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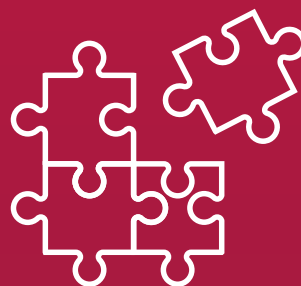
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editorial

Species

No man is an island, or rather, no species is an island. Not only do we rely on connections with other people but also everything that lives within our bodies, the pets and pests that we meet each day, and all that we consume.

Take a moment to look around you. What can you see that is not somehow connected to another living thing? From the clothes you are wearing to this edition in your hands, someone or something has played a part in its history. This is because the living whole of the natural world is essentially a net-like, entangled fabric that is continuously transforming itself.

Through vast, complex and collaborative systems, organisms are bound to participate in a lifelong tango of feeding, breeding, and dying – changing the landscape of Earth and its available resources. In Issue 46, **THINK** is examining these systems to learn how we interact with other living things, from microbes to bees, fish to fauna.

Everything we do has an effect, be it on ourselves or another living thing. And although we may not always understand the extent of our actions, we cannot disentangle ourselves from this Earth or this life. So, for now, let's start by understanding some of the relationships that colour our lives.

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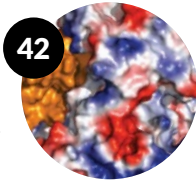
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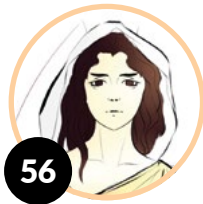


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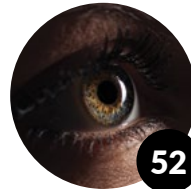
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Seagrass Death Threatens Ancient Shipwrecks: An Urgent Call for Preservation

Author: Colan Llewellyn Mackenzie

Among the many aspects of our world under threat from climate change are the shipwrecks, temples, and tombs of the ancient world. Archaeological artefacts are preserved once they reach some form of stasis with their surrounding environment. Yet the tiniest of changes in that environment can completely destroy otherwise protected objects. Perhaps in no sub-discipline of archaeology is this threat more immediate than in maritime archaeology, where rising sea temperatures, rampant ocean acidification, deep sea mining, cable laying, pipeline projects, and even small-scale pleasure craft anchoring cast an ominous shadow over humanity's shared maritime history.

In the Mediterranean, these threats combine to cause serious damage to the island's *Posidonia oceanica* seagrass meadows and threaten its underwater archaeology. *P. oceanica* can protect archaeological materials like wood and ceramics from ocean currents, storms, and sea life, which often destroy those artefacts. *P. oceanica* has shielded several famous ancient shipwrecks and harbours from damage in the Mediterranean. Among these is a 3rd century CE Roman shipwreck in Malta known as the Mellieħa Bay Mortar Wreck, where researchers discovered dye from Egypt, hundreds of pieces of pottery from around the Mediterranean, and even a personal pendant to the Roman god, Sol Invictus. Beautiful artefacts like a Bronze Age wooden anchor and painted perfume jars in Turkish waters have been similarly protected by *P. oceanica*, as have ancient Greek wrecks and ancient military harbours in the Aegean.

P. oceanica is also Europe's largest carbon sink, covering some 1.2 million hectares of the Mediterranean seafloor, but it is dying. The 2015 pan-European study 'Seagrass meadows (*Posidonia oceanica*) distribution and trajectories of change' found that nearly 33% of seagrass coverage across the Mediterranean has been lost since the 1970s. This reflects a global decline in seagrass coverage of similar severity. That 2015 study said that 1.5% of global seagrasses died per year.

And while 21% of sites sampled in 'Recent trend reversal for declining European seagrass meadows' in 2019 showed some sort of improvement, 49% of seagrass sites sampled in Europe were still in a state of decline. Estimates for seagrass decline are around 7% of coverage annually since the late 20th century. That's almost 1.3 Real-Madrid football fields (10,700 m²) an hour. An incomprehensible number and an extremely devastating loss both environmentally and economically.

Ecological and cultural conservation should be emphasised more than cold, hard cash; that being said, seagrass conservation also has economic benefits. In another 2015 article, 'The seagrass *Posidonia oceanica*: Ecosystem services identification and economic evaluation of goods and benefits', researchers estimated that humans derive from *P. oceanica* between €28.5k–€51k per km²/year in economic goods and benefits. The EU estimated that the loss of this seagrass in the Gulf of Gabes in Tunisia alone resulted in €105 million in lost ecosystem services a year.

The loss of seagrass habitats threatens to expose underwater archaeological sites to the elements, which could cause serious damage: storms and wave action can shatter unsecured ancient pottery, certain sealife like the Tereido Worm can colonise exposed wood and completely destroy it in a few short years, and humans can easily loot such unprotected sites.

American naturalist John Muir once said, 'When one tugs at a string in nature, one finds it connected to the rest of the world.' Protecting *P. oceanica* is vital because of its critical ecological role and because it creates a region-wide vault in which thousands of years of humanity's shared history has been stored. Underwater cultural heritage provides a unique view into our past global connections and can shed light on incredibly important cultural developments like Malta's role in the Roman world. As seagrasses globally die and retreat, they could be exposing massive amounts of this heritage to the elements. **T**

Optimisation in Radiography: A Skill Taken for Granted

Author: **Andrea Bellizzi**



A fundamental principle of radiography is optimisation, which in this context, means finding the best compromise between conflicting requirements. Since common procedures such as X-rays and computed tomography (CT) scans involve using radiation, optimisation is essential to ensure that the patient receives the safest and lowest levels of radiation exposure without sacrificing the clarity of the diagnostic images.

Optimisation requires the radiographer to be skilled in manipulating different parameters in the scanning devices, such as voltage and current. These parameters determine not only the amount of radiation emitted but also the resultant image quality, which needs to be sufficient for the reporting radiologist to form a diagnosis. Therefore, an appropriate balance between image quality and patient exposure is needed.

Innovative methods of optimisation are consistently and competitively being researched worldwide. It is an area of specialisation that requires creativity to discover new strategies. Lumbar spine X-rays were the first I researched, since this procedure is very commonly performed locally for patients suffering from back pain or arthritis. By developing an optimisation technique that manipulated different parameters, a 72% radiation dose reduction was achieved, with no significant impact on image quality.

In another study, I researched optimisation for CT of the pulmonary arteries, a scan commonly performed to detect blood clots. After establishing the optimisation technique, a clinical study was performed to compare the old (not-optimised) protocol and the new (optimised) protocol. The radiation dose was reduced by 50% with no significant change to image quality. This technique has now been applied locally at Mater Dei Hospital, which means that all patients referred for this CT scan are now being scanned with a 50% reduction in radiation dose. This was a significant achievement, as 3,000 CT scans of pulmonary arteries are performed each year locally, including on radiosensitive patients such as pregnant women.

Last year, a new CT scanner was installed in the Mater Dei Accident & Emergency Department. This scanner uses technology that is new to our practice, meaning there are innovative optimisations waiting to be discovered. This will be the next step in my doctoral studies as I endeavour to optimise CT scanning in the emergency setting.

Optimisation in practice makes for an 'optimised' radiographer, one who feels fulfilled in knowing that their skills reduce the dose of radiation exposure to patients while still obtaining good image quality. 

Acknowledgements

I am grateful to my supervisors Prof. Francis Zarb, Prof. Paul Bezzina, Dr Jonathan Portelli, and Dr Gabriel Galea for their support throughout my student journey.

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Colorectal Cancer Awareness: How Much Do We Really Know About Diet and Risk?

Authors: **Thea Schembri** and **Dr Petra Jones**

Colorectal (or bowel) cancer (CRC) is more common than most people realise and deadlier than it needs to be. Around 45% of CRC cases are estimated to be preventable. And yet, it remains the second most common cancer in Malta and one of the leading causes of cancer-related deaths worldwide. So, what's going wrong?

Blaming it partly on lifestyle choices and a lack of public awareness, there is a mountain of strong evidence linking CRC to diet, nutrition, and physical activity. The World Cancer Research Fund sums up the causes as follows: while consuming processed meat causes bowel cancer, basing your diet on red meat, consuming alcohol, and carrying excess weight also raises your risk. Conversely, being physically active, eating whole grains and fibre-rich food, and ensuring calcium sources in your diet can help protect you. Despite all this, many people have no idea these factors play a role.

A local cross-sectional study led by Thea Schembri and supervised by Dr Petra Jones drove this point home. The researchers surveyed 150 Maltese adults to measure their awareness of CRC risk factors and the role of diet in its prevention. While most participants recognised that diet plays a role in CRC development, fewer than half were aware that CRC could be prevented at all. About a third of participants identified an unhealthy diet as a risk factor, and slightly more suggested a healthy diet could reduce their risk of bowel cancer. However, few participants mentioned steps like increasing fibre, reducing alcohol intake, or maintaining a healthy weight as key actions in reducing risk. In fact, most failed to mention the consumption of processed meat as a risk or even recognise bacon as a typical example when given a list. Younger participants, in particular, were less aware, signalling a need for targeted education.

Processed meat, for example, ham, salami, and some sausages, refers to any meat that has been altered to enhance its flavour, shelf life, or quality through curing, smoking, salting, or adding preservatives. Eating processed meat regularly can significantly increase the risk of colorectal cancer (by 18%) and colon cancer (by 23%) for every 50g consumed daily – that's roughly the size of a sausage or a couple of slices of bacon.

Public health campaigns have successfully promoted seat belt use, sunscreen, and smoking awareness – CRC prevention deserves the same focus. Teaching children at a young age about the benefits of whole grains, the perils of processed meats, and the importance of eating vegetables can make a lasting impact. Preventing CRC isn't rocket science, but it does require proactive steps like education, awareness, and simple lifestyle changes. Let's use food as our medicine and take meaningful action. 



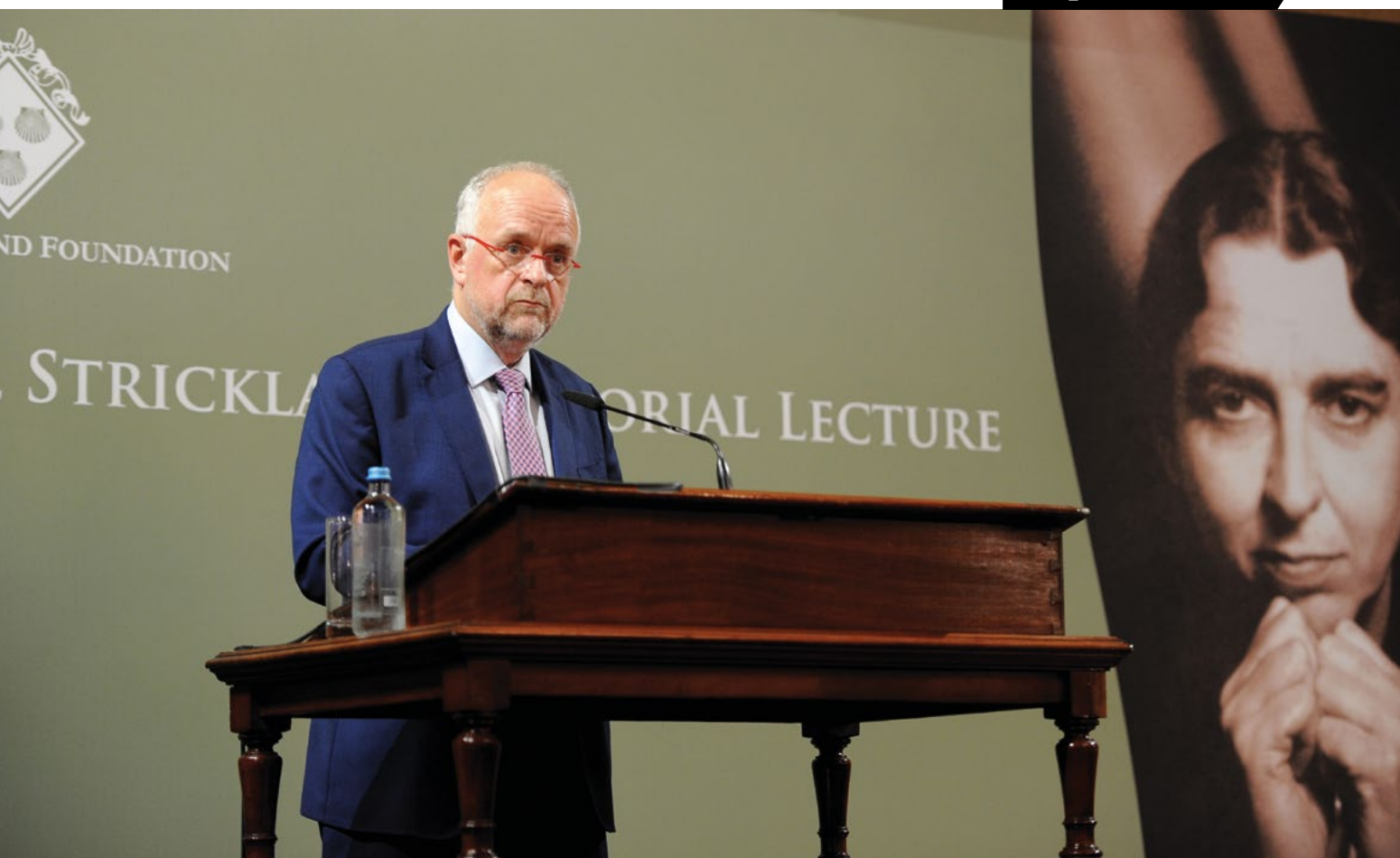
Thea Schembri
Photo by Kristov Scicluna



Dr Petra Jones
Photo by James Moffett

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What Malta Can Learn from the European Court of Human Rights Climate Judgement



Author: **Timothy Alden**

Tim Eicke delivering his lecture at the 2024 Mabel Strickland Memorial Lecture
Photo by Chris Sant Fournier

On 21 November, 2024, Tim Eicke, Judge of the European Court of Human Rights, delivered a lecture at the Casino Maltese for the annual Mabel Strickland Memorial Lecture. The event centred on the Court's historic decision in the landmark case, Verein KlimaSeniorinnen Schweiz and Others v. Switzerland, which held that states have a responsibility to combat climate change to protect human rights. Drawing parallels with Malta's constitutional framework, questions arose about lessons from the judgement applicable to Malta.

Human rights law is a key topic of study at the University of Malta, with a particular focus on the European Court of Human Rights (ECHR). However, it is not every day that one of its judges visits Malta to impart an insider perspective, let alone one which links current environmental trends to recent court judgements. In November 2024, the Strickland Foundation invited Judge Eicke, the United Kingdom's representative on the Court, to speak at the year's recurrent Mabel Strickland Lecture Series. Emeritus Judge Giovanni Bonello, himself a previous and important ECHR judge, is chair of the foundation and honorary president of the Casino Maltese, where the lecture took place. The lecture was introduced by Prof. Clare Vassallo, a board member of the foundation as well as a lecturer in the UM Faculty of Art's Department of Translation, Terminology & Interpreting Studies.

Eicke began his lecture by referencing a March 2024 report from the European Environment Agency, which highlighted that Europe is warming faster than any other continent. The effects of climate change are already reshaping lives

and landscapes. This year alone, extreme heat events have become alarmingly frequent; southern Europe is grappling with worsening droughts, and catastrophic floods have devastated communities, most recently in Valencia.

Against this backdrop, the European Court of Human Rights issued its landmark ruling in *Verein KlimaSeniorinnen Schweiz and Others v. Switzerland* on 9 April, 2024. The ECHR found that Switzerland had failed to act promptly and consistently to mitigate climate change, violating its positive obligations under the European Convention on Human Rights. Additionally, Switzerland was faulted for failing to provide adequate legal recourse for the association to seek justice domestically. This judgement marks a turning point in legal history, not just for its content but for the evolution it represents in the ECHR's interpretation of human rights.

'The Court has acknowledged that the Convention was not designed to address the environment. Nonetheless, there have been more than 300 decisions on environmental issues. As first recorded, it is a living instrument – it cannot help but be

influenced by developments. Existing case law, therefore, reflects that according to today's society, protection of the environment is an increasingly important consideration. To define the extent to which protection is to be provided has not always been easy,' Eicke explained, underlining how and why the Convention has hardly changed over the decades, yet is continuously interpreted according to evolving realities in the present.

IMPLICATIONS OF THE RULING

Turning now to substantive rights, the judgement is noteworthy as the Court identified for the first time that its articles provided a right for individuals to experience effective protection from the harmful effects of climate change. According to the Court, this right finds expression in three ways. Eicke states that, firstly, this right imposes on the state a primary duty to adopt regulations and measures capable of mitigating the existing and potential irreversible future effects of climate change. This requires states to tackle carbon dioxide levels with a view to reaching net neutrality within

the next three decades. In order for measures to be effective, governments must act in good time and in an effective manner.

Secondly, Eicke states that these actions must be matched by adaptation measures, taking into account the best available scientific evidence. Thirdly, the Court said that the state is under obligation to provide the public with information on its decision-making for climate policy. Furthermore, procedures must be in place to take the views of the public into consideration when it comes to policymaking.

The Court traditionally gave states significant leeway, known as a 'margin of appreciation', in interpreting their obligations under the Convention. However, for climate change, this margin is now much narrower due to the severity of the threat. States are expected to meet greenhouse gas reduction targets and commitments as a general obligation. The Court allows flexibility only in how these goals are achieved, considering the specific policies and resources each state chooses to prioritise.

In the Swiss case, it was judged that there was a failure of mitigation, and this failure of the state's positive obligation is sufficient for failure to comply with the Convention's Article 8, the right to family life. It was not necessary to examine whether ancillary adaptation measures had been put into place. The focus remained on the failure of the government to take proactive action towards greenhouse gas emissions in the first place. This makes it clear that a state cannot avoid the necessary and necessarily expensive and controversial

mitigation measures by only adopting adaptation measures.

States are obliged to act quickly and effectively to avoid a disproportionate burden on future generations. Eicke emphasises that, while this judgement represents a significant leap, it is only the first step in defining the obligations the Convention imposes, as well as the methods and details through which the Committee of Ministers can oversee and enforce compliance.

A MISSING LEGAL ANCHOR?

Article 9 of Malta's Constitution recognises the state's duty to safeguard the environment, committing to the protection of its landscape and resources for the benefit of future generations. In 2018, this article was expanded to include further obligations towards conserving natural resources for the benefit of present and future generations, as well as addressing environmental degradation and pollution. Finally, the expanded article calls for the promotion and nurturing of the right of action in favour of the environment.

Nonetheless, there has been controversy over the Declaration of Principles in our Constitution, with a popular mistaken perception being that the Articles thereunder are not at all justiciable. They have therefore not been referenced in court cases, although it should be possible to use them to obtain a ruling specifically against a law which does not comply with them. In practice, they have wrongly been interpreted as cosmetic guidelines. Eicke was invited to address whether courts refusing to offer justice via Article 9 could form the basis for a

case to be taken to the ECHR. In the famous recent Swiss climate judgement it was determined that the Swiss state had not given sufficient weight to the petitioners' concerns. In this regard, there had also been a violation of the Convention's Article 6, a right to a fair and public hearing within a reasonable time by an independent and impartial tribunal established by law. Eicke acknowledged the parallels but emphasised it would be up to Malta to make a case before the Court as necessary, though he underlined the factors which allowed the Swiss case to be brought forward successfully.

Particularly given the lack of independence of the Planning Authority and similar institutions, there is a need for continued emphasis regarding the enforceability of Article 9 of Malta's constitution. The country is not only obliged by the Declaration of Principles to protect our heritage and environment, but also by the interpretations of the Convention, particularly as concerns grow in Malta about quality of life, justice, and public health. As Article 9 has yet to feature in a Maltese court case, the Convention as a living instrument may yet serve to offer a potential source of inspiration for both law and policy in Malta.

The Strickland Foundation invited the Judiciary, all of Malta and Gozo's Environmental NGOs, representatives from the relevant ministries, representatives of the Local Councils, and academics from various Faculties of the UM, as well as the general public to the lecture. The topic is crucial to the state of the island and the wellbeing of its citizens. 





Species

Over millennia, humanity has connected with other species. Some, like the 100 trillion bacteria living in our gut, have formed inextricable bonds with us since time immemorial.

Some relationships may be relatively straightforward to imagine, such as that with bees – we protect and tend to their hives in exchange for honey. However, other relationships are more complex.

In this edition, **THINK** explores UM-led

research focusing on our relationships with the non-human species around us, starting inside our large intestines. From there, we'll follow the honey bees to map optimal nectar sites, and learn how fungi make for excellent building material.

Lastly, we'll be retracing our steps to understand how alien fish and invasive plant species found their way into new spaces, and how we can preserve disrupted local ecosystems from further harm.



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Is this the greatest collaboration of all time?

Author: **Yanika Borg**

Marie and Pierre Curie. Ennio Morricone and Sergio Leone. Queen and David Bowie. Unarguably, these are some of the greatest collaborations of our times. They have shaped our cultural and scientific landscapes. But what happens when humans and other species collaborate?

The first step in my exploration was to define what constitutes a collaboration. This took me down a wild and meandering path, one which I now invite you to join me on. It goes deep into the world of philosophy, past the springs of existence, the pillars of the self, and the labyrinths of logic. That said, there are many ways to interpret this subject, so read on, and then get in touch with your own interpretations.

WHAT IS A COLLABORATION?

'A collaboration is a piece of work that has been produced as the result of

groups working together', the Collins English dictionary tells us, in more word salad than most of us can consume.

The definition doesn't mention this explicitly, but a collaboration implies that the end result is mutually beneficial. Moreover, it implies that the participating groups are doing so with consent or, at the very least, were not coerced.

We might be hard-pressed to call the domestication of animals or the practice of agriculture a collaboration between humans and other species. However, there are plenty of examples of humans and other species collaborating: we have

a relationship with the bee, which pollinates the flowers and fruit we grow (they get the sweet, sweet nectar and we get the fruit). In some fishing communities, dolphins herd fish toward fishermen (resulting in a better catch for both groups). We have a relationship with the gut microbiome, which can flag up pathogenic organisms for the human immune system to tackle (they get a stable habitat and we have a better chance of survival).

The gut microbiome is something we have been increasingly hearing about in news related to healthcare, medicine, and wellness. It is that



complex ecosystem of bacteria, fungi, viruses, and archaea (single-celled organisms that sit somewhere between bacteria and eukaryotes) found in our gut. You can see more about it in the infographic we have created in the following pages. The gut microbiome is linked to anything and everything, from diabetes to our immune system and mental health. I suspected this could be a particularly fantastic example of human/other species collaborations.

