SER News

Volume 36 Issue 3

Coral Reef Restoration

Building Capacity

Community buy-in helps Blue Corner Marine Research to restore degraded reefs in the Nusa Islands

Raising the Reef

Innovation by the Coral Restoration Foundation™ supports ambitious Florida reef restoration

Scalable Methods

Mars employs supply chain thinking and scalable methods to restore Indonesian reefs

Shellfish Restoration

The Nature Conservancy works to bring back shellfish reefs across Australia

MARS AND CORAL REEF RESTORATION: LEARNINGS FROM 15+ YEARS OF TRIAL AND ERROR

Alicia McArdle (CERP), Philippa Mansell, Jos van Oostrum, and David J. Smith
Mars, Incorporated

Mars, Incorporated is a privately-owned company founded in 1911 that is widely known around the world for its chocolate and pet care brands. Mars has a long history of working within Indonesia, sourcing cocoa, coconuts, seaweed, and spices, along with local manufacturing of cocoa and confectionery products. The Mars business and the many communities that it sources raw materials from depend on a healthy ocean. Since operating within Indonesia, the Mars team has noted significant declines in the availability of coastal fish products that support the food security of many of the people within its supply chains. This decline is due to several reasons, including declines in the health of coral reef ecosystems and the fish populations they support. Its long history of working within Indonesia and knowledge of how important coastal resources are for local communities within its supply chains drove Mars in 2006 to embark on a long-term program of reef rehabilitation and restoration off the west coast of South Sulawesi within the Spermonde Archipelago of Indonesia.

The Mars team installs Reef Stars on a reef in Pulau Bontosua, Indonesia. Credit: Mars, Inc.

The Spermonde Archipelago, like many other coastal regions of Indonesia, suffers from historic intense blast fishing and coral mining (Sawall et al., 2013; Plass-Johnson et al., 2015). These activities resulted in barren and highly mobile coral rubble beds with greatly reduced biodiversity. A small team at Mars evaluated a number of restoration techniques during the first few years of the program, which ultimately resulted in the development of the Mars Assisted Reef Restoration System (MARRS).

One component of the MARRS is a hexagonal steel structure, called a Reef Star, which is coated with resin and sand. Coral fragments are attached to the Reef Stars and the legs are connected to produce a strong web that is anchored to, and covers, the bare rubble substrate in a carefully planned build.

Successful implementation of the MARRS method isn't all about Reef Stars, though — it also requires careful site evaluation, planning, and stakeholder engagement. At time of publishing, the MARRS method is now used at 12 locations in six countries. Our organization alone has restored over four hectares of coral reef using more than 27,500 Reef Stars and over 420,000 coral fragments — the majority of these installed in the Spermonde Archipelago. However, our impact is far greater than Mars-initiated projects, with our reef restoration reach nearly doubling through collaboration with our partners across many sites. Through 15 years of continuous research and development, we have learned many lessons which we will share in this article:

The Mars team and local partners assemble Reef Stars before installing them on a reef in Fulhadhoo, Maldives. Credit: Mars, Inc.

LEARN FROM THE MISTAKES OF OTHERS

While the field of coral reef restoration has only been around for roughly 40 years (Smith et al., 2020), coral reef restoration practitioners can draw on knowledge from many sources and environments. Various techniques of restoring marine ecosystems have been around for millennia. For example, Traditional Owners of the Great Barrier Reef region have historically made small changes to maintain the health of the ecosystems they relied on. For example, the seasonal calendar of certain communities often includes reproduction of marine mammals and coral spawning, and typically coincides with a change in weather patterns. This period is thus considered to be a regeneration time, during which limited fishing is allowed. Additionally, ecological restoration as we know it now dates back to the early twentieth century (Jordan and Lubick, 2011). Over the course of the last 200+ years, practitioners and researchers who work in terrestrial restoration have developed knowledge and experiences that can be applied in coral systems, such as the need to understand a species' life history before deciding how to outplant it; how weed management can greatly increase survivorship and growth of outplantings; and the need for restoration managers to go into new projects with eyes open to the true cost of the project, including costs for maintenance and ongoing monitoring.

