Repairing reefs

Coral is under threat all over the world. Trials are under way to find out whether it is possible to plant out coral to restore afflicted reefs. Researchers are collaborating on this with local organizations in East Africa and the Caribbean Netherlands. 'Our corals have already grown several decimetres.'

TEXT NIENKE BEINTEMA **PHOTO** ERIK MEESTERS **INFOGRAPHIC** WUR/PETRA SIEBELINK

Coral reefs capture our imaginations with their multitude of colours and shapes – from yellow 'brains' to blood-red fans, and from pink tubes to corals which look a bit like neon green footballs. In tropical waters they can grow into reefs thousands of kilometres long, with corals growing all over each other to form underwater cathedrals, bursting with life.

Coral is an amazing life form, says Ronald Osinga, coral researcher and university lecturer at the Marine Animal Ecology chair group in Wageningen. 'It is a symbiosis between polyps and single-cell algae, a community.' The algae, he explains, live in the fibres of the polyps and make use of sunlight to produce sugars, most of which they give to their host. In exchange the polyps supply the algae with nitrogen and carbon dioxide, as well as with a strong calcium skeleton which captures optimal amounts of sunlight.

SKELETONS REMAIN

'But that complex form of community makes corals vulnerable as well,' says Osinga. 'They are deteriorating all around the world due to human activity.' The biggest culprit he identifies is climate change, which is making the oceans warmer and more acid. Corals and their algae cannot cope with that. The corals reject their algae, or the algae die. The result is coral bleaching, whereby the corals lose their bright colours. If the algae populations do not recover fast enough, the polyps die as well and only bare calcium skeletons remain.

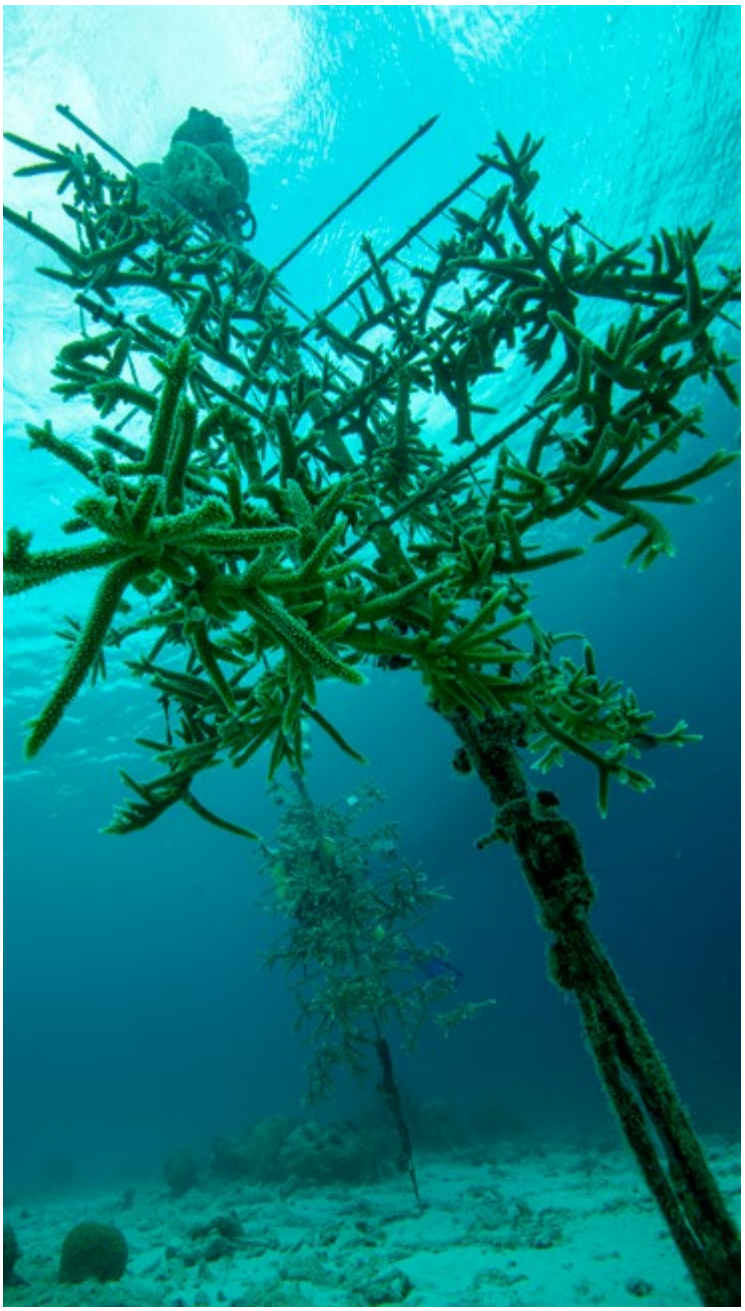
Another threat is pollution, especially along the coast. Waste water makes the sea too nutrient-rich and soil erosion makes the water murky. 'The balance between different species shifts,' says Osinga. 'Some species disappear while others become dominant. Blue-green algae, for instance, and the crown-of-thorns starfish, which preys on living coral.'

