

AI makes smarter use of seaweed and kelp

April 2 2024, by Steinar Brandslet



Seaweed and kelp products have already become a major industry. This is the gang at Polar Algae in Hammerfest. Their years of experience are now being boosted by artificial intelligence. Credit: Caroline Haukeland, Polar Algae

Seaweed and kelp are eaten by both humans and domestic animals all over the world. Several species are used in everything from cosmetics and food additives to fertilizers and medicines.

However, [seaweed](#) and kelp are also part of vulnerable ecosystems that are at risk of over-exploitation. Researchers and industry want to prevent this from happening by using [artificial intelligence](#).

"If we harvest seaweed without having a management plan in place, we put these vulnerable ecosystems and the biodiversity they are part of at risk," says Nadav Bar, a professor at NTNU's Department of Chemical Engineering.

Bar says society shouldn't make the same mistake with seaweed and kelp as has been done with [fish stocks](#).

"Large parts of the world's fish stocks are either completely depleted or overexploited, and the percentage of fish species that are found in sustainable quantities in the ocean is declining dramatically. For example, cod has almost completely disappeared from Canadian waters," Bar says.

According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), one million of the world's plant and animal species are at risk of extinction. Approximately 66% of the oceans on our planet are affected by human activity.

That's why it's important to plan properly how we should use seaweed and kelp.

European plans using artificial intelligence

Bar is coordinating a major new EU Horizon Europe project called iCulture, a collaboration involving 17 partners from 10 countries. The goal is to be able to use seaweed and kelp as a sustainably important resource while also safeguarding biodiversity.

"We will use artificial intelligence to better understand these vulnerable ecosystems to ensure we use resources in a smart way," Bar says.

Several large companies are already trying to use environmentally-

friendly methods in their production, but these efforts constitute only a small part of their activities.

iCulture is a major research project led by NTNU in Trondheim.

"We are developing artificial intelligence that investigates the vulnerability of known species of seaweed and kelp. We are also identifying new species that contain chemical substances with great potential for society. If we are successful, they can be harvested commercially," says Bar.

Both alginate and fertilizer products for the [agricultural industry](#) are currently produced from macroalgae, but these products only use certain parts of these marine plants. Currently, over 70% of the plant mass simply goes to waste.

"For this reason, we are also developing an artificial intelligence-based algorithm that directs specially modified bacteria to consume the rest of the raw algae material. As a result, the remaining raw material is converted into valuable products, and there is no residue or waste," says Bar.

These modified bacteria produce useful, expensive [chemical substances](#) such as antimicrobial molecules and antioxidants.



Polar Algae harvests algae for use in several different products. The harvest rotates so that the same areas are only harvested every five years. Photo: Caroline Haukeland, Polar Algae

"The new AI-led technology is based on algorithms currently used in popular computer games such as StarCraft and Civilization," says Professor Bar.

The project involves people from many fields, such as marine biologists, geneticists, artificial intelligence and modeling experts, environmental engineers, process engineers and cyberneticists, social scientists as well as people from the industry itself.

Finding out when and where to harvest

Researchers and the industry are studying the effects of harvesting on seaweed and kelp stocks. They are also looking at how climate change affects the stocks and how ecosystems recover after harvesting takes place. The data can indicate where and when sustainable harvesting should take place.

"Using machine learning algorithms, iCulture analyzes over 80 TB of data. This provides us with key information, enabling us to combine seaweed and kelp harvesting with protection of the ecosystem. It helps us conduct a less invasive harvest. We demonstrate that it is possible to combine seaweed and kelp harvesting with environmental considerations," says Bar.

Responsible harvesting ensures that the resource is not depleted, benefiting both the industry and the ecosystems.

Georg Kopplin is research manager at Alginor ASA and responsible for the processing of raw seaweed and kelp materials in this project.

"Alginor harvests tangle kelp along the Norwegian coast, and our approach has always been total utilization of kelp and a zero-waste policy. This means that we divide kelp into all its components, such as alginate, fucoidan and cellulose. These are used in the medical, pharmaceutical, food and textile industries," says Kopplin.

Fermentation is particularly interesting.

"Fermentation helps us use more of the raw material. This increases the total value of the raw material, and we can offer many different products," says the research manager.

Years of experience result in sustainable harvesting

Many industry actors in Norway base their harvesting of knotted kelp on years of experience.

"The harvesting of tangle kelp and knotted kelp is currently sustainable in Norway, and has been since 1937," says Caroline Haukeland, founder of Polar Algae.

Located in Hammerfest, the company harvests algae for use in several different products. The harvest rotates so that the same areas are only harvested every five years.

"It is important for Polar Algae that we harvest our areas according to a scientifically based management plan," says Stig Ove Hjelmevoll, Research Director at Polar Algae.

The company is researching how different harvesting methods affect fauna and flora in the intertidal zone.

"Using artificial intelligence, we can create a dynamic management plan that is based on parameters beyond measuring regenerated biomass, climate change, weather and so on," says Hjelmevoll.

"Both the industry of the future and the environmental policies of the future will benefit from iCulture, allowing us to use natural resources while leaving a minimal environmental footprint," says Bar.

Provided by Norwegian University of Science and Technology

Citation: AI makes smarter use of seaweed and kelp (2024, April 2) retrieved 20 May 2024 from <https://phys.org/news/2024-04-ai-smarter-seaweed-kelp.html>

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