Despite the information available on terrestrial restoration best practices, it is easy to find published information on coral restoration projects in which poor practices were used. For example, projects in which a single species of corals was used in restoration efforts, despite nearby reference sites hosting mixed communities, or projects in which little concern has been given to ensuring that conditions are most suitable for restoration – such as neglecting to remove algae from restoration sites or addressing the causes that led the system to become dominated by algae in the first place. Talking to people both in the marine and land restoration space and learning from their experiences in the field may save time, money, and a lot of headaches.

A SUPPLY CHAIN APPROACH IS USEFUL

Supply chain thinking is a common feature of most industry pipelines and commercial product development, but it's less common in conservation. Within the conservation context, we consider the supply chain approach to represent holistic management encompassing all of the links needed to ensure a project can run smoothly and successfully.

In business terms, it often involves utilizing other entities or suppliers for the raw materials to make a product and then distribute the final product to the consumer in the most efficient and effective way possible. We apply supply chain logic when trying to increase the efficiency of project delivery and to prevent bottlenecks in the process of restoration. Within MARRS, each link in the "supply chain" represents a specific task – the delivery of which has been optimized through specific training and experience to maximize efficiency and scalability of restoration delivery. Within our program, these links are:

- Site suitability assessment
- Stakeholder liaison
- Sourcing raw materials
- Fabricating and coating of Reef Stars
- Sourcing corals
- Attaching corals
- Deployment/installation
- Maintenance
- Ecological monitoring

For example, the fabricating and coating of Reef Stars in the Spermonde Archipelago is conducted by two different small businesses. First, a welder makes Reef Stars in large quantities, at which point they are transferred to a small island close to a restoration site. Then, an experienced boat builder organizes a team of local women to coat the Reef Stars in a rust converter before he and his family undertake the resin and sand coating. The coated Reef Stars are then transported to the restoration site. Not only does this program help several small businesses to get positive financial outcomes, but it also ensures that we have a consistent, high quality product that can be used in our restoration projects.

PARTNERSHIPS STRENGTHEN PROJECTS

The value of partnerships can never be underestimated. While partnerships take time to cultivate, require diverse levels of interaction, and lengthen the time until a given restoration activity is implemented, they are an essential component to the long-term success of a restoration project. A great example of this is our partnerships model in Australia, where we work with tourism operators, park rangers, researchers, and Traditional Owners to identify sites for coral restoration. The unique viewpoints and knowledge of these partners have strengthened our projects. For example, Traditional Owners have shared Traditional Ecological Knowledge (TEK) about potential restoration sites, and brought in another facet to the site assessment process: cultural value. By working with tourism operators, we have been able to support their site stewardship framework to ensure longevity of their business while also prioritizing source reefs — i.e., those reefs that re-seed other reefs during larval spawning. Researchers provide another perspective, and with their input, restoration activities can have a positive secondary effect as a research trial — for example, trialing a different coral attachment method during outplanting. This then provides further understanding for future restoration and contributes to the growing knowledge bank that underpins current and future coral reef restoration. By working in close partnership with park rangers, which includes delivery of bespoke training in the MARRS approach, we are increasing national restoration capacity to the teams who are ultimately responsible for the protection and conservation of these areas.

Saipul Rapi (Mars) transports a Reef Star to site in Pulau Bontosua, Indonesia. Credit: Mars, Inc.

Noel Janetski (Mars) demonstrates MARRS to community members in Fulhadhoo, Maldives. Credit: Mars, Inc.

A local community member in Pulau Bontosua, Indonesia prepares to install a Reef Star. Credit: Mars, Inc.

Partnerships also include linkages with the community. It should be very obvious that local communities are key partners in any restoration project, and without strong and authentic collaboration, restoration is likely to fail or have a very short life span. The local community is likely to have more detailed, qualitative information regarding the history of the area than any published article may provide. Community members are the ones who provide you with the social license to undertake your project, and it's absolutely essential that they are actively engaged in every step of the project, and most importantly at the start. In fact, an active, willing community could be considered a prerequisite for any restoration project, as described and explained in the very first principle for ecological restoration in the SER *International Principles and Standards for the Practice of Ecological Restoration*.

