Dr Alexia Massa-Gallucci
Image courtesy of the researcher

Ocean's Trash is Another Woman's Treasure

Author: **Sarah Schembri**

Heaps of dead seagrass on beaches are picked up and thrown away every year. However, this smelly beach wrack has value that ***Blue EcoTech Ltd****. intends to extract, reducing waste and contributing to the circular economy in the process.*

Every year, the Mediterranean Sea throws out its rubbish and lays it on our beaches. I'm not talking about the garbage that we pollute the sea with. This rubbish is organic, supports seasonal ecosystems, provides coastal waters with nutrients, and preserves the integrity of sandy beaches. I'm talking about beach wrack, which on Mediterranean beaches, consists mostly of dead *Posidonia oceanica* leaves (*alka* in Maltese).

DEAR OR ALIVE

P. oceanica is an aquatic plant that is endemic to the Mediterranean Sea and is a protected species because of the multiple ecosystem services that it provides. It oxygenates the water through the process of photosynthesis, it grows in dense meadows that provide a safe nursery ground for the larvae of many species, it sequesters (captures and stores) carbon, and it dampens the strength of waves before they hit the shore. Furthermore, the oxygen produced by *P. oceanica* (and all the other photosynthetic organisms in the marine environment) contributes to the oxygen we breathe. The oxygen released in the water percolates into the atmosphere becoming part of the air we breathe every moment during the day. Around 60% of the oxygen we breathe is produced by marine photosynthetic organisms. The benefits that this one plant provides do not stop with death.

Posidonia oceanica
Image courtesy of Dr Thanos Dailianis

Mostly during winter and autumn months, the shed leaves wash up on the shore, forming thick, spongy banquettes that provide habitat for land invertebrates. The banquettes slow down the natural erosion of sandy beaches, and as the leaves decompose, nutrients are released and washed back into the sea.

These banquettes of dead *Posidonia* are not only formed by leaves but also all the other parts of the plant that grow old and detach, ending up washed ashore. Ideally, they should be left in place for as long as possible to maximise their ecological function. However, the arrival of summer necessitates their removal as people want to use the beach and the foul odour of the deteriorating leaves is unpleasant. The government's Cleansing and Maintenance Division is in charge of clearing up the beach wrack from sandy beaches. Each year the Division gets a permit from the Environment and Resource Authority, and the appropriate machinery is used to pick up the decaying leaves from the beach, which are dumped in a landfill. Every year, the Cleansing and Maintenance Division removes several tonnes of beach wrack from the beaches and stretches of coastline interested in tourism activities. The same process happens in other Mediterranean countries too, meaning that plenty of local authorities in different countries are spending money to move beach wrack from beaches only to leave it to deteriorate somewhere else.

VALORISATION

Farmers in Malta use dead *Posidonia* beach wrack as animal bedding or as a covering to protect produce like potatoes when they need to be stored for a length of time. Despite these uses, the vast majority of beach wrack still ends up in landfills, where it releases CO_2 and methane as it rots.

This waste is one thing that Dr Alexia Massa-Gallucci hopes to address with the start-up that she has founded, Blue EcoTech Ltd. As a scientist, she recognises the significance of an essential resource being squandered and is determined to take action to address the issue. Massa-Gallucci has spent most of her career so far on marine research but decided to switch to entrepreneurship three years ago to, '[...] use my skills to make a positive impact on the environment.' Said skills have been accumulated over a long and varied career covering multiple areas of aquatic research, from pelagic and benthic food webs in Italy to fresh-water fisheries and population genetics in Ireland, to managing EU and local projects on commercial Mediterranean fish. With plenty of qualifications and experience under her belt, Massa-Gallucci believes that she could have a bigger positive impact on the marine environment by building a company aimed at making use of currently wasted marine resources. Presently, her sight is set on the *Posidonia* beach wrack.

Massa-Gallucci explained that *P. oceanica* is a marine plant, not an algae (don't let the similarity of the words *alka* and *algae* confuse you). *Posidonia*'s evolutionary ancestors are flowering plants that grew on land millions of years ago and later re-adapted to an aquatic environment. This means that the seagrass' molecular structure is made of the biopolymers cellulose and lignin, the same organic material that wood is made up of. These properties allow the plant to be utilised in various industries, from textiles to biotechnology and even plastics. The advantage of extracting these polymers from *Posidonia* leaves instead of from other plant materials is that the seagrass beach wrack is naturally renewable. We do not need to use resources to grow the plant; we simply need to pick the beach wrack up from the beaches.

Posidonia oceanica
Image courtesy of Dr Thanos Dailianis

When the *Posidonia* beach wrack is fractionated, cellulose and lignin can be extracted and processed with various biotechnological methods. Several useful materials can then be made from the extracted polymers. Cellulose can be used to make textiles such as rayon and viscose. Cellulose can also be converted into macrocellulose, nanocellulose, and sugars that can be used to make nanomaterials in the composite industry. Nanomaterials have various biomedical applications. Extruded lignin can be used for bioplastics that biodegrade and therefore do not cause the same environmental damage caused by plastics made from fossil fuel byproducts. Massa-Gallucci calls the process of extracting useful material out of marine waste *valorisation* because value and use are added to a resource.

GETTING DOWN TO BUSINESS

The biotechnological processes needed to make useful products out of beach wrack require the collaboration of experts in several disciplines. 'A successful collaboration requires that the collaborators have a shared passion and are on the same page,' states Massa-Gallucci. She talks warmly about the fruitful professional relationships she has built in the process of running Blue EcoTech Ltd. such as with Dr Inga Matijošytė, head of the Sector of Applied Biocatalysis at Vilnius University and other colleagues of the Cost Action CA18238 Ocean4Biotech on marine biotechnology.

One of the challenges for Massa-Gallucci was the transition from researcher to business owner. She has had a steep learning curve and is still learning every day about the ins and outs of funding and maintaining a business. In this aspect, Massa-Gallucci is also appreciative of the guidance and mentorship she has received, such as from Dr Stefano Acunto, who collaborated with Blue EcoTech on seagrass meadows habitat restoration projects.

The University of Malta's Take-Off business incubator has also had an important role in the story of Blue EcoTech. Massa-Gallucci was awarded seed funding via the Maritime Seed Award supported by the incubator. Furthermore, the incubator provides the opportunity to receive mentorship from experienced personnel at TAKEOFF and the University's Centre for Entrepreneurship and Business Incubation. Massa-Gallucci made use of this mentorship and advocated for the importance of getting a reality check when needed.

Using *Posidonia* leaves to produce valuable and environmentally friendly products is just one of the ideas that Massa-Gallucci has for Blue EcoTech. Massa-Gallucci is passionate about the Mediterranean Sea and dedicated to fully using all the resources we extract from it. For example, plenty of fish caught are not fit or are considered not desirable for human consumption; however, they still have oils rich with omega 3 and 6 that can be extracted and used in fish feed. The start-up has also worked on underwater reforestation projects, planting *Posidonia oceanica* meadows in areas where they had degraded.

'I was given my first snorkel and mask when I was eight years old. I put my head in the water and never took it out. That sense of wonder never left!' says Massa-Gallucci. Her passion for ocean preservation is evident when she talks about outreach activities she does as part of Blue EcoTech's mission for ocean conservation and education. You might catch her at the next Science in the City convention or citizen science campaign. There are many ways by which scientists are contributing to preserving the environment. Making a decent step forward towards creating a more circular, blue economy is an essential one. T