WE ARE A COLLABORATION

Our relationship with the gut goes beyond this. We are not just in a collaboration with the gut microbiome. 'We *are* the collaboration,' as Dr Niki Young of the UM's Department of Philosophy explains. 'We are an ecosystem of mutualistic relations between human cells and microbial

allies.' Without the gut microbiome, there would be no us. You can read more about this in the second part of this article by Inês Ventura.

It might sound strange to call ourselves a collaboration. That is because we understand ourselves by setting clear boundaries around us. This shapes how we relate to things and think about them. We think of ourselves as different and distinct from everything around us. As Plato put it, we 'carve nature at its joints', meaning that we find clean categories to organise and order the world around us. A lot of modern philosophy examines this critically, arguing that these distinctions are not fixed or inherent.

Take this outdated example, which used to be really popular: humans are the only animals that have complex language. Since then, it

has been shown that chimpanzees, dolphins, whales, and crows all have complex communication patterns. It shows that definitions based on categorical distinctions can collapse under scrutiny.

So the ground for reevaluating what we – humans – are, has been laid. We are the collaboration of a collective of beings. We are a fantastic, intricate, and essential collaboration.

But are we the greatest collaboration of all time? That is for you to decide. 

Further Reading

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Meet your 100 trillion tiny roommates

Known collectively as the gut microbiome, they are the bacteria, viruses, archaea, and fungi found mainly in the gut. They are linked to immune, mental, and digestive health.

Your gut
microbiome
weighs 2kg



What else weighs 2kg?



Your brain

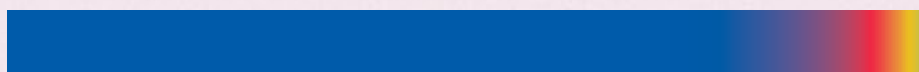


A 2L water bottle



A chihuahua

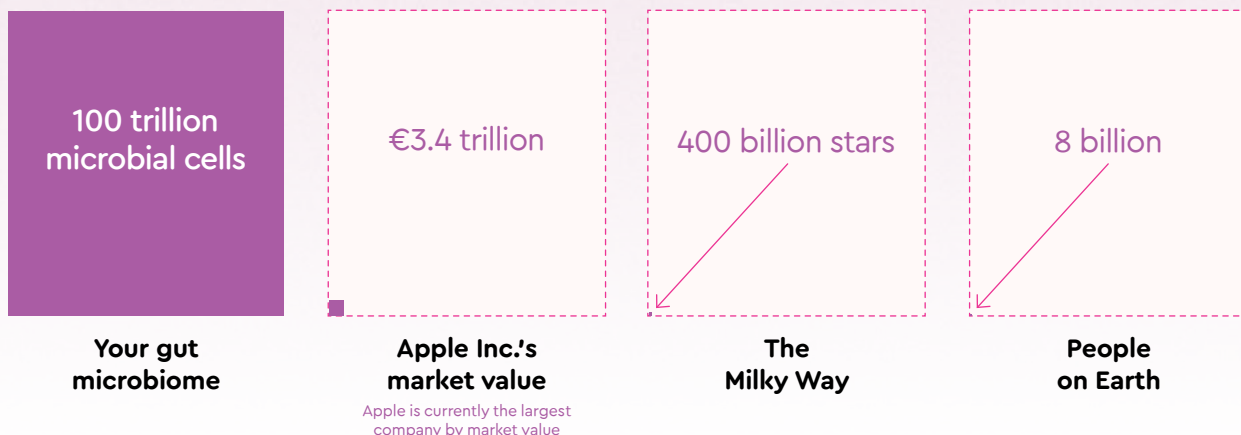
The gut microbiome is made up of:



Exact numbers will vary as gut microbiomes differ massively over one's lifetime and between people

~93% **bacteria**
~6% **viruses**
<1% **archaea**
<1% **fungi**

How large is the gut microbiome? • 1 trillion = 1,000,000,000,000 = 1×10^{12}



An incomplete list of genera and groups in the gut



Bacteria: Bifidobacterium, Clostridium, Escherichia, Eubacterium, Faecalibacterium, Lactobacillus, Peptococcus, Peptostreptococcus, Ruminococcus



Viruses: Adenoviruses, Caudovirales, Microviridae, Herpesviruses, Picobirnaviruses



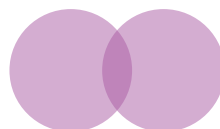
Archaea: Aspergillus, Bullera, Candida, Galactomyces, Pleospora, Rhodotorula



Fungi: Methanobrevibacter and many more which remain unknown



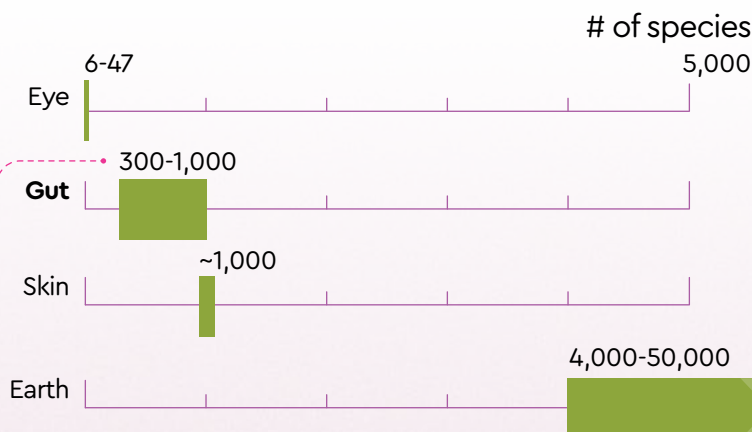
Identical twins only share 30% of their gut microbiome



Did you know there are other microbiomes? Here's how they compare to each other:

Depends on diet, location, cleanliness, and lots more

The human microbiomes pale in comparison to the Earth's microbiome i.e. soil



More than a gut feeling: The science behind the human gut microbiome

Author: Inês Ventura

The human gut microbiome is many things. It includes microbes we inherit from our mothers during birth and through breastfeeding. It can change because of diet, stress, and anxiety management, amongst other factors. But what is the microbiome, and how does it relate to human health?

The term 'microbiome' was coined to describe the collective community of bacteria, viruses, fungi, and other microbes that colonise a particular space or ecosystem – for example, the soil. Indoor spaces like homes, offices, and hospitals also have distinct microbiomes, as do all surfaces and objects. And most life forms have their own microbiomes that adapt to and take advantage of the conditions presented by the host. But aren't bacteria the cause of diseases like tuberculosis or pneumonia?

IS BACTERIA GOOD OR BAD?

This is where the concept of beneficial bacteria (those that help our health) and pathogenic bacteria (those that cause diseases) becomes relevant. Many bacteria live in and on our bodies and contribute to maintaining health. 'The human body

has several distinct microbiomes on the skin, in the mouth, and in our airways,' explains Prof. Godfrey Grech from UM's Department of Pathology. 'That is known as a mutualistic symbiosis – a relationship where both the bacteria and the host (us) benefit.'

But how do we benefit? One of the most consequential microbiomes for human health is the gut microbiome in the digestive system. According to Grech, approximately 100 trillion bacteria live in our large intestine (also known as the colon). That is 12 thousand times more bacteria in one person than there are people in the world!

The gut microbiome is responsible for constantly exchanging chemical signals with the body's cells and helping digest nutrients. This microbiome does things that the gut can't, such as:

- liberating or synthesising nutrients from food,

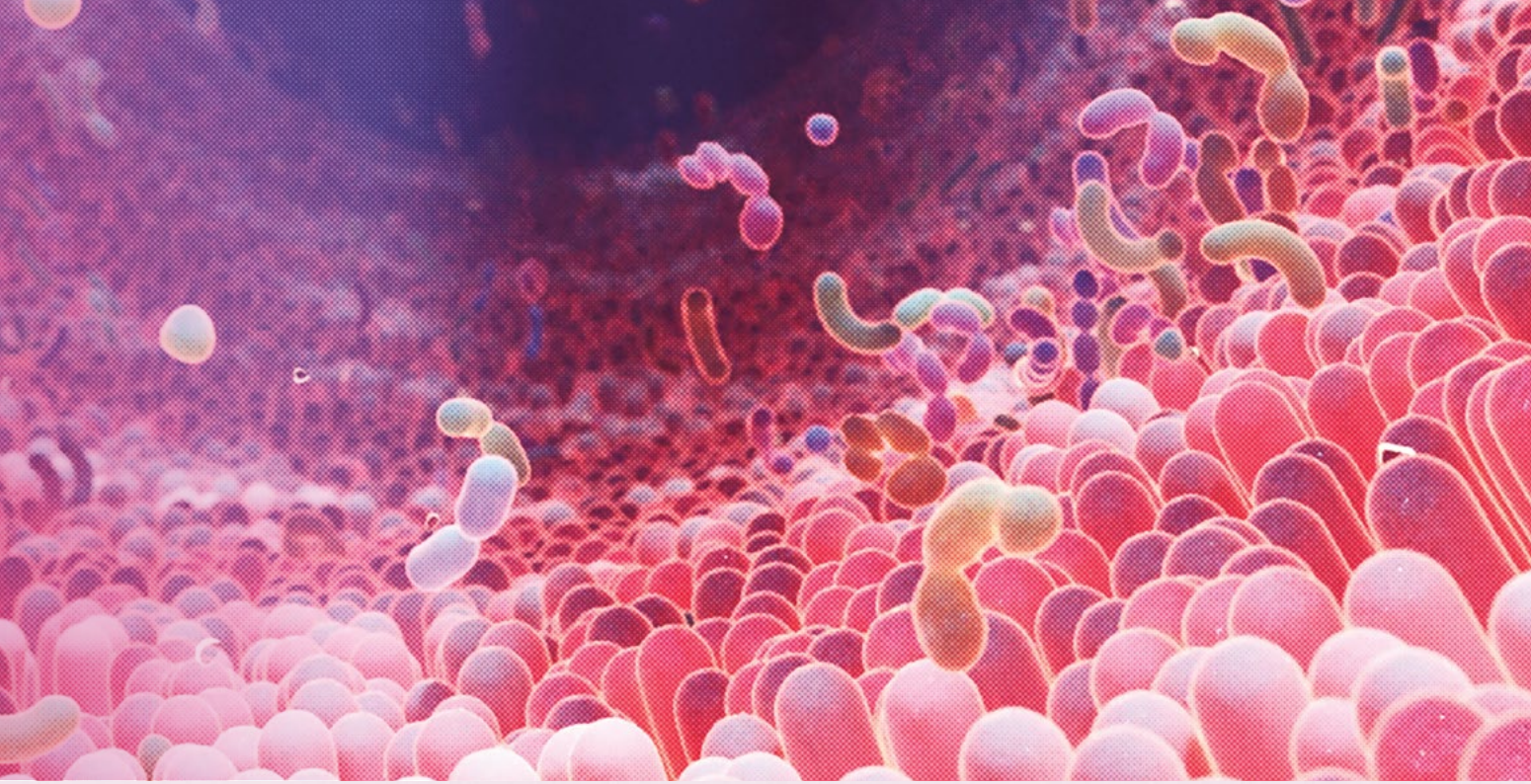
especially from plants and their polyphenols;

- living off non-digestible substrates like fibre;
- producing thousands of metabolites (useful chemicals);
- making vital short-chain fatty acids that are involved with immunity;
- keeping the gut and colon healthy; and
- moderating the body's inflammatory responses.

However, the gut microbiome relies on a careful balance of certain types of bacteria. When off balance, dysbiosis of the gut microbiota occurs, which leads to several diseases.

HOW THE GUT MICROBIOME AFFECTS EVERYTHING

The gut microbiome is deeply interconnected with various human systems like the brain, immune system, liver, metabolism, and even the lungs.



However, this also means that when the gut is in dysbiosis, the body may also experience anxiety, depression, hypertension, cardiovascular diseases, obesity, diabetes, inflammatory bowel disease, and cancer.

Taking a closer look at the gut-brain link, 'up to 90% of neurotransmitters are produced in the gut,' explains Grech. 'This includes serotonin, the happy hormone, and dopamine, the reward hormone.' That means that even neurotransmitters that are involved in social behaviour are affected and regulated by the gut microbiome. 'So even what we call butterflies in our stomach is an example of hormonal regulation and just goes to show how complex this gut-brain relationship is,' laughs Grech. When we are nervous, stress hormones like adrenaline or cortisol are released, which can stop the intestines from functioning or increase the blood flow to certain stomach areas, creating that feeling.

The link between systems can be negatively affected by stress, lack of sleep, poor nutrition, and no exercise. For example, chronic stress elevates cortisol levels, impeding gut motility and altering microbial composition.

This creates a vicious cycle, where an imbalanced microbiome further influences mood and stress responses.

The same is observed for immunity. In the intestines, the helper T cells are key players in maintaining a balance between immune defence against harmful pathogens and tolerance to beneficial bacteria and food antigens. In cases of a prolonged imbalance, these cells change their properties, and instead of suppressing the remaining immune cells, they will start activating them. This leads to chronic inflammation that drives more immune problems. These effects suggest the importance of understanding more about how the gut microbiome affects other parts of the body.

MICROBIOME AND PUBLIC HEALTH IMPLICATIONS

Despite significant advancements, studying the microbiome presents unique challenges. Sampling methodologies, such as relying on faecal samples as proxies for intestinal microbiota, introduce variability that age, individual routines, and hormonal levels only exacerbate. Furthermore, the dynamic and individualised nature of the

microbiome itself also complicates comparisons across individuals.

'Still, it all depends on the question that we want to answer,' says Grech. Up until now, regulating gut inflammation through dietary and lifestyle interventions offers promising avenues for mitigating related conditions. In severe cases and when pathogenic bacteria take over, faecal microbiota transplants are used. However, integrating early microbiome-based diagnostics could enhance accuracy and reduce unnecessary procedures in all cases.

Prevention strategies are also gaining momentum in microbiome research. Promoting dietary diversity and reducing exposure to endocrine disruptors may preserve microbial balance, mitigating risks of chronic diseases. The need to understand the gut microbiome and its links across the body extends beyond individual health, bearing implications for public health and preventive medicine as well. And so inevitably, the microbiome's role in nutrient metabolism only makes it all the more vital in our approach to addressing malnutrition and fostering healthier populations. **T**



Mapping a Sweeter Future for

HONEY

Production



Author: **James Moffett**

*Combining data-driven technology with traditional beekeeping, the **BEE-OPTECH4Honey** project aims to elevate honey quality in Malta and Türkiye. **THINK** meets with researchers **Arthur Lamoliere** and **Prof. David Mifsud** to discuss the potential benefits and groundbreaking use of modern technologies to enhance honey production.*



In a world increasingly dominated by digital solutions, the BEE-OPTECH4Honey project stands out with its unique fusion of technology and tradition.

This initiative, a collaborative effort between Malta and Türkiye, leverages Geographic Information Systems (GIS) and advanced data-processing techniques to optimise beekeeping practices. The aim is straightforward yet ambitious: to enhance the quality and sustainability of honey production by pinpointing ideal nectar sites and optimising beekeeper routes. With this innovative approach, BEE-OPTECH4Honey not only supports beekeepers but also works to secure a more resilient future for honeybees in an evolving ecosystem.

At the heart of this research are Prof. David Mifsud and affiliate researcher Arthur Lamoliere, both members of the Biodiversity and

Ecology Research Group (BERG) at UM. Mifsud, a professor of entomology and an apiculture expert, brings more than three decades of dedication to honeybee studies. Lamoliere, an ecologist specialising in GIS, complements this expertise with cutting-edge spatial data analysis, enabling the project to bring a scientific edge to traditional beekeeping practices.

In Türkiye, Dr Şahin Aydın is the founder and principal researcher of INTALA LAB (Intelligent Agriculture and Livestock Applications Laboratory) at Işık University, Istanbul. He coordinates the project and works alongside Dr Gülsüm Çiğdem Çavdaroğlu Akkoç (assistant professor in GIS and researcher), as well as Hüseyin Deniz and Hasan Kıvrakdal, research students at Işık University. Their expertise lies in IT and includes the development of optimisation models for assignment

and routing problems. They are also responsible for the design, development, and testing of an integrated information system for apiculture product management. The team also collaborate with Gökhan Akdeniz, Samet Okuyan, and Serhat Solmaz from the Apiculture Research Institute of Türkiye, who bring expertise in beekeeping, coordination with beekeepers across Türkiye, and honey analysis.

According to Lamoliere, 'The project aims to improve the efficiency, quality, and marketability of wild thyme honey, bridging tradition with innovation. We aim to optimise honey production quality by identifying the most suitable areas for beekeepers to place their hives.' This thoughtful intersection of technology and tradition is a reflection of the wider goals of this project. The focus is on collaboration, whether it means working with local farmers, ➤



Experimental apiary in the Denizli Province, Türkiye

Photo courtesy of Arthur Lamolieri



A Maltese honey bee foraging on wild thyme flowers

Photo courtesy of Arthur Lamolieri

conservation groups, or researchers from other institutions, and the aim is to advance ecological knowledge while creating real-world solutions for pressing environmental challenges.

FROM INSPIRATION TO REALISATION

The BEE-OPTECH4Honey project emerged from Mifsud's desire to develop and properly market a monofloral honey – honey produced from the nectar of a single plant species – in this case, wild thyme. Wild thyme honey has a unique flavour profile. Lamolieri's expertise in GIS provided the missing piece to Mifsud's vision, allowing the project to scale up traditional practices through digital tools and spatial analysis. By working together, they have crafted a strategy to both refine the quality of wild thyme honey and improve the efficiency of honey production as a whole.

The process uses models that combine multispectral images (layers of images with specific wavelength bands) captured by drones and satellites to locate areas rich in wild thyme. Machine learning then analyses these images, helping to identify prime spots for beekeepers to position their hives. Additionally, the model considers environmental conditions in order to

select the most favourable locations for honeybee foraging. This method effectively guides beekeepers to the most resource-abundant flower areas for better honey production.

BREAKING DOWN THE GOALS OF BEE-OPTECH4HONEY

BEE-OPTECH4Honey operates through a clear set of objectives designed to support both novice and seasoned beekeepers. These goals encompass a range of activities, from honey characterisation to the use of AI-driven imaging for land assessment.

1. **Honey Characterisation:** The first aim of the project is to characterise monofloral honey. By examining honey samples from different regions, researchers hope to pinpoint their floral origin and understand how environmental factors influence honey quality. This research could potentially help establish protected status for Malta's locally-produced wild thyme honey. 'The ultimate goal is to develop standards for achieving Protected Geographical Indication status for monofloral honey in Malta,' confirms Lamolieri. Such a designation would officially recognise the quality of Maltese

honey, benefiting local beekeepers and adding marketing value to the product.

2. **Mapping Nectar Sites with GIS**

and AI: Utilising satellite and drone imagery as well as machine learning, the team can identify the most productive areas for beekeeping practices in Malta. These assessments focus on floral availability, environmental conditions, and other factors critical to honey quality. By providing beekeepers with clear, data-driven recommendations, the project hopes to improve the productivity of each hive while ensuring that honey maintains its desired quality.

3. **Optimising Beekeeper Routes:**

In Türkiye, migratory beekeeping, which involves moving beehives to better sites according to the changing seasons, is a well-established practice. Mapping and optimising these routes allows beekeepers to avoid overpopulated areas and pollution, reducing costs and protecting the health of bee colonies. Ultimately, it is about finding the best paths for bees and beekeepers alike. The research analysis will provide a reliable way to move beehives so that they



Drone mapping setup in the wild thyme garrigue of northern Malta

Photo courtesy of Arthur Lamolier

are always where they need to be for the highest yield. Locally, the emphasis would rely more on finding suitable, fixed locations rather than routes.

4. **Creating a Digital Toolkit:** The project's final objective is to develop an accessible, integrated system where beekeepers can find essential information about nectar availability, site quality, and optimal migration paths. This toolkit would include user-friendly digital resources that streamline the beekeeping process, offering insights into seasonal changes, floral density, and more.

SELECTING SUITABLE NECTAR SITES: A PRECISION-DRIVEN PROCESS

A core focus of BEE-OPTECH4Honey is identifying optimal locations for beehives to ensure maximum honey quality. Lamolier details the factors that determine a site's suitability. Specifically in Malta, 'to be considered suitable, a site must have plenty of wild thyme, as it's essential for our monofloral honey. The area should also be free from pollution and be accessible to beekeepers.'

Using high-resolution multispectral imagery and AI-driven data analysis,

the team maps areas abundant in wild thyme that are free from pollutants. These models examine environmental variables and floral density, to recommend locations where bees can thrive. Maximising both the productivity of each hive and the health of each colony is key. Such technology not only benefits the beekeepers but also protects the delicate ecosystems that support honeybees.

For migratory beekeepers, this is a game-changer. Instead of relying on historical knowledge alone, one can now predict optimal routes based on real-time data. This reduces operational costs and helps prevent hive overcrowding. 'Optimising these routes improves honey production,' says Lamolier, 'and reduces operational costs while also promoting the health of the bee colonies.'

A BUZZING COLLABORATION WITH A BRIGHT FUTURE

Looking ahead, BEE-OPTECH4Honey is redefining how we think about honey production and environmental stewardship. The significance of the project goes beyond honey. At its core, the project represents a holistic approach to sustainable agriculture that respects traditional methods

while embracing the possibilities of modern technology.

By enhancing nectar sites and migratory routes, this research preserves valuable beekeeping traditions while addressing the realities of climate change and urban expansion.

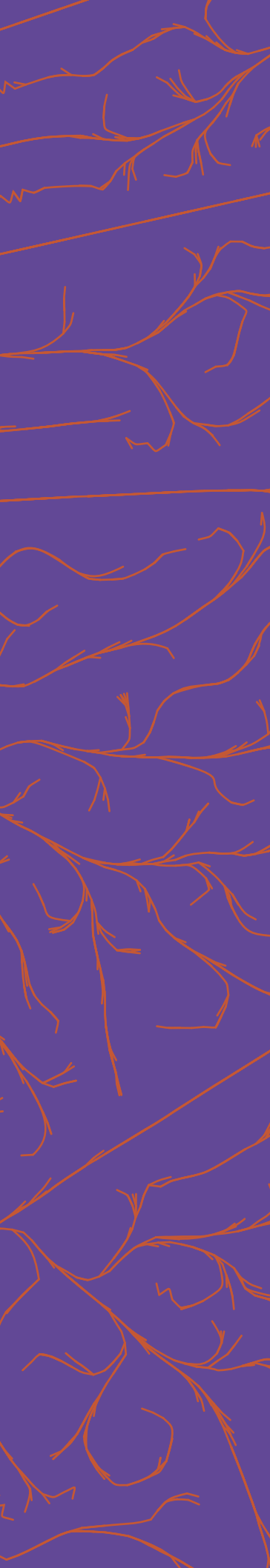
Working with a passionate group of individuals makes the effort even more worthwhile. Reflecting on their progress, Lamolier notes, 'It is a very exciting project, and I love to work on it with such a nice team.' It is evident that the technology being implemented is making a tangible difference in a time-honoured craft – while safeguarding that legacy for forthcoming generations. With the collaboration between Malta and Türkiye, BEE-OPTECH4Honey is poised to set new standards in honey production, ensuring that beekeepers – and their bees – thrive for years to come. 

