity or nutrient limitations. The ability to produce astaxanthin has been identified in several microalgae species and a few examples are provided below:

*Haematococcus pluvialis*: Astaxanthin is found in abundance in this green microalgae. When subjected to severe conditions of stress, such as high light intensity and deficiency of nutrients, it accumulates astaxanthin as a protective mechanism (Lorenz and Cysewski, 2000).

*Chlorella zofingiensis*: It is common for this green alga to be used for the production of astaxanthin, given that it contains high levels of astaxanthin and fast growth rate (Shourie et al., 2022).



*Chlorococcum* sp.: In the Chlorophyceae class, this microalga displays astaxanthin production capabilities and is considered a promising source for commercial astaxanthin production (Shiels et al., 2021).

*Scenedesmus* sp.: The genus Scenedesmus is known for producing astaxanthin. A variety of species within this genus have been studied for their potential applications and astaxanthin content.

Aquaculture, dietary supplements, and cosmetics employ these microalgae as natural sources of astaxanthin.

### **Roles of astaxanthin in fish nutrition**

1. Astaxanthin plays a crucial role in rainbow trout diet by acting as a potent antioxidant, protecting against oxidative stress and cellular damage caused by free radicals (Lim et al., 2018).
2. When astaxanthin is included in rainbow trout diets, it enhances pigmentation, resulting in the vibrant red or pink color of their flesh, providing consumers with a high-quality product (Rahman et al., 2016).
3. When astaxanthin is added to the diet of rainbow trout, levels of growth hormones are increased, nutrient absorption is improved, and metabolism is enhanced, resulting in faster and more efficient growth of rainbow trout (Zhang et al., 2023).
4. Astaxanthin has immunomodulatory properties that enhance immune cell activity, produce antibodies, and enhance the ability of fish or rainbow trout to combat infection and disease (Jafari et al., 2021).

### **Importance of astaxanthin in human health**

1. *Potent Antioxidant*: The antioxidant property of astaxanthin protects cells from the damage caused by free radicals. Compared to other antioxidants, it is capable of neutralizing a wide range of free radicals (Jannel et al., 2020) such as vitamins C and E.
2. *Eyesight protection*: A significant benefit of astaxanthin is its ability to reduce the risk of age-related macular degeneration (AMD), cataracts, and eye fatigue. A significant portion of this substance crosses the blood-retinal barrier and accumulates in the retina's tissues, thereby protecting the retina from oxidative damage and inflammation. (Yang and Wang, 2022).
3. *Anti-Inflammatory Properties*: An important characteristic of astaxanthin is that it has strong anti-inflammatory properties, thus allowing it to reduce inflammation throughout the body. The presence of chronic inflammation is associated with a multitude of health conditions, including cardiovascular disease, arthritic conditions, and neurodegenerative disorders. Astaxanthin may have the potential to alleviate symptoms of inflammation and improve overall health by lowering inflammation levels (Lee et al., 2022).
4. *Skin protection*: A significant benefit of astaxanthin is the enhancement of skin health and appearance. In addition to providing protection against UV-induced damage to the skin, it reduces signs of aging such as wrinkles and age spots, as well as enhancing the moisture and elasticity of the skin. Several properties of Astaxanthin contribute to its beneficial effects on the skin, including its antioxidant and anti-inflammatory properties (Tominaga et al., 2017).
5. *Boost Exercise Performance and Recovery*: This supplement enhances exercise performance and reduces muscle damage and fatigue during exercise. Increases endurance, strength, and reduces oxidative stress associated with exercise. Sportsmen and women commonly take astaxanthin as a supplement to enhance their exercise performance and to aid in the recovery process after exercising (Brown et al., 2018).

### **Conclusion/Recommendations**

In summary, the incorporation of microalgal-derived astaxanthin into rainbow trout feed has the potential to enhance the growth, pigmentation, immune response, and general well-being of these fish. Furthermore, astaxanthin provides a variety of health benefits that make it an attractive ingredient for both aquaculture and dietary supplements. It is, however, essential to address issues associated with costs, supply, formulation, regulations, and consumer acceptance to ensure successful implementation and market acceptance.

