Quorum
SCELSE
Singapore Centre for Environmental Life Sciences Engineering
10 YEARS OF RESEARCH EXCELLENCE
MAY 2022

Rare bioluminescent algae put on light show in Singapore's waters

Marine microorganisms called dinoflagellates are behind this phenomenon

Ever had a magical swim like this? After Straits Times' interview with SCELSE PI A/Prof Rebecca Case, hundreds flocked to the beaches for a glimpse of this beautiful sight.

A dazzling but fleeting display of blue as A/Prof Rebecca Case glided across the water in Changi Beach. The beaches were still empty as Prof Case collected samples, a stark contrast to the crowds that would flock there over the next few days.

Singaporeans were treated to a rare phenomenon in late March - a bloom of bioluminescent dinoflagellates - microscopic marine algae that drift in the ocean. The dinoflagellate responsible for this glow was identified as *Noctiluca scintillans* by the National Parks Board.They produce a luciferase enzyme which reacts with oxygen, resulting in bioluminescence.

> While dinoflagellates are not uncommon in our waters, it takes a combination of factors such as the right rainfall, salinity and temperature, to result in a bioluminescent algal bloom.

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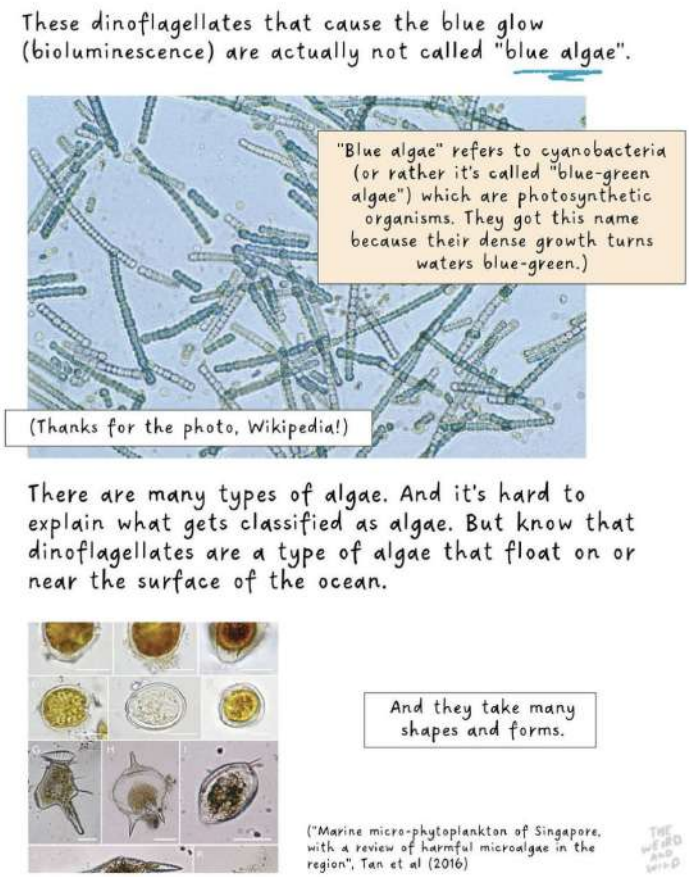
How BIOLUMINESCENCE occurs

By science communicator Woo Qiyun for The Weird and Wild (@theweirdandwild)



Prof Case suggested that the recent monsoon season and warm weather may have contributed to this event.

The glow was most prominently seen in Pasir Ris Beach and Changi Beach, with many heading down with their families to witness it for themselves.

While this glow may be beautiful, there could be harmful impacts on our ecosystems as well. An overgrowth of the algae may negatively impact the marine ecosystem by reducing the oxygen supply, and therefore suffocating other organisms, explained A/Prof Case.

She told Straits Times (ST): “It would therefore be important to be able to know what environmental factors would result in such extreme events, and be able to mitigate their negative effects. But much more research is needed before predictive technology becomes possible.”

RESEARCH UPDATES

Creating nutritious protein from soybean-processing wastewaters

This breakthrough will help advance Singapore's "30 by 30" Food security vision

The recycled food trend continues! A team of SCELSE researchers has presented a work titled, "Microbial protein production through mixed-culture anaerobic/aerobic fermentation of soybean processing wastewaters of variable chemical and microbial composition" in Singapore International Water Week Convention on April 18, 2022.