Project BEE-OPTECH4Honey is funded by Xjenza Malta and the Scientific Technological Research Council of Türkiye (TÜBİTAK) through the MCST-TÜBİTAK 2023 Joint Call for R&I projects. This initiative is part of the PRIMA Programme supported by the European Union.

The background of the entire page is a solid purple color. Overlaid on this is a dense, intricate pattern of thin, orange lines. These lines are drawn in a way that suggests the branching structure of fungi, with many lines starting from a single point and spreading out in various directions, some ending in small, feathery or spiky tips. The pattern covers the entire page, creating a textured, organic feel.

FUNGI-BASED AUXETIC MATERIALS

**A New Type of
Mushroom Recipe**



Author: **Antónia Ribeiro**

*We need to rethink the materials we use, from the types of clothes we buy to the construction bricks in our homes. Reducing the amount of waste that ends up in landfills is crucial for the future of our planet. The **AUXFIM** project at UM proposes a solution by producing a sustainable yet strong auxetic mushroom-based composite material.*

Every year, the European Union generates 2.2 billion tonnes of waste, and in Malta, 86.2% of municipal waste goes to landfills. Landfills are problematic because they occupy useful space and pollute the environment – not only through the infiltration of toxins from the soil and water but also by creating the perfect conditions for decomposing waste to produce greenhouse gases. Escaping toxins and air pollutants can also affect the health of surrounding populations.

Protecting our health and the environment demands that we think about the life cycle of products. Which products can we consume less of? What can we exchange or give instead of throwing away? What can be reused or repurposed? Mindful consumption is important even in the production phase. How does the product's design

shape how it will be used, repurposed, or discarded? Which raw materials can be replaced by biodegradable or energetically sustainable options?

MUSHROOMS AS BUILDING MATERIALS

If you are looking for an ingenious example of sustainable material development, look no further than the Auxetic Fungi Biomaterial (AUXFIM) project at UM, a collaboration between the Metamaterials Unit of the Faculty of Science and the Department of Physiology and Biochemistry at the Faculty of Medicine and Surgery. The team are working on producing biodegradable auxetic materials (materials that contract vertically when compressed horizontally) using mushrooms, promising a novel composite material that is durable, cost-effective, and good for the environment. ➔

In conversation with **THINK**, the AUXFIM team, consisting of principal investigator Prof. Pierre-Sandre Farrugia and Prof. Ruben Gatt from the Materials Unit, together with Chev. Prof. Renald Blundell, from the Department of Physiology and Biochemistry, and research support officer Claudia Cadinu, explain how they are creating this unique material.

Mushrooms offer a plethora of benefits. Besides being biodegradable, they can withstand physical stress such as compression or bending. Some species even produce by-products during their growing stage that can be used for biomedical applications like drug production. Some species can also filtrate toxic elements, like heavy metals, when they come into contact with them in the soil or landfills.

For the purpose of the study, the team selected three mushroom species: *Ganoderma lucidum* (reishi mushroom), *Pleurotus ostreatus* (oyster mushroom), and *Trametes versicolor* (turkey tail mushroom). These species are naturally abundant, easily accessible, and have been extensively researched, meaning that the team has readily available information about cultivation protocols, safety concerns, and impact on composite properties. Blundell and Cadinu also explain that, according to existing literature, these fungi species do not produce harmful compounds, 'ensuring safety in biocomposite production'.

Oyster mushrooms are the main characters in many culinary dishes. They can grow on a wide variety of substrates, reducing production costs and, effectively, the cost of the final product. Reishi mushrooms are known for their anti-tumour properties, while turkey tails mushrooms are 'valued

for their medicinal properties, including immunostimulant and antiviral effects,' Blundell and Cadinu point out.

A PROOF OF CONCEPT FOR AUXETIC BIOMATERIALS

Composites are materials formed by two or more elements that, when combined, result in a material with different properties from its individual components. In this case, the auxetic biomaterial will be composed of mushroom mycelia (the mushroom equivalent to plants' roots) and the substrate from which the fungi get their nutrients. While the mycelia grow, they start adhering to the substrate and forming solid structures, making it possible to use moulds to guide their growth and dictate the final shape of the biocomposite.

A system is auxetic if it expands vertically when pulled horizontally, meaning it becomes longer and wider when pulled, also known as a negative Poisson's Ratio. This differs from most natural materials, which typically have a positive Poisson's Ratio. Like elastics, materials with a positive Poisson's Ratio become longer but thinner when pulled.

A negative Poisson's Ratio translates into important physical properties, like improved shock absorption. Such properties give these materials incredible potential for applications not only in impact loading systems but also as smart particle filters (filters with pores that increase in area when pulled, making them easier to clean), fastening devices (like screws, rivets, and nails), dilators for medical applications (such as a stent inserted into the heart artery), and smart sporting accessories including running shoes and garments.

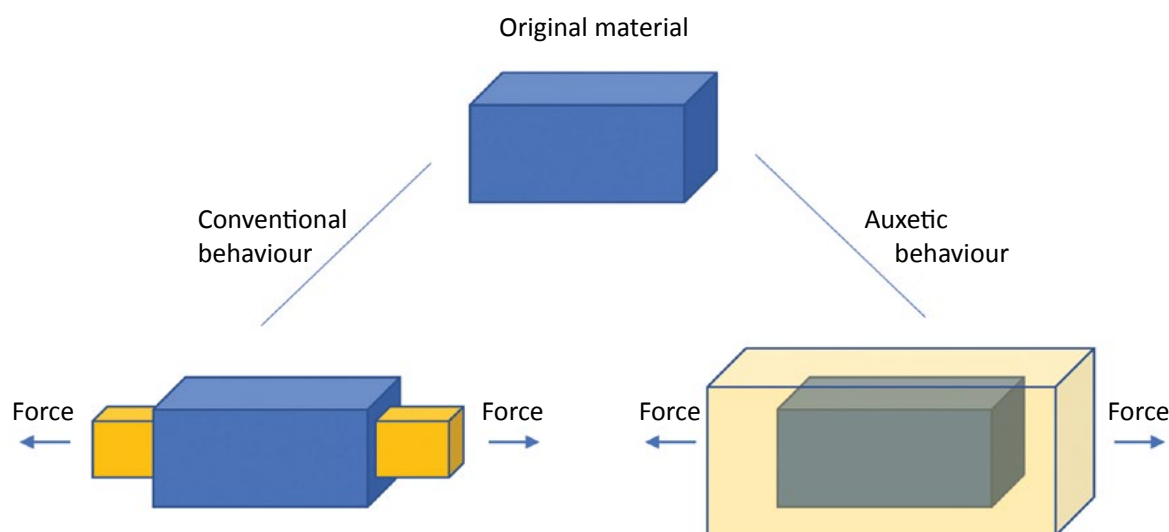


Illustration of the difference in behaviour between a conventional material (bottom left) and an auxetic one (bottom right)

Illustration courtesy of the AUXFIM Team

The AUXFIM team decided to test their biomaterial in the form of a pot for agriculture, a proof of concept showcasing the potential application of the new biocomposite. Can they produce a fungi-based material that not only has auxetic properties, but is also cost-effective and can be reproduced on a large scale with no alteration of its physical properties?

If successful, the pot will be biodegradable. Because the design of the mushroom-based composite should have auxetic properties, the pot should be able to expand with the roots of the plant. The pot can also provide nutrients to the plant itself. These features are particularly important for repotting, as they remove the need to transfer the plants from their nursery pot (usually made of plastic) to their final planter. Instead, the plant can simply be repotted with its nursery pot. Eventually, the biodegradable auxetic pot is meant to degrade into compost, reducing the use of plastic.

SHAPING FUNGI IN THE LAB

The team is now testing the best combination of mushroom mycelia and growing substrate, as well as different methods to grow and dry each species. The goal is to see how these variables affect the mechanical properties of the resulting biomaterial. For example, the figure below shows two biocomposites formed by the mycelia of two different mushroom species (the white block used turkey tail and the grey block used reishi).

Gatt explains that usually, fungi-based materials can sustain relatively large compressions but easily break under tension (like stretching). Farrugia adds that they would like their biocomposite to undergo relatively large deformations

under both tension and compression. As such, the team wants to determine the best growth conditions and fungal species needed for a biocomposite that has these mechanical properties.

The shapes the mycelia grow into will also affect the properties of the final product, so the team is 3D printing moulds to test different shape configurations. Another factor affecting the final product is the substrate used to grow the fungi. Agricultural waste like sawdust, rye, straw, and even municipal organic waste can be used as substrates. Using materials that would otherwise be discarded in landfills as substrates is a great way to reduce waste and nurture a circular economy. Yet, these types of substrate can actually present a risk for the standardisation of the biocomposite because producers will not be able to control the composition of the substrate, which could potentially affect the characteristics of the final material.

At the moment, the research team is testing various growth conditions, substrates, and fungal species to see how they affect the properties of the biocomposites. Farrugia remarks that because 'this is the first study combining mushrooms with auxetic properties of composites, it is very hard to predict the outcomes. It is an anything can happen situation.' Ultimately, they hope to find the ideal mushroom species and processing methods to create a biodegradable, mushroom-based material that is strong, cost-effective, and easily applied to different industry sectors, and that can contribute to a zero-waste society. 

AUXFIM is a project financed by Xjenza Malta through the FUSION: R&I Research Excellence Programme.



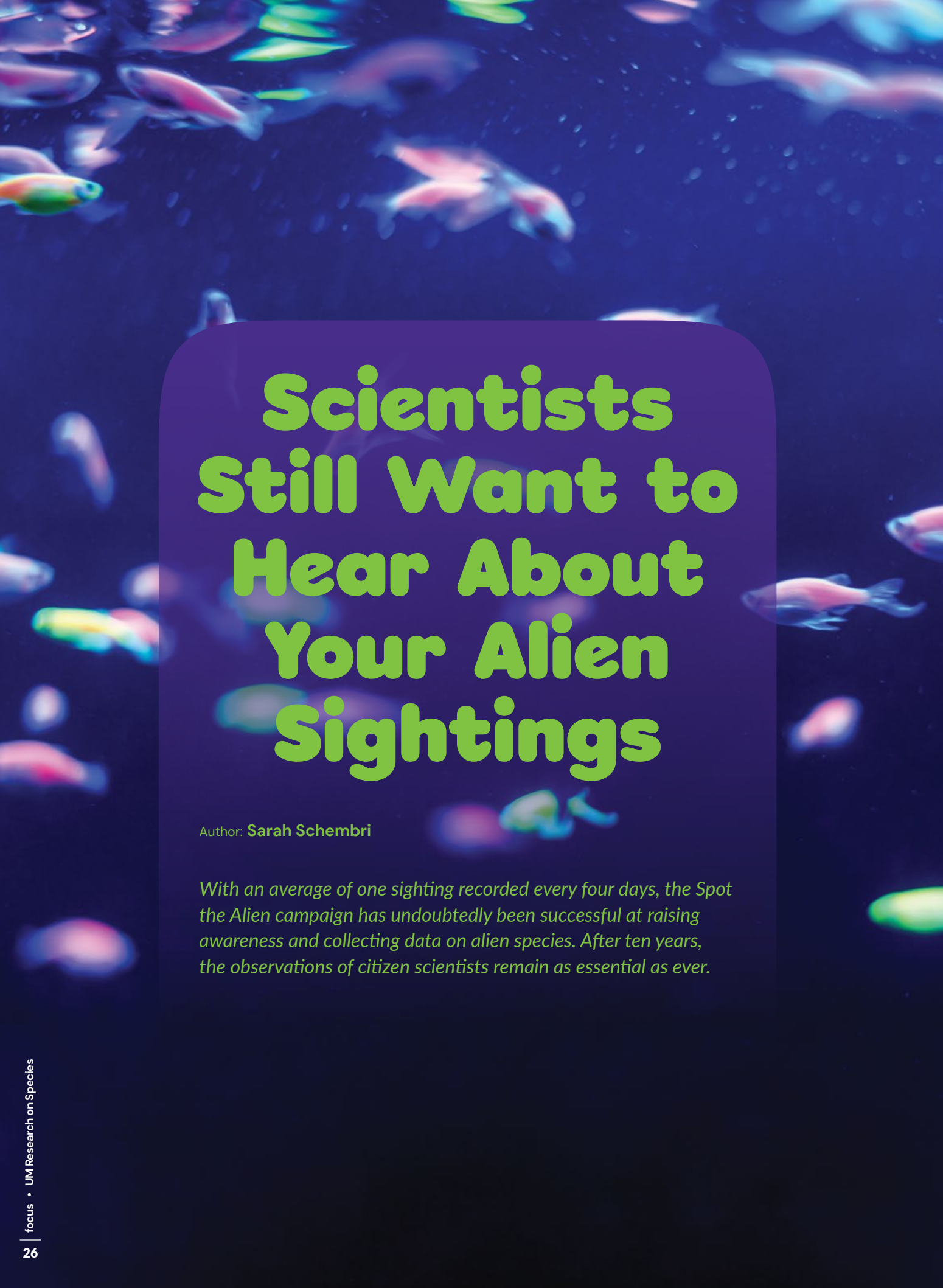
Mycelium biocomposites grown in rectangular shapes and dried using a microwave

Photo courtesy of the AUXFIM Team



The first batch of auxetic systems built using fungi

Photo courtesy of the AUXFIM Team



Scientists Still Want to Hear About Your Alien Sightings

Author: **Sarah Schembri**

With an average of one sighting recorded every four days, the Spot the Alien campaign has undoubtedly been successful at raising awareness and collecting data on alien species. After ten years, the observations of citizen scientists remain as essential as ever.



It is very important that we keep monitoring the aliens.' This is one of the main messages from my conversation with Prof. Alan Deidun on the Spot the Alien campaign. The campaign has been ongoing since 2015, and after 10 years, it is more important than ever to be constantly on the lookout for alien fish and other alien marine species. (If you were hoping to read about extra-terrestrial aliens, sorry, wrong article.)

MONITORING FOR ALIENS

Thanks in no small part to the Oceanography Malta Research Group's (OMRG) campaigns, the public is generally well aware that, in recent years, several marine species that are not native to our waters – alien species – have been sighted, filmed, captured, and seem to be making themselves at home. The first sighting of an alien species is very important because it indicates a range expansion of the species. First records of a species in a new location are published in a peer-reviewed journal to inform the scientific community. However, continued records of the presence of a species are equally, if not more, important for monitoring purposes. This is why, after ten years, everyone and anyone is still encouraged to inform the Spot the Alien campaign whenever they spot an alien species.

The more observers scientists have, the more information they can glean. From the information scientists get from alien reports,

they can learn about the species' seasonal trends and how established they are in the new habitat, leading to some educated assumptions on how they were introduced to Maltese waters. They can also use the data for innovative research, such as training computer vision algorithms to identify species from photos.

If you are not sure if you've spotted an alien species or not, you can find information online, on social media, through educational videos, and on beach signs, with the sister Spot the Jellyfish campaign including beach signs with alien jellyfish species. You will also get a response for every observation you submit to the campaign.

The alien-spotting campaigns managed by the OMRG are also assisting biologists in North Africa (eastern Libya and western Egypt) to record marine alien species in their waters, thus compensating for the fledgling scientific infrastructure in such a challenging (geopolitically-speaking) region of the Mediterranean. All the citizen science campaigns managed by the OMRG have now been included in the European Citizen Science Association's online database.

ALIEN INVADERS

By definition, alien species are species that have been introduced to a new habitat through human intervention. Some people buy tropical fish and algae for their aquariums and then, accidentally or on purpose,

release those species into the wild. This is likely how the Australian algae *Caulerpa racemosa* and *Caulerpa taxifolia* were introduced to the Maltese coastal habitat years ago. The aquarium trade is also likely to blame for how the tropical lionfish, native to the Indo-Pacific, has spread from the Caribbean to the northwestern Atlantic and recently into the Mediterranean too. The highly invasive and destructive lionfish has been spotted in Sicily and in Tunisia, so it will likely be spotted in Malta very soon – Spot the Alien Fish is implementing an early warning system in this case by giving away a brand-new Go-Pro 12 model to the first person to report it.

The shipping industry is another pathway for the introduction of alien species. Ships take ballast water in one ocean and release it in another; with it, unsuspecting organisms are moved across the globe. Additionally, some marine craft act as a fish aggregating device – if they move slowly, the fish move with them. This might be how two Guinean angelfish (*Holacanthus africanus*), spotted in April 2017 in the Senglea port through the Spot the Alien campaign, are believed to have arrived there. They probably hitched a ride on an oil rig that had just arrived from West Africa – the native habitat of the Guinean angelfish. Several international and European laws have been introduced to control and mitigate the spread, including the International Convention for the Control and Management of Ships

Ballast Water and Sediments by the International Maritime Organisation of the United Nations. However, maritime laws are difficult to implement, and most regulations do not even apply to the recreational boating industry. Although recreational vessels might not have ballast water, marine species can be carried on the biofoul stuck to vessels' undersides (read more in **THINK** Issue 41, p. 68). Even non-sessile species like crabs can be carried for miles in this manner.

In the 1860s, the French engineer and diplomat Ferdinand de Lesseps led the construction of the Suez Canal, opening a new route for shipping while also opening the proverbial floodgates for tropical marine migrants, which started to spread from the Red Sea into the Mediterranean. These species are called Lessepsian migrants, and hundreds of them established themselves in the Eastern Mediterranean around the 1980s, taking up a good proportion of the fish market there. This is a grim portent for us in the Central Mediterranean, as the Lessepsian migrants continue to make their way westward.

It's reasonable to ask: how come Lessepsian migrants only started to be observed in large numbers several decades after the opening of the Suez Canal? The answer is climate change. These tropical species could not overwinter in the Mediterranean and establish viable populations until it started to warm up. As we see more marine heatwaves and milder winters, the Lessepsian migrants can overwinter and reproduce in areas further to the west.

Apart from climate change, alien species generally thrive in stressed environments. This means that pollution, overfishing, and

habitat destruction, such as by boat anchors, prepare the ground for the takeover by the new arrivals.

EXTENT OF THE PROBLEM

Just because a species is introduced to new surroundings does not mean that it will harm the new habitat. Empirically, about 90% of alien species are not invasive. However, the 10% that are invasive can drastically change the ecosystem to the point that, globally, alien species are considered a top threat to the conservation of marine ecosystems.

Usually, invasive species are not fussy eaters, have high fecundity, and have few natural predators. These adaptations allow them to thrive in many different habitats and quickly increase in numbers to outcompete native species. In the process, the newly introduced species can change how the ecosystem functions, disrupt nutrient

and carbon cycles, and in a worst-case scenario, lead to ecosystem breakdown. These ecosystem disruptions impact economic activity and human health by disrupting fisheries and decreasing water quality, for example.

In Malta, impacts on human health have been direct, as some alien species, like silver-cheeked toadfish, are highly toxic. Incidentally, five of this type of pufferfish were caught in Marsamxett harbour in January of this year. The presence of five individuals caught in one place shows that the species is reproducing and increasing in abundance, demonstrating the importance of continuing to report records of alien species. Fishers are familiar with pufferfish and know that it should not be consumed. However, in 2019, two patients were admitted to Mater Dei suffering from neurotoxicity after eating octopus. Almost no octopus have the neurotoxin



Five silver-cheeked toadfish (*Lagocephalus sceleratus*) that were caught in Marsamxett harbour during January of this year
Photo by Alan Gatt



Bluespotted cornetfish (*Fistularia commersonii*) spotted in Ċirkewwa
Photo by Edward Vella

tetrodotoxin, but it is hypothesised that the octopus had eaten a pufferfish, thus poisoning its own consumers via secondary intoxication.

SOLUTION

Controlling the spread of alien species is a difficult and sometimes impossible task. The Environment and Resources Authority has a national strategy for preventing and mitigating the impact of alien species, but efforts so far have been primarily focused on non-marine species. That said, good efforts have

been made to remove invasive crayfish from freshwater habitats (such as Chadwick Lakes) and invasive plants from Comino despite a late start.

In certain cases, such as with some algae, trying to remove them from the environment can aggravate the problem because small bits that fall off can propagate; therefore, efforts to remove the algae can unwittingly spread them. Still, some new arrivals might go through boom-and-bust cycles and eventually become less of a threat, as in the case of the previously

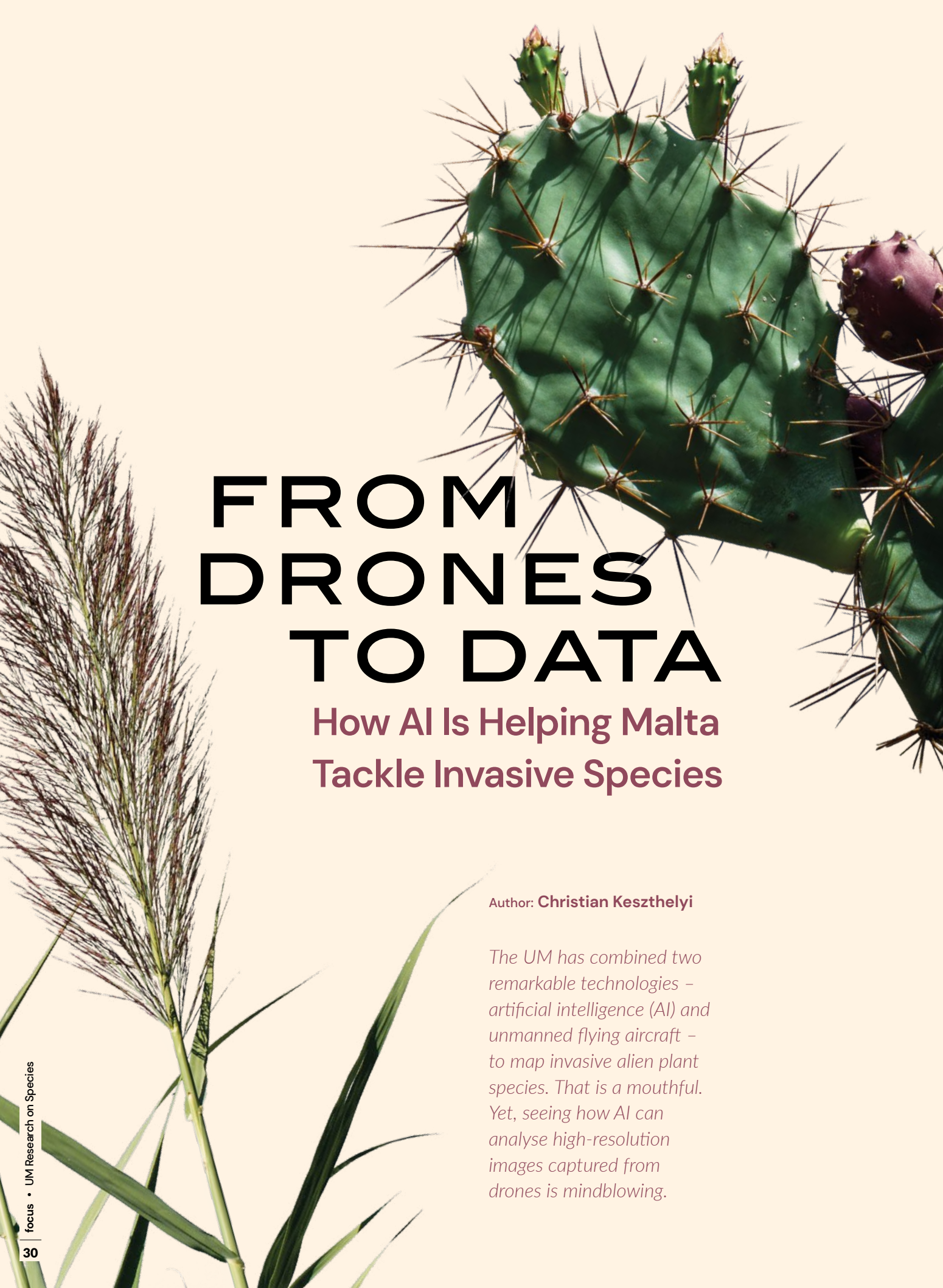
mentioned *C. racemosa* and *C. taxifolia*, which have regressed naturally.