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## Event Report of Global Algae Summit (GAS) 2023

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### Abstract

The inaugural Global Algae Summit (GAS) 2023 marked a pioneering milestone in algae research and industry in Malaysia and the Asian region. Co-hosted by Leave a Nest Malaysia Sdn. Bhd., Euglena Euglena Co. Ltd., and Universiti Teknologi Malaysia (UTM), the event held on August 17th, 2023, brought together scientists, entrepreneurs, policymakers, and industry experts. GAS illuminated cutting-edge advancements, catalyzed collaborative dialogues, and underscored a collective commitment to sustainable solutions. The summit featured panel discussions on pivotal topics shaping the algae industry's future. The first panel explored 'Essentials in Building a Thriving Algae Ecosystem,' addressing strategies and challenges in the 'Algae Venture' theme. The second panel focused on 'Exploring the Potential of Algae-based Healthcare Solutions: A Global Perspective,' delved into algae's impact on healthcare. The closing panel delved into 'Advancing Algae-Based Biofuel for Sustainable Green Alternatives,' investigating algae's potential for bioenergy. GAS 2023 gathered 185 attendees who engaged with keynote, scientific sessions, and networking. The event showcased an exhibition with university partners, spotlighting algae research and applications. 'Pocket Talk' sessions enriched perspectives on algae innovation, uniting stakeholders dedicated to propelling the industry's growth. Conversations, presentations, and 67 posters reinforced the commitment to unlocking algae's potential for sustainability. GAS 2023's success reflects a steadfast dedication to innovation and collaboration. The summit not only advanced algae research but also paved the way for ongoing partnerships and initiatives, providing a foundational platform for the industry's growth and transformative ideas. As we look to the future, we aspire to enhance global participation in the upcoming editions of the summit. Interested parties are encouraged to express their interest to the author for future involvement. In conclusion, GAS 2023 not only advanced algae research and technologies but also laid the groundwork for continued collaborations and initiatives. This summit serves as a cornerstone for growth, knowledge exchange, and the transformation of innovative ideas into impactful actions.

### Introduction

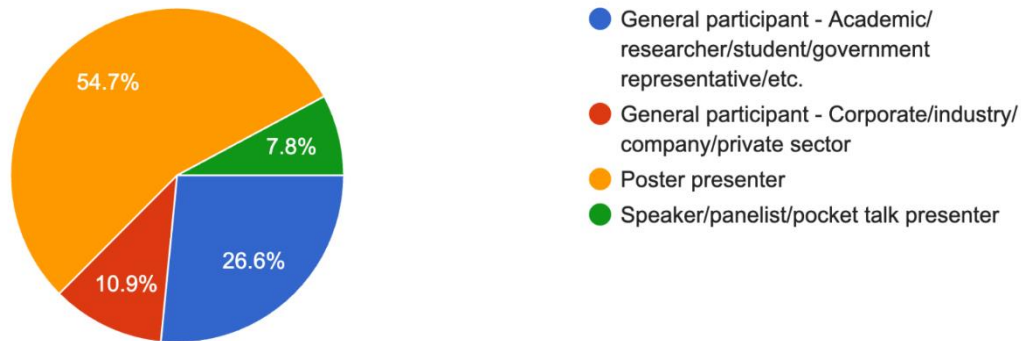
Since the establishment of Euglena (Malaysia) Sdn Bhd in 2022, the close partnership between Leave a Nest Group and Euglena Co. Ltd. has remained largely unexplored within the local Malaysian algae industry landscape. Over the years, Euglena has maintained a collaborative relationship with the iKohzas research group at MJIT-UTM in the field of algae research. The evolution of these joint endeavours and research pursuits has culminated in the inception of the "Global Algae Summit (GAS) 2023". This summit serves as a vital conduit for us to delve into the nuances of Malaysia's algae ecosystem, discern its trajectory, and strategize for future advancement. GAS 2023 stands as an instrumental platform, uniting the local potential algae workforce, with the overarching objective of globalizing our mission to meet the burgeoning economic demand, particularly within the realms of sustainability and the green economy. As we gather at the Global Algae Summit to discuss "**Paving the Future of Circular Algae Bioeconomy**," it is crucial to highlight the numerous algae-based innovations that are driving sustainable development and creating new avenues for a circular economy. This discussion will shed light on the transformative power of algae and its role in paving the way for a greener, more sustainable future.