We speak to SCELSE lead researcher Mr Vethathirri Ramanujam Srinivasan, SCELSE PhD student, to learn more.

1. In layman terms, what is your research about?

Our research aims to recycle food processing wastewater into food-grade microbial protein rich in essential amino acids. Microbial protein is made of dried microorganisms with a high protein content along with fats, carbohydrates, vitamins and minerals.

2. Why was your research chosen for SIWW among all the other research?

The current work is aligned with the Singapore Green Plan and "30 by 30" vision, whereby 30% of Singapore's nutritional needs will be produced locally by 2030, up from less than 10% today. It can help in achieving Singapore's goals of food security and sustainable management of water and sanitation.

3. What is the problem you're trying to solve?

The main objective is to evaluate microbial protein production from soybean processing wastewaters by providing controlled bioconversion conditions to recycle nutrients using the microbial communities already present in these wastewaters.

4. What is the impact of your research?

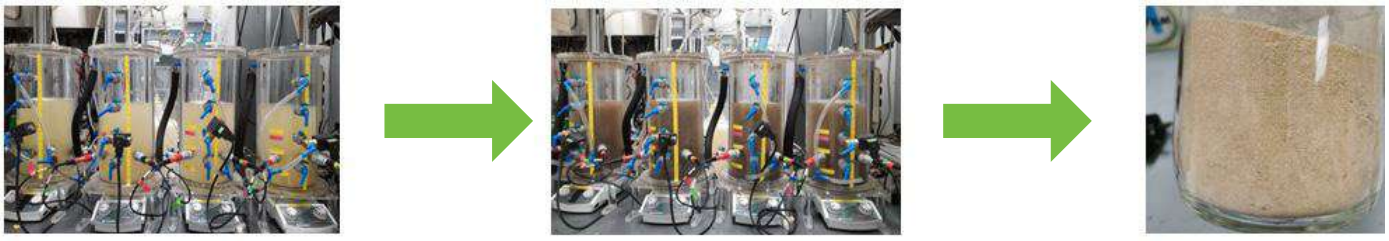
This research demonstrates alternative sustainable protein production using food processing wastewater to address the food security of the ever-increasing world population. This would help alleviate the environmental impact caused by both traditional agricultural food production and wastewater treatment and disposal.

5. What is the takeaway message for your audience?

Food processing wastewater can be converted directly into microbial protein meeting the animal feed requirements through a mixed culture-based bioconversion approach.

6. Who did you collaborate with or hope to collaborate with, going forward?

The present work is part of the bioreactor work currently done at SCELSE, which in turn is part of the multi-institutional effort of our NRF Competitive Research Programme project titled "Recovery and microbial synthesis of high-value aquaculture feed additives from food-processing wastewater". It involves collaboration with industrial partners, a multi-institutional team, and the Singapore Food Agency, to really harness Singapore's potential for biotech innovation.



Microbial community-based bioconversion of soybean processing wastewaters into protein

READ THE POSITION PAPER: Microbial community-based protein production from wastewater for animal feed applications
https://doi.org/10.1016/j.biortech.2021.125723

RESEARCH UPDATES

Breakthrough: Coating probiotics for better absorption

A collaboration between SCELSE A/Prof Joachim Loo and PhD student Li Ling Tan led to the innovation

The effectiveness of probiotics we take to help our gut microbiome may soon increase, thanks to an innovation by SCELSE PI A/Prof Joachim and PhD student Li Ling Tan from NTU Materials Science & Engineering.

They have come up with a novel coating for probiotics, ensuring that they survive past the acidic environment of the gut. Once it reaches the intestine, the probiotics will be able to be released and carry out their job. The applications of this innovation are broad, ranging from health supplements to animal feed. Watch this two-minute SCELSE video to learn more:

Or read Sraits Times Online: NTU team develops edible coating for probiotics that helps better deliver health benefits

INDUSTRY BEAT

SCELSE wows P&G with its excellent, impactful research

*SNBC facilitated a tour for P&G and A*STAR for future collaboration*

*(L-R) Michel Birnbaum (SNBC) and Prof Staffan Kjelleberg (SCELSE) welcome Dr Tan Sze Wee (A*STAR); and Victor Aguilar, Yuko Nakamura and Andrew Weatherston (P&G)*

Sharing expertise – that's what P&G researchers and senior management did when they spent an hour touring SCELSE's labs.