As apex predators, we can lessen the problem of invasive species by eating them. For this reason, Ambjent Malta, Deidun, and RSO Alessio Marrone are working on a recipe book of invasive alien species such as the blue-swimmer crab. Alien species have been with us for so long that five have even been christened with Maltese names: Qawsalla, Trumbettier, Hmar tal-Lvant, Gurbell tal-Port, and Xkall tal-Lvant. According to Deidun, we can prepare to name many more because 'we can expect a quantum increase in the amount of alien species in our waters.'

As usual with big structural problems, an individual is limited in what they can do to help. Ultimately, what can slow down the spread of alien species is making sure that our marine habitat has fewer stressors. For this, we need big structural changes that mitigate climate change and reduce the detrimental impacts of our many marine activities. However, knowing the extent of the problem helps, and any citizen can lend a hand, so keep an eye out for the aliens! 



Two blue-swimmer crabs (*Portunus segnis*) that were caught in Qajjenza
Photo by Reno Tonna



FROM DRONES TO DATA

How AI Is Helping Malta
Tackle Invasive Species

Author: **Christian Keszthelyi**

The UM has combined two remarkable technologies – artificial intelligence (AI) and unmanned flying aircraft – to map invasive alien plant species. That is a mouthful. Yet, seeing how AI can analyse high-resolution images captured from drones is mindblowing.

Bang in the middle of the Mediterranean Sea, Malta is locked between Europe and Africa with its own geographic ecosystem. However, domestic flora and fauna have been under duress due to the introduction of invasive alien animal and plant species that disrupt local ecosystems.

The Louisiana crawfish, likely released into Malta's Chadwick Lakes as discarded pets, prey on native frogs and their eggs while competing with indigenous species for resources, threatening local aquatic life. At the same time, the Asian hornet is a growing concern on land. These aggressive predators threaten biodiversity, crop yields, and natural vegetation by preying on the native honey bees essential for pollination and agriculture. Their rapid reproduction makes control and eradication difficult.

Plants can cause equally severe disruptions to the island's ecosystem. Therefore, the UM teamed up with Ambjent Malta, a government entity tasked with preserving and enhancing Malta's natural capital and biodiversity, to map plants that are foreign to Malta and understand their impact on the local ecosystem. The Malta Information Technology Agency, the government's IT agency, funded the project.

'Ambjent Malta was particularly keen to tackle invasive plant species, which often spread through discarded seeds or plants and outcompete native flora. The proposed solution centred around deploying a drone equipped with a high-resolution camera to survey local valleys and capture the images. Then, using artificial intelligence, we would detect and map the invasive species,' Prof. John Abela from UM's Department of Computer Information Systems tells **THINK**.

DISRUPTING LOCAL ECOSYSTEMS

Invasive plants outcompete native species for sunlight and nutrients, eventually dominating the environment and leaving little room for indigenous plants. This disrupts domestic ecosystems, as native plants often provide food and habitat for local wildlife, affecting the entire food chain.

'The issue underscores how human actions, such as releasing pets into the wild or unintentionally importing species, can have long-term and wide-reaching consequences on biodiversity,' Abela says.

But why would humans introduce alien plant species to their homeland? There can be many reasons, often practical. Malta's well-known prickly pear was intentionally planted along

field edges to protect crops from wind damage. While it served this purpose effectively, it eventually began competing with native species. Similarly, many invasive plants were imported as ornamental garden additions. Over time, their seeds were dispersed by the wind, spreading uncontrollably and encroaching on local ecosystems.

'Before addressing the issue, it's crucial to understand the extent of the problem. This is where our project plays a key role. By mapping the locations and spread of invasive plant species, we provide a clear picture of their distribution. Annually monitoring these species enables us to track changes over time, identifying whether their populations increase or decrease,' Abela says.

The project began with a drone survey of 37 valleys selected by Ambjent Malta, capturing high-resolution aerial photos of plants. These images were then stitched together to create a mosaic. A trained biologist at Ambjent Malta then reviewed the images to identify and label invasive species. Once identified, the biologist used a tool to outline the invasive plants in each image, a time-consuming process that took nearly a year to complete across all 37 valleys. ➔



Top left: A typical drone used for aerial surveys



Top right: The *Opuntia ficus-indica* (Bajtar tex-xewk) is an invasive cactus that was probably introduced because the fruit is edible

Bottom right: The *Arundo donax* (great reed) invasive alien reed that has taken over many of Malta's and Gozo's valleys and water courses

Photos courtesy of the team



TEACHING THE AI

'After labelling, we used open-source convolutional neural network (CNN) models adapted to our project's needs. A research support officer (RSO) with a Masters degree in ICT implemented the deep learning models. While data labelling continued, I worked closely with the RSO to refine the models. We trained the models on mosaics from five or six areas, leaving parts out for testing. This iterative process ensured accuracy in identifying invasive species. At the same time, we wrote custom code to address image noise and anomalies,' Abela says.

The model analyses mosaics to locate invasive species, highlighting them in different colours based on the species. During training, the researchers provided labelled data for the model to learn iteratively.

This process is similar to training a model to differentiate between dogs and cats using 1,000 pictures of each

and a smaller validation set of 100 images per category which are not used during training. When the model is given a picture, it outputs probabilities for each class (dog or cat). If the model misclassifies the image, the error is calculated, and the model adjusts its internal weights to improve accuracy.

The analysis and learning steps require significant computing power, as the computers need to run continuously for five to six days in air-conditioned rooms. Once the model optimised its process of differentiating between different flora, it was tested on unseen validation images. When it classified these correctly, the team considered it ready for real-world use.

'AI is invaluable because, unlike traditional programming, it doesn't require complex rules. Neural networks, inspired by biological brains, learn from vast data, automatically adapting and improving. While powerful machines and GPUs [graphics processing units, which are specialised

processors designed to handle the complex calculations needed for rendering images and videos] enable training, the biggest challenge is acquiring and labelling data. For our project, this meant painstakingly labelling invasive species in large images – a time-consuming but essential task,' Abela says.

CHALLENGING FEAT

The project team faced some challenges. One of these was that some local plants closely resemble the invasive species. Even a trained human eye, carefully examining high-resolution photos, could sometimes mistake one for the other. To address this, the team conducted field trips to physically verify the species.

Another challenge was refining the models. Although deep learning models are often considered to be general-purpose, their core engine is versatile. Still, significant customisation through extensive coding was needed to tailor



Top: Ortho-image inputted into ArcGIS showing identified patches of the species *Opuntia ficus-indica*

Bottom: The red is the coarse grain *Opuntia* label, the purple line is the fine grain

Images courtesy of the team

the engine for this specific task to suit the project team's needs.

Additionally, plants can look quite different depending on the season, which posed another problem. 'For instance, if you take an image in May, the plant might appear very different in August. By then, much of the green could be gone. After the rains in October and November, the plants would change again. Ideally, to handle these seasonal variations, we would have run the drone surveys four times a year, but unfortunately, the cost of doing so was prohibitive,' Abela says.

Although the project ended after mapping the invasive species, Abela is launching another project to automate the entire process. Now that the team has a robust dataset, they can focus on streamlining operations and improving efficiency, potentially transforming how we monitor and address invasive plant species in Malta.

This shall lead to the ultimate goal of eradication, for which experts

need comprehensive knowledge, as strategies and decisions are complex.

'Take the giant *Arundo* reed, for example. This plant grows in waterways and has displaced local flora. However, many local fauna have adapted to use it as breeding grounds. This creates a dilemma: eradicating the reed would help restore native plants but could harm the ecologies now dependent on it,' Abela says.

Ambjent Malta is considering a balanced approach. In some areas, full eradication may restore the original ecosystem. In others, invasive species may be left intact to preserve the adapted ecology. This strategy allows for both conservation and practicality.

The project has appeal – and use – beyond Malta's shores. 'We are planning to move forward with this project, and Ambjent Malta has contacts with the University of Palermo, who are interested in our work. We will likely collaborate with them and share our findings and methodologies, which

is especially relevant because Italy faces the same issue. Similarly, France and Spain are also grappling with invasive fauna and flora,' Abela says.

'The key issue, as I often point out, is funding. We would like to move to Phase 2 of the project. This will include using a drone with a multispectral camera, seasonal surveys, and the application of the latest Transformer AI models. This will require funding for equipment and also human resources. While the potential exists, funding remains a significant barrier,' Abela concludes. 

Funding for the Detection of Invasive Alien Plant Species from High-Resolution Drone Images project (MITA: C074/20/SOW) was provided by the Malta Information Technology Agency (MITA) in the form of a grant.

The full list of acknowledgements is available on the digital version of the article at thinkmagazine.mt

BYTHOS: Transforming Fish Waste into Resources

Author: **Elena Said**

BYTHOS and its successor, **Waste2Taste**, are pioneering projects that transform fish waste into valuable resources. They promote sustainable biotechnologies and circular economy principles and have achieved significant breakthroughs, converting waste into health-enhancing products while tackling environmental challenges.

BYTHOS was a cross-border cooperation initiative funded by the Interreg V-A Italia-Malta 2014–2020 program and launched in 2018. The project's primary goal was to convert waste biomass from the fishing and aquaculture industries into valuable resources, advancing investment in biotechnologies that support human health and sustainable blue growth.

Inspired by the principles of a circular economy, BYTHOS emphasised resource reuse to minimise waste, reduce environmental impact, and improve efficiency. The project challenged the conventional view of waste, treating it as a source of valuable molecules that can be broken down and repurposed. Through its innovative approach, BYTHOS aimed to reduce reliance on fresh resources, lower carbon footprints, and foster sustainability.

The UM's participation within the project was led by Prof. Alan Deidun, a marine biologist and Professor at UM's Department of Geosciences. With nearly

three decades of association with the university, Deidun has contributed extensively to marine policy, sustainable practices, and climate action. As head of the Oceanography Malta Research Group, his expertise played a key role in advancing the project's objectives.

WINNING THE REGIOSTARS AWARD

Coordinated by the STEBICEF team led by Prof. Vincenzo Arizza at the University of Palermo, BYTHOS brought together a diverse team, including the UM, four Italian partners, the Maltese company Biotech, and the Maltese Government's Department of Fisheries and Aquaculture. This collaboration is part of a long-standing tradition, as UM has participated in Italia-Malta projects for over 20 years.

A major highlight of the project was winning the prestigious RegioStars award. Organised by the Italia-Malta Managing Authority in Palermo, the award recognised BYTHOS as the best overall project. For the first time in the award's history, a single project won



both the technical jury vote and the public vote, which was open to all European citizens. This groundbreaking achievement was a first for both BYTHOS and UM.

'Winning the RegioStars award came as a massive surprise,' says Deidun, recalling a late-night call from Arizza, who was representing the team in Brussels. When the announcement was made, Arizza immediately contacted Deidun to share



Lyophilised (freeze-dried) collagen samples extracted from waste Atlantic bluefin tuna
Photo by Neil Cutajar

the news. The Maltese Ministry celebrated the achievement, highlighting its significance for a Malta-involved project.

THE BYTHOS PROJECT: FROM HYPOTHESIS TO RESULTS

The BYTHOS project applied circular economy principles to biologically active molecules (BAMs), such as collagen, unsaturated fatty acids, and fish oils, which play crucial roles in human metabolism. These molecules, often consumed as food supplements, offer benefits like improving heart health and joint function. Collagen, in particular, is used extensively in cosmetics and reconstructive medicine, as it supports skin elasticity and bone health. As collagen levels naturally decrease with age, it becomes increasingly important to supplement them.

'So far, most of the collagen used in food supplements comes from land-based livestock, meaning from the organs of butchered animals,' explains Deidun. 'However, in marine organisms, the levels are higher and of better quality. Apart from this, some cultures and religions cannot use collagen extracted from certain land animals.'

Malta's bluefin tuna industry, one of the largest in the Mediterranean, produces around 5,000 tons of waste annually, including fish heads, tails, scales, and internal organs. This waste is often discarded into the sea, posing environmental challenges. BYTHOS focuses on extracting BAMs from this [▶](#)

Fresh Atlantic bluefin tuna samples sourced from local operators for further processing

Photos by Neil Cutajar



waste and repurposing it for applications in food supplements. Fish oils offer benefits for heart function by reducing the risk of cardiac arrest and serve as a healthier alternative to animal fats.

The project also explored the use of fish waste in wound healing and antibacterial applications. Some partners were focused on extracting BAMs with antibacterial properties or those that aid in tissue repair. 'Emerging research in BAMs shows promise for extracting molecules that help accelerate wound healing, which could have significant market applications,' states Deidun.

To ensure safety and quality, BYTHOS-produced collagen was sent to a cosmetic company in Parma, Italy, where it was tested for mercury content and certified as safe for use. A scientific publication documented the extraction work conducted within the BYTHOS project.

CHALLENGES AND BREAKTHROUGHS

BYTHOS faced numerous challenges during its development. Extracting collagen and fish oils had never been done locally. 'There was a steep learning curve, and the University of Malta sent their researchers and students to the University of Palermo to learn,' expresses Deidun. Additionally, the project initially lacked the necessary equipment and reagents, requiring investment in specialised materials to achieve the required specifications.

Ensuring that the extracted collagen met the safety standards for human use was another significant challenge. High-quality standards were essential for cosmetics and medical applications, and the project successfully met these requirements.

A challenge common to many EU-funded projects was finding enough qualified and interested individuals

to work on the project. There was difficulty in securing a sufficient number of skilled professionals with the right qualifications and interest – this issue needed to be addressed throughout the project.

Despite these obstacles, BYTHOS achieved key breakthroughs. The Italia-Malta Managing Authority extended funding to explore jellyfish as an additional resource. This led to the successful creation of a protein concentrate for use in livestock feed made from fried egg jellyfish.

Another success was inspiring the tuna farming industry to adopt sustainable practices. The team met with tuna farm operators early in the project to explain its goals. Soon after,



High-PUFA (polyunsaturated fatty acid) oils extracted and separated from waste Atlantic bluefin tuna
Photo by Neil Cutajar



Processing of *Pelagia noctiluca* (mauve stinger) jellyfish as part of the Bythos Extend project

Photo by Neil Cutajar

a company was established in Hal Far to collect tuna slime, which was processed into fish flour for farmed fish feed. 'By applying some of the project's concepts, this initiative helps reduce the demand for wild-caught fish, thereby lessening the environmental impact,' explains Deidun.

WASTE2TASTE: BUILDING ON BYTHOS'S SUCCESS

Following the conclusion of BYTHOS, the Waste2Taste project recognised its achievements and invited the team to collaborate on a new initiative. 'With funding secured, Waste2Taste expands BYTHOS's scope by incorporating additional sources of waste biomass to the bluefish tuna and fish markets. These include waste from restaurant fish processing and invasive species such as alien crabs,' claims Deidun.

The team has already begun extracting fish oils from invasive crabs, which are being sent to Norwegian partners for analysis. These tests ensure the oils are free from toxic mercury and suitable for beneficial use. Moreover, a Turkish partner (Ulker) is developing food products like biscuits and cereal bars containing collagen, offering a more enjoyable way to consume supplements.

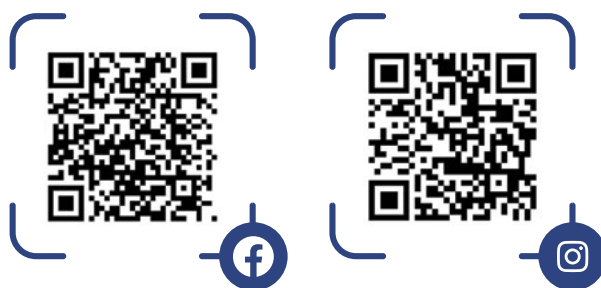
Despite sharing the same goals and philosophy as BYTHOS, the three-year long Waste2Taste project is funded under a separate programme – the Sustainable Blue Economy Partnership (SBEP), kicking off in May 2024. In addition to the leading technical research team from UM's Department of GeoSciences, Waste2Taste has benefitted from the expertise of another university faculty and department, that of the Department of Physiology & Biochemistry. Prof.

Marion Zammit Mangion from this department, together with her team of researchers, is carrying out the extractions, as they did on the BYTHOS project.

Looking ahead, Waste2Taste continues to explore emerging applications of BAMs, including their potential for wound healing and antibacterial use, through the expertise of other consortium partners besides the UM. Furthermore, the project is focused on extracting antitumoral BAMs, which could aid in killing cancer cells. While this is not the primary objective, the team is leaving room for the possibility of discovering new applications as the research progresses.

With a focus on converting existing waste into useful resources, Waste2Taste is paving the way for future developments in food production, wound healing, and possibly even cancer treatment, highlighting the importance of circular economy solutions in emerging scientific fields. **T**

Scan the QR codes to find out more about WASTE2TASTE



Antimicrobial Resistance: Misconceptions and Misuse of Antibiotics in Malta

Author: **Inês Ventura**

*Antimicrobial resistance is a pressing global health challenge, and Malta is no exception. **Gavin Schranz**'s recent research has identified critical misconceptions about antibiotic use among the Maltese public which lead to improper practices, contributing to a global health crisis.*

According to the European Commission's predictions, antimicrobial resistance (AMR) could cause up to 10 million deaths per year by 2050 if preventive measures are not implemented. This would be the equivalent of losing 27,400 people every single day. But what exactly is AMR, and how has it become such a major concern?

According to the World Health Organization, AMR occurs when microorganisms such as bacteria, viruses, fungi, and parasites evolve to resist the effects of medications designed to kill or inhibit them. In other words, they become resistant and survive even when exposed to medications, making infections harder to treat and increasing the risk of severe illness, disease spread, and death.

COMMON MISCONCEPTIONS ABOUT ANTIBIOTIC USE

It is now known that microorganisms develop resistance through genetic mutations or by acquiring resistance genes from other microbes. This can occur naturally but is accelerated by human actions such as misuse or overuse of antibiotics, incomplete courses of treatment, overuse of antibiotics in livestock and agriculture, and poor infection control and hygiene practices.

One of the most prevalent misconceptions is the belief that antibiotics are effective against viral infections, such as the common cold or flu. This misunderstanding leads to the unnecessary use of antibiotics, which can fuel resistance. Another issue is the misuse of leftover antibiotics –

a practice where individuals self-medicate without proper medical guidance, potentially exacerbating AMR.

These misconceptions are not unique to Malta, but they are particularly pronounced due to cultural and systemic factors. For example, the 2022 Eurobarometer on antibiotic consumption revealed that Malta had one of the highest use rates in Europe. This pattern is partly attributed to Mediterranean cultural norms, where antibiotics are often seen as a precautionary measure to prevent illnesses from worsening. Additionally, some general practitioners may feel pressured to prescribe antibiotics to avoid losing patients who expect a quick fix.

Gavin Schranz, an M.Sc. Digital Health graduate from UM, explains that people's decisions about antibiotic

use are shaped by three key factors: what they know, what's available to them, and what they believe. 'Many misuse antibiotics simply because they don't fully understand when they are necessary,' he notes. 'Others take them out of convenience – using leftover antibiotics at home or obtaining them easily from a friend or family member. Cultural habits also play a role, as some patients expect a prescription whenever they visit a doctor, even when antibiotics aren't needed.' Addressing AMR effectively, therefore, requires more than just raising awareness; it demands a shift in prescribing practices and public attitudes toward antibiotic use.

As a patient advocate and researcher, Schranz has worked on an unconventional approach to bring awareness of the AMR crisis to the public and educate them interactively. Supervised by Dr Ermira Tartari Bonnici from UM's Faculty of Health Sciences and Dr Vanessa Camilleri from UM's Faculty of ICT, he conducted a public survey involving 476 participants to assess knowledge of antibiotic use and resistance.

Before designing the survey, Schranz conducted interviews with experts across multiple disciplines – including pharmacy, microbiology, infection prevention and control, surgery, public health, primary care, epidemiology, and agriculture – to gain a deeper understanding of the root causes of antibiotic misuse and the barriers to AMR education. Experts highlighted key priorities such as the need for clearer public health messaging, better communication between doctors and patients, and stronger regulations around antibiotic prescribing.

The survey showed that, while many people knew antibiotics should be taken as prescribed, self-medication remained common due to convenience and cost. Schranz also discovered that



Presenting at STYPA (an event organised by the European Patients Forum) in Brussels to a group of patient advocates discussing antimicrobial resistance
Image courtesy of Gavin Schranz

there is still the belief that antibiotics are effective against viral infections, with 34% of people believing it was acceptable to use antibiotics to cure fevers and 40% sore throats. Additionally, 70% of respondents were unaware of what AMR truly entails, mistakenly believing that it occurs when the body becomes resistant to antibiotics, and they no longer work as well. In reality, AMR occurs when bacteria and other microbes, not the body, become resistant to treatment.