[GAS 2023](#) (was a one-day conference held at Azman Hashim Hall, University Teknologi Malaysia (UTM), Kuala Lumpur, Malaysia. We aimed to bring together leading experts, researchers, industry players, academia, government, and civil society to share their knowledge and experiences in the field of algae-based industries. The primary objectives of the event were:

1. To foster collaboration and networking among key players in algae research,
2. Provide a platform for showcasing innovative research and development,
3. Identify challenges and opportunities in the algae-based industry, and
4. Develop strategies & synergize efforts to overcome those challenges.

## Attendance Overview

A total of 185 attendees joined GAS 2023. The breakdown of participants is as follows: 85% from universities and government agencies and up to 15% from corporates and private sectors. This figure 1 aligns with our goal of reaching an audience ranging from 150 to 200 participants. In details, there were: 67 poster presenters; 9 panellists; an esteemed keynote speaker; 8 pocket talk presenters; 3 partners (session & strategic); 8 university partners; 3 co-organizers; and a gathering of 185 attendees.



**Figure 1: Registered participants in GAS 2023.**

## Event Highlights

GAS 2023 showcased a diverse range of activities, including a keynote address, three panel sessions, a pocket talk session, partner booths and exhibitions, a poster session, and networking opportunities. The specifics of each session are outlined below:

### **Keynote Address “Meeting the Challenges of Establishing an Algal Industry”**

Emeritus Professor Dr. Phang Siew Moi FASc, FMBA (UK), Deputy Vice Chancellor of UCSI University highlighted that Malaysia's favourable tropical location and abundant sunshine position it well for large-scale algae production (Figure 2). Despite a projected global microalgae market of USD 25.4 billion by 2033 and seaweed market of USD 16.43 billion by 2029, Southeast Asian countries, including Malaysia, are notably absent from the dominant players list. Major industry participants have scaled back from algal biofuel, focusing on more promising avenues such as functional foods, feed, and cosmetics. According to her, challenges include scalability, economic viability, diversification, funding, compliance, and consumer acceptance. Algae biofuel confronts cost and productivity hurdles, while AI and digitization hold potential for efficiency gains. Geographical location influences these challenges, but solutions can establish the algae industry as a driver of the Blue Economy, aligning with sustainability goals as seen in Malaysia's energy policies and strategies. She concluded her speech with an urgent invitation to all attendees to initiate national algae industry roadmaps, aimed at advancing the field of algae production.



**Figure 2: Keynote address**

### **Panel Discussion 1: Algae Venture “Essentials in Building a Thriving Algae Ecosystem”**

Panel Discussion 1 focused on the theme "Algae Venture & Ecosystem" with the topic "Essentials in Building a Thriving Algae Ecosystem." The session was moderated by Assoc. Prof. Dr. Koji Iwamoto from MJIT, UTM. The panellists included Dato' Paduka Syed Isa Syed Alwi from Eureka Farms Sdn. Bhd., Assoc Prof Dr. Mohd Razif bin Harun from UPM, and ChM. Dr. Kuan Shiong Khoo MRSC from ABC (Figure 3). The discussion began with self-introductions, followed by three rounds of focused conversation. It started by exploring the challenges of establishing and maintaining a thriving algae ecosystem, along with key considerations for embarking on algae cultivation businesses. Second round delved into how technology and innovation can enhance efficiency, factors beyond scientific knowledge for successful algae businesses, and the role of ABC in the ecosystem. Final round provided insights into

the hurdles in transforming research into commercial success, partnerships' roles in ecosystem development, and strategies for balancing economic viability and ecological sustainability. The conclusion highlighted tips for newcomers to the algae industry and the importance of sustainable practices, policy frameworks, and regulations in supporting industry growth while safeguarding the environment. The discussion encompassed Malaysia's unique offerings, learning from global experiences, and challenges related to algae ventures such as location, funding, technology, and market dynamics. The main challenge of mass-producing high-quality algae was emphasized, calling for solutions and insights. The session concluded by acknowledging algae's potential in addressing food security concerns and protein dependency. Overall, the panel explored essential aspects of building a successful algae ecosystem while addressing practical challenges and prospects.



**Figure 3: Panel Discussion 1 (Algae Venture) moderator and panellists.**

From left to right: Panel moderator, Assoc. Prof. Dr. Koji Iwamoto, Dato' Paduka Syed Isa Syed Alwi, Assoc. Prof. Ts. Dr Mohd Razif bin Harun, and ChM. Dr. Kuan Shiong Khoo MRSC.