And then there is overfishing. 'Corals are dependent on the fish which live among them, and vice versa,' says Osinga. 'All sorts of fish species find food and shelter there. In exchange, the fish prevent seaweed from getting the chance to overrun the coral.'

In some areas fishers use destructive fishing methods, throwing explosives into the water which bring dead fish >

'Many fishers have no idea what lives below the surface of the sea'

PHOTO NANANG SUJANA / WETLANDS INTERNATIONAL



Above: the staghorn coral: the individual polyps it consists of are clearly visible. Each polyp is a clone. Right: coral fragments hang in a 'coral tree' where they grow, out of danger from predators. Below: a student weighs coral fragments.

> ‘Corals are dependent on the fish which live among them, and vice versa’

floating to the surface. ‘This blows up large chunks of coral,’ says the researcher. ‘It looks appalling. It’s bad for tourism and for the ecosystem too. Ultimately the fishers are destroying their own livelihoods.’

SIMULATION

Scientists around the world are trying to find out exactly what corals need and how you can protect and even restore them. Some of this research is going on in Wageningen, for instance in the Aquatic Research Facility at the research facility Carus. This is a state-of-the-art aquarium laboratory with tanks of all shapes and sizes in which researchers can simulate the conditions in a coral reef as accurately as possible. ‘For example, we are looking at how oxygen, nutrients and acidity influence the speed at which corals lay down calcium,’ says Osinga, ‘and at the interaction between those factors. And we are studying why certain corals are more vulnerable than others.’

This kind of knowledge – still in its infancy – is needed for the task of restoring coral. Restoration is done by ‘planting out’ living polyps on dead coral skeletons, or on human-made structures such as Christmas tree-like constructions made of PVC or bamboo, shelves at various heights or a kind of rope ladder. ‘We are looking for the ideal combination of factors that create the optimal conditions for breeding coral,’ says Osinga. Under natural conditions it is admittedly difficult to influence those factors, but it is possible to estimate in advance whether a particular area would be a good place to set up a breeding or restoration project. ‘You can identify places with more light or less, with currents or murky water. And if it goes wrong, it is easier to figure out why.’

One new approach is to collect pieces of coral which have survived mass coral death at a certain location. Osinga and his colleagues are investigating whether you can use more resistant colonies from elsewhere as the basis for a new population. That approach is looking promising. ‘But there are limits,’ says Osinga. ‘You lose genetic diversity, and as a result the coral may become more vulnerable to other stress factors such as diseases.’

Coral research is not limited to Osinga’s chair group, Marine Animal Ecology, but is also taking place at the Wageningen Marine Research institute in Den Helder. Erik Meesters has been researching coral here for 30 years, mainly in the Caribbean Netherlands. He too sees the coral deteriorating, but also that it is difficult to do anything about it. There is not much funding available for tangible measures and not everybody sees the urgency of doing so. ‘On Bonaire, sewerage and water purification systems have now been constructed with EU support,’ he says, ‘but that is very expensive because of the rocky ground.’

Meanwhile the coral is still under threat, Meesters explains. ‘The population goes on growing and the coast is getting built-up, causing more erosion during heavy rain. This leads to more mud and sand being dumped in the sea here than along unspoiled coasts, and the coastal waters are very murky. Corals need light, so they suffer.’

Meesters too is interested in why it is that some colonies of a particular coral species are more resistant than others. ‘Together with Lisa Becking of Marine Animal Ecology, we are researching which genes are involved in this. Once you know that, you can more precisely track down populations to use for further breeding. Assisted evolution, we call that.’

Meesters also studied corals which grow in shallows further from the coast, in cleaner water. ‘There’s an area like that near Saba, the Saba Bank,’ he says. ‘It is our largest national park, about 2000 square kilometres. Bigger than the Wadden Sea. One of the things we are studying is the influence of local lobster fishing on the reefs. If it turns out they have been overfished, we can take steps to stop that.’