Are these misconceptions due to a lack of care? 'I do not believe so,' emphasises Schranz. 'Unless people have lived through it themselves or had a loved one who did, the urgency just isn't there. They don't know that it is a major issue because they don't hear that someone died from antibiotic resistance; they hear it was post-surgery complications, pneumonia, sepsis, organ failure, or a bloodstream infection. But in many cases, these aren't just complications – they're the result of infections that antibiotics could no longer treat. That's what makes AMR a silent and invisible threat.'

ADDRESSING MISCONCEPTIONS AND COMBATING ANTIMICROBIAL RESISTANCE

Schranz's findings have informed the development of a digital tool to address these misconceptions and combat AMR, with public education being the cornerstone of these efforts.

'In collaboration with a group of undergraduate AI students, we developed an e-learning tool aimed at educating the public about antibiotics and their proper use, based on knowledge gaps identified in the survey,' he explains. The tool is designed to be interactive and accessible, particularly for those with lower health and digital literacy.

This e-learning tool incorporates features such as an interactive chatbot, which allows users to anonymously ask questions about antibiotics, and a detailed explainer module. For example, users can input their prescribed antibiotic, and the tool will provide instructions on correct usage. It also includes a quiz to reinforce learning and a map showing the nearest pharmacies and healthcare providers. Being designed to meet public needs, this tool can have several applications, from use in tertiary schools to integration with governmental health portals.

'Patient-doctor communication also needs to improve,' highlights Schranz. 'Clear communication by general practitioners is crucial in helping patients understand when antibiotics aren't needed and exploring alternative treatment options together.' Engaging patients in these conversations can be essential for better public understanding and adherence to proper antibiotic use.

In addition to these tools, simple actions can make a significant difference. Washing hands effectively is one of the most impactful ways to prevent the spread of infections. Avoiding antibiotics for colds and ➤

Left: Hospital tags from multiple hospitalisations due to infections caused by antimicrobial-resistant bacteria

Right: Post-surgery recovery in 2016 with brothers and sister, highlighting personal experiences with antibiotic-resistant infections

Images courtesy of Gavin Schranz



flu, as well as refraining from sharing antibiotics with others, are also critical measures.

This focus on practical solutions led the researcher to be invited to present at STYPA 2024 in Brussels, where he discussed the importance of patient involvement in developing digital health tools.

A PERSONAL PERSPECTIVE

‘This research is deeply personal for me,’ explains Schranz. Having been born with chronic kidney disease, he underwent numerous surgeries, some of which led to infections that were resistant to first-line antibiotics. ‘Ironically, it’s not the kidney disease that caused my biggest problems over the years, but the infections that resulted from the necessary surgeries to treat my kidney disease.’

However, this concern is not restricted to people with chronic

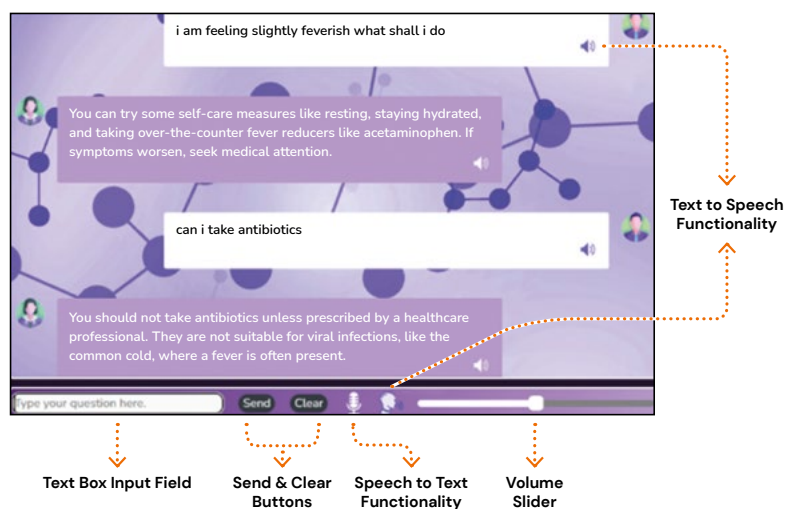
conditions. Resistance to antibiotics can happen to anyone. According to the World Health Organization, if AMR continues unchecked, even routine medical procedures such as organ transplants and chemotherapy could become impossible due to the lack of effective antibiotics. Schranz’s battle with antibiotic resistance is far from over. In the coming months, he faces multiple surgeries, including a kidney transplant. ‘Every operation comes with a risk of infection, and without effective antibiotics, routine operations become dangerous,’ he says. His story is a stark reminder of why protecting these medicines is so important.

‘I plan to continue speaking out and advocating to ensure that everyone is aware of this problem. My hope is that the insights from my work will inspire unconventional approaches to public education and engagement,’ he says. ‘By using interactive digital tools

and supporting a culture of informed antibiotic use, we can combat AMR more effectively.’ While this is a global challenge, each country, including Malta, has a role to play in curbing this silent pandemic.

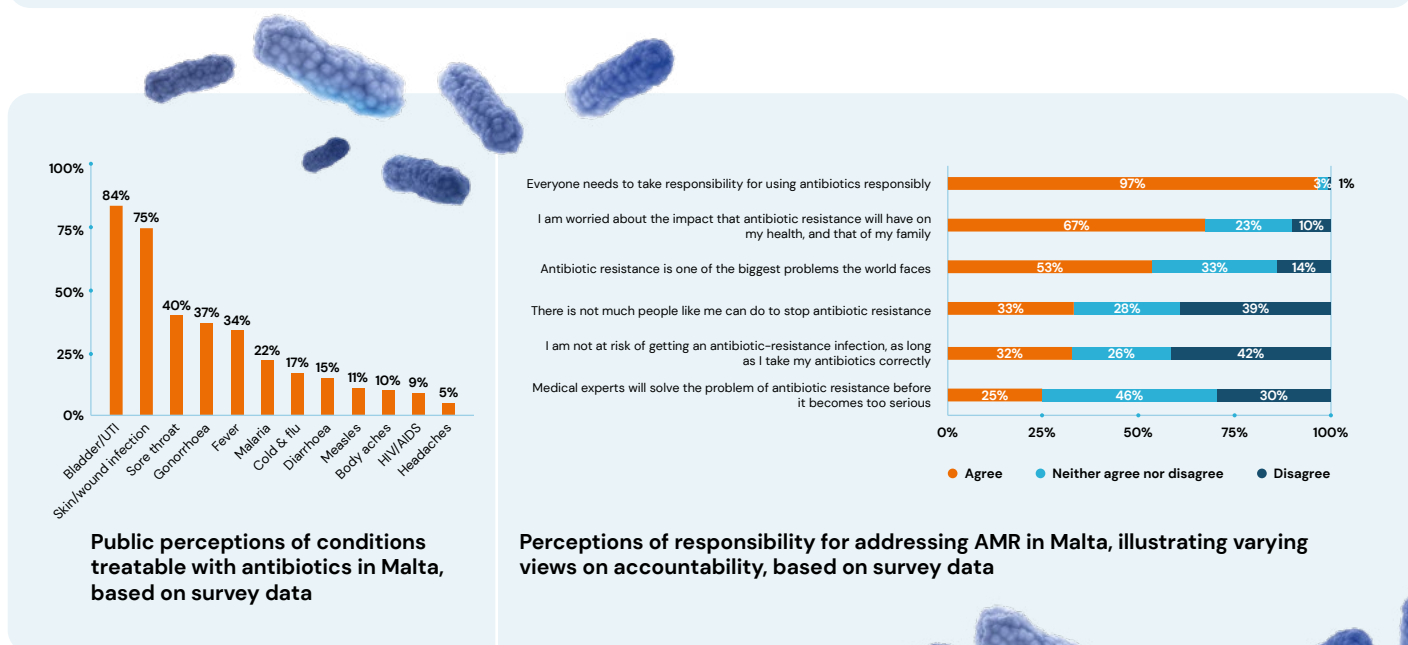
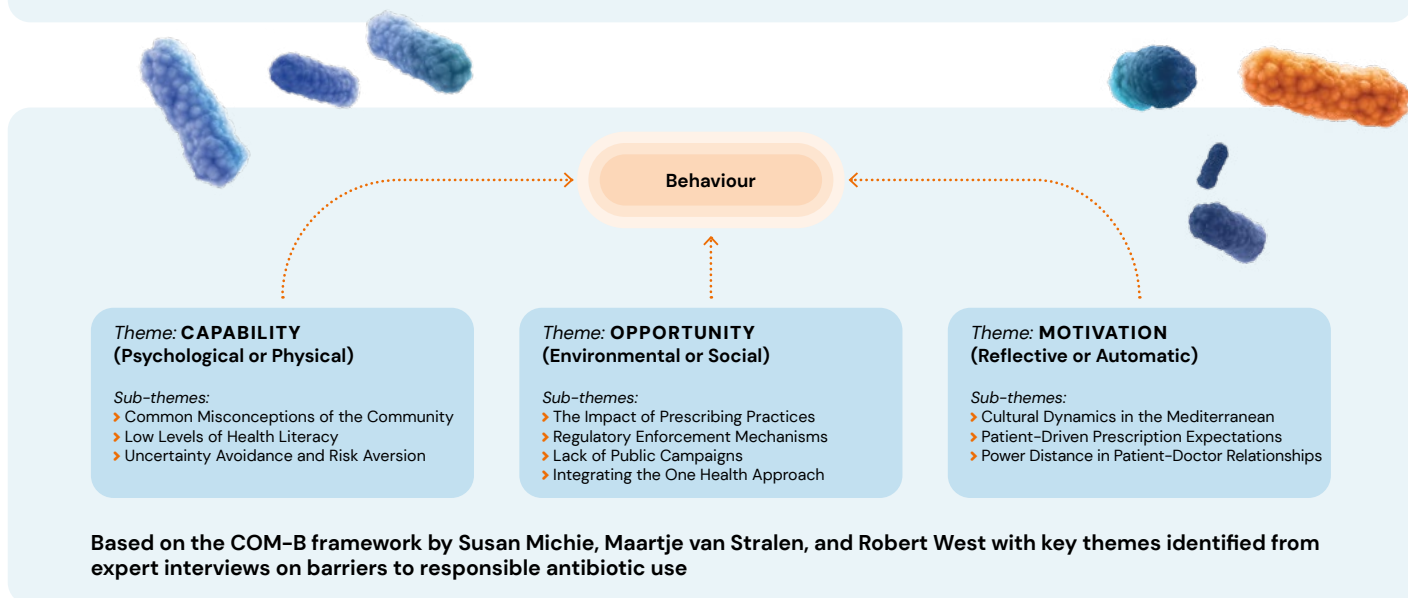
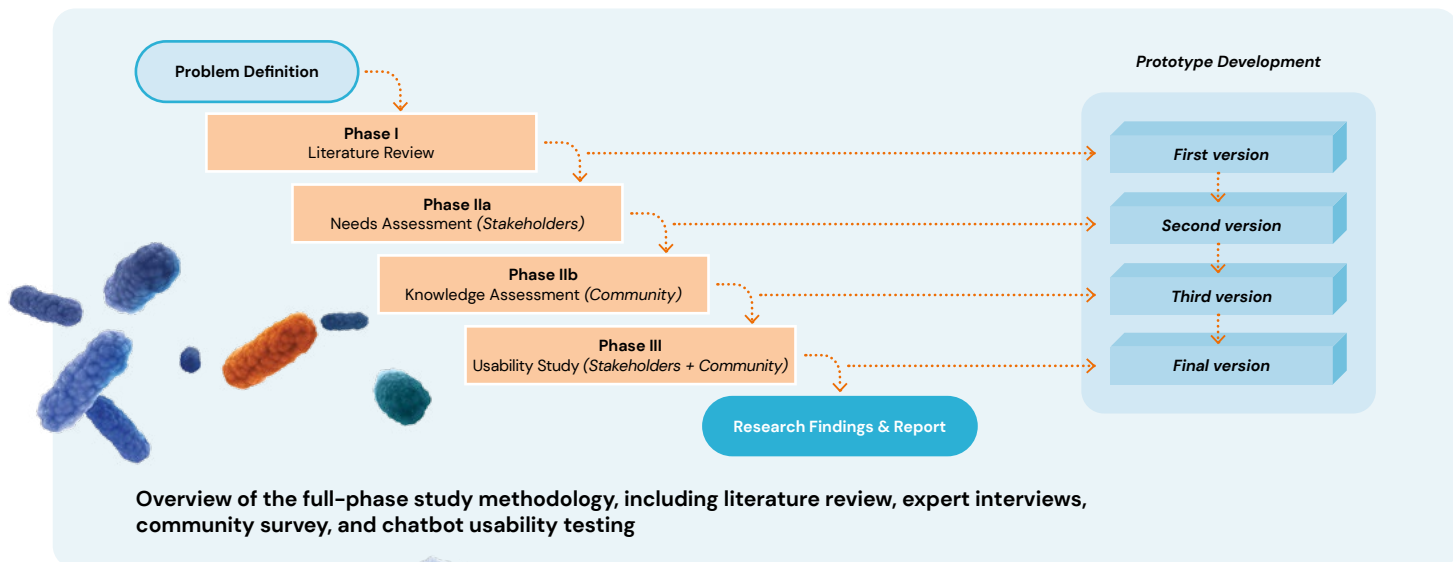
Through continued research, advocacy, and collaboration, we can safeguard the effectiveness of antibiotics for future generations. It’s not just about addressing misconceptions; it’s about changing behaviours and ensuring a healthier tomorrow for all. If you want to learn more about AMR worldwide and the ongoing global actions to address it, more information can be found by scanning the QR code below. 

This research will be presented at the Congress of the European Society of Clinical Microbiology and Infectious Diseases, Vienna and the Future of Information and Communication Conference, Berlin, both in April 2025.



Left: Example of a chatbot conversation between a patient and the e-learning tool designed to improve public understanding of antibiotic use
Image courtesy of Gavin Schranz





From Lab to Life: Nanobodies as Biomarkers for Cancer

Author: Erika Puglisevich

*In the ongoing fight against cancer, one truth stands paramount: monitoring the progression of the disease is essential for patients and healthcare providers alike. The ongoing **FABXS** project opens up the opportunity to revolutionise cancer diagnostics through cost-effective and ethical methods.*

led by Prof. Therese Hunter as the principal investigator, the FABXS team is unmasking hidden clues about cancer cells through proteins. The FABXS team is composed of a UM team that includes Prof. Gary J. Hunter, postdoctoral researcher Dr Brandon Charles Seychell, and the Protein Lab team from the Department of Physiology and Biochemistry in partnership with the SAMOC team led by Dr Nick Refalo. The researchers' primary focus lies in producing and characterising the structure and function of recombinant proteins. This work allows them to follow a protein's path and function in our body.

The researchers' deep understanding of how mutations affect protein function is crucial, especially in the context of cancer. Mutations can lead to significant changes in disease progression, altering how

proteins behave within the body. This knowledge is pivotal in bridging the gap between basic protein research and practical applications in cancer diagnostics. This expertise forms the foundation for their ambitious project: developing a cutting-edge diagnostic kit for cancer biomarkers.

WHAT ARE BIOMARKERS?

Playing a central role in the researchers' work, biomarkers are measurable indicators of biological processes that offer invaluable insights into a patient's response to cancer or treatment. When cancer develops, it can cause certain proteins to be produced in higher or lower quantities than normal. These proteins can be used as biomarkers that indicate the presence of cancer cells. In oncology, these biomarkers can serve multiple vital roles: predicting disease progression, indicating

remission, or even signalling potential chemoresistance – when a patient becomes unresponsive to chemotherapy.

By measuring these protein levels in tissue samples or blood, doctors can gain valuable insights into the presence, progression, or response to cancer treatment. Since protein levels can be measured, T. Hunter and Seychell have set out to produce and use nanobodies to detect four biomarkers. Nanobodies are protein molecules that act similarly to antibodies, whereby they recognise and specifically bind to the biomarker proteins and thus function as sensors for these biomarkers.

Effective biomarker monitoring is pivotal; it empowers healthcare professionals to make informed decisions about patient care. However, the cost and limitations of existing diagnostic kits can



**Chromatography machine
used for protein purification**
Photo courtesy of the FABXS Team

hinder access, especially for those in underprivileged communities. By leveraging advances in molecular biology and ethical production methods, the team aims to provide healthcare professionals with powerful tools for monitoring disease progression effectively.

A CRUELTY-FREE ALTERNATIVE: NANOBODIES

Traditionally, antibodies used in diagnostics are produced by injecting an antigen into animals like mice or rabbits. Antigens are molecules or structures that the immune system recognises as foreign or potentially harmful. By injecting an animal with an antigen, its immune system is triggered to produce antibodies against the antigen, which are then harvested from their serum. However, this method has several drawbacks: animal-derived antibodies can be

unstable and costly. Moreover, since animals are euthanised after antibody harvesting, new antibodies would need to be harvested from a new animal, resulting in batch-to-batch differences. As T. Hunter explains, every time new antibodies are needed, the entire process must be repeated, leading to variability in results.

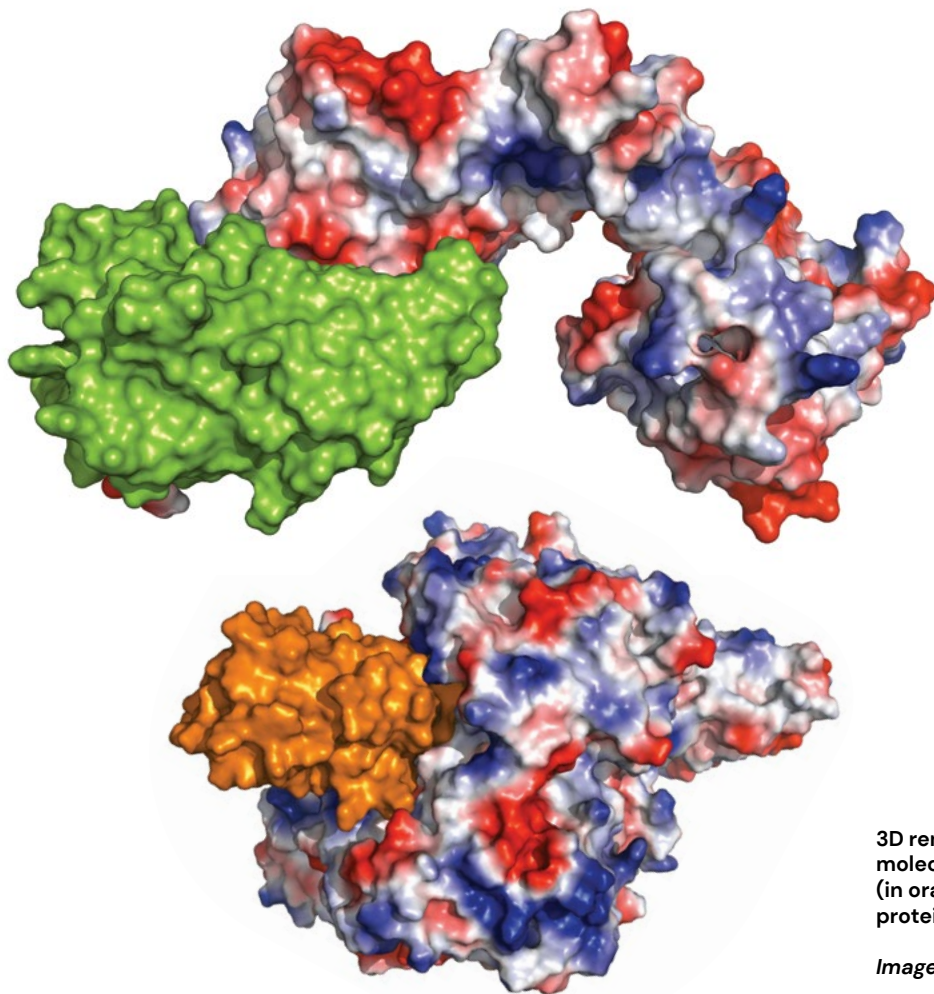
The FABXS project seeks to address these issues by utilising 'recombinant antibodies', specifically nanobodies – small single-domain proteins that can bind to specific antigens or target proteins with high affinity. The researchers have prioritised ethical considerations by ensuring that the process employed to produce these nanobodies does not involve animals.

The benefits of using nanobodies extend beyond ethical concerns; they also offer improved reproducibility. A current issue of animal-derived

antibodies is that while they can be reproduced, it does not mean that all the reproduced antibodies are identical. Think of it like different solutions for the same answer. The animal's immune system will produce an antibody to bind to the triggering antigen; however, they might bind in different positions. Alternatively, once you have the map to produce the right nanobody for the right antigen, this would allow you to produce identical clones. This is extremely important for ensuring consistency and reproducibility across experiments and is critical for large-scale production and reliable diagnostic results.

THE JOURNEY OF NANOBODY PRODUCTION

Protein biomarkers were carefully chosen based on their established roles in oncology. One protein ➔



3D renderings showing *in silico* molecular models of nanobodies (in orange and green) bound to protein biomarkers

Images courtesy of the FABXS Team

has been recorded in over 60% of cancers, and its different forms in cancer cells are linked to the spread of cancer. The proteins chosen are not solely biomarkers for use in oncology but also act as markers for other conditions, such as high blood pressure, heart failure, liver disease, and chronic inflammation.

Building upon Seychell's Ph.D. research and other research conducted in UM's Protein Lab, the proteins were synthesised recombinantly in a bacterial host, purified and characterised, and sent to a partner company specialising in nanobody production. The large number of nanobodies generated in this manner then had to be analysed at the University of Malta. This step was very labour-intensive, as it involved the recombinant production

of many nanobody proteins to assess which were viable by testing their solubility, stability, and degree of binding to the biomarker of interest. Seychell highlights that this method allows for reproducibility as long as consistent growth conditions are maintained – again highlighting the stark contrast to the variability seen with animal-derived antibodies.

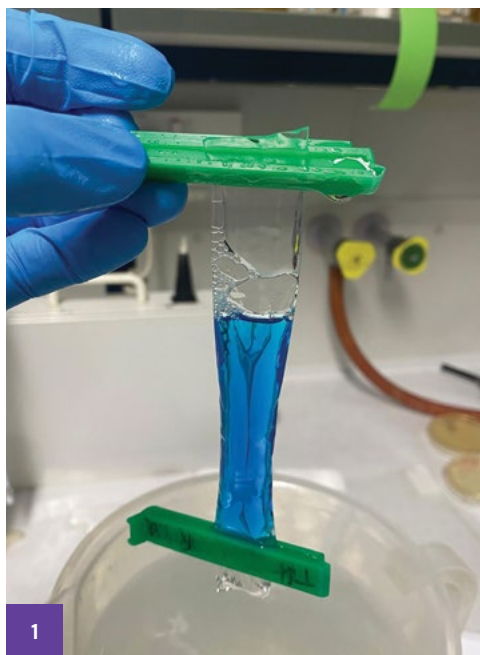
WILL THE DETECTION SYSTEM WORK?

