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NEWSLETTER

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Message from the President, Dr. Céline Rebours

Dear ISAP Members,

I am happy to announce the first issue of ISAP Newsletter for 2020.

In February 2020, due to the global COVID-19 outbreak, the Local Organizing Committee (LOC) in consultation with the ISAP Executive Committee (EC) took the decision postpone the Seventh Conference of the International Society of Applied Phycology by a year. This conference continues to be supported by the Algae Biomass and Energy System R&D Center, University of Tsukuba (ABES) and Algae Industry Incubation Consortium Japan (AIIC). Having closely monitored the situation for the last 6 months and with no significant improvement in sight globally, the committee reluctantly transitioned this conference to a "virtual format".

The conference program remains largely unchanged, although the LOC has made it more attractive with online-specific programs. Registered delegates will be able to access all the content of the conference, such as oral sessions, poster (or short presentation) sessions, special sessions, panel discussions, special lectures, keynote sessions, virtual tours, etc. Various networking programs such as B2B meeting, exhibition booth, and student & young researchers' forum will be organised to accelerate interaction among participants. Certain sessions such as the scientific and grant writing workshop, career workshop, etc., will be specifically reserved for students and young researchers. Grants and awards will also be available for students and young researchers.

Registrations for the postponed conference will remain valid. However, please note that the registration fee for the virtual format of ISAP 2021 is about half of the original rate. A reduced student registration fee for the virtual conference will apply. I will therefore invite you to consult the conference webpage for the refund policy. We have also made it possible to share your registration with your colleagues. However, if you wish to cancel your registration, please contact the conference secretariat directly at isap2020_makuhari@c-linkage.co.jp

The conference will be streaming from the 14th May 2021 and will then become available 'on demand' until the 13th August 2021. You will find detailed information and the latest updates to the programme and events under the ISAP2021 conference webpage, Facebook and Instagram (#isap2020japan, #isap2020) pages.

With the postponement of the conference, most elected members of the EC have kindly volunteered to continue in their role for an additional year. I wish to thank them all for their engagement and support that will help the society in achieving the goals under these unprecedented times. In the coming months the EC members will be brainstorming to prepare our society for the next triennium, sustain its activities and grow in the post Covid-19 phase.

Furthermore, I am pleased to announce that an agreement was signed between ISAP and Springer that provides for free electronic access to Journal of Applied of Phycology and Marine Biotechnology through the webpage of the society. If you are not yet a member, please do not hesitate to sign up and take advantage of this offer.

May I also emphasise that keeping your ISAP membership current is critical in ensuring acivities of the society continue unhindered. Membership fees support maintenance of the website, funding workshops and training programs in algal biotechnology as well as sponsoring student travel grants. I will sincerely appreciate it if all members can ensure that they are up to date with membership payments. If you can also contribute with a donation to support the participation of young scientists in ISAP2021, that would be very much welcome. For this issue, please consult the conference webpage, our webpage or contact either the ISAP Secretary/Treasurer, Valeria Montalescot, or myself. Our contact information is at the end of the newsletter.

I would like to thank our editor-in-chief, **Sasi Nayar** for compiling interesting articles for this issue of the newsletter. I would like to bring to your attention that all ISAP members can participate in the activities of the society. We would appreciate your ideas, feedback on ISAP, news, and announcements of interest for ISAP members. We would also be delighted to receive articles for our forthcoming issues of the newsletter due in November 2020 or April 2021. For further details, please contact either the Editor of the newsletter (Sasi Nayar), or the ISAP Secretary/Treasurer (Valeria Montalescot) whose contact details can be found at the end of the newsletter.

I wish to encourage you all to save the date for your attendance to the **7th ISAP Conference** online**,** from **14th May 2021**!

With my warm regards,

Céline Rebours

President, International Society for Applied Phycology

Message from the Editor, Sasi Nayar

Dear Colleagues,

Under these unprecedented times, I trust and hope that this issue of our newsletter finds you in good health. Little did we realise when we published the last issue that our lives would change forever due to the pandemic. Sadly, that saw postponement of a much-anticipated congress in Japan, which will now become a virtual congress next year. This will mean that the current Editorial committee that would have handed over the baton to the new team this year will continue until the next congress in 2021. Our team will now bring out two more issues of the newsletter before we hand over the reins.

Because of all the disruptions, this issue has been delayed considerably and we apologise for that. We do hope, however, to bring out the next issue before the end of the year to comply with the requirements of the National Libraries of Australia. I take this opportunity in thanking Celine, Fiona and Valeria for their assistance with the preparation of this issue of the newsletter. Just as we were compiling all the articles, Fiona welcomed a new addition to her family. A hearty congratulations to her from the team!

We have attempted to balance this issue of the newsletter by including an article each on microalgae and macroalgae. The first article by Ward et al. provides the readers a unique insight on some novel work undertaken by a Water Utility by integrating high rate algal production systems in treating over 70KL/day of domestic effluents in a regional community in Queensland, Australia. This pilot project, in collaboration with researchers from the University of Queensland, is currently being scale-up.

The second article by Doubell and Bailleul pertains to the development of a modelling suite called Gulfview, which among other applications could also be used for site selection of coastal mariculture systems including seaweed production systems. This web-based, interactive spatial modelling tool will enable researchers, stakeholders, managers, and policy makers to visualise and overlay spatial information on key environmental variables, ecological assets, human activities and management arrangements.

The final article by Ktari is a post-event report on an ISAP funded training course entitled 'Marine algae: Potential uses and developments' held in Tunisia from the 9th to 14th July 2018. This workshop organised by Blue Biotechnology and Aquatic Bioproducts Laboratory (B3Aqua lab) from the National Institute of Marine Sciences and Technologies (INSTM) in association with the Tunisian Association for Scientific Information (ATIS) was aimed to present basic and applied aspects of both micro- and macro-algal taxonomy, ecology, culture and utilisation with particular emphasis on applied aspects harnessing regional biodiversity.

The editorial team and I wish you the very best of health and wellbeing and hope you enjoy reading this edition of the newsletter. As always, we are looking for contributions for the coming issues. Should you have an idea, please do not hesitate to discuss with one of us.

Sasi Nayar,
Editor of the ISAP Newsletter and Social media administrator

ALGAE: A water utility perspective

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Abstract

Urban Utilities has an established algae research program with a focus on identifying new opportunities to utilise algae in wastewater remediation and biomass production. Established in 2017, a research program was developed with four key research focus areas for the application of algae-based wastewater treatment and production. This article details the four research focus areas and their application, scale-up and integration into operational processes. A key outcome of the project include development of a 70 kL day^{-1} regional treatment facility at one of Urban Utilities regional wastewater treatment sites, which will treat wastewater of up to 250 customers each day.

Introduction

Urban Utilities provide both potable water and sewage services for approximately 1.4 million residents in Southern Queensland, Australia. Service includes 140 GL of potable drinking water supply and collection of 110 GL of sewage for treatment. Urban Utilities has approximately $5.5 billion in infrastructure assets, operating 18,500 km of pipes, 146 pump stations, 332 sewage pump stations, 116 reservoirs and 28 sewage treatment plants (STP) across the service territory.