While P&G researchers shared about their membrane modelling project and Virucidal lab, SCELSE highlighted fundamental to translational research including membrane modulation and antibiofilm technologies, and biofilm-host interactions applying to real-life applications (e.g., air microbiome, human skin and gut, industrial settings, marine).

"Collaboration is key to enabling research centres to innovate. Singapore National Biofilm Consortium (SNBC) plays a key role in enabling collaboration between academia and industry. We are happy to facilitate

this meeting with P&G, SCELSE and other industry players keen to innovate in the areas of biofilm and microbiomes," said Michel Birnbaum, SCELSE's director of research translation and entrepreneurship.

This tour, which included presentations from seven SCELSE researchers, was held on 24 Feb 2022 at SCELSE at NTU.

Kudos to the following SCELSE researchers for sharing their expertise:

- Prof Stephan Schuster - Air microbiome
- Prof Stefan Wuertz – Microbial monitoring projects in wastewater treatment plant and waterways
- Dr James Ho- Biomatrix characterisation and ways to understand mechanistic interactions within biofilms
- Dr Ezequiel Santillan - Examples of growing biofilms for specific purposes and modelling to have better representation of real-life situations
- Dr Foo Yong Hwee & Matthew Sng – Spectra imaging of polysaccharide utilising bacteria in biofilms
- Dr Stephen Summers, Prof Fei Xunchang (CEE, NTU) and Dr Stefano Bartolucci (from P&G)- on Circular Material Lab

Prof Stephan Schuster (left) shared insights into the ultra-low biomass studies (such as the air microbiome) conducted in Singapore and beyond.

Shikhar Gupta (P&G) (standing) presenting his work on microbial membrane modelling.

P&G scientist Ross Strand (centre) suggesting potential R&D synergies during the poster presentation by Dr James Ho (SCELSE).

Dr Ezequiel Santillan (SCELSE) (in white) giving an example of using microbial communities to convert waste streams to value-added products.

Dr Matthew Sng (SCELSE) (in chequered shirt) presented work done in collaboration with Dr Rohan William's team on spectral imaging of bacterial biofilms

Dr Stephen Summers (SCELSE) presenting an overview of his work on microbial plastic degradation to Stefano Bartolucci (P&G).

SCELSE HAPPENINGS

SCELSE 10 Year Anniversary Conference

Pushing Boundaries, Creating Legacies

This year we celebrate SCELSE's 10 Year anniversary with a conference to be held at Capella, Sentosa. Look out for registration information in your email (for staff and invited guests). The opening keynotes on the first day will be live streamed for virtual guests.

SCELSE STUDENTS

A passion for sustainability and translating research into real-world applications

Newly minted graduates Yissue & Norazean share their thoughts on doing a PhD at SCELSE

Dr Norazean Zaiden (L), also known as Azean, is poised to help solve water pollution by applying synthetic biology methods to engineer biofilm matrix into a biological material that is efficient for contaminant removal in water matrices. Dr Yissue Woo is focusing on works related to monochloramine disinfected drinking waters, in the areas of nitrification and biofilm control

Hi both, why did you decide to do a PhD at SCELSE?

Azean: I am a huge fan of nature. Doing a PhD at SCELSE gave me a greater sense of purpose on how I can better utilise my science background to solve environmental issues. My interest in environmental life science was sparked after a lecture by a SCELSE professor whose work aimed to preserve coral reefs through studying their biological interactions with microbes. From that very moment, I knew I'd like to take part in SCELSE's research mission that aligns with my appreciation for nature.

Yissue: I had accumulated about five years of experience working as a research assistant, and felt that I had reached a plateau on my training as a scientist. Taking up graduate studies felt like a natural next step, and doing so in SCELSE was very advantageous, given the various connections in SCELSE I had developed over the years.

What was your research focusing on?

Azean: My research focused on applying synthetic biology methods to engineer biofilm matrix into a biological material that is efficient for contaminant removal in water matrices. Water is a precious natural resource, and the ever increasing human activities that heavily rely on clean water can deplete it. Through harnessing the potential of the microbial properties such as its biofilm matrix, this can be applied in bioremediation efforts such as improving water quality or resource recovery. Therefore, offering a solution for a more sustainable usage of our natural resources like water.