### ***Panel Discussion 2: Healthcare "Exploring the Potential of Algae-based Healthcare Solutions: A Global Perspective"***

The healthcare panel discussion was moderated by Ms. Natasha Nabila Ibrahim from Euglena Malaysia, the session aimed to examine the potential of algae-based healthcare solutions worldwide (Figure 4). The focus was on recent developments in algae-based healthcare products, spanning pharmaceuticals, nutraceuticals, and cosmetics. Esteemed panellists included Mr. Daniel Ho Yu-Kun from the National Pharmaceutical Regulatory Division (NPRD), Professor Dr. Suzana Binti Makpol from Universiti Kebangsaan Malaysia (UKM), and Mr. Marcus Fei Xiao Song from Algae Living Sdn. Bhd. The panellists shared insights through multiple rounds of discussion, introducing themselves and their roles, discussing technology trends and innovations in algae-based healthcare products, addressing challenges and opportunities, and offering perspectives on the prospects of such solutions. The session shed light on the benefits, regulatory aspects, research advancements, and potential impact of algae-based healthcare products on global health and sustainability. The key takeaways included the importance of stringent regulatory measures, the potential benefits of *Chlorella vulgaris*, and challenges like quality control and awareness. The panellists concluded with their individual messages, emphasizing the need for informed consumer choices, technological advancements, and wider adoption of algae-based solutions for global health.



**Figure 4: Panel Session 2**

From left to right: Nabila Ibrahim (modarator), Mr. Daniel Ho Yu-Kun, Professor Dr. Suzana Binti Makpol, and Mr. Marcus Fei Xiao Song.

### **Panel Discussion 3: Renewable Energy “Advancing Algae-Based Biofuel for Green Energy Alternatives”**

The panel discussion commenced with an exploration of algae's potential as a biofuel source (Figure 5). Mr. Yu Inaba, Director, Euglena Tropical Biomass Technology Research Institute showcased Euglena Group's innovative lipid extraction and conversion methods for biofuel production. Dr. Liew Kan Em, CEO, Aerospace Malaysia Innovation Centre (AMIC) then highlighted the benefits of Sustainable Aviation Fuel (SAF) derived from algae-based biofuels. Dr. Rezal Khairi Bin Ahmad, CEO, NanoMalaysia Berhad emphasized nanotechnology's role in biorefinery infrastructure and urged more algae research integration with nanotechnology. Shifting focus, the discussion delved into assessing economic viability. Dr. Liew outlined aviation's expectations—affordable and sustainable algae-based biofuels. He emphasized the multifaceted value of algae, contrasting it with limited resources like used-cooking oil. Overcoming challenges in coupling nanotechnology with algae research was discussed, with the concept of the "Valley of Death" addressed, requiring passion, funding, and networking. Environmental factors were highlighted by Mr. Inaba, citing Euglena's collaboration with Petronas in Malaysia due to the climate's suitability. The final segment explored synergies between algae biofuel and current trends. All panellists stressed passion, funding, and networking. Dr. Rezal urged integrating nanotechnology, Mr. Inaba welcomed collaboration, and Dr. Liew emphasized continued research for SAF adoption in local aviation. A collective effort was underscored for SAF's success within the local aviation sector, necessitating collaboration among diverse algae research groups.



**Figure 5: Panel Session 3 Session moderator and panelists.**

From left to right: Dr. Hadi Akbar Bin Dahlan, Dr. Rezal Khairi Bin Ahmad, Dr. Liew Kan Ern, and Mr. Yu Inaba.

### **Pocket Talk**

The Pocket Talk session aims to foster knowledge exchange, inspire new perspectives, and ignite collaboration among the participants. With the theme of "Pioneering a Sustainable Algae Revolution", we hope it will serve as a catalyst for innovative thinking and invites attendees to explore emerging trends, cutting-edge technologies, and sustainable practices within the realm of algae-based industries. Table 1 shows each presenter and their presentation overview:

**Table 1:** Pocket talk line up

| No. | Title  | Presenter  |
|-----|--|--|
| 1   | SATREPS-COSMOS Project report  | Assoc. Prof. Ts. Dr Mohd Razif bin Harun, Department of Chemical & Environmental Engineering, UPM                    |
| 2   | Introduction of Algae Biotechnology Consortium                               | ChM. Dr. Kuan Shiong Khoo MRSC, Algal Biotechnology Consortium (ABC)   |
| 3   | Introduction of Business Council for Sustainable Development (BCSD) Malaysia | Celine Ng, Associate Consultant, Business Council for Sustainable, Development (BCSD) Malaysia                       |
| 4   | Zooxanthellae; The Leaves of the Marine Rainforests                          | Associate Professor Dr. Chen Jit Ern, Director, Jeffrey Sachs Center on Sustainable Development                      |
| 5   | Overview on Malaysian Bioeconomy Development Corporation                     | Ahmad Muzzammil Bin Mohd Faridza, Industrial Development Executive, Bioeconomy Corporation                           |
| 6   | Thematic Strategic Research Fund (SRF)                                       | Abdul Azim Akbar Ali, Senior Technology Analyst, Malaysian Research Accelerator for Technology & Innovation (MRANTI) |
| 7   | Venture Building the Algae Technology Ecosystem                              | Sharizal Shaarani, Senior Vice President, Business Development Office, NanoMalaysia Berhad                           |
| 8   | PETRONAS's Renewable Oil Aspiration  | Pauziyah Bt Abdul Hamid, Head of Renewable Oil Technology Program, PETRONAS Research Sdn. Bhd.                       |

## Conclusion

In concluding the Global Algae Summit (GAS) 2023, we stand on the brink of a sustainable innovation era. The summit fostered knowledge exchange, collaboration, and inspiration as brilliant minds explored algae-based solutions' potential. Delving into the emerging economy, we charted a path to a circular algae bioeconomy, guided by insights from experts, industry leaders, and researchers. GAS 2023 facilitated cross-disciplinary discussions, igniting innovation in renewable energy, biotechnology, and more. Gratitude is extended to participants, including poster presenters, panellists, keynote speakers, and partners, for shaping this journey. Departing, we carry the torch of knowledge, exploring, innovating, and collaborating for a sustainable future. The collective commitment displayed and reinforced our shared vision. We look forward, nurturing connections, and empowering each other. Thank you for illuminating new horizons, as we champion sustainability and transform the world through green innovation, fuelled by the Global Algae Summit 2023. Until we meet again at GAS 2024.

## Appendix



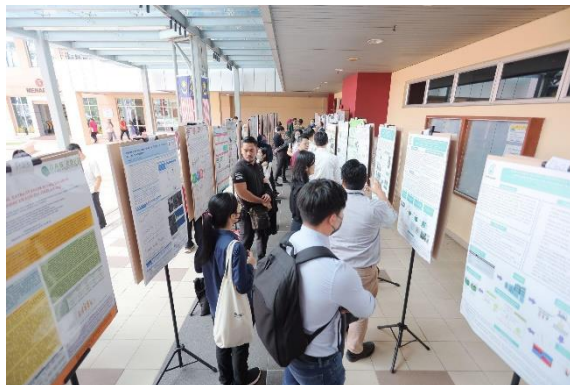
A1: Social Media Posts,



A2: Best Poster Awards<sup>1</sup>.



A3: Closing remarks by Dr. Yuko Ueno.



A4: Poster exhibitions.



A5: University Booth.

<sup>1</sup> Right to left Mr. Kia Fatt Chia, Dr. Vel Murugan Vadivelu, Mr. Muhamad Helmi Husaini Rusmidi, Mr. Aisamuddin Ardi Zainal, and Ms. Chee Sheau Chien's representative.

## News and Views

### Stay Tune! Follow on our ISAP webpages!

#### ISAP will soon advertise funding opportunity for a training course on Algal-Biotechnology in 2024.

This is part of the mission and commitment of ISAP to promote and contribute to the education of a young generation of scientists and engineers dealing with Algal Biotechnology. In 2023, the society decided to allocate funds to the proposal made by Dr Leila Ktari from the National Institute of Marine Sciences and Technologies (INSTM) in Tunisia. INSTM has organized a face to face and online Training course on Applied Phycology titled “Seaweed cultivation and biotechnology” on 12-16th September 2023.

All the previous workshop information and programme can be found on our [ISAP webpages](#).

For more information, please contact our Training Courses Working Group Leader (Prof. Alejandro H. Buschmann, [abuschma@ulagos.cl](mailto:abuschma@ulagos.cl)) or our Assistant-President (Sze Wan Poong, [applied.phycologysoc@gmail.com](mailto:applied.phycologysoc@gmail.com)).