SEXUAL REPRODUCTION

Meesters and his colleagues are coordinating a three-year EU project, RESCQ (Restoration of Ecosystem Services and Coral Reef Quality), which was launched in the Caribbean last summer. The project’s aim is to restore relatively large tracts of reef - hundreds of square metres – using corals bred in experimental nurseries on the spot. Meesters: ‘We are researching all sorts of aspects of this. Under what conditions do you need to breed them to give them the best chances of survival in the wild? What is the optimal size for the fragments of coral you plant out? And how can you >

> ‘We are studying why certain corals are more vulnerable than others’

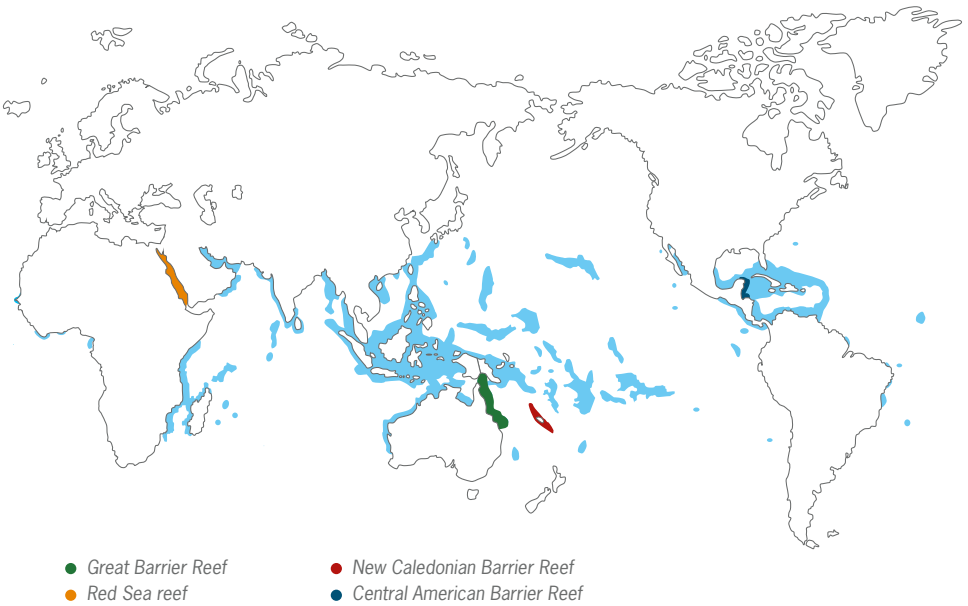
Above left: when the coral fragments are big enough, they are returned to special structures on bare stretches of the coral reef, so they can grow into large colonies (below). Above right: students from Wageningen measure the growth of the returned corals.

CORAL REEFS AROUND THE WORLD

Coral reefs take up only one percent of the ocean's surface. Yet they house one quarter of the marine fish species on earth.

The largest coral reef is the Australian Great Barrier reef, which is made up of almost 3000 underwater reefs and 900 islands, stretching out over 2600 kilometres. Other large reefs are the Red Sea Reef (1900 km), the New Caledonian Barrier Reef (1500 km) and the Central American Barrier Reef (almost 1000 km).

Coral reefs are disappearing fast, due to human activity. Almost one quarter have disappeared in the past 30 years.



ensure that they reproduce sexually as much as possible so that the genetic diversity is as great as possible?' Another important objective of RESCQ is the transfer of knowledge so that local people can take over the work. Ultimately the project should become self-funding when healthier reefs lead to higher incomes from tourism and sustainable fisheries. Clarisse Buma, director of Sint Eustatius National Parks (STENAPA), collaborates closely with Erik Meesters within RESCQ. 'It is about a cross-Caribbean project,' she says. 'Sint Maarten, Saba and the Turks and Caicos islands are taking part as well.'

WEEKLY CHECKS

Coral is very important to the islands, she stresses. Not just as a nursery for fish but also for tourism. So STENAPA willingly collaborates on the coral restoration. 'We now have eight flexible bamboo ladders underwater at a depth of about six metres,' says Buma. 'We have hung little pieces of coral from them and they have already grown a few decimetres. We check on them weekly to see if all goes well. Our rangers are involved in this work, as well as interns from the Netherlands.' Once the fragments of coral in the nursery are big enough, they are transplanted to low bamboo structures 'in the wild' and attached to them. In the course of time the bamboo disintegrates and the growing corals become sturdy enough themselves to grow tall.

Osinga is working on a comparable project off the coast of East Africa, under the auspices of the REEFolution foundation. This foundation was set up by two Dutch people, one of whom owns a diving school on the Kenyan coast. 'He saw the reefs deteriorating and wanted to do something about it,' explains Osinga. 'We were keen to get involved and apply our lab expertise in the field. Local organizations and Kenyatta University in Nairobi are involved too.'

Reef restoration is one component of this project, which also targets local fishers. 'Many fishers cannot swim and have no idea what lives below the surface of the sea. That is why they use dynamite without giving it any thought. The diving school owner is now teaching them to swim and dive so that they can see the wealth of underwater life for themselves.' And that really works, says Osinga. 'When they see those colourful fish and corals they think they are beautiful and they are keen to help conserve them.'

Science is playing the lead role at the moment, conclude Meesters and Osinga. Reef restoration is largely being carried out by scientists. In future that has got to change if this approach is really to achieve anything, concludes Osinga. 'The trick now is to develop methods we can use to upscale this work.' ■

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