

# HELP FOR THE HIGH SEAS

As a treaty to protect life in the open ocean nears completion, scientists applaud the new pact and worry about provisions that could hamper research. **By Olive Heffernan**

In 1945, a young chemist called Werner Bergmann was diving off the Florida coast, scouring its waters for undiscovered marine life. One of the species he came across was a rather plain brown sponge. A colleague named the new-found creature *Cryptotethia crypta*, and Bergmann isolated from it two unknown compounds – spongothymidine and spongouridine.

He suspected they could have medical uses, but their true value didn't become apparent for more than 40 years. In 1987, the US Food and Drug Administration approved the first therapy for HIV; that drug, called azidothymidine (AZT), was modelled on the sponge compounds that Bergmann had identified. By 1989, AZT had become the most expensive drug known, at US\$8,000 per patient per year, generating more than \$100 million a year in profits for the drug company.

Eight other natural marine products have led to clinically approved drugs and another 28 are in clinical trials. Projections suggest that the global marine biotechnology market – which includes products for the pharmaceutical, bio-fuels and chemical industries – could reach \$6.4 billion by 2025. There's even a chance that a marine organism could help to combat viruses, such as the one responsible for the current pandemic; a compound isolated from red algae has shown promise in tests on different types of coronavirus (see A. Zumla *et al. Nature Rev. Drug Discov.* 15, 327–347; 2016). Commercial interest in the genetic resources of the high seas has never been greater.

It has also never been more divisive. In the next few months, barring delays caused by

the COVID-19 pandemic, nations are expected to strike a historic deal to protect marine life in the high seas – the ocean beyond national governance. This region accounts for 90% of Earth's available living space, and is thought to be home to millions of undiscovered species.

For the deal to go ahead, nations must agree to a system for creating large marine sanctuaries on the high seas and must lay out rules for how industry operates in these waters. But by far the most contentious issue they will tackle is how to regulate the use of the genetic resources of the high seas – both the marine creatures themselves and their gene sequences. The goal is to prevent 'biopiracy' – attempts by wealthy nations or companies to commercialize biological resources without sharing the benefits with their rightful owners. In the case of the high seas, those owners are all nations.

Researchers are overjoyed by the prospects of a high-seas treaty, but they are worried that efforts to prevent biopiracy will curtail their ability to do basic research in the open ocean.

It's not an idle concern. Although almost all details of the treaty have yet to be agreed, the draft text includes several ideas that would change how high-seas research happens. Most notable are proposals that scientists would need to notify the United Nations before conducting research cruises in the high seas, or that they would need to obtain permits for such work, which would require them to share data or other benefits from their research.

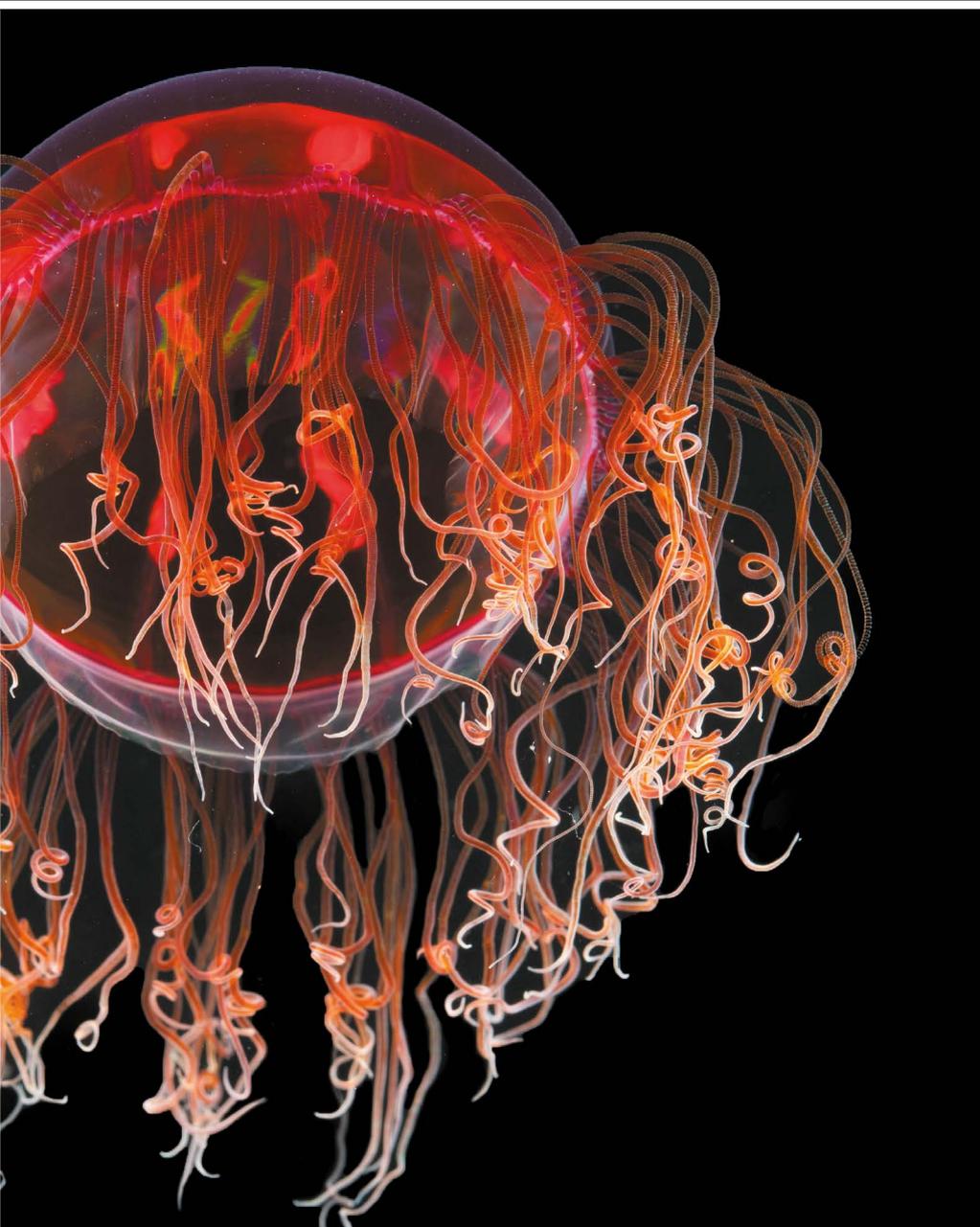
Most scientists are keen to share benefits with developing nations and Indigenous groups, but they do not favour constraints on research. Some fear that the proposed