Urban Utilities has a strategic goal to be an environmental leader. This includes pursuing environmentally sustainable treatment practices, with the goal of achieving service excellence in the field of carbon neutrality and even reduced nutrient discharge.

Algae can play a pivotal role in helping Urban Utilities achieve this goal and can contribute to the company's future operating strategy. To investigate the potential of algae-based biotechnologies, a research program was established. The aim of this program was to assess the feasibility and develop research pathways for algae technologies that create environmental, social and economic value for Urban Utilities, their customers as well as the community by enabling increased renewable energy production, novel value-add opportunities, wastewater treatment at municipal STP and nutrient offset opportunities.

Over the course of 12 months, 4 key areas for further research where established where micro- and macro- algae were identified to have the potential to play a significant role in Urban Utilities future operating. The four key areas identified where:

1. Remote and rural wastewater treatment,
2. Algae biomass to biogas,
3. Application of novel aggregated photoautotrophic microalgae and non-phototrophic bacterial bio-flocs, and
4. Macroalgae for nutrient offsets.

To facilitate microalgae research, a laboratory, and a pilot high rate algae pond (HRAP) pilot facility was established at the Luggage Point STP located at Brisbane, Australia (Figure 1). The macroalgae research on the other hand aims to understand the bioremediation potential of various seaweeds, evaluate seaweed production systems (and any associated environmental impacts) in two small-scale aquaculture systems, determine yield and seaweed properties and assess the potential for such systems to generate nutrient pollution credits that could be used to offset point of diffuse source pollution into Moreton Bay.

Figure 1: Pilot HRAP facility located at the Luggage Point STP Queensland, Australia.

Remote and rural treatment

The majority of Queensland and Australian rural STPs utilises lagoon-based systems for the treatment of domestic wastewater effluent (Li et al. 2018). Lagoon based technology is over 100 years old and can be very inefficient in water treatment. Current lagoon systems have limitations of long retention time (50-60 days), high carbon footprint due to rogue greenhouse gas emissions (Green 1998) and are prone to Cyanobacteria blooms. Current configurations lead to evaporation losses from the lagoons reducing water reuse potential (Young et al. 2017). Environmental licence compliance for rural lagoons is as important as it is for larger urban STP, but often this requirement is difficult to meet due to the lack of robust control of these systems amongst other operational challenges. This is also compounded by the projected population growth in rural areas; the projected requirements for wastewater treatment exceed the current design capacity at many of the rural STP.

High Rate Algae Ponds (HRAP) provide an attractive alternative to facultative lagoon systems as a means to optimise the treatment process in rural STP applications with the potential to reduce treatment times and improve the quality of water discharge, improve the reliability and resilience of the processes (Green 1998). Initial laboratory scale work at Urban Utilities research facilities demonstrated that microalgae could efficiently remove nutrients and remediate domestic wastewater. Experimental work investigated the difference between algae growth in raw wastewater, raw wastewater pre-treated with an up-flow anaerobic sludge blanket digester (UASB) and raw wastewater treated with an anaerobic membrane bioreactor (AMBR). Results clearly demonstrated that all treatment cell counts reached a similar cell density. However, the AMBR treatment cell counts reached their peak density first on day 3, whereas the UASB cell density peaked on day 4 and finally on day 5 for the raw wastewater (Figure 2). The results from this initial research work were also scaled-up to the pilot HRAPs. Results from the pilot HRAPs showed that remediation of wastewater utilising a UASB pre-treatment combined with HRAP algae treatment could achieve water quality discharge standards in a shorter treatment times (12 days) than conventional lagoon treatment systems (up to 60 days). The integrated UASB and HRAP system also reduced problematic issues such as sludge accumulation, Cyanobacterial blooms, lower Greenhouse gas emissions and lower evaporation rates.

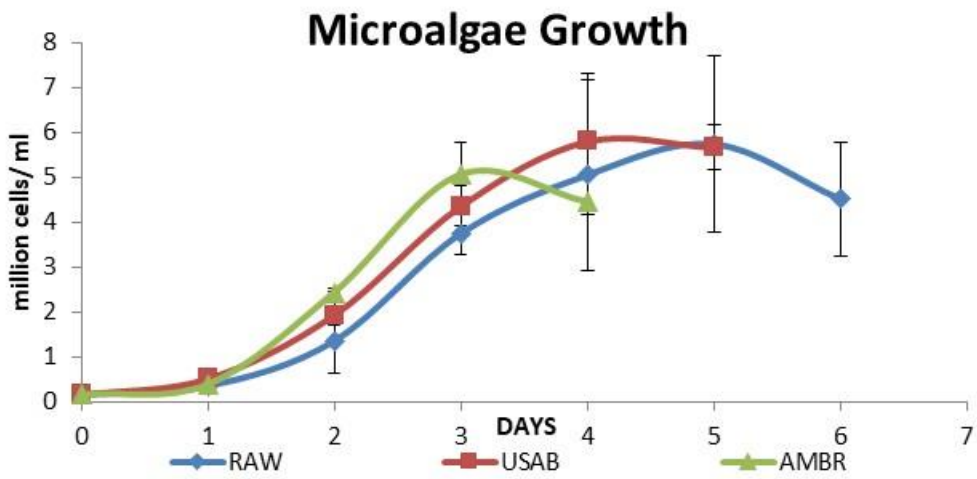

Figure 2: Microalgae growth on raw wastewater and anaerobic digestate from a UASB and AMBR

These preliminary results formed the basis of an application for federal government funding to look at the implementation of high-rate anaerobic digestion and algae-based HRAP systems, to provide an opportunity to optimise the treatment process in rural applications. A successful $5.2 million Australian federal government CRC-P (Project Number CRC-P8104) project titled 'Transforming wastewater treatment in regional Australia with robust technology for multiple benefits' was secured. This project is adapting and integrating three key technologies such as high-rate anaerobic treatment, high-rate algae system and machine learning, to deliver a holistic packaged solution for upgrading lagoon STP in Australia. This CRC-P project will develop and integrate the emerging technologies, explore risks and limitations of these technologies for small-scale rural application, and automate these technologies as a STP retrofitting opportunity.

To undertake this project, a strong collaboration has been formed between industry, government, and universities to further develop and deliver this project. Project partners include The University of Queensland's Advanced Water Management Centre, University of Western Australia, Northern Territory Power and Water, The Lockyer Valley Council, Aquatec Maxcon, and The Department of Environment and Science. Further Pilot and laboratory experimental investigations and two full-scale demonstration STP sites will be used to research, develop, and validate the technology to create a commercially viable solution. There will be a well-integrated knowledge transfer strategy to maximise skills, commercial outcomes, community engagement and benefits realisation.

The technology developed will:

- provide reliable water supply for beneficial reuse;
- enable the recovery of nutrients such as nitrogen and phosphorous embedded in bio-solids for reuse, e.g. as a soil conditioner;
- substantially reduce odour and greenhouse gas emissions; and
- reduce operator intervention, enhance process control outcomes, and improve water quality and consistency via machine learning automation.