A COMMON GOAL/OBJECTIVE IS KEY

Setting a common objective for the restoration activity that is formulated and agreed to by all stakeholders gives each party motivation to be involved and creates the "buy-in" needed for a project to be successful. There might be multiple objectives in a project and it might take time to develop them, but project objectives are guiding lights that you will refer to throughout a project. An example is the ongoing MARRS restoration program at two islands in the Spermonde Archipelago. Our initial objective was to undertake research and development of MARRS and to refine the technique; however, when speaking to the community it became clear that coastal erosion was one of the key issues facing the island, so we added an additional objective to assist with coastal protection of the low-lying island in the area (Smith et al., 2020). Here, objectives were

combined to assist both parties in their needs. We undertook hydrodynamic modeling of the island and determined the best areas for coral restoration to provide the protective barrier that the community was after.

EVERY LOCATION WILL BE DIFFERENT

The MARRS technique began in Indonesia, and the archipelago is still by far the largest area of restoration Mars has been involved with to date. While we learned a lot during research, development, and installation of coral restoration in Indonesia, every location is unique with different corals, conditions, communities, management, and ways of working. This is where strong partnerships become even more valuable, both for learning more about a site from a local perspective and to educate new partners about the restoration process. It may also be possible and highly beneficial to work with other restoration-focused organizations that may be operating at a site, as we have found that many locations require a mixed restoration approach. Moving to new locations can lead to unexpected challenges, and you may need to moderate your expectations for success. Although not desirable, your restoration failures can be extremely informative and help increase the probability of future project success.

The Mars team monitors an area of restored reef. Credit: Mars, Inc.

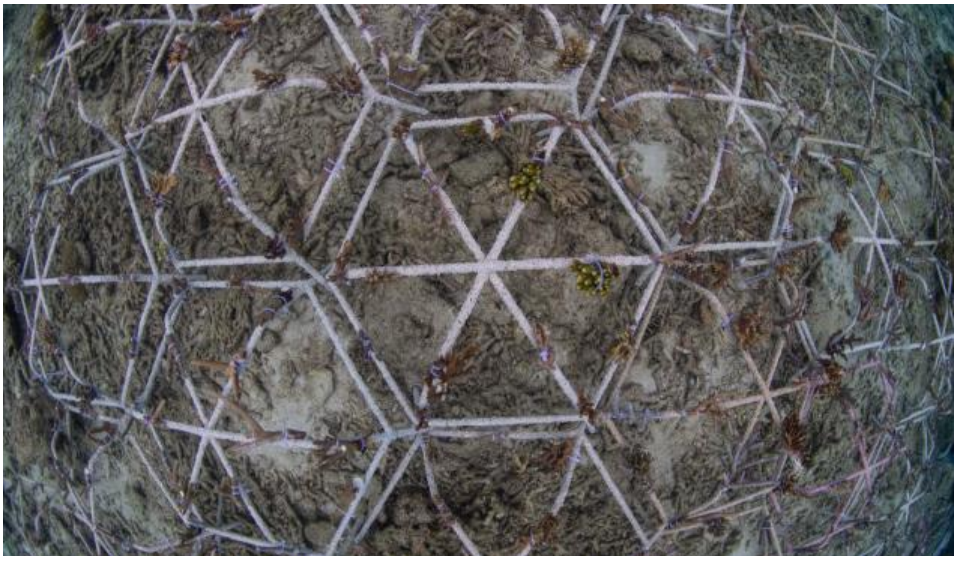
MONITORING ALLOWS YOU TO UNDERSTAND YOUR ENVIRONMENT AND PROVIDE UPDATES

How can you say a restoration project was successful if you don't have data to prove it? At Mars, we have a series of standard operating procedures for the scientific monitoring of MARRS restoration sites that includes environmental monitoring, fish assemblage and biomass, coral cover and community composition, invertebrate communities, natural coral recruitment, and coral mortality. We also include social, economic, or cultural monitoring through linkages with researchers which are essential components of many restoration projects. This isn't to say that all projects need to monitor every potential response variable, but knowledge of ecological responses to restoration will benefit greatly if more organizations activate and report on the performance of their projects using standardized ecological monitoring protocols. Projects should also include "positive" and "negative" control sites so the actual response to restoration can be evaluated and compared to natural changes. At the same time it is key to assess ecological status prior to any restoration and then for monitoring to continue at regular intervals for as long as possible, but for no less than 5 years.

LOOK FURTHER THAN THE TRADITIONAL FUNDING MODELS

At Mars, we are very fortunate that, as a private company, we have the freedom to undertake this