Yissue: My focus was on the drinking water distribution using monochloramine for secondary disinfection. The research homed in on the response and/or adaptations by the three nitrifiers found in the local distribution system: ammonia-oxidising archaea and bacteria, and nitrite-oxidising bacteria.

Your most memorable experience at SCELSE?

Azean: It has got to be the SCELSE Summer Course, which is an intensive three-week course during which I had the opportunity to interact with both local and international students, and the true rockstars of the biofilm world. In-person! I was very new to biofilm studies. Those two weeks made me giddy with loads of exciting information on the damaging, but also beneficial properties of biofilms.

Yissue: It has to be the in-person interactions I had through various events: Seminars, coffee/tea sessions, happy hours, celebrations etc.

What are your plans going forward?

Azean: Being a researcher feeds my many curiosities, which is not limited to biofilms. Besides achieving academic success, I also gained many useful skills from the PhD training such as critical thinking and communications, which I'd like to bring forward to other research interests relevant in improving sustainable living.

Yissue: My long-term plan is to enter the industry, to translate scientific knowledge and discoveries into real world applications.

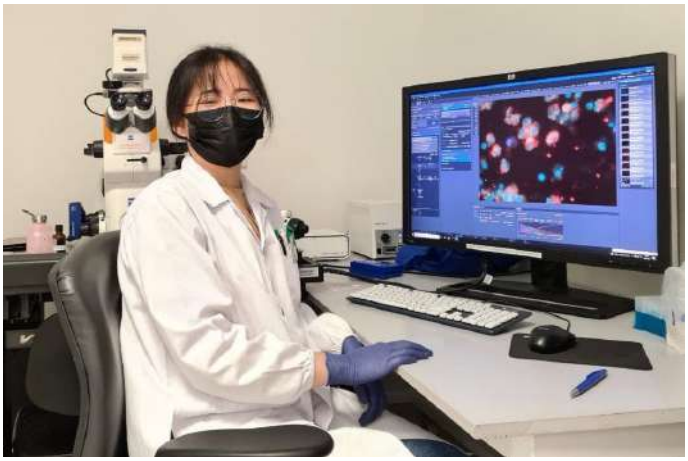
One piece of advice for students considering a PhD?

Azean: Doing PhD is a serious four to five years commitment. And so, I am offering a 3-in-1 advice that consists of WHY, WHAT and WHO. (1) Have an honest answer as to WHY would you like to do PhD. Is the answer worth the commitment? (2) Have a good specific idea of WHAT your research would be about. This helps to accelerate the initial study exploration and motivates you to wake up each day to pursue. (3) Do a good research on WHO you'd like to be supervised by during your PhD journey. A good mentor is respectful, conducts constructive discussions, listens and motivates.

Yissue: Pace yourself smartly and fail small but often.

Student intern hails SCELSE as 'absolutely amazing!'

A bouquet by final-year Ngee Ann Polytechnic student, Audrey Tan, whose post on LinkedIn caught SCELSE's eyes.



Audrey conducting immunofluorescence microscopy in the laboratory. In the image on the computer, we can see the interaction between human neutrophils and E. facecalis.

Working in SCELSE has been absolutely amazing!

My key responsibilities included helping Dr Haris Antypas and Dr Claudia Stocks plan and execute experiments, where I was taught many interesting techniques such as bacteria and mammalian cell culture, 3D-cell culture, immunofluorescence microscopy, polymerase chain reaction (PCR). I also had to give mini-presentations and write detailed laboratory reports, which greatly improved my public speaking, communication and critical thinking skills.

I gained an insight into the workings of a research laboratory. Through this experience, I obtained a better appreciation for research and the scientific method, all of which has ignited my passion for research.

In all, I am incredibly grateful to my supervisors: Dr Haris and Dr Claudia, for their patience and enthusiasm in guiding me throughout my internship. I also thank my fellow interns Victoria Tan, Seth Lee, Chen Sheng, Marcus Chu, Goh Yi Han, Kam Chong Jing Samuel, and Trevor Wong for their unwavering support and friendship.

Cheers to finishing my final year of polytechnic at such a fantastic company!

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