This project will deliver a new, low cost, integrated wastewater treatment and resource recovery system for remote, rural and low-density regional communities, with a small footprint and appropriate remote process control. The solution will be delivered through a genuinely collaborative effort, where knowledge-sharing will build capacity and lead to rapid dissemination and uptake of a novel, packaged technology.

Algae Biomass to Biogas

Conversion of microalgae to renewable energy via anaerobic digestion can play a pivotal role in transitioning towards a sustainable, carbon-neutral water utility. Many STPs are well suited for biomass to biogas bioenergy projects for several reasons. Importantly, sewage contains a ready supply of key

nutrients for algae growth. Also, STPs contain existing dewatering infrastructure that may be suitable for harvesting and/or thickening algae, and in some cases, existing anaerobic digestion infrastructure for the conversion of microalgae biomass to renewable electrical and thermal energy. Luggage Point STP is well suited for this project as it currently has the infrastructure that is required for harvesting biomass, anaerobic digesters and co-gens for electrical and thermal energy production.

Luggage Point STP currently generates thermal and electrical energy from the anaerobic digestion of waste activated sludge. After anaerobic digestion and subsequent centrifugation, an aqueous phase remains. This centrate is extremely high in nutrients (up to 1000 mg L^{-1} ammonia-N). Laboratory work has been undertaken to isolate microalgae from centrate that can tolerate high-ammonia concentrations associated with centrate. Laboratory experiments demonstrated that the isolated microalga could survive in centrate with ammonia concentrations of 600 mg-N L^{-1} with the optimum growth at concentration of approximately 450-500 mg-N L^{-1}.

This isolated microalga was then cultured on centrate in duplicate pilot HRAP systems (4.5m^2 surface areas) and operated over a 12-month period (Figure 3). The pilot HRAPs were used to determine the growth and productivities of microalgae over the 12-month period including measurement of seasonal variability under outdoor conditions at the Luggage Point STP. Experimental results indicated that the average yearly ash free dry weight (AFDW) biomass production was 21 ± 6 g m^{-2} day^{-1}. The seasonal variation showed highest AFDW biomass productivities during the summer period with 26 g m^{-2} day^{-1}, however reduced to 17 g m^{-2} day^{-1} during winter.

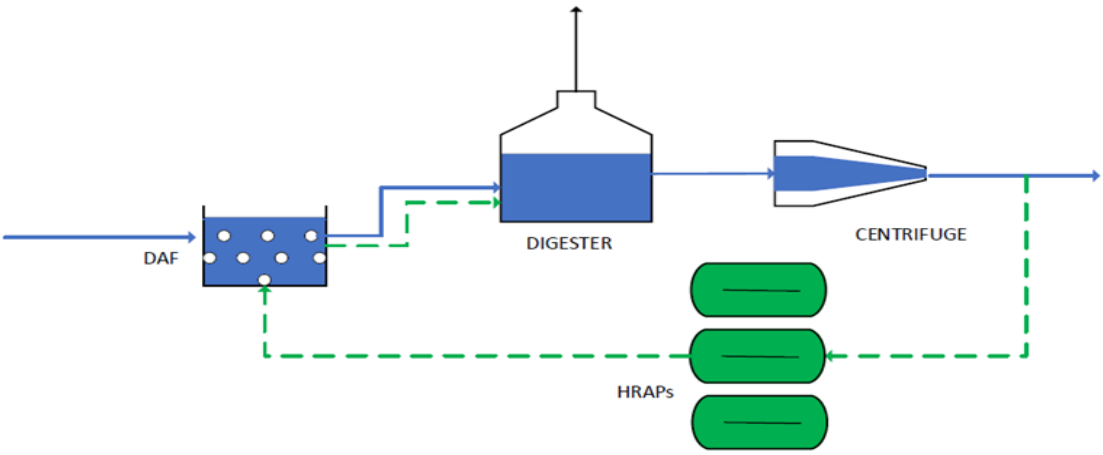

Figure 3: Schematic process flow diagram showing the integration of microalgae raceway production systems, DAF harvesting and biomass conversion via anaerobic digestion.

Harvesting microalgae for anaerobic digestion and conversion to biogas requires concentration of the algal suspension to 5% (Muylaert et al. 2017). Biomass harvesting at an STP could be achieved using the existing dissolved air flotation (DAF) units. The DAFs achieve solid-liquid separation by pumping air to introduce microbubbles on the surface of the sludge, which reduces the density and makes the solids more buoyant for surface extraction. Experimentation of biomass recovery efficiencies were conducted using algae sourced from the onsite experimental pilot HRAPs. Results indicated an optimum ratio of waste activated sludge (WAS) when mixed with microalgae total suspended solids (TSS) resulted in maximum algal biomass recovery. In this case an optimal ratio of 0.3:1 resulted in a 64% algae biomass removal. Flocculation of WAS and algae biomass with a cationic polymer (currently used onsite) achieved even higher recovery. Peak algal biomass recovery of 85% was achieved with a 0.4:1 WAS to algae TSS ratio supplemented with 50mg L^{-1} final dose concentration of the cationic polymer. These results demonstrate that possible integration of microalgae harvesting by the existing DAF infrastructure is a viable option. With further optimisation it has the potential to further decrease the costs of algae biomass to biogas STP based integrated systems.

The digestibility of the resulting microalgal biomass was examined using biochemical methane potential (BMP) test (Holliger et al. 2016). The BMP test simulates Anaerobic Digestion (AD) processes in a lab-

scale batch reactor over a 30-day incubation period (Koch, et al. 2019). The resulting dataset quantifies the cumulative methane potential versus time. All tests were performed in triplicate and used centrate algae sourced from the outdoor pilot system. The SMP is expressed as the volume of dry methane gas under Standard Temperature and Pressure (i.e. 273 K and 101 kPa) per mass of substrate VS added, L_{CH4} kg^{-1}_{VS} (Holliger et al. 2016).

The average centrate algae BMP was determined to be 1050 ± 50 L_{CH4} kg^{-1}_{VS}. This gas production was significantly higher than the current WAS digestion, and indicates an attractive potential for biogas production from the algae biomass (Figure 4). The results demonstrate that the biomass to biogas process, outlined in Figure 3, is attractive do to the high methane potential and the integration of the system offers the potential to utilise existing infrastructure for the algal separation, thus significantly simplifying process requirement and reducing the cost to process.