A significant challenge in developing a reliable detection system is ensuring that the binding of the protein actually occurs at the intended site on the antigen. To tackle this issue, the researchers needed to devise a method for labelling each nanobody with a fluorescent marker. Fluorescent markers function by

attaching to the intended molecules (in this case, proteins) and emitting a fluorescent light when exposed to light of a particular wavelength. This fluorescence enables the detection and measurement of signal intensity, providing information about the amount of the biomarker of interest present in the sample.

To validate their detection system, Seychell explains that they employ a technique known as Fluorescent-Linked Immunosorbent Assay. By using known concentrations of nanobodies and biomarkers, they create a standard curve that helps determine the limits of detection.

With nanobody production underway and fluorescent tags in place, the final phase involves testing these components on biological samples – specifically patient



1. Preliminary fluorescent protein used for detection
2. Microtitre plate reader used for fluorescence detection of the FABXS nanobodies
3. Microtitre plate prepared with a serial dilution setup

Photos courtesy of the FABXS Team



blood samples – to assess their effectiveness in real-world scenarios.

REDEFINING THE FUTURE OF CANCER PATIENTS

Effective biomarker monitoring is pivotal in oncology; it empowers healthcare professionals to make informed decisions about patient care. Biomarkers serve multiple vital roles: predicting disease progression, indicating remission or relapse, and signalling potential chemoresistance. The FABXS project is the start of a journey not only toward sensitive and affordable diagnostic kits but also toward improved patient outcomes through timely interventions and tailored treatments based on accurate biomarker detection.

The potential applications of nanobodies extend beyond cancer

diagnostics; they hold promise for various research fields requiring protein detection. For instance, traditional antibodies can be prohibitively expensive, costing hundreds of euros for just 100 micrograms, while laboratory-produced nanobodies can yield significantly larger quantities at a fraction of the cost. This cost-effective approach could democratise access to essential diagnostic tools, particularly benefiting underprivileged communities where access to healthcare resources may be limited.

T. Hunter and Seychell emphasise that this project represents an important first step. As T. Hunter says: 'I'd look at this project as the first stage for providing the tools that will validate the use of these nanobodies.' By ensuring that these innovative solutions are

both effective and accessible, the team hopes to contribute toward enhancing the quality of life for cancer patients across Europe.

The collaborative effort between UM researchers and clinical partners at Sir Anthony Mamo Oncology Centre exemplifies how interdisciplinary approaches can lead to meaningful innovations in healthcare. With continued support and development, initiatives such as the FABXS project have the potential to not only transform cancer diagnostics but also pave the way for more equitable healthcare solutions worldwide. **T**

The FABXS project was financed by Xjenza for and on behalf of the Foundation for Science and Technology through the FUSION: R&I Technology Development Programme.

special feature



TRITHEMIS ANNULATA



POLYPAGA AEGYPTIACA



MANTIS RELIGIOSA



VESPULA GERMANICA

INSECTS

of the

MALTESE ISLANDS



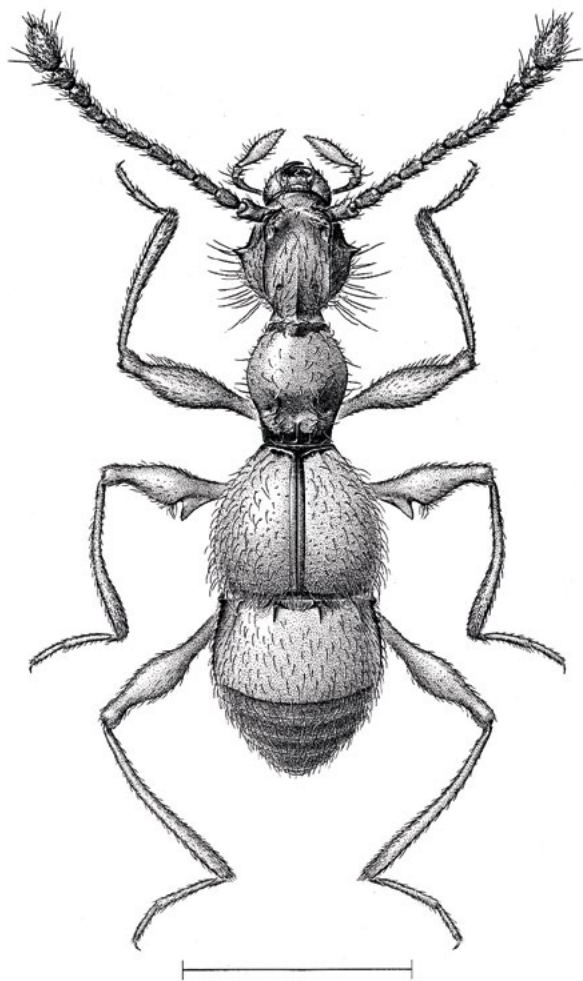
CICADA
BARBARA

Author:

Jonathan Firbank



Images courtesy of Thomas Cassar



AMAUROPS MIFSUDI

Insects of the Maltese Islands has recently been published by **Prof. David Mifsud** and **Thomas Cassar**. The book highlights the incredible diversity of Malta's insect world, its importance, and its mysteries yet to be uncovered. **Jonathan Firbank** speaks to Prof. Mifsud about the work behind it and the stories it tells.



Images courtesy of Armin Coray (left) and Thomas Cassar (right)

VANESSA CARDUI



We cannot meaningfully think about our ecosystem without

considering insects. While an ecosystem refers to all the living things in an area, interacting with each other and their environment, in large part, insects *are* our ecosystem.

Out of the world's animals, they make up over four-fifths of known species, account for around half of all animal biomass, and in terms of individual organisms, outnumber all other animals put together by multiple orders of magnitude. Insects number in the quintillions – tens of quintillions, in fact – and most feed and interact with almost every plant and tree present on planet Earth, with a minor component strictly associated with animals. For this reason, flowering plants evolved to take advantage of insects' proliferation. The topsoil, which supports so much life, is largely created by insect activity. And insects are, of course, a cornerstone of the food chain. The sheer scale of their impact is matched by the scale of what we have yet to learn. We may have only discovered a tenth of the insect species alive today.

Therefore, the act of documenting insect species is both Sisyphean and essential. Prof. David Mifsud, UM entomologist, and Thomas Cassar, biologist and filmmaker, are contributing to that effort with their recent publication, *Insects of the Maltese Islands*, released in December 2024. Mifsud and



HYLES EUPHORBIAE



MEGACHILE PARIETINA

Cassar have created an encyclopedic book that depicts native insect species descriptively and photographically.

A crucial function of the text is accessibility. Between them, Mifsud and Cassar have over 300 scientific publications related to insect studies in Malta, but as with most academic texts, they are spread across different international journals. Texts such as these are often found in labyrinthine websites that are opaque or even inaccessible to laypeople. It is hard for Maltese people to engage with this cornerstone of their vulnerable ecosystem, all the more so given how invisible insect life can be. To that end, the book puts photography at the forefront. Cassar led the Herculean effort of capturing images of insects at crucial moments in their lifecycle, and two graphic designers, Daniel Spagnol and Melchiorre Farrugia, sorted through the wealth of photographs. Cost is also crucial for accessibility. The book is set at a far lower price than similar publications, something that was made possible by funding provided by philanthropist Jean Claude Gandur.

An affordable compendium of Malta's insects, written in accessible language and showcasing exceptional photography, is something that should find a place in any Maltese home. Any conservationist can tell you about the importance of awareness – it can be hard for us to realise how vital something is if we don't have a relationship with it. Mifsud's own love for entomology started as a child, with the life in his family garden. A family bookshelf can be no less inspirational. ➤



LOCUSTA MIGRATORIA

DOCUMENTING THE INFINITE

Of course, this task also brings with it certain constraints – the book couldn't be a comprehensive account of Malta's insects lest it become too heavy to lift. As Mifsud explains, 'The first idea Thomas and I had was that, from each family or group of insects, we would include one species. But this idea had to be abandoned, as even that would have turned an 800-page book into a 3000-page one.' This forced Mifsud and Cassar to be ever more selective, but the end result 'is the first book to include information on all the insect orders of Malta'. Notable books have been published prior, including Gauci's *Dragonflies and Damselflies of the Maltese Islands* and Valletta's *The Moths of the Maltese Islands*. But there was a conspicuous absence of a broader insect compendium. As such, *Insects of the Maltese Islands* serves as both an overview of and introduction to Maltese entomology.

The sheer amount of information available presented one problem, but the information itself often presented another. A single historical, entomological mistake can create misconceptions that last centuries, as the sheer scale of the field means that some definitions are revisited or challenged less frequently. Righting these wrongs was a driving force in how Mifsud and Cassar chose which species to showcase. For example, Malta has over 70 species of ant, but Mifsud and Cassar decided to focus on two which look particularly similar to one another despite coming from separate genera. 'This is known as Batesian mimicry,' when one species evolves to look like another, more dangerous one. 'But why did we include them? It's because these two species are often recorded in natural

history texts under the wrong name.' The ants' evolutionary disguise was effective enough to work on human beings. Selecting them for *Insects of the Maltese Islands* provides a multifaceted opportunity. Most simply, it clarifies which one is which. But it also gives the reader an example of and explanation for Batesian mimicry, while showcasing the breadth that a study of the tiny creatures involves.

Mifsud explains that 'in the past, there have been a lot of misidentified insects. So much so that, even 10 years ago, making this book would have been impossible.' Mifsud and Cassar addressed this through international collaboration with many experts to ensure historical mistakes weren't repeated. 'Let me give you an example: the most common insect in the Maltese Islands is the one featured on our front cover, our cicada,' the insect that spends years in a subterranean larval stage before emerging to sing, mate, and die. The insect's life cycle and deafening presence makes it famous. 'Every year, a local newspaper article will be published about it, everyone knows it, even by its scientific name. In fact, this insect has been reported on for almost 200 years by the name of *Cicada orni*. But one thing about science is that you cannot take anything for granted.' Mifsud and Cassar were perplexed by its song, which seemed distinct from other examples of this species. 'We invited a group of experts and recorded cicada sounds. We found that, after 162 years of Malta thinking its cicadas were *Cicada orni*, the species was misidentified, and its correct name should be that of another species – *Cicada barbara*, all along.'

Sometimes, insects do not need inscrutable disguises or century-old mistakes to be lost to science.



GASTROPACHA QUERCIFOLIA



OCYPUS OLENS



BRACHYCERUS ALBIDENTATUS



MACROGLOSSUM STELLATUM

Images courtesy of Thomas Cassar

Sometimes, they simply disappear. 'In the old literature, over 100 years ago, a new species of beetle was recorded that was said to only live in mud.' There were no accompanying descriptions of the beetle itself, only the claim that when their mud was disturbed, the insects would fly into the air. Mifsud searched for the incompletely described insect for over 30 years, in spite of many considering it extinct. Eventually, they revealed themselves to him in a tiny, muddy habitat in Gozo after a century-long absence. This is a very rare and endangered species that should be protected at all costs.

Species of insects which spend all their life cycle deep in the soil, known as endogean insects, were never studied locally. Some 20 years ago, Mifsud decided to explore this unique habitat and found some exceptional surprises – more than a dozen species of insects were discovered, including *Amaurops mifsudi*, which was named in honour of their rediscoverer. The stories these animals present are endless – some depended on Maltese livestock and their dung, which declined as Malta became less hospitable to grazing. Some still dwell amongst the sand of beaches and dunes. A small group of species of the genus *Ochthebius* even lives in rockpools, endlessly swimming to the surface and back as they harvest bubbles of air.

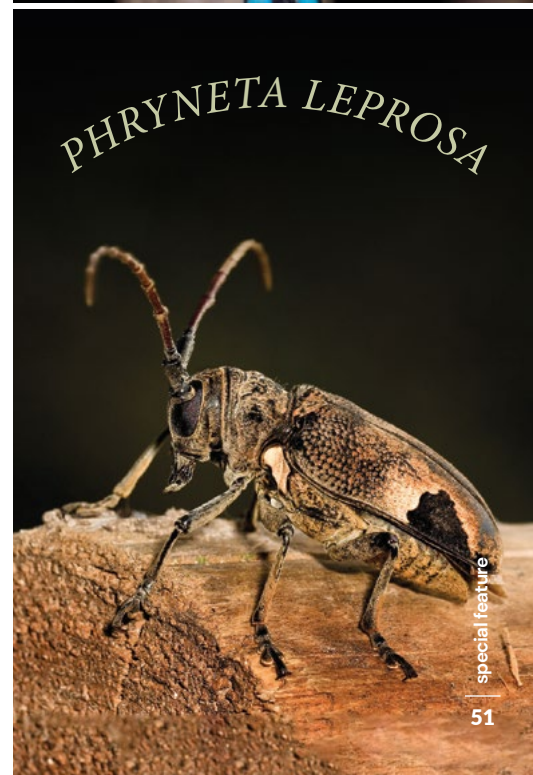
THE ESSENTIALITY OF ECOSYSTEMS

Not all of these stories are Maltese. Malta hosts a vast number of invasive species, a few of which are showcased in *Insects of the Maltese Islands*. One such insect is *Phrynetta leprosa*, a longhorn beetle that appeared on the islands some 25 years ago. Identifying

it necessitated consultation and, eventually, a trip to archives in Germany to track down precisely what it was. The beetle originated in Cameroon, travelling from Central Africa within lumber that had not been properly debarked. Once it arrived in Malta, it found itself with no natural predators and set upon Malta's already sparse tree count. Specifically, they killed numerous century-old mulberry trees that, ironically, had been introduced to the Islands themselves as food for silkworm caterpillars when the British wanted to set up a silk industry here.

As Mifsud explains, 'Biodiversity is a network. In fact, we can imagine it as a net – a fine net entangled together, where all organisms depend on each other. When we make a mistake', such as introducing an invasive species or destroying a native species through overconstruction or pesticide use, 'we tear a hole in this net. Each mistake further compromises this structure, this network, which supports us. 90% of our vegetables and fruit depend on pollinators, bees, and other insects. Without those pollinators, a big chunk of our food diversity will simply disappear. I cannot tell you the story of each and every species of insect. Many are known only from one or two specimens housed in a museum. They aren't the subject of studies; we don't even know whether they have become extinct or not.'

To that end, *Insects of the Maltese Islands* draws a reader towards a different perspective of conservation: that we should not only protect what we know, but also protect what we don't know. There are habitats and ecosystems that contain life we may never encounter, hidden by size, stealth, and the enormity of diversity. But it is life that may prove indispensable, nonetheless. **T**



Lighting the Way: How EyeTrack's Electrooculography Is Set to Transform Gaze-Tracking Systems

Author: **Christian Keszthelyi**

*In an era where precision and efficiency in human-computer interactions are paramount, the **EyeTrack** project is pushing the boundaries of eye-gaze tracking technology. By harnessing the power of electrooculography, a technique that records the electrical signals generated by eye movements, this cutting-edge initiative aims to enhance the accuracy of eye-gaze tracking systems.*

Eye-gaze tracking is a technology that monitors and records eye movements to determine where a person is looking.

It has various applications, including human-computer interaction, where it enables gaze-based input as an alternative to traditional interfaces like keyboards, mice, and touchscreens.

On first look, electrooculography (EOG) sounds like a word one would only encounter when checking the crossword solution at the back of this publication. In reality, the term itself clearly indicates how it works. *Electro* refers to the electrical nature of the signals; *oculo* relates to the eyes, as the signals are produced by the eyes; and *graphy* means the recording or

graphing of these signals over time. In fact, EOG signal acquisition requires electrodes to be placed near the eyes, which means the technology is non-invasive (it does not break the skin).

The standard setup involves four electrodes: two electrodes (one above the eyebrow and one below the eye socket) are used to monitor the vertical movement of the eyes and two other electrodes (at the outer corners of each eye) are used to monitor the horizontal movement of the eyes. Essentially, EOG captures the subtle electrical variations created as the eyes move, which can then be analysed to track eye movements and gaze direction. Sounds like a walk in the park. But it is more complicated than that.

The EyeTrack project, launched in November 2023 and scheduled to conclude in April 2025, seeks to achieve two key objectives: firstly, to determine the optimal arrangement of electrodes around the eyes, and secondly, to explore the impact of background illumination on the EOG signals. Variations in lighting can cause significant errors in eye-gaze tracking estimates, so to address this, the project team is developing compensation algorithms designed to counteract the effects of these changes in illumination, ensuring more precise and consistent tracking results.

CONTINUOUS EYE TRACKING

The project's lead investigator, Dr Ing. Nathaniel Barbara, has conducted



Participant setup for eye movement recording: The cue display on the screen directs the user's eye movements, while the chin-rest ensures a fixed head pose, position, and consistent distance from the screen

Photo by Kristov Scicluna

significant research on EOG for continuous eye tracking. 'Existing research primarily focuses on discrete eye movements, such as using eye gaze to jump between icons on a virtual keyboard. Using this approach, the user is required to direct their gaze to extreme up, down, left, right, or diagonal directions, moving from one icon to the next sequentially. While effective, this method lacks a natural flow. My research has focused on enabling continuous eye movements, allowing users to move directly from one letter to the next in one go. This approach led to the development of advanced algorithms, which we are using in our EyeTrack project,' says Barbara, who is a Lecturer at UM's Centre for Biomedical Cybernetics.

EyeTrack's main aim is to tackle challenges related to EOG technology. 'For this study, we used a high-density configuration of 14 electrodes placed around the eye region, essentially covering the entire area with sensors. The goal was to systematically investigate and compare

the performance of various electrode combinations against the standard setup, which typically uses just two pairs of electrodes,' Barbara says. The research team tested thousands of potential combinations of 14 electrodes to find configurations that could offer comparable or improved accuracy to the conventional setup.

The researchers found that slight misalignments in the standard electrode positioning do not significantly affect accuracy, and statistical tests confirmed that minor errors did not significantly affect results. These findings, which are currently under review for publication, are crucial for the practicality of human-computer interface (HCI) systems, as they eliminate the need for users to worry about the precise placement of the electrodes.

LIGHTING IMPACT UNCOVERED

The project's second aim is even more intriguing. EOG is often praised against camera-based eye tracking, as

the latter is computationally intensive, bulkier, and the technology is costly. EOG is generally considered less sensitive to lighting variations than camera-based systems. However, clinical literature reveals that EOG signals are still influenced by changes in lighting, emphasising the importance of addressing this factor when refining the technology and considering potential enhancements.

'Preliminary results of investigating lighting impact show that EOG signals vary under different lighting conditions, with oscillating changes in amplitude observed between dark and brightly lit environments. We continue to test EOG under various lighting conditions and aim to incorporate lighting-related variations into the processing of EOG signals for gaze tracking. This is crucial, because even with consistent eye movement, lighting changes can affect the amplitude of the EOG signal,' says Jeremy James Cachia, the research support officer (RSO) working on the project. ➔



1. Dr Ing. Nathaniel Barbara
2. Prof. Ing. Kenneth P. Camilleri
3. Prof. Ing. Tracey Camilleri
4. Mr Jeremy James Cachia

*Photos by James Moffett
and Kristov Scicluna*

Right page

Top: The illumination devices used to study the effect of illumination on EOG signals in the EyeTrack project

Middle: The standard electrode setup used to record EOG signals

Bottom: A participant performing eye movements as instructed by the on-screen cues

Photos by Kristov Scicluna

The objective is to adapt algorithms to account for these lighting variations so that the accuracy of the EOG-based eye tracking remains consistent, even when lighting conditions change. In other words, Cachia wants to ensure that lighting fluctuations do not result in errors in gaze tracking. Eventually, the team must incorporate an illumination sensor to monitor ambient light levels. But first, they must conduct tests transitioning between dark and bright lighting, as well as dark and dim lighting, to better understand how the EOG signal reacts. While there is some clinical literature on this, many aspects are still unclear and need further investigation.

OVERCOMING LIGHT CHALLENGES

Cachia's work is demanding. The recording session takes about two to three hours since stabilising the signal is slow, necessitating extended periods in dark and light environments. One

session consists of three phases: a five-minute baseline in ambient light, an hour of dark adaptation, and an hour and a half of light adaptation. Data is recorded in one-minute intervals with two-minute breaks for comfort. The process is time-consuming, often requiring multiple sessions to gather sufficient data at various lighting intensities.

So, how does ambient light affect the tracked data? If the EOG method picks up eye movements based on electric signals travelling through the skin around the eyes, how would light changes affect this? Well, up-to-date literature does not elaborate. The changes in EOG signals during light adaptation are understood, but the mechanism behind changes in the dark is still unclear.

Considering the demanding nature of testing, the lack of understanding of ambient light's effect on tracking, and the looming integration of a light sensor, why bother with EOG?