anti-biopiracy regulations will mirror those of the Convention on Biological Diversity, most notably the Nagoya Protocol, an international agreement adopted in 2010 that restricts scientists' access to the territories of other nations, including their coastal waters. Nations drafted the Nagoya Protocol to prevent companies from patenting Indigenous medicines without sharing the profits, and now some researchers say it has made it difficult to get permits to work in some developing nations.

"I'm delighted that the UN is undertaking this effort as a way of trying to ensure conservation and appropriate oversight of the high seas," says Peter Girguis, an ocean scientist and evolutionary biologist at Harvard University in Cambridge, Massachusetts. But Girguis says he is "hugely concerned that we'll find

DAVID SHOLE/NPL



A new treaty will govern uses of organisms from the open ocean, such as this hydromedusa.

by the UN Convention on the Law of the Sea, but there is no law to protect marine life in this vast region.

Up to now, some 34,000 marine natural products have been identified that could potentially be used in medicine, food and cosmetics. Of the eight existing marine drugs, five are cancer treatments. With the global marine biotechnology market growing rapidly, concern has mounted about ownership of these resources. At present, it's possible for anyone to develop and profit from a product derived from biological samples taken in the high seas, and some developing nations are concerned that wealthy nations or companies will reap most of the profits to be made from this global commons.

Already, 12,998 genetic sequences from marine species have been patented. The multinational chemical giant BASF, based in Ludwigshafen in Germany, has registered 47% of those gene sequences in patents – a figure that Robert Blasiak, an ocean-governance researcher at the Stockholm Resilience Centre in Sweden, and his colleagues say represents a worrying trend of corporate control over marine genetic resources. A sequence used to fortify canola oil, from the rapeseed plant, with omega-3 fatty acids.

When nations meet to thrash out the treaty, they will have to decide whether the new law to prevent biopiracy covers physical samples only, such as an alga and its DNA – or whether it extends to digital sequence information, such as a gene sequence from an alga stored in a data repository.

They will also have to consider two other issues related to biopiracy: how to ensure equal access to marine genetic resources and how to share benefits from them. These provisions would parallel the protections adopted through the Nagoya Protocol. Developing nations pushed for the protocol out of concern that companies were patenting Indigenous medicines without sharing the profits.

One example involves the Madagascar periwinkle, *Catharanthus roseus*, which has been used for centuries as a medicine in Africa and China. Compounds from the plant and their derivatives are now ingredients of numerous medications patented and sold by large pharmaceutical companies. So far, the provisions included in the Nagoya Protocol have led to one profit-sharing arrangement, for South African rooibos tea.

Nations hope to strike a high-seas deal this year, but there are still deep philosophical divides. Countries such as Russia, the United States and Japan, which have the technological and financial clout to scour the deep sea in search of new drugs, cosmetics and food products, are advocating a 'free seas' mentality that favours unrestricted access, patent protection and sharing of non-financial benefits such as data. Developing nations, typified by the

ourselves hindering access for everybody to do academic research”.

### Final stretch

Conservationists and scientists have pushed for a high-seas treaty for more than a decade, and they are now entering the home stretch. Negotiators were scheduled to start the fourth and final round of talks on 23 March in New York, but that meeting has been postponed until further notice because of the COVID-19 pandemic.