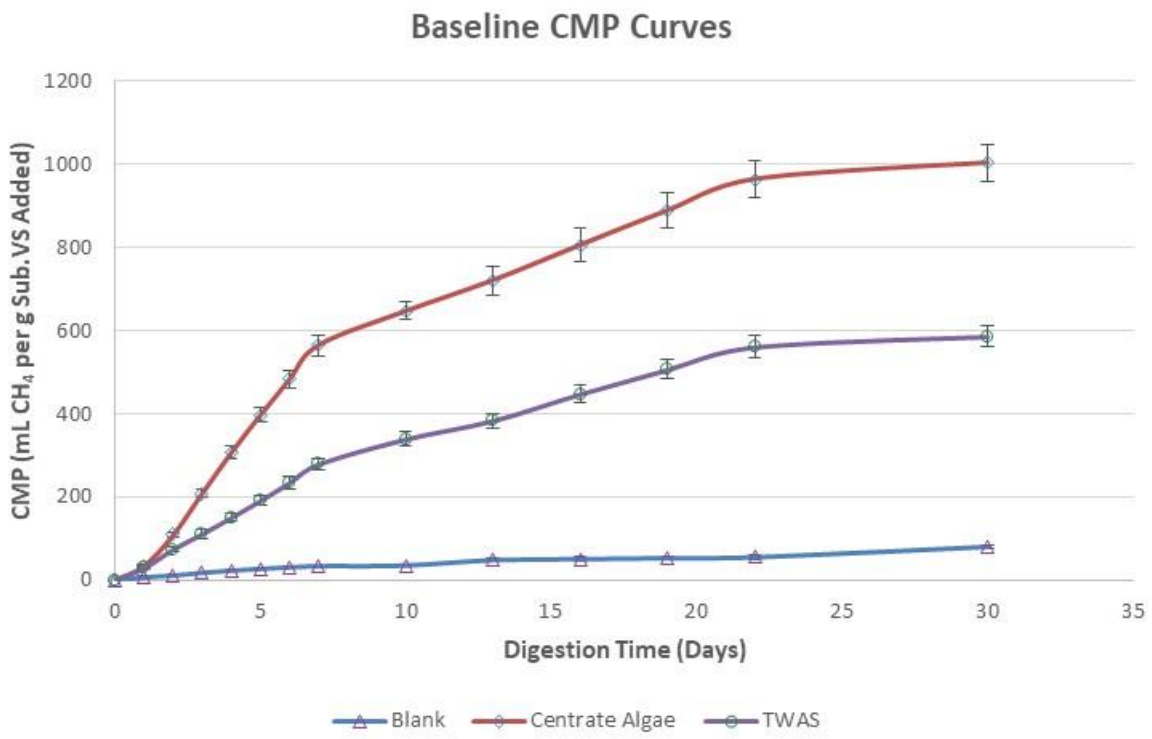

Figure 4: The BMP results and CMP curves for the blank, WAS and Centrate algae biomass (n=3).

Macroalgae and nutrient offset credits

Moreton Bay is a 1,500 km^2 urbanised estuary adjacent to greater Brisbane, one of the fastest growing regions in Australia. Although Urban Utilities has invested in building a fleet of best practice biological nutrient removal technology sewage treatment plants over the past twenty years, forecast population growth creates a challenge for wastewater utilities to cost effectively manage the associated increase in nutrient loads entering the bay. Engineering processes can be optimized for enhanced nutrient removal, but capital cost intensity is forecast to increase over time. Alternative off-site nutrient reduction actions, such as macroalgae aquaculture, may become a cost-effective option and provide community co-benefits.

Urban Utilities, the University of the Sunshine Coast (USC) and other partners have teamed up to evaluate macroalgae production and harvesting systems to determine the nutrient uptake and extraction rates of these systems (Figure 5).

Figure 5: Macroalgae nutrient offset biomass growth pilot trial.

Seaweeds grow quickly and strip nutrients from the water column, draw down carbon dioxide and can remove pollutants such as heavy metals. At the right scale, seaweed farming may play a future role to manage nutrients in Moreton Bay. A recent grant from the Fisheries Research Development Corporation (FRDC) will assist the project team to:

1. Compare and contrast the nutrient offset and bioremediation potential of target seaweeds in controlled experiments;
2. Evaluate seaweed production systems using commercially available aquaculture equipment during the scale-up of target seaweeds;
3. Determine the yield and properties of harvested seaweed from a year-round pilot production trial at two sites within Moreton Bay;
4. Assess the potential effects of seaweed culture on water quality and adjacent marine animals and vegetation; and
5. Model the removal of nutrients, carbon and other pollutants and the offset capacity of seaweed farming for Moreton Bay.

A recent funding grant has been secured to undertake the next steps in this project. The next steps will undertake large-scale seaweed farming trails at multiple sites in Brisbane Moreton Bay.

Aggregated Photoautotrophic Microalgae and Non- phototrophic Bacterial Bio-flocs

During initial research a new process to treat wastewater using aggregated phototrophic microalgae and non-phototrophic bacterial bio-flocs was identified. Aggregated bio-flocs are advantageous as they are readily harvested via gravitational settling; overcoming one of the major hurdles associated with algae wastewater and biomass production culture systems. This significantly reduces the cost of biomass recovery and de-watering of biomass from culture systems and simplifies the recovery of nutrients, energy, bio-chemicals and other resources, whilst simultaneously treating wastewater. Current research results demonstrate an innovative novel biological wastewater treatment process based on an aggregated microbial bio-floc comprising of a photoautotrophic algae and non-phototrophic bacterial based consortia (Figure 6). The aggregation of the photoautotrophic algae and non-phototrophic bacterial consortia into a stable bio-floc was successfully demonstrated over a 12-month period in pilot scale outdoor 4.5m^2 open HRAPs. The robustness of the microbial bio-floc aggregates was demonstrated by utilising existing HRAP culture techniques with continuous paddle wheel mixing. Results of the 12 month study demonstrated average domestic wastewater nutrient removal efficiencies for NH_4-N, PO_4-P and Total Nitrogen of 98%, 74% and 57% respectively.

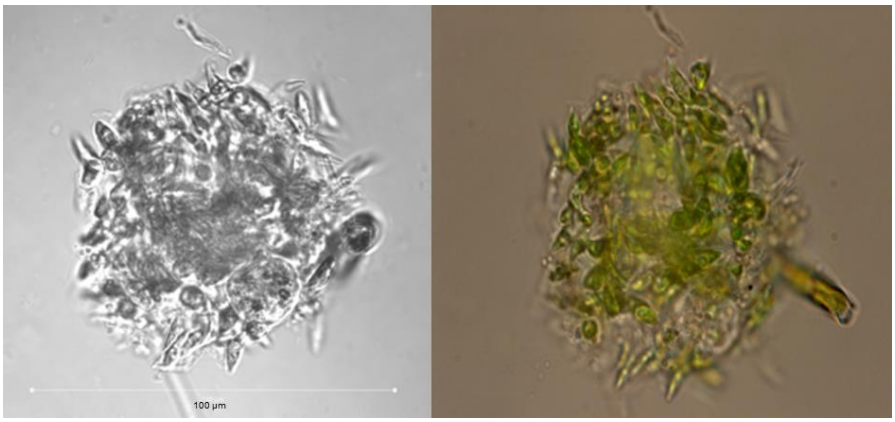

Figure 6: Aggregated photoautotrophic microalgae and non- phototrophic bacterial bio-flocs under 40x bright field normal field.