### ISAP is on different social media platforms!

To help grow our algae networking community we encourage to follow, like and subscribe of our various platforms. All platforms can be accessed via this linktree [https://linktr.ee/isap\\_phycology](https://linktr.ee/isap_phycology) or scan the QR Code below.



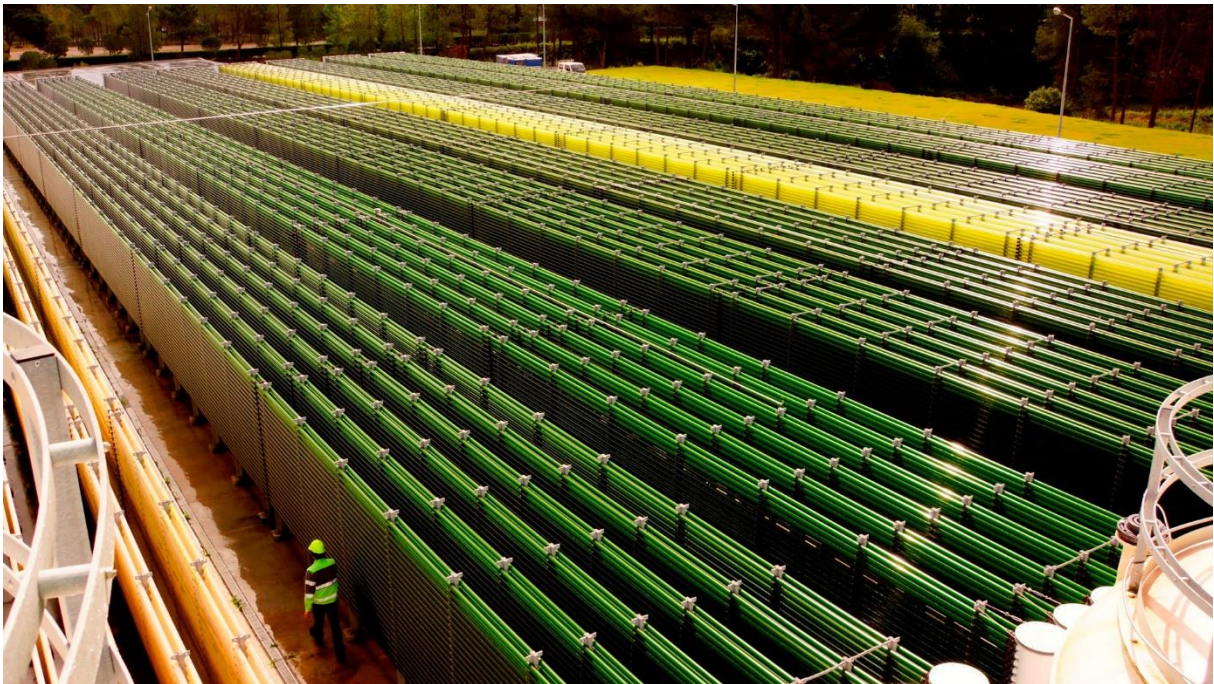


## Join us in Porto for the 8th Congress of the International Society for Applied Phycology!

Set against the vibrant backdrop of **Porto, Portugal**, from **June 16 to 21, 2024**, the [ISAP 2024 congress](#) revolves around the theme "**Algae 2030: Challenges and Opportunities**." Embracing this theme, the scientific programme focuses on six key themes covering the diverse spectrum of algae research. Attendees will delve into discussions, presentations, and debates surrounding:

- **Biodiversity and Applications of Algae**
- **Climate Change Impact on Algae**
- **Algae and Energy**
- **Algae Biorefineries**
- **Algae for Food and Feed**
- **Algae and Bioremediation**

The Congress will offer immersive tours encompassing cultural and educational experiences. Participants will have the opportunity to visit **Allmicroalgae – Natural Products S.A** (Figure 1). This biotechnology company focuses on offering microalgae solutions for dietary supplements, food, animal feed and agricultural applications. Walking along the masseiras in Apúlia, will reveal the historical significance of sea-farming practices, combined with a visit to the Sargaço museum in Esposende, unveiling the cultural heritage of "sargasso harvesting" (Figure 2).



**Figure 1: Allmicroalgae – Natural Products S.A facilities are situated near Leiria.**

The invitation extends to shape the conversation by submitting proposals for special sessions. These sessions can be workshops, break-out events, or presentations aligned with the Congress theme. Submission deadline is set for **December 30, 2023**.