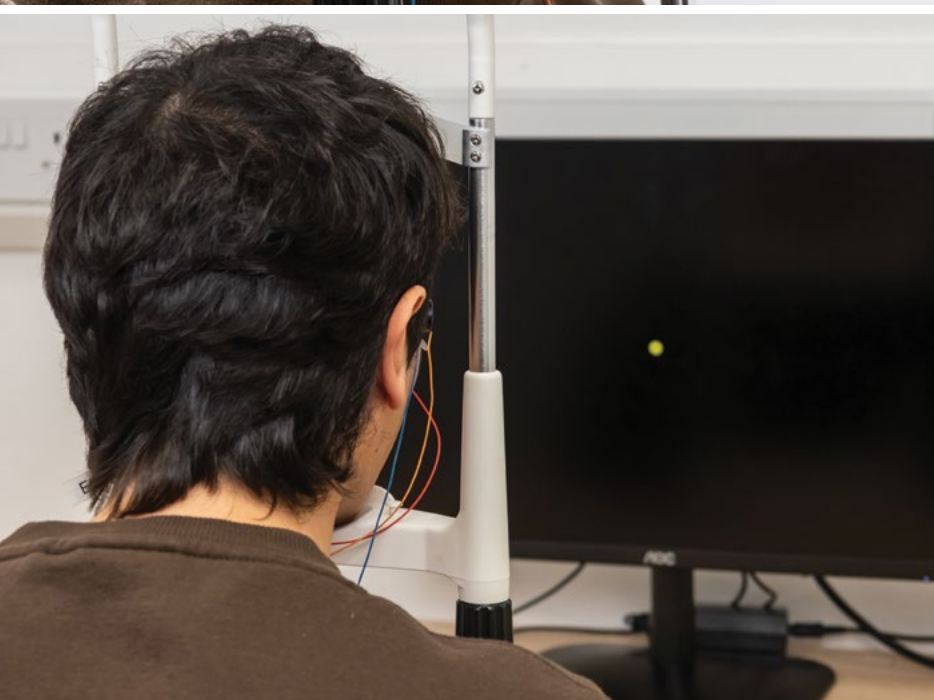
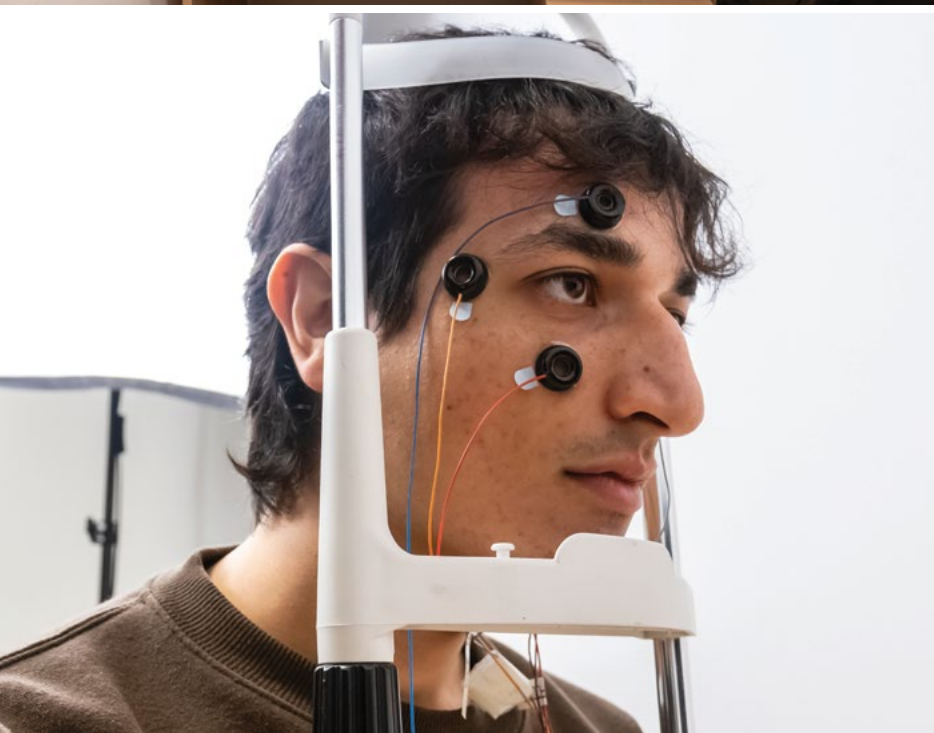
Why not just go with camera-based tracking? To answer this question, we need to understand how camera-based tracking works.

Camera-based systems rely on cameras and image processing. They are sensitive to lighting, angles, and calibration, leading to lighting changes or movement inaccuracies. Moreover, these systems require significant computational power and also raise privacy concerns due to constant monitoring.

On the other hand, EOG systems use only a few electrodes, making them less bulky and less demanding on computational power. They come with no privacy issues, and the research team is working on counteracting the impact of ambient light on the technology.

EMPOWERING THROUGH GAZE

'In a project running in parallel with EyeTrack, called SmartGaze, we have developed a system for more natural,

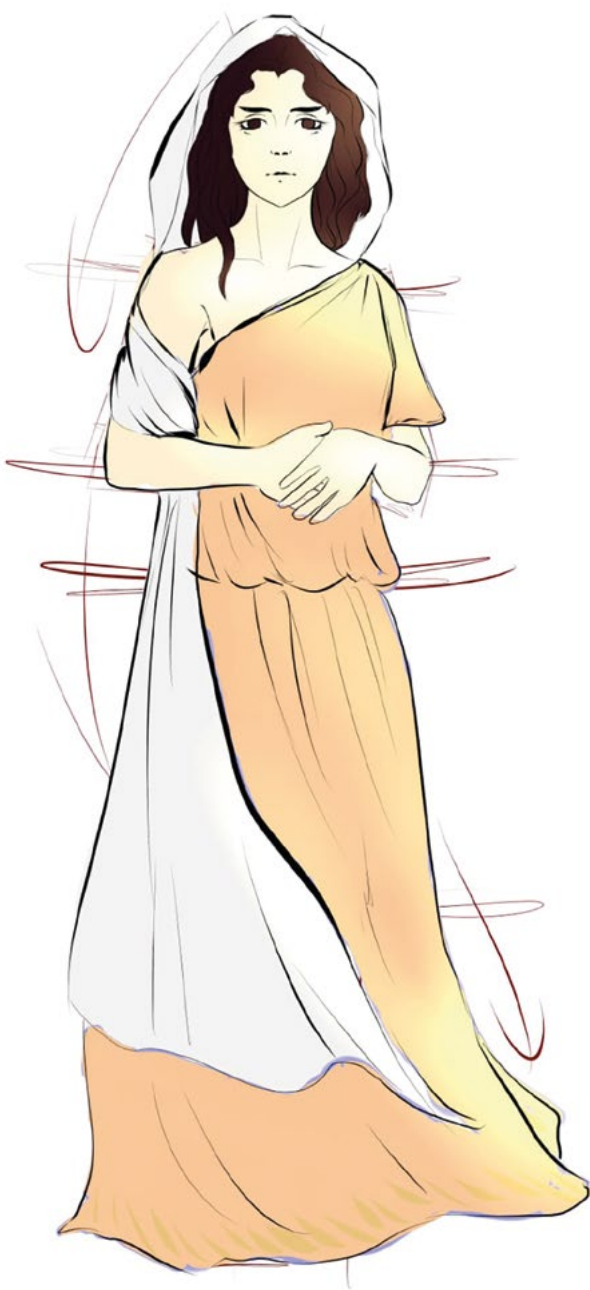


unobtrusive interaction and control of smart devices, without requiring users to be tethered to a screen. The system tracked the user's position and head orientation to identify the device that is to be controlled and intelligently processed the EOG signals of the user to determine and automatically activate the desired device function. In addition, we also developed the first prototype of an EOG wearable device to make the recording of the EOG signals as seamless and comfortable as possible,' says Prof. Tracey Camilleri from UM's Department of Systems and Control Engineering. Camilleri coordinated the Xjenza Malta-funded SmartGaze project and is a member of the technical team leading the EyeTrack project.

Upon reaching the market, such a technology could benefit individuals with limited mobility, allowing control through gaze rather than apps or remotes. Having a wearable solution to record EOG signals offers flexibility for these natural interactions, which is a key focus for the future.

'The primary application of the EyeTrack project lies in developing human-computer interface systems, particularly for individuals with mobility impairments. These systems provide an alternative method of communication for people who cannot use traditional input devices like a mouse, keyboard, or touchscreen. Since such individuals typically retain an intact ocular system, we can use their eye movements as a means of interaction,' Camilleri concludes. **T**

The EyeTrack project is funded by Xjenza Malta, through the FUSION: R&I Research Excellence Programme. This project is led by Dr Ing. Nathaniel Barbara from the Centre for Biomedical Cybernetics and Prof. Ing. Kenneth P. Camilleri and Prof. Ing. Tracey Camilleri from the Department of Systems and Control Engineering. Mr Jeremy James Cachia is the RSO working on this project.



Andromache
Image courtesy of the Project CITADEL team

Project CITADEL: Reigniting the Trojan War

Author: **Kristov Scicluna**

Similar to experiencing a novel through an audiobook, the **Project CITADEL** consortium is tailoring a way to experience the Greek and Roman world through a video game. **THINK** speaks to **Dr Carmel Serracino** and Research Support Officer **Andrew Debono Cauchi** about their ongoing project funded by the Creative Europe Programme.



Remember that old game console you rediscovered the other day, buried under many boxes of knick-knacks in your closet? A wave of nostalgia hits you as you hook everything up and fire it back to life after what seems to have been decades. You fill with excitement as you rediscover your favourite old games, now with a new mindset. The consortium of Project CITADEL aims to tap into this very sentiment as they develop a mobile phone game that will let players rediscover the Trojan War and hopefully reignite their love for classical literature.

'Classics is a wellspring of ideas. I've been teaching the classics for 30 years. Classical literature expands beyond reading a few renowned titles; the knowledge in those tomes is essential,' explains Dr Carmel Serracino, a resident academic lecturing in classic literature and Head of UM's Department of Classics and Archaeology within the Faculty of Arts.

Andrew Debono Cauchi, currently a Research Support Officer within the same department, joined Project CITADEL following previous outreach projects with Serracino. The two form a strong team, sharing a common goal, with

Serracino having supervised Debono Cauchi's undergraduate dissertation. 'Although people often dread thinking about reading classical literature due to the distant and archaic style, these texts, characters, and stories still influence our contemporary lives. That's what we aim to emphasise in our project,' Debono Cauchi says.

CLASSICS? WE DON'T KNOW HER

Ancient Greek and Roman literature is generally referred to as 'the Classics'. Most people are familiar with Homer's *Odyssey* or *Iliad*, maybe even Sophocles' *Oedipus the King*. However, the collective knowledge falls short, with most people having never even read these storylines, let alone the many other works that reflect how our histories and cultures are shaped.

Serracino and Debono Cauchi approach classical literature from a different angle. Using ubiquitous technology and contemporary media, they aim to captivate a new audience by presenting them with an irresistible Trojan Horse.

Project CITADEL seeks to retell the story of the Trojan War through the medium of video games. But why a video game? Well, it probably

goes without saying that this medium would appeal to a younger audience, many of whom engage with video games on a daily basis. This makes the medium a natural outlet to help pique their interest in the Classics through a story-driven role-playing video game.

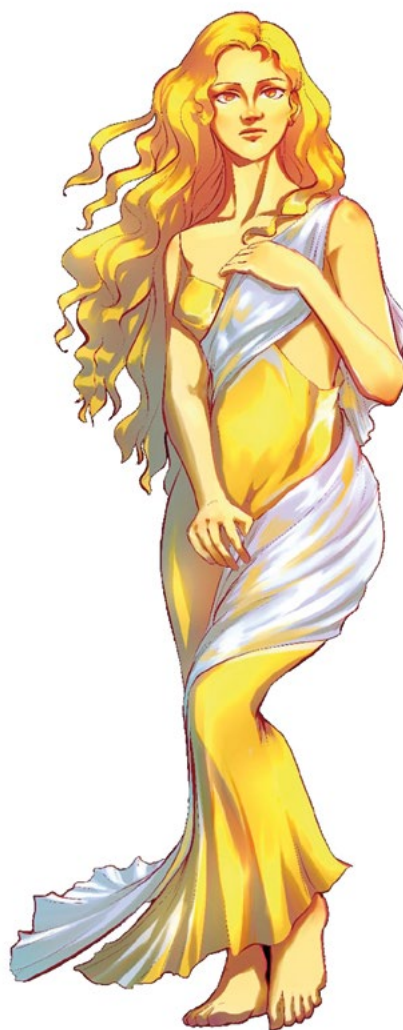
Skye Vassallo, one of Serracino's students, created a video game demo concept for an assignment as part of a study-unit that explored the Homeric epics. While Vassallo is not directly involved in Project CITADEL, her work became the inspiration for the much larger project. In fact, the final game will take Vassallo's demo as the starting point of its storyline.

The demo showcased the story of a female student who becomes enamoured with the story of the Trojan War. She gets transported through divine intervention of the ancient gods to the city of Troy at the time of the siege. The game's protagonist takes the place of Helen of Troy: daughter of Zeus, wife to Menelaus of Sparta, and the most beautiful woman in Greece. Alongside Paris, son of the Trojan king, Priam, she fled to Troy, which sparked the beginning of the ten-year-long Trojan War. Players of the game will be guided to identify methods of redirecting the outcome of the war.

The game offers a fresh take on the Classics, embracing gender inclusion with its female-fronted approach – a contrast to the predominantly androcentric perspectives in much of classical literature and history. Millennia after the battle took place, this game would act as a form of redemption for Helen of Troy, who this time would be the extinguisher of the war rather than the spark which caused it to ignite in the first place. This would offer a reimagining of the original account by Homer, breathing new life into what is a very old horse.

A DIGITAL TROJAN HORSE

Much like a Trojan Horse harbouring many Greeks, Project CITADEL itself is a consortium of collaborators and contributors. The consortium consists of the University of Malta, the University of Gdańsk in Poland, the University of Groningen in the Netherlands, and WeBee Ltd., a web services company that will develop the game. The consortium formed for this project is responsible for conducting



*Top: Zeus
Bottom: Aphrodite
Images courtesy of the Project CITADEL team*





Andrew Debono Cauchi (left) and Dr Carmel Serracino (right)
Photo by Kristov Scicluna

research and gathering data and information to support its development.

A multitude of students residing in Malta, Poland, and the Netherlands are also contributing to the making of the game by providing their own ideas for the game's development and ending. Moreover, thanks to funding secured from the Creative Europe Programme (CREA), the research and work for Project CITADEL has begun and is now in its early stages.

This game will be available as a mobile application for greater accessibility and ease of use. Debono Cauchi noted that this stems from a contemporary approach to Classics and New Media, specifically by integrating digital technologies.

'Classics are no longer limited to poetry, prose, and novels – they now extend to apps, TV, comics, manga, and more. You don't have to read a poem or a book to engage with the Classics. You can get to the Classics through an app,' Debono Cauchi says.

A THREAD AND SPARK OF HOPE

Debono Cauchi also discussed the process of condensing and retelling this Homeric epic. Classical reception involves reinterpreting the past: 'When we reappropriate, we re-choose, we retell, we re-analyse.' For this reason, the team must be selective in which parts of the epic will be in the game, determining the most interesting and beneficial plot points for engagement and entertainment.

To start, the team will run a teaching campaign to guide and support students who wish to contribute to the game's development. Debono Cauchi will lead the teaching campaign in Malta, while teachers from the other consortium members will run teaching campaigns in Poland and the Netherlands.

This campaign will introduce students to the classics and mythology while gathering feedback to refine the game. 'This approach may even instil a love for the Classics within these students, creating a small thread to hang onto, which they can continue to weave into a fabric of literary escapades,' Debono Cauchi says enthusiastically. The team hopes that engaging directly with the story of Helen of Troy will inspire students to explore further classical literature and its terminology.

The teaching campaign is yet to start throughout the consortium. The campaign aims to be standardised across the consortium member states, which will in itself be a challenge, since educational curricula differ across Europe.

'Another challenge, locally, is the lack of the Classics in the Maltese curriculum as opposed to some other countries, where the Classics appear alongside Mathematics or English. Still, other media can help bring people closer to the Classics. I'm indebted to film as I owe my profession to motion pictures. A movie (Pietro Francisci's 1958 adaptation of *Hercules* for those who are curious) sparked my love for the Classics, as much as I hope Project CITADEL will serve as a conduit for the game's players,' Serracino says. 

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.



Co-funded by
the European Union

From Seaweed to Stretch-and-Seal

Author: **David Mizzi**

*How much plastic do you think is actually recycled? Maybe 20–25%? What a grand and intoxicating innocence. Only a mere 9% of plastic ever produced has been recycled, and 95% of the plastic used in packaging is disposed of after just one use. However, one local start-up, **Natural Edge**, has developed an award-winning, food-safe, compostable film made from a natural gelling agent found in seaweed.*

I love leftovers. I always cook a little extra specifically to have for the next day. It just offers the pleasure of a warm meal without the cooking or clean up. Just cover it with stretch-and-seal, and you're good to go. But where do you throw away the cling film after you've used it?

I used to think it went in the grey recycling bag – it's plastic, after all, right? It turns out that once it has touched food, that plastic film is considered contaminated and cannot be recycled. Beyond our delicious plate of leftovers, think of the food you buy at the supermarket: the plastic film used for meat, the bags used for frozen produce, the plastic used for sliced cheese. None of it is recyclable unless it is washed at home. A trio of students from UM have founded Natural Edge and developed an award-winning, food-safe film that eliminates the need for recycling; instead, their product is completely compostable.

'The EU is encouraging the use of recyclable materials, particularly in packing,' says Ing. Nicky Zarb, a mechanical engineer and director of ReplantMT. 'However, for single-use items used for food packaging – things like candy wrappers, stretch-and-seal, and sauce packets – the focus should instead shift towards compostable materials. Despite being technically recyclable, food packaging cannot be recycled once contaminated by food. However, for compostable materials, this doesn't matter,' he explains.

Natural Edge stems from another company called ReplantMT, which focuses on sourcing and working with sustainable alternatives for the catering industry, such as straws and cutlery. The catering industry, whether a fast food restaurant or a caterer during a massive social event, generates a large amount of waste. 'ReplantMT started after an exam we had at University about sustainability and its policies,' explains Zarb. 'Alex

and I went out to eat next to the University after the exam, and we were shocked at the amount of waste generated for a short 30-minute meal.' The irony of creating enough waste to choke a baby dolphin directly after an exam about sustainable policy was not lost on them.

Zarb, Ing. Alex Tanti (mechanical engineer specialising in energy sustainability), and Noeleen Buttigieg (lead research chemist at Natural Edge) became friends during their time as students at UM. They noticed that sustainable raw materials, such as seaweed, could be used as an alternative to plastic. 'Seaweed has significant carbon capture opportunities, and it is easy to harvest,' explains Buttigieg. They applied for and secured funding from Xjenza Malta and began working to develop a sustainable solution for food packaging from natural ingredients.

'Ecosustainability is the future. We cannot continue with our ➔



Top: Ing. Nicky Zarb and Noeleen Buttigieg, the Natural Edge Team
Bottom: A working prototype of one of the first biofilms

Photos courtesy of the Natural Edge Team

current, unsustainable ways, affecting the planet and polluting. It is imperative to change our ways, and this initiative will be part of that process,' Buttigieg asserts.

FROM SEAWEED TO STRETCH-AND-SEAL

But how do you go from seaweed to stretch-and-seal? The trick lies in using a compound found in the cell walls of specific types of red algae. 'Think of powdered jelly,' says Zarb. 'You take that powdered jelly, in this case the seaweed, and after mixing it with water, it forms that jelly-gel.' This seaweed gel, together with other edible additives, is then spread out thinly to form a film.

The concept of producing films from seaweed isn't particularly new. However, the main challenge is giving the film water-resistant properties. 'When you try to make a package for liquid products like sauces or moisture-rich foods such as meat, the film swells up, and its mechanical strength decreases. We want to avoid this and create packaging that is resistant to water, something like plastic. Essentially, we are trying to replicate the resistance found in plastics, using a nature-derived, sustainable, and biodegradable material,' explains Buttigieg.

Using various natural, plant-based compounds, like rice starch, resins, and waxes, they have developed various techniques to improve the waterproofing of their packaging. It is this waterproofing element that makes Natural Edge's seaweed film unique from its competitors. Besides being waterproof, the film also has a good oxygen barrier, comparable to conventional cling film, so food will be safe and protected. The film is also transparent, an important

point to consider for food packaging. Furthermore, because it is made from edible ingredients, the entire film is technically edible. 'This doesn't mean it's meant to be eaten,' Zarb adds quickly, 'but even if it gets into your food, it's perfectly safe. And if it's purely edible, then it is also organic and compostable.' Following succinctly, Buttigieg adds, 'If it's safe for your body, then it's safe for the environment.'

MORE RESEARCH FOR MORE RECYCLING

Developing their product has required rigorous research. Besides taking care of the general administration of running the company, Zarb tests numerous mixtures to see how they perform,

how they mix, and what solvents to use. Buttigieg, on the other hand, sifts through research papers, seeing which ideas have already been tested and whether those findings can be utilised. In some cases, they require a bit of help, and this is where UM's Department of Metallurgy and Materials Engineering comes in, specifically with microscopy – using powerful microscopes to study the structure of an object. To refine their product, Natural Edge needed to better understand how their films worked and looked on a microscopic level, so they reached out to Prof. Ing. Joseph Buhagiar (Head of the Department of Metallurgy and Materials Engineering).

'A scanning electron microscope (SEM) is a special type of microscope



Testing biofilms covering fruit to show the real-life effects of the film. The covered apple is not as oxidised as the uncovered apple, even though they were cut for the same amount of time (approx. 5 minutes). The covered orange did not dry out after being exposed to air for 5 days.

Photo courtesy of the Natural Edge Team



Dry food items kept fresh in biofilm
Photo courtesy of the Natural Edge Team

that uses electrons instead of light. It allows for a high level of magnification and great depths-of-field. The surface of a sample is scanned with an electron beam, and the reflected (or back-scattered) beam of electrons is collected to obtain an image,' Buhagiar explains. 'However, Natural Edge's samples are non-conductive, so to image them, we need to deposit a very thin coating of gold on their surface.' Besides an image from the SEM, the department used an Electro-Dispersive X-ray detector to chemically analyse the material in real-time on a specific area. This device uses X-rays to help researchers

understand the chemical composition of a sample. Through this data, Buttigieg, Zarb, and Tanti could optimise and understand their product better, which is crucial for the next part of their plan.

'We want our film to be suitable for existing machinery,' explains Buttigieg. Eliminating the need for custom-made (and expensive) machinery should 'help encourage uptake by producers and, in turn, end users,' adds Zarb. Ultimately, your product needs to be easy to mass produce and offer the same convenience as current, conventional products. 'Conventional plastics can be heat-sealed, which is crucial in the

packaging industry,' explains Buttigieg. 'While our current material can be easily adapted to existing machinery, being heat-sealable will still be a focus in our future research,' she adds.

SEALING THE DEAL

So, how long before you can wrap your leftovers using Natural Edge's film? Currently, Natural Edge is aiming for a Technological Readiness Level (TRL) of 4. 'TRL 1 is the most basic, while TRL 9 is a final, commercial product. 4 and 5 are somewhere in between: having a prototype, but not necessarily the final version – rather, a proof of concept,' explains Zarb. 'We'd like to try a small pilot production line. This would mean we'd be at TRL 6 or even 7,' Zarb says excitedly. Having a pilot production line would help prove the commercial viability of their product and, hopefully, encourage further investment.

However, until then, the next step is to complete the Research Excellence Programme (funded by Xjenza Malta) and apply for more funding to buy the machines for their small production line. 'As soon as that works, we will have a minimum viable product. The science is sound – it works – we just need to get certification and cover testing involved,' Zarb says. 'In the meantime, we are constantly looking for investors who have an affinity or interest in this industry.'

With a prototype in hand, Zarb and Buttigieg have taken us a step closer to sustainability. Using a natural resource like seaweed, they have developed an alternative to plastic that will hopefully see wider adoption in the near future. As Buhagiar puts it, 'Change is not brought by talking but also by doing. This is what Natural Edge is doing: ideas turned into action.' 