Conclusions

Urban Utilities has established an algal research program identifying four main areas where microalgae and macroalgae can play a pivotal role in their future operating strategy. The technology developed as a result of the rural efficient algae-based treatment project will contribute to the transformation of rural STPs into well controlled resource recovery centres treating up to 250 equivalent populations waste each day in this pilot facility. Increasing current plant capacity and extending the life of current assets. Biomass to biogas can play a pivotal role in STPs becoming energy and carbon neutral through the sequestration and transformation of atmospheric carbon into biogas chemical energy that can be used for electrical and thermal generation. The utilisation of macroalgae to offset nutrients will help water utilities to reduce their nutrient outputs and could allow them to have zero nutrient outputs to the environment. The development of the novel aggregated photoautotrophic microalgae and non-phototrophic bacterial bio-flocs technologies developed in this project represent a novel approach to water treatment and algae production. Specifically, aggregated microalgae and bacterial bio-flocs address major limitations of existing algal technologies by enabling rapid low-cost biomass harvesting.

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Spatial tools to optimise mariculture siting in coastal systems

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Summary

As the global demand for sustainable resources grows, offshore seaweed cultivation is emerging as a potential new billion-dollar aquaculture industry within Australia. An essential part of developing the industry lies in identifying regions which will sustainably support seaweed production, whilst minimizing costs and reducing conflicts with other users of the marine environment. To support siting assessments and the holistic spatial management of marine resources within Spencer Gulf, South Australia, oceanographers and spatial modellers from the South Australian Research and Development Institute (SARDI) have developed an interactive web-based spatial mapping system named Gulfview. Gulfview allows researchers, stakeholders, managers, and policy makers to efficiently visualise and overlap spatial information on key environmental variables, ecological assets, human activities and management arrangements. Users can control the multiple selection criteria in order to assess trade-offs and ultimately identify locations that are most likely to suit their needs. Here we provide a brief overview of Gulfview and use a simple scenario study to demonstrate how the system is being used to assist the development of seaweed aquaculture.

Introduction

Spencer Gulf (SG) is a large inverse estuary located on the southern, temperate coast of Australia (Figure 1). The gulf provides an essential gateway to regional land-based energy, mining and agricultural resources, and supports a wide range of fisheries, aquaculture, recreational marine activities and an expanding marine ecotourism sector (Tanner et al. 2019). Collectively, the gulfs marine environment is estimated to contribute more than $1 billion per annum to the South Australian state economy (Deloitte 2017).

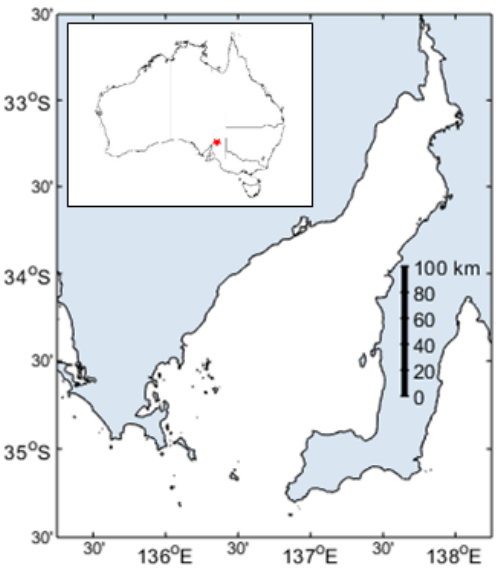


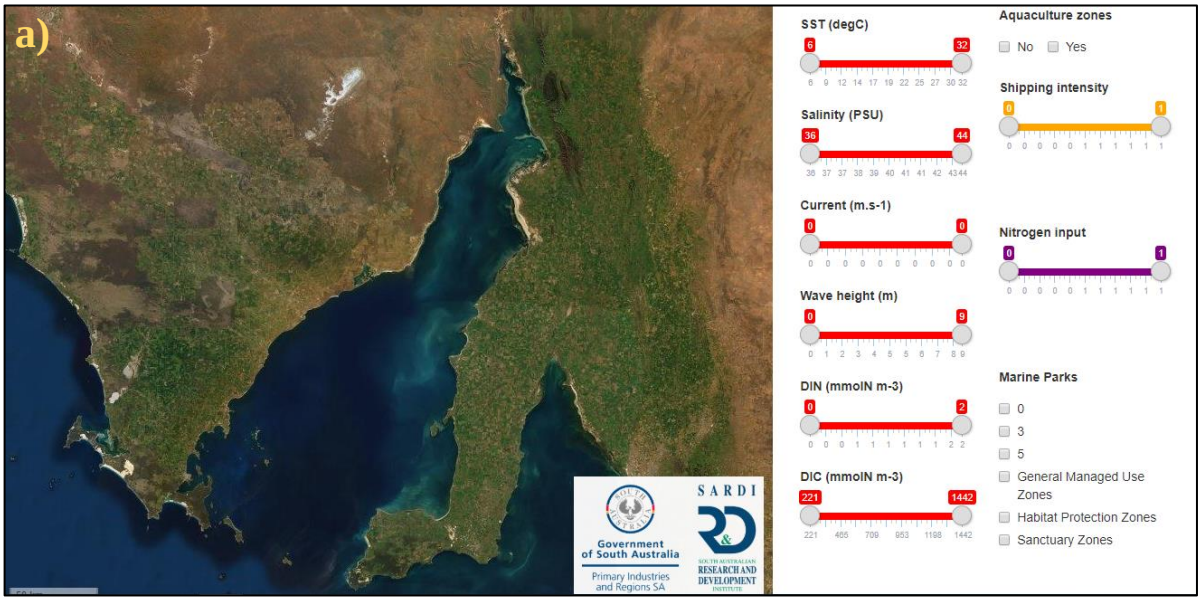
Figure 1: Map of Australia (inset) showing the location of Spencer Gulf on the southern coast of Australia.

In common with many productive coastal regions around the world, the productivity and ecosystem services provided by SG are under pressure from increasing levels of human use. Hence, there is a growing need to shift from conventional sectorial management to an integrated coastal management approach that can assist in optimising economic opportunities whilst balancing decision making and conflicts across multiple stakeholders and sectors (Gillanders et al. 2013, 2015; Tanner et al. 2019). Considering the increasing global demand for seafood and marine products over the coming decades is expected to be met largely through the expansion of offshore aquaculture, innovative new tools are needed to holistically assess and optimise the environmental and economic viability of new aquaculture industries.

Offshore aquaculture in SG currently comprise multiple sectors cultivating a variety a different species including southern bluefin tuna, Yellowtail Kingfish, mussels, oysters and abalone. Future expansion of these sectors is constrained by a multitude of factors including space and carrying capacity limitations and environmental impacts. Owing to the wide-range of food and industrial products cultured seaweeds provide, as well as their ability to improve water quality in areas by offsetting the anthropogenic nutrients, seaweed cultivation is now emerging as a potential mutli-million dollar industry. Whilst early studies identified several native species including the red seaweeds Soleria robusta and Gelidium austral (Wiltshire et al. 2015) as having the greatest potential for commercial production, new projects aimed at fast-tracking the 'at-sea' cultivation of certain commercially relevant taxa began in early 2020. Supported by the state government Primary Industries and Regions South Australia (PIRSA) agency and the Fisheries Research and Development Corporation (FRDC) identification of offshore locations which will optimise the growth and quality of the farmed seaweed is a key component of the research currently being undertaken to develop the industry.