### **Portugal's algae industry**

Portugal's commitment to sustainability is exemplified through its burgeoning algae industry. The country's coastal regions, blessed with sunlight and nutrient-rich waters, foster an ideal environment for algae cultivation. Algae's multifaceted potential spans culinary innovation, agricultural solutions, pharmaceutical research, and renewable energy initiatives.



**Figure 2: Walking along the beachside trail (a. photographer: Alexandre Moreira) will give you the opportunity to discover the “masseiras”, coastal farming systems that shield crops from coastal winds and salt (b.).**

### **The Venue and Local Expertise**

The Congress venue, **Centro de Congressos of Alfândega do Porto**, epitomizes historic charm alongside modern facilities. **CIIMAR**, an interdisciplinary marine research centre, boasts expertise and resources dedicated to algae research. Additionally, Portugal houses an array of companies and research centres dedicated to algae-based innovation.

### **Inclusive Activities**

The Congress isn't just about science; it will be an inclusive event offering technical tours, B2B meetings, and activities focused on nurturing the next generation of Phycology experts, encouraging engagement among PhD students.

Amidst the Congress, embrace the charms of Porto, a city celebrated for its rich cultural heritage. Experience the St John festivities, immersing yourself in the vibrant celebrations with grilled sardines, dances, fireworks, and the jovial tradition of plastic hammer salutations.

### **Save the Date!**

ISAP 2024 promises to be a landmark event, blending scientific rigor with cultural immersion.

**Mark your calendars for June 16-21, 2024, in Porto, Portugal, visit the congress website at [www.isap2024.com](http://www.isap2024.com) and register!**

*The Local Organising Committee of ISAP 2024*

**More details will be posted on the [ISAP webpage](#), all ISAP social media pages and [the ISAP 2024 congress webpages](#).**

**In collaboration with the ISAP Executive Committee, the congress is being organised by**



**ciimar**

**CIIMAR**

[www.ciimar.up.pt](http://www.ciimar.up.pt)

**Faculdade de Ciências da Universidade do Porto**

[www.fc.up.pt](http://www.fc.up.pt)

# Conferences and events

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## **AQUAFARM 2024** | In Person

14<sup>th</sup> – 15<sup>th</sup> February 2024 | Pordenone (Italy)

International conference & trade show on aquaculture, algaculture and fishing industry dedicated to the sustainable production of food from water. Two days dedicated to professionals within the sector of aquaculture, shellfish farming, algaculture and sustainable fishing.

Further information: <https://www.aquafarm.show/en/>

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## **Ocean Sciences Meeting (OSM) 2024** | Hybrid

18<sup>th</sup> -23<sup>rd</sup> February 2024 | New Orleans, Louisiana (United States of America)

The Ocean Sciences Meeting (OSM) is the flagship conference for the ocean sciences and the larger ocean-connected community. Every two years, the OSM unifies the oceans community to share findings, connect scientists from around the world, and advance the impact of science. The Ocean Sciences Meeting 2024 is co-sponsored by the American Geophysical Union (AGU), the Association for the Sciences of Limnology and Oceanography (ASLO), and the Oceanography Society (TOS). The OSM is committed to the OSM24 theme of “Inspire. Discover. Restore”. Exciting future generations of ocean enthusiasts and colleagues are invited to explore the new frontiers in ocean science, to share knowledge of our interconnected ocean, and to ensure its health for future generations.

More Information: <https://agu.confex.com/agu/OSM24/prelim.cgi/Home/0>

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## **ALGAEFARM / NOVELFARM 2024** | In Person

20<sup>th</sup> – 21<sup>st</sup> March 2024 | Pordenone (Italy)

The event is dedicated to algaculture and is now in its third edition. The goal is to give a leading role also to the algae and microalgae cultivation sector, as already present in the previous editions. AlgaeFarm becomes the perfect opportunity to meet the best professionals engaged in a continuously growing sector such as that of the production of algae in aquaculture or in greenhouses. This exhibition space dedicated to algaculture offers a great wealth of ideas for all those people interested in new business opportunities or for farms that want to reconvert their production. AlgaeFarm will also be accompanied by conferences and debates dedicated to algae and microalgae. We will have the opportunity to learn more about the latest news both in the field of research and in the development of new technologies for the cultivation and application of the product.