Aurora Luminaria: Revolutionising Entertainment in Malta Through Drone Light Shows



Author: **Neil Spiteri**

*In the world of start-ups, innovation thrives where creativity meets practicality. Enter **Aurora Luminaria**, a Malta-based start-up venture aiming to redefine evening entertainment with mesmerising drone light shows. By combining cutting-edge technology, a passion for engineering, and a sprinkle of entrepreneurial grit, the team behind Aurora Luminaria is poised to light up the skies – literally.*

At a time when innovation continues to redefine entertainment, Aurora Luminaria, a Maltese start-up, is breaking new ground with synchronised drone light shows. Combining the latest technology with local ingenuity, this project promises to revolutionise how we experience events – from festivals to grand opening ceremonies. With prototypes under development and ambitious plans for the future, Aurora Luminaria is carving out a niche in Malta's technological and creative landscape.

The team is currently made up of Christian Dalli and Zachary DeMarco, both of whom have an engineering background, but each is fluent in their own respective stream. Dalli, the project's founder, specialises in printed circuit board design, electronic speed controller and motor design, and component selection. Meanwhile, DeMarco specialises in manufacturing techniques and 3D printing, computer-aided design and 3D modelling with generative design AI. The two collaborate well; although each person has their own dedicated roles, the knowledge and experience

of both team members overlap. This allows for double verification of the work conducted and for each to help the other when an obstacle arises.

INSPIRATION BEHIND AURORA LUMINARIA

Aurora Luminaria emerged from a blend of cinematic inspiration and technological potential. 'The idea was born out of a fascination with swarm operations and synchronised drone technology,' Dalli explains. 'We were inspired by international start-ups and wanted to create something that would bring this technology to Malta. Our



Opposite: Aurora Luminaria as 1 of 7 start-ups at the DiHubMT inauguration, showcasing their research and development
Photo by Nathan Borg

Top: The first two drone prototypes
Photo by Christian Dalli

goal is to redefine local entertainment standards, making these light shows accessible and impactful.' Drawing from off-the-shelf hardware and innovative software design, the start-up aims to create a fully synchronised fleet of drones capable of breathtaking performances. The inspiration is as much about artistry as it is about showcasing Malta's technological capabilities.

The project's objectives are clear: develop a local fleet of drones for use in public events, festivals, and private functions, all while ensuring safety and accessibility. 'We want these drones to be available for public use, whether it's for a local feast or a corporate event,' says Dalli. The system is designed to be flexible, offering customisable shows tailored to client needs. From designing bespoke displays to managing permissions and logistics, Aurora Luminaria provides an all-inclusive solution.

'Our vision is to create an affordable and reliable service that eliminates the need to import these technologies from abroad,' the founder emphasises. By doing so, Aurora Luminaria hopes

to establish Malta as a hub for drone-based entertainment.

OVERCOMING CHALLENGES

Every start-up faces its fair share of challenges, and Aurora Luminaria is no exception. 'One of the biggest hurdles is navigating the legal landscape,' Dalli admits. The operation of multiple drones in synchronised flight requires special permissions and permits, and the local legal framework is still catching up to this emerging technology.

Technical challenges also abound. For example, the team recently switched to a new GPS system mid-way through the project, which required significant adjustments to both their hardware and software setup. Additionally, supply chain disruptions, such as delays in importing components, have posed difficulties and delayed their progress. 'We've faced setbacks, but each challenge has taught us valuable lessons and strengthened our resolve,' Dalli shares.

What sets Aurora Luminaria apart is its commitment to pushing the boundaries of drone technology.

'Our primary focus is extending flight times and enhancing synchronisation,' he explains. The current prototype can synchronise three to four drones, a number the team hopes to expand significantly in the near future.

Maintenance for these drones will be similar to that of single drones but scaled for larger fleets. Regular checks on propellers, batteries, and weather conditions are essential to ensure smooth operations. 'We're working hard to create a system that is both high-performing and user-friendly,' Dalli adds.

AFFORDABILITY AND ACCESSIBILITY

Aurora Luminaria aims to make its services as accessible as possible. Whether for public events or private functions, the team offers flexibility in pricing and operations. 'Clients can work with us to create a custom-designed light show with the flexibility of choosing the number of drones they want to employ, the show complexity, and its duration,' Dalli explains. This approach ensures that the service will be able to ➔

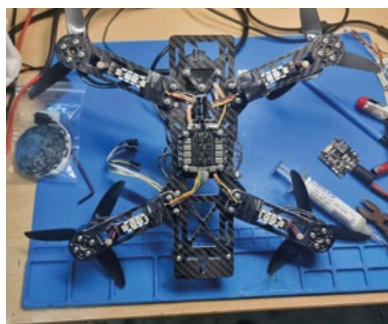


Left: The first prototype



Right: The second prototype, which is smaller and lighter than the first one

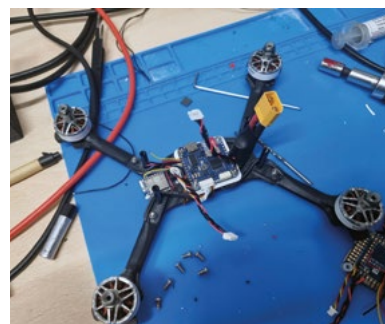
Photos by Christian Dalli



The first prototype with LED light module underneath



The third prototype with improved flight time



Building process of the third prototype

Photos by Christian Dalli

cater to a wide range of budgets and requirements.

Despite its relatively short journey so far, Aurora Luminaria has already achieved significant milestones. The project received a €25,000 grant through the TAKEOFF SeedFund Award (TOSFA), which has been instrumental in its development. Additionally, partnerships with organisations like DiHubMT have provided access to facilities, mentorship, and administrative support.

'We've successfully developed a proof of concept, demonstrating that our system works,' he says proudly. The prototype fleet can perform synchronised flights, showcasing the feasibility of the project. These achievements mark the first steps toward a full-scale launch.

LOOKING AHEAD

Aurora Luminaria has ambitious plans for the future. By the end of

the year, the team hopes to launch simple light shows to showcase their capabilities. 'Our ultimate goal is to participate in large-scale events by next year,' Dalli explains. Future developments will include expanding the fleet, improving synchronisation, and enhancing the drones' physical design to increase durability and flight times.

The team is also exploring additional funding opportunities to accelerate progress. 'We're committed to continuous improvement and innovation,' he states.

The impact of Aurora Luminaria's project on the local community could be transformative. 'Currently, there's nothing like this available locally,' Dalli explains. Event organisers often rely on foreign companies to provide drone light shows, a process that can be expensive and logistically complex. By offering these services locally, Aurora Luminaria aims to fill a significant gap in the market.

The founder also hopes the project will inspire other local entrepreneurs to explore innovative technologies: 'We want to show that Malta has the talent and resources to compete on a global stage.'

As a young entrepreneur, the founder of Aurora Luminaria understands the challenges of starting a new venture. His advice? 'The first step is the hardest. It's easy to have ideas, but taking that initial step – seeking advice, attending meetings, and making a plan – is what sets successful entrepreneurs apart. Once you start, things will gradually fall into place.'

Aurora Luminaria represents a bold step forward for Malta's entertainment and technology sectors. With a clear vision, innovative technology, and a dedicated team, the project has the potential to revolutionise how events are experienced in Malta and beyond. As Dalli aptly puts it: 'This is just the beginning. We're excited to see where this journey takes us.' 

The Making of a Modern Artist: From *Star Wars* to Digital Mastery

Author: **Alexandra Alden**

*'It was a complete flop,' laughs **Nicholas Vella Magri Demajo**, recalling his first attempt at prop-making: a fibreglass Master Chief helmet crafted at age 14. For UM alumnus Vella Magri Demajo, that was only the beginning. Today, that teenage experiment has evolved into an impressive career spanning digital art and custom props.*

Growing up in a sci-fi-obsessed family, Vella Magri Demajo's creative journey began with *Star Wars* screenings. Evidently, exposure to this iconic series proved to be the ultimate creative catalyst for the young maker. 'Ever since I was practically a baby, my dad used to show me *Star Wars*,' he reflects. This early exposure to props, music, and visual effects sparked a career-defining passion.

What started as fascination evolved into practical experience. 'I used to work in 3D companies, creating 3D assets for video games,' Vella Magri Demajo explains, describing his transition into making physical props. Each project, from that first failed helmet to later successes with Boba Fett and Commander Cody designs, helped refine

his craft. These early experiments, all handcrafted in fibreglass before 3D printing became his preferred medium, laid the foundation for his future work.

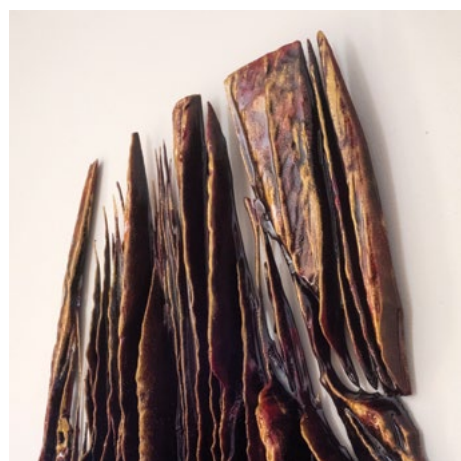
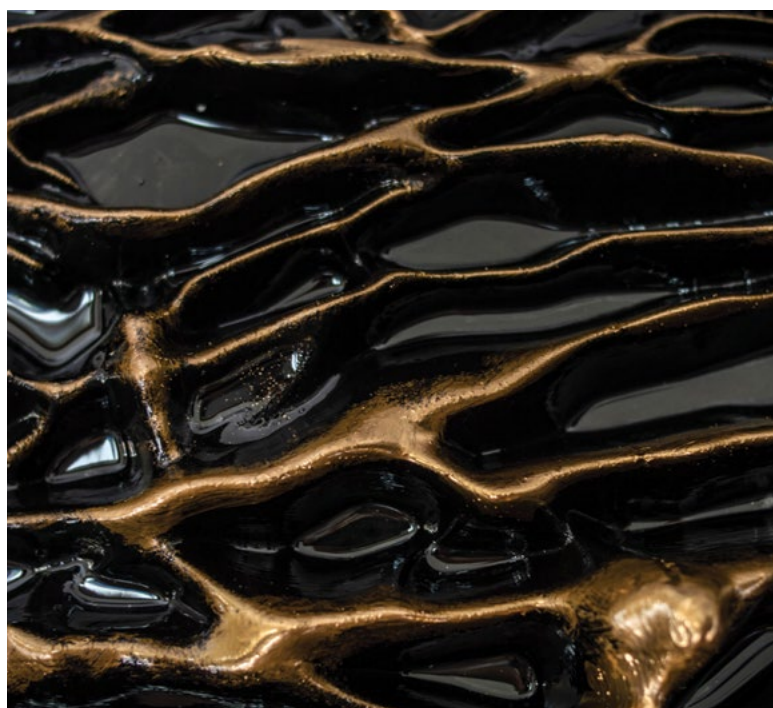
EXPANDING HORIZONS

After completing his Maths and Physics A-levels and a Diploma in Architecture and Design Foundation Studies, Vella Magri Demajo chose digital arts over architecture. This is a decision he celebrates daily. His bachelor's and master's degrees in digital arts, carried out at the University of Malta, provided more than just technical skills. 'The master's was vital,' he explains, 'to have a very deep understanding of learning cross-disciplinary research – matching two things that have nothing to do with each other and creating something completely unique and original.'

A pivotal moment in his education came during his year abroad at the Fachhochschule Salzburg, one of Austria's premier digital art universities. 'That was the most important year of my entire life,' he says. Studying under industry veterans who had worked on blockbusters like *Iron Man* and *Harry Potter* gave him unprecedented insight into the professional world of 3D artistry. This experience, combined with his academic training, helped him develop what he calls 'a set of fresh eyes to understanding the industry.'

CHASING GOALS

His most challenging project? The Insta Muse museum in Shoreline. 'I built a full-scale plane interior, a one-metre-tall mascot character, and a life-size unicorn,' Vella Magri Demajo reveals. The project, taking nearly ➤



A selection of Nicholas' 3D artworks
Photos courtesy of Nicholas Vella
Magri Demajo



Nicholas working on his installation pieces for the Insta Muse museum
Photos courtesy of Nicholas Vella Magri Demajo



Nicholas with one of his installations at the Insta Muse museum
Photos courtesy of Nicholas Vella Magri Demajo

a year, showcases his versatility. Walking through the museum, visitors can experience his handiwork firsthand, from the detailed aeroplane panels to a striking metre-tall chess piece suspended from the ceiling. 'It was quite a daunting project,' he admits, 'but extremely rewarding.'

Notable collaborations include works with prominent artists Austin Camilleri, Trevor Borg, and Zach Ritchie. He has also created custom pieces for international clients, including a *Squid Game*-inspired mask for UK DJ Herbie Diamond. His Etsy shop recently surpassed 2,000 sales, with a five-star rating from over 500 reviews.

Vella Magri Demajo's willingness to embrace challenges has led to extraordinary creations. A recent project involved crafting a one-metre-long spaceship with detachable smaller ships connected by magnets. 'The client just kept telling me, "Can you do this, this, this? Can you make the ships come out of the port? Can you make the lights on this?" And I literally said yes to everything,' he recalls with a laugh. 'It was so difficult, but we managed to do it anyway.'

This 'yes-first' approach to client requests has become a defining characteristic of his work. 'I always say yes. I don't think I've once

said no,' he notes, explaining how this openness has led to some of his most innovative projects.

DETERMINED ENTREPRENEURSHIP

Currently operating as a 'one-man band' but growing rapidly, Vella Magri Demajo has invested in new equipment and space for expansion. To aspiring 3D artists facing today's saturated market, he offers pragmatic advice: 'If it's literally your life goal, YouTube is your best friend. Stay open-minded, shut up, and listen.'

His journey from that first 'flop' to his current success demonstrates the power of persistence and continuous learning. Drawing from his experience at Blaze Productions in Malta, where he spent four years honing his craft, he emphasises the value of practical experience. 'Like literally half of all my 3D artist work is from Blaze,' he acknowledges, highlighting how internships and hands-on learning can shape a career.

As he looks to the future, Vella Magri Demajo remains focused on sustainable growth. While he might bring on additional help in the coming years, his primary goal is to maintain the quality and creativity that have become his trademark. With nothing holding him back and new projects constantly on the horizon, this *Star Wars*-inspired journey continues to evolve, proving that sometimes the most impressive careers start with a simple childhood passion. **T**



Written by
Martin Lochman

FIVE STAGES OF HUBRIS



(FIRST DRAFT, 14th FEBRUARY 2029)

Dear Mrs Sciberras,

Allow me to begin by stating that all I ever wanted was to make our country a better place to live. Unlike plenty of my peers who went into science to make a name for themselves or revel in the theory, my ultimate objective has always been to develop practical, easily applicable solutions to problems. And let's face it, Malta suffers from plenty – from chronic overpopulation coupled with collapsing infrastructure and short-sighted development policies, to climatic changes with increasingly more devastating effects on the local environment.

I was never one to complain, but when push came to shove, everyone just stuck their heads in the sand and pretended the hornet issue didn't concern them. I wasn't about to lump it in with the rest of this country's issues, nor was I ever going to be among those who would flee the country the first

chance they got, renouncing everything that tied them to it. I vowed to do everything in my power to help the island and my fellow countrymen, as any true Maltese should.

You might understand this as an excuse, a desperate attempt at justifying this inexplicable accident, and I suppose you have every right to do so. However, I need you to know where I am coming from and |

(SECOND DRAFT, 23rd FEBRUARY 2029)

Dear Mrs Sciberras,

I believe the best way to begin this is by explaining the nature of my work and what I set out to achieve. I am – I was – the head of a small research group at the Department of Applied Entomology, the youngest postdoctoral fellow at the University (though I understand that you may deem that hardly relevant). We were investigating the Oriental hornet (*Vespa orientalis*), specifically the methods that could

be used to drastically reduce their numbers in Malta.

I am sure you are aware of the profound negative impact the species, albeit native to the Archipelago, has had on the environment, especially in the last decade when their population exploded as a result of uncontrolled urbanisation and its accompanying symptoms. Destroyed bee colonies, reduced agricultural production, damaged infrastructure – these are only a few highlights that made the papers. The hornets' true achievement, in the negative sense of the word, was the irreversible, irreparable change to the local ecological landscape.

We considered different options, from the Sterile Insect Technique to growth inhibitors, but I wanted a solution that would have a more immediate and tangible effect. I felt we were racing against time and soon there wouldn't be anything anyone could do to stop the situation from spiralling out of control.

You can therefore imagine my

excitement when the answer finally presented itself – partly a happy combination of the right factors, partly the result of my unwillingness to let go of what everyone else dismissed as a dead end: pheromones. Though the hornets communicate primarily through sound vibrations, they are as susceptible to chemical cues as virtually all representatives of the insect world, and that fact turned out to be the key. In a nutshell, what we did was create a synthetic pheromone that turned the species' innate aggression inward.

We made them hunt and kill each other |

(THIRD DRAFT, 28th FEBRUARY 2029)

Dear Mrs Sciberras,

I imagine that by now, you have the full story. The conventional mass media as well as the social networks have done an excellent job of giving you the minute details of my life and work and painting me as the worst human being to ever walk the Earth. Some cold-hearted scientist with delusions of grandeur and ambitions that could never be satisfied. I find it tragically amusing that in a country with a long, rich history of political corruption, rampant greed, and overt classism, where the law is reduced to a mere suggestion to be considered and discarded, someone whose only goal was to improve the dismal status quo can be so readily designated public enemy number one.

It's the era we live in: an era of instant gratification, foregone conclusions, and black-and-white narratives. But I digress. I need you to know that I never intended for anyone to get hurt, even if nobody believes it.

I admit that, while largely exaggerated and simplified, a few claims posited in the news do contain a grain of truth. Some of the test subjects did indeed exhibit aberrant behaviours during the trials, lingering in place or taking interest in their surroundings rather than the other hornets after being exposed to the pheromones, but these constituted a fraction of their total numbers – dismissing it as inconsequential was only logical.

And yes, the implementation phase was somewhat rushed; however, the initial results spoke for themselves. Within days, major colonies had collapsed with little to no collateral damage. Within a few weeks, the hornet population in Malta had been reduced by thirty percent – and those were only the conservative estimates!

You see, my solution worked *exactly* as it should have |

(FOURTH DRAFT, 4th MARCH 2029)

Dear Mrs Sciberras,

What happened to your daughter and the other children at Il-Farfett Childcare was a tragedy, there is no denying that. I cannot even begin to imagine what they must have felt when the swarm descended on them and their carers. I have seen the video more times than I can count – the prosecution made sure that I would have access to *all* damning evidence – and I can honestly say that there exists no worse fate.

I want to offer you my sincere apology for the part I played in the horrible event. I am well aware that my words are meaningless to you and your family, yet I must emphasise that none of us, not the members of my

team nor my superiors, could have foreseen it. We had expected a degree of adaptation – after all, the stress we induced in the hornet population was unparalleled; however, their newfound cooperation, hyper-aggression, and strategic behaviour were so far beyond our wildest thoughts that they never even occurred to us. It should have been impossible. This is not meant as an excuse but simply an explanation, an effort to |

(FIFTH DRAFT, 6th MARCH 2029)

Dear Mrs Sciberras,

I am truly sorry. I realise now that there is nothing I can say that would ease the pain and suffering you are feeling. No matter how hard I cling to justifications, the truth remains plain and simple: I was wrong. I made a mistake, and that mistake cost lives.

Even if I am ultimately convicted and sentenced, I will do everything in my power to eliminate the threat I created. The hornets' unprecedented adaptation has rendered them completely unpredictable; however, they are biologically still the same species, and surely therein lies the key to bringing them back under control.

I know my apology won't bring Julia or the others back. I know you can never forgive me, and I accept that. My only hope is that one day, you can find some small measure of peace.

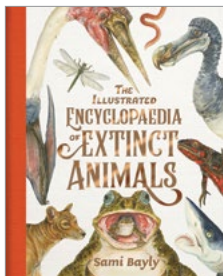
I am sorry.

Kindest regards,
Dr Alex Azzopardi

END. 

to-do list

book



***The Illustrated Encyclopaedia of Extinct Animals* by Sami Bayly**

A beautifully illustrated book documenting sixty extinct and critically endangered animals to educate readers on biodiversity and wildlife conservation.

videogame



***Empires of the Undergrowth* developed by Slug Disco Studios**

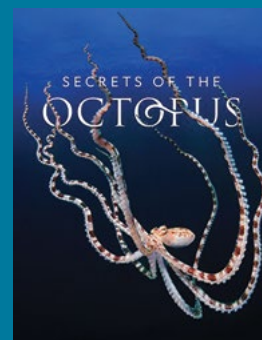
A real-time strategy game in which players manage an ant colony, interacting with and competing against various insect species.

series

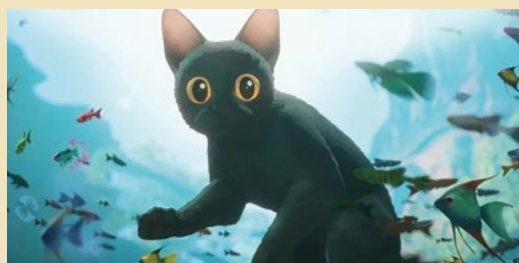


Secrets of the Octopus

Narrated by **Paul Rudd**, and executive produced by **James Cameron**, this immersive docuseries explores the intelligence and cultural behaviours of one of the world's most intelligent yet mysterious creatures – the octopus.



film



***Flow* directed by Gints Zilbalodis**

A spellbinding, dialogue-free animated film about a black cat navigating a post-apocalyptic world who finds refuge on a boat of unlikely companions.

Brian's Corner

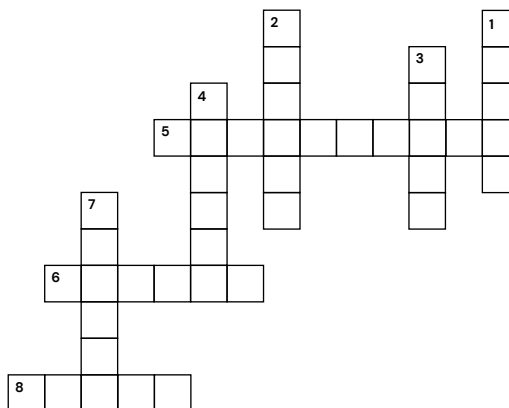
Crossword Puzzle

Across

5. A community of microorganisms that colonise a space
6. A small part/quantity of something used for analysis
8. A discarded material or byproduct

Down

1. Strange or unfamiliar; belonging to another place
2. Excessive pride or arrogance; narcissism
3. A male bee; a remote-controlled small flying device
4. An electrical impulse; an indication; a gesture
7. A state of equilibrium, stability, or inactivity



CAMPUS BREAKFAST

Costa Fascinosa Cruise

GIVEAWAY



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TO WIN A CRUISE FOR 2



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