Gulfview: an interactive spatial management tool

To assist with spatial planning and the sustainable use and development of marine resources within SG, SARDI researchers have developed an interactive spatial mapping web-based interface named Gulfview (Bailleul and Ward 2018). Gulfview allows map layers for a range of key environmental variables, ecological assets, human activities and management arrangements to be visualised and manipulated (Figures 2 a, b & c). Users can control the selection criteria for individual and multiple map layers to cumulatively narrow down on areas which meet the user needs. Created in an html format using the R open source software, Gulfview can be linked to any existing website and is easily modified to add or remove layers based on stakeholders needs, data availability and performance requirements.



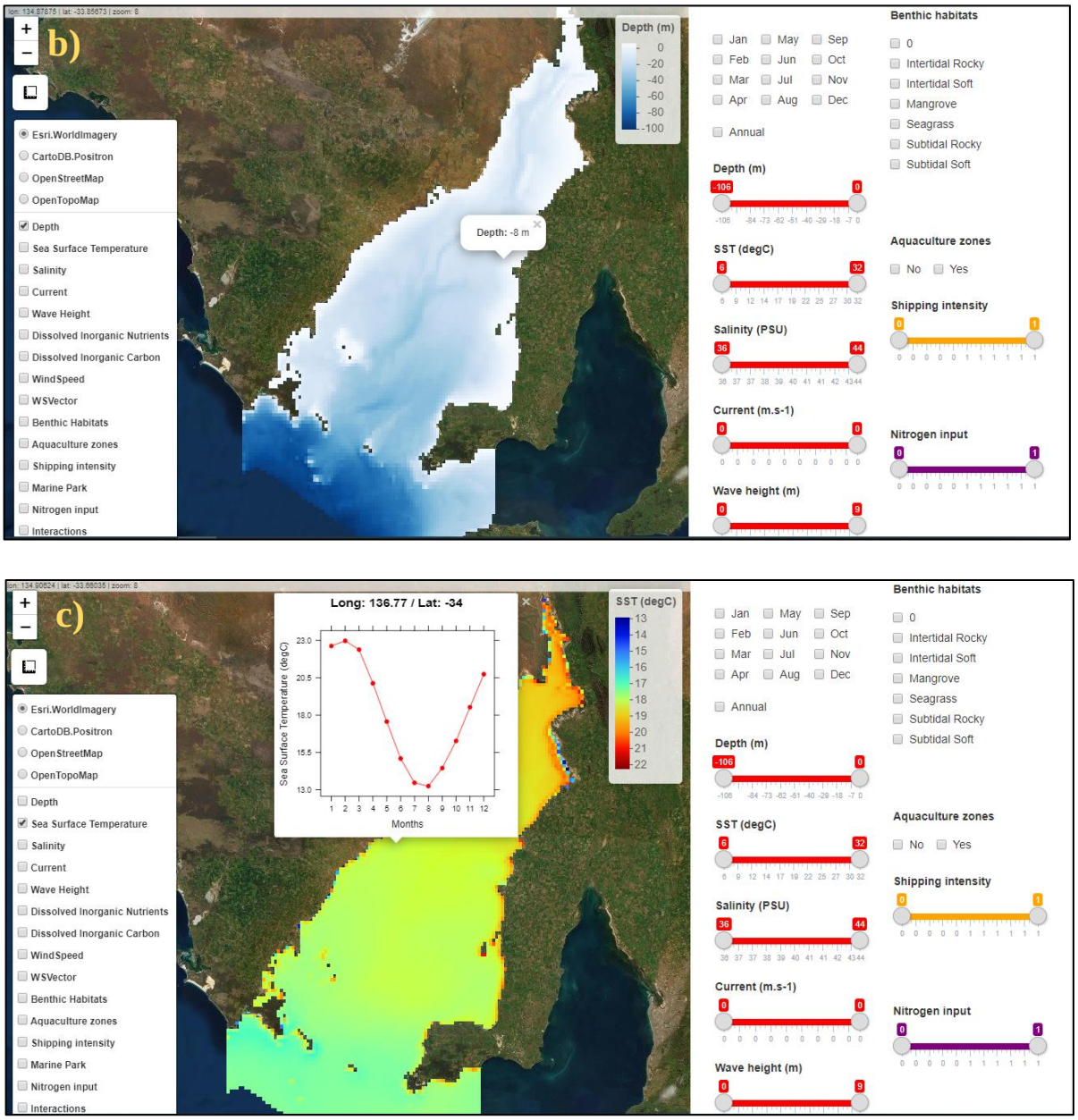


Figure 2: a) Esri WorldImagery default base map. b) Depth layer with depth value displayed when clicking on map pixels. c) Mean annual sea surface temperature with seasonal trend and location displayed when clicking on map pixels.

Due to a sparsity of direct observations for many environmental variables in SG, many of the environmental layers are generated from a suite SARDI ocean models (Middleton et al. 2013) which have been validated against observations collected by the national Integrated Marine Observing System (IMOS). Figure 3 demonstrates how Gulfview may be used to identify regions potentially suitable for seaweed aquaculture. In this scenario, locations identified by Gulfview were based on the following criteria; depth range between 10 – 30 m, maximum current speeds of 0.4 $m.s^{-1}$, maximum monthly average wave heights less than 2 m and an average annual temperature with the range 15 – 20 °C.

To further assist in the finding the optimal locations for seaweed aquaculture production, Gulfview is currently being updated to include modelled distributions of dissolved inorganic nitrogen sourced from natural cross-shelf exchange processes and anthropogenic inputs from finfish aquaculture, waste water treatment plants and industrial sources. Integration of ocean model predictions of nutrient distributions in space and time into Gulfview will provide stakeholders and managers a better understanding how finfish and seaweed aquaculture sectors may mutually benefit each other through the offsetting nutrient

wastes associated with intensive tuna and finfish production (Fernandes et al. 2007, Fernandes and Tanner 2008).