The treaty would close a giant gap in the existing network of international and national laws. Countries have exclusive rights to fish and mine in waters up to a distance of 200 nautical miles from their shores. Beyond that are the high seas. Right now, certain activities on the high seas, such as mining and cable laying, are regulated



**THE GLOBAL MARINE BIOTECHNOLOGY MARKET COULD REACH \$6.4 BILLION BY 2025.”**

## Feature

Group of African States (the African Group), argue that marine genetic resources are 'common heritage' and need some oversight so that their use can be monitored and any profits, as well as other benefits, shared. "If there's almost no form of regulation, there wouldn't be any opportunities for us to track and trace when there is commercialization," says Michael Kanu, deputy permanent representative to the UN for Sierra Leone, and coordinator of the African Group at the treaty talks.

Christian Tiambo, a livestock scientist at the International Livestock Research Institute in Nairobi, agrees. He says that developing nations and Indigenous people should be worried about biopiracy, and that it's very important to regulate access to the high seas to prevent biopiracy from happening there.

### Global permit scheme

Just what those regulations would look like is up for discussion, but the draft text includes several ideas. One is to create a global body that would authorize, and possibly even grant permits to, scientists to undertake research on life in the high seas – a first for researchers. An alternative idea is for scientists to submit their post-cruise data, research findings and sporadic progress reports to a committee or a platform created by the UN. There is also a proposal to assign unique identifiers to all marine genetic resources on collection, allowing their use to be tracked.

Siva Thambisetty, who studies patents and biotechnology at the London School of Economics, says that these options essentially follow two different paths. A light-touch approach would require researchers and companies to give notification of their research plans and voluntarily share any benefits, such as data. A more tightly regulated scheme would grant permits to scientists for access to the high seas in exchange for their sharing benefits, such as data or any profits made from new products.

Thambisetty says she favours conditional permits, rather than a system that assumes scientists will be given approval and encouraged to share benefits voluntarily. She says that granting scientists exclusive rights to data for a short period, perhaps one or two years, might be a fair exchange for a permit.

Although researchers accept the idea of some controls, they worry that certain ones could be too onerous.

Muriel Rabone, for example, a curator and ecologist at the Natural History Museum in London, recognizes problems with the current system but has concerns about changes. "It's not good for the science community to have this big north-south divide in terms of research capacity," she says, adding that "we need things that are going to streamline processes rather than hamper them".

"The idea that approval would be given by an overseeing body before a cruise is allowed



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Cancer drugs are derived from this tunicate.

throws up a lot of questions: who's approving this, how and why? What sort of bottleneck is that going to create?" she says.

Scientists are wary because similar anti-biopiracy laws – and the Nagoya Protocol in particular – have hampered foreign researchers from gaining access to certain countries, such as Colombia and Sri Lanka. "A lot of the biodiversity research community has been a little bit bruised by Nagoya," says Rabone. Shirley Pomponi, a marine biodiversity researcher at Florida Atlantic University Harbor Branch in Fort Pierce, Florida, says that before access and benefit-sharing laws came into place, her team collected samples from around the world. But she has now had to stop working in some countries, such as Brazil and Colombia.

"It just got to be harder and harder," she says. "We would be days away from an expedition that was going to cost us hundreds of thousands of dollars and still not have permits from the countries to be able to bring our ship into their waters. And it's just not worth the hassle. So we thought, 'let's just focus on the US'."

Although some scientists say that the Nagoya Protocol has restricted their work, Tiambo says he already sees many benefits coming out of the agreement. Scientists are now being trained to better understand the value of genetic information, he says, and "this information is trickling down to local communities, who can now really take advantage of the genetic resources that they have been keeping for generations". Researchers working on dairy-cattle genomics, for example, have shared data and expertise with African scientists and communities, which has allowed them to improve their national breeding programmes.

Rachel Wynberg, a bio-economics expert at the University of Cape Town, South Africa, agrees that anti-biopiracy laws, including the Nagoya Protocol, have had benefits. "There has definitely been a shift in perception and in the ethics of working with biodiversity. There has also been a significant shift in company practices," she says. But she questions whether the Nagoya Protocol has had any meaningful impact on economic development, conservation and Indigenous people.

### Balancing act

Despite the concerns, many see a way to craft an agreement that both restricts biopiracy and fosters research. If, for example, a unique identifier is assigned to each sample, then if a product is developed, a share of profits will go into a pot that could be shared between nations for use in biodiversity conservation. "This would allow for full traceability of materials all the way from the ocean floor to commercialization," says Marcel Jaspars, a biodiversity researcher at the University of Aberdeen, UK, who is advising the UN on how to design the treaty.

Another possibility that's been floated is that the treaty could support, rather than restrict, access to the high seas, treating access as a benefit. Scientists from developing countries could join research cruises with other nations, finding available berths on ships through a global registry of research cruises. "This could promote access to the high seas by all scientists who are interested, ensuring that those scientists are there when discoveries are made," says Girguis. Scientists from the developing world would then also have a share of patents arising from that research.

Rather than resisting change, marine scientists need to step up to the mark, and accept the need for new research protocols, says Thambisetty.

Now is the time to engage, say researchers who have followed the negotiations. "If we get it right, this treaty could be transformational," says Jaspars. "We could actually end up with more knowledge about the deep oceans than we had before."

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