Further information: <https://novelfarmexpo.it/en/algafarm-algaculture-event/>

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## **AlgalBBB 2024: International Conference on Algal Biomass, Biofuels and Bioproducts**

10<sup>th</sup> – 12<sup>th</sup> June 2024 | Florida (United States of America)

AlgalBBB places a major emphasis on the latest published and unpublished technical and scientific results, along with discussion and direct interactions with broad spectrum scientists and engineers, funding sponsors, and leaders in the field from all over the world. The conference presents the work of the algae research community through a balanced set of oral presentations and posters selected from the best submissions to the conference. Our list of keynote and invited speakers includes funding agency sponsors, key industry players, and top scientists and engineers from the international community. The conference will cover all areas of emerging technologies in all areas of algal research, including microalgae, macroalgae, and cyanobacteria: synthetic biology, molecular biotechnology, biomass

production, cultivation, harvesting, extraction, biorefinery, feedstock conversion, production of fine and bulk chemicals, econometrics, and sustainability analyses.

More Information: <https://www.elsevier.com/events/conferences/all/international-conference-on-algal-biomass-biofuels-and-bioproducs-algalbbb>

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### **World Aquaculture and Fisheries Conference | Hybrid**

24th - 26th June 2024 | Paris (France)

The congress will be centered on the theme “*Panoramic View of Innovations That Impact Life Below Water.*” WAC conference was established as a knowledge-sharing platform to highlight the possibility and distinctiveness of small-scale artisanal fisheries and aquaculture, as well as the advantage that can be gained by fostering collaborations and cooperation with fish farmers and workers, as well as the Sustainable Development Goals (SDGs). WAC conference has a reputation for being a welcoming gathering where old friends are reconnected, and new ones are created. We hope you will join us at WAC 2024 to share your expertise, expand your professional networks, and form collaborative relationships with those who are enthusiastic about ‘aquaculture, fisheries, its well-being and seafood.’

More Information: <https://www.worldaquacultureconference.com/>

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### **ICABA 2024: 18. International Conference on Algal Biotechnology and Applications | In Person**

29<sup>th</sup> – 30<sup>th</sup> July 2024 | Vienna (Austria)

The International Research Conference is a federated organization dedicated to bringing together a significant number of diverse scholarly events for presentation within the conference program. International Conference on Algal Biotechnology and Applications aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results on all aspects of Algal Biotechnology and Applications. It also provides a premier interdisciplinary platform for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns as well as practical challenges encountered, and solutions adopted in the fields of Algal Biotechnology and Applications.

Further Information: <https://waset.org/algal-biotechnology-and-applications-conference-in-july-2024-in-vienna>

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### **AQUA 2024 | In Person**

26<sup>th</sup> – 30<sup>th</sup> August 2024 | Copenhagen (Denmark)

The theme of AQUA 2024 is "Blue Food: Green Solutions". It will comprise a scientific conference, trade exhibition, industry forums, workshops, student events and receptions. The event will highlight the latest aquaculture research and innovation to underpin continued growth of this exciting food production sector. The AQUA events are co-organised by the European Aquaculture Society (EAS) and the World Aquaculture Society (WAS) and are held every six years. Past events were held in Nice (2000), Florence (2006), Prague (2012) and Montpellier (2018).

More information: <https://www.aquaeas.eu/events/future-eas-events>

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### **ISS – 25th INTERNATIONAL SEAWEED SYMPOSIUM 2025 | In Person**

4<sup>th</sup> – 9<sup>th</sup> May 2025 | British Columbia (Canada)

To celebrate the Silver Jubilee of the International Seaweed Symposium, where seaweed academia and industry meet. Theme: Igniting Innovation: Building on The Past To Advance The Seaweed Momentum.

Further Information: <https://iss25.com/>

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

### Contributing an article to the ISAP newsletter

Subscribers and non-Subscribers 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 500 subscribers 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.

### Language

English (United Kingdom).

### 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<sup>1</sup>, K. R. Roman<sup>2</sup> and A. R. Camello<sup>3\*</sup>

<sup>1</sup>Affiliation of first author with institutional address

<sup>2</sup>Affiliation of second author with institutional address

<sup>3</sup>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 title.

*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 [celine.rebours@moreforskning.no](mailto:celine.rebours@moreforskning.no). 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.

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