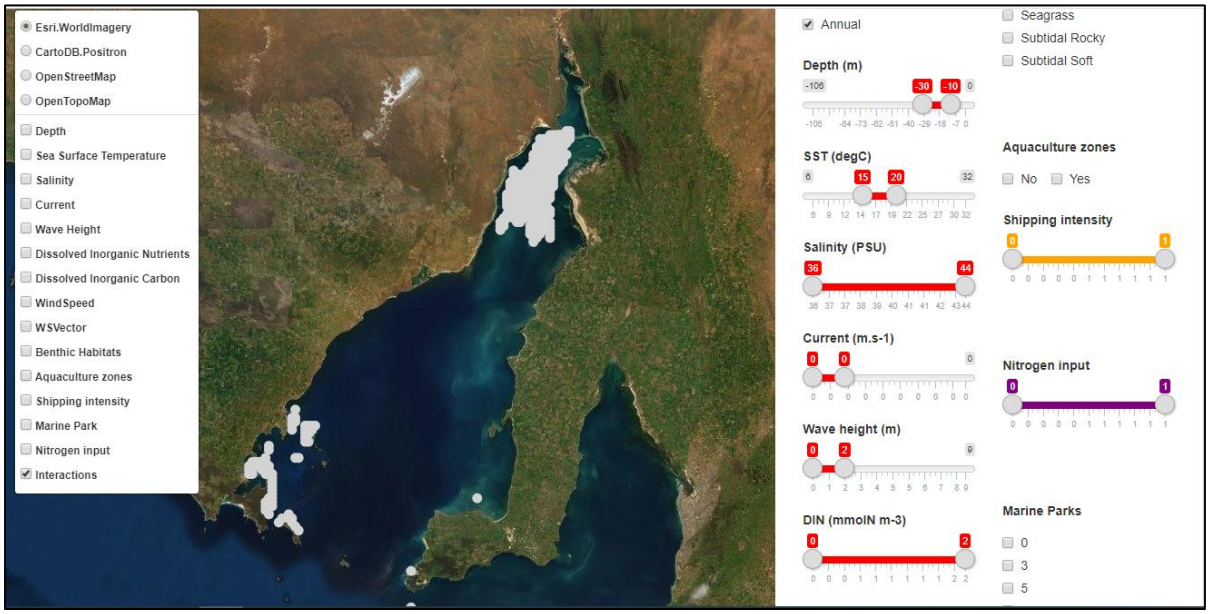


Figure 3: Identification of regions potentially suitable for seaweed aquaculture using the layer 'Interactions'. In this scenario, locations identified were based on the flowing criteria: depth range: 10 – 30 m, maximum current speed of 0.4 m.s^{-1}, maximum wave heights less than 2 m and an average annual temperature range between 15 – 20°C.

Conclusions

The new platform 'Gulfview' allows users to control criteria selection and overlap spatial environmental and management layers for Spencer Gulf to identify areas that may be suitable for particular activities. The platform design is extremely flexible and can be easily customised to meet end-users needs through the addition or removal of spatial or temporal layers in order to optimise its application and performance. Further development of the platform to provide greater coverage of the states marine waters out to the 200 nautical mile limit of Australia's Exclusive Economic Zone would be beneficial by making the platform useful to a broader range of stakeholders, and in realizing the full development potential of seaweed aquaculture in southern Australia.

Acknowledgements

Funds for the development of Gulfview were provided by the Goyder Institute for Water Research, the Fisheries Research and Development Corporation (FRDC project 2016-104) and the Spencer Gulf Ecosystem and Development Initiative (SGEDI).

Australia's Integrated Marine Observing System (IMOS) is enabled by the National Collaborative Research Infrastructure Strategy (NCRIS). It is operated by a consortium of institutions as an unincorporated joint venture, with the University of Tasmania as Lead Agent. www.imos.org.au.

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WORKSHOP RETROSPECTIVE - 'Marine algae: Potential uses and developments', Tunisia, 9th -14th July 2018

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Objective

An emerging interest and support for algal applications from the government in the last decade saw an expansion in applied phycology research in Tunisia. In this context, the course was aimed to present basic and applied aspects of both micro- and macro-algal taxonomy, ecology, culture and utilisation with particular emphasis on applied aspects harnessing regional biodiversity.

Organization

The course has been organized by Blue Biotechnology and Aquatic Bioproducts Laboratory (B^3Aqua lab) from the National Institute of Marine Sciences and Technologies (INSTM) in association with the Tunisian Association for Scientific Information (ATIS) with financial support from the International Society for Applied Phycology (ISAP).

Training workshop

The training course took place from the 9th to 14th July 2018. Fifteen participants attended all sessions and participated in the field trip to Gabès to collect seaweeds (south of Tunisia) to visit 'Eden Life', a Spirulina production company.

Group photo of workshop participants

The training program comprised 11 lectures on basic and applied aspects of both micro- and macroalgae focusing on taxonomy, ecology, culture and utilisation of biomass. Emphasis was laid on applied aspects and new development of significance to Tunisia. Lectures were delivered on the following topics:

1. Algal classification, biology and ecology
2. Algal production in the word
3. Seaweed cultivation in Tunisia
4. Microalgae cultivation
5. Use of seaweeds (phycocolloids)
6. Seaweed cultivation (IMTA)

7. Use of microalgae
8. Seaweed uses (food, nutraceutical pharmaceutical)
9. Seaweed uses (biofuel, bioremediation, agriculture)
10. Cultivation of microalgae
11. Factors influencing biomass production

The practical topics included:

- Collecting and identifying seaweeds
- Phycocolloid extraction
- Pigment and secondary metabolites extraction from seaweeds
- Microalgae cultures modeling

National and international subject specialists who lectured included:

- Dr Céline Rebours, Møreforsking AS, Norway
- Dr Juan Luis Gómez Pinchetti, University of Las Palmas of Gran Canaria, Spain
- Dr Gazbar Hedi, Eden Life, Tunisia
- Dr Chebil Ajjabi Leila, National Institute of Marine Sciences and Technologies (INSTM), Tunisia
- Dr Ktari Leila, National Institute of Marine Sciences and Technologies (INSTM), Tunisia
- Dr Ben Ouada Hatem, National Institute of Marine Sciences and Technologies (INSTM), Tunisia
- Dr Mensi Fethi, National Institute of Marine Sciences and Technologies (INSTM), Tunisia
- Dr Ben Said Rafik, National Institute of Marine Sciences and Technologies (INSTM), Tunisia

Workshop Lecturers *(from left to right: Rafik Ben Said, Céline Rebours, Leila Chebil Ajjabi, Saloua Sadok (head of B^{3}Aqua Laboratory), Leila Ktari, Fethi Mensi and Juan Luis Gomez Pinchetti).*

Field trip collecting seaweeds

Laboratory session identifying seaweeds and analyzing organic extracts

Visit to the Spirulina cultivation facilities of Eden Life

News and Views

Due to the COVID-19 pandemic the 7th International Society for Applied Phycology conference will now be held as a virtual congress from

On-demand sessions from 14th May to 13th August 2021

Live streaming sessions from 14th May 2021

Important deadlines

Registration:	Early bird: **15th September to 01st March 2021** Standard: **2nd March to 13th August 2021**
Abstract Submission Deadline:	**1st June to 16th November 2020**
Sponsor:	**15th September 2020 to 30th April 2021**
Refund process:	**will be announced soon** For those who registered for the original congress

Please visit the official ISAP2021 website for updates.

Organized by:

ABES

筑波大学 University of Tsukuba

euglena

AIIC Algae Industry Incubation Consortium JAPAN

Conferences and Events

GENIALG & IDEALG Final Conference 2020, TBA in Brest (France)

A four-day open-door, joint final international conference for the IDEALG and GENIALG projects. IDEALG and GENIALG, have been working to develop research to transfer knowledge and technology to develop the seaweed sector in France and Europe for sustainable utilisation and processing of macroalgae into high value compounds. New dates to be announced shortly.

Further information: https://genialgproject.eu/about-the-conference/

The 9th SEAGRICULTURE conference, September 24th – 25th 2020 (online)

The 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. The two-day program will go into the many different applications of seaweed that exist now.

Further information: https://seagriculture.eu/

Algae-UK and Interreg2Seas joint event: developing the roadmap for industrial applications of algae for food and novel food ingredients in the UK, October (TBA) 2020 in TBA

This event is being hosted jointly by Algae-UK and a team from the Interreg2Seas funded project, Valorizing Algae for Taste, and will bring together all interested stakeholders, to discuss the latest developments and UK requirements for increasing the use of algae for food and food ingredients.

Further information: https://www.algae-uk.org.uk/events/developing-the-roadmap-for-industrial-applications-of-algae-for-food-and-novel-food-ingredients-in-the-uk/

The 19th International Conference on Harmful Algae, October 11th – 16th 2020, La Paz, Baja California Sur (Mexico)

The 19th ICHA will include all topics related to understanding the causes, evolution and impacts of harmful microalgae and cyanobacteria. At the meeting scientists will present their research, share new ideas, and establish new collaborations and friendships. La Paz, a place where many academic institutes are found, is an ideal city for the meeting

Further information: http://www.icha2020.com/Secciones/contenido/14

The 10th European Algae Industry Summit, October 20th – 21st 2020 in Reykjavík (Iceland)

Following the success of its nine previous editions and to mark its 10th year anniversary, the next European Algae Industry Summit will take place in Reykjavík, Iceland. There will be an exclusive site visit at the Algalif production plant and the event will once again bring together key players within the algae industry including leaders from cosmetics, food, feed, nutraceuticals and pharmaceuticals across the globe.

Further information: https://www.wplgroup.com/aci/event/european-algae-industry-summit/

The 2nd US Microalgae Industry Summit, November 10th – 11th 2020 in Orlando, Florida (USA)

The event will bring together key players from the industry to discuss the latest technical developments, challenges and research breakthroughs across the microalgae value chain. The two day event will not only give the participants an insight on the current challenges and opportunities the industry is facing but also provide the opportunity to network and discuss solutions to keep the industry thriving as a whole during the numerous Q&As, and the extended networking breaks.

Further information: https://www.wplgroup.com/aci/event/us-algae-industry-summit/

AlgaEurope2020, December 1st – 3rd 2020 (Online event)

AlgaEurope offers a unique opportunity for an exchange between academia and industry, established in a networking-based environment that will explore sector's evolution worldwide as well as the main European players. Currently, there are several European projects, from lab scale to demonstration plants and commercial facilities, aiming to accelerate the commercialization of algal products.

Further information: https://algaeurope.org/

The 10th International Conference on Alga Biomass, Biofuels and Bioproducts (AlgalBBB2020), December 7th – 9th 2020 in Pittsburgh, PA (USA)

The conference will cover all areas of emerging technologies in all areas of algal research, including microalgae, macroalgae, and cyanobacteria. AlgalBBB2020 will have focus on seaweed-based systems, engineering advances, molecular characterization technologies, strain engineering technologies for biofuels and high value products and pharmaceuticals, biomaterials, photobioreactor design and control systems, among others.

Further information: https://www.elsevier.com/events/conferences/international-conference-on-algal-biomass-biofuels-and-bioproducts

The 12th International Phycological Congress (IPC2021), March 21st – 26th 2021, Puerto Varas (Chile)

IPC 2021 will be a 5-day Congress and it will include a mid-Congress break to visit the natural attractions surrounding Puerto Varas. The event is intended for scientists and professional organizations with an interest in phycology. Aim is to elaborate a solid and innovative scientific program that will include invited speakers, oral presentations, and posters.

Further information: https://ipc2021.com/

Aquaculture Europe 2020: the Blue and the Green, April 12th – 15th 2021 in Cork (Ireland)

Aquaculture can take the lead in the BlueGreen BioEconomy and is well placed to lead by example with new technologies such as land-based marine aquaponics, large-scale recirculating marine farms and innovative, integrated freshwater initiatives on brown field sites. This conference will bring together stakeholders from many diverse disciplines to discuss and debate cross cutting issues such as new circular economies, life-long health, and environmentally sustainable production.

Further information: https://www.aquaeas.eu/

Wando International Marine Algae Symposium, April 22nd – 25th 2021 in Wando (South Korea)

Wando International Marine Algae Symposium will be organized in celebration of the 2021 Wando Seaweed Expo. Wando is known to be the "Capital of Seaweed Aquaculture" in Korea and has hosted the Wando Seaweed Expo in 2014 and 2017. The Wando International Marine Algae Symposium will include diverse sessions, covering topics such as seaweed aquaculture and industry, ecology, biodiversity, microalgae, and biomass applications.

Further information: http://www.wando.go.kr/expo or contact at jang.kim@inu.ac.kr

The 19th International Conference on the Cell and Molecular Biology of Chlamydomonas (Chlamy2021), May 18th – 23rd 2021 in Six-Fours-les-Plages (France)

Every two years, the international research community working on the unicellular green alga *Chlamydomonas reinhardtii* and its close multicellular relatives, meets to share their most exciting results. Do not miss this opportunity to expose your research and develop collaborations with the best specialists in your field!

Further information: https://chlamy2020.sciencesconf.org/

The 10th International CeBiTec Research Conference – prospects and challenges for the development of algal biotechnology, September 13th – 15th 2021 in Bielefield (Germany)

The 2021 International CeBiTec Research Conference Bielefeld aims at giving a complete overview of the challenges facing the exploitation of microalgae and cyanobacteria for industrial biotechnology, from biofuels to high value proteins and chemicals.

Further information: https://www.cebitec.uni-bielefeld.de/events/conferences/575-algal-biotech-202

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/

The European Algae Biomass Association (EABA) Webinars for 2020:

The EABA is organizing a series of webinars promoting mutual interchange and cooperation in the field of biomass production and use, including biofuels uses and all other utilizations.

7 October 2020: Algae Biofertilizers and Biostimulants
4 November 2020: Atlantic Sargassum Belt

For more information: https://www.eaba-association.org/en

The European Aquaculture Society (EAS)

Aquaculture Europe Conference is Rescheduled for April 12-15, 2021: https://www.aquaeas.org/Meeting/AE2020

The EAS is organizing a series of webinars promoting mutual interchange and cooperation between all involved or interested in marine and freshwater aquaculture.

For more information: https://www.aquaeas.eu/

Promote YOUR COMPANY with the International Society of Applied Phycology

The International Society of Applied Phycology would like offer your company/organization the opportunity to conduct public relation activities with us. We are pleased to announce that there are a wide variety of the sponsorship options available to meet your needs.

We would also like to invite you to **participate in our triennial international conference** that attracts over 500 of the world's leading phycological researchers from world-renowned universities, research institutes and companies!

International Society for Applied Phycology
ISAP

Contact Valeria.Montalescot@sams.ac.uk for more information

CALL FOR ARTICLES

The ISAP Newsletter team is looking for YOUR INPUT for the next edition of the newsletter (December 2020)! We are interested in technical articles pertaining to applied phycology from any type of ecosystem as well as news clips or announcements you wish to share with the ISAP community.

We would like to especially invite PhD STUDENTS and EARLY-STAGE RESEARCHERS to submit!

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.

Please e-mail Sasi Nayar (Sasi.Nayar@sa.gov.au) to express your interest in submitting an article. First drafts should be ready for submission by 31 October 2020.

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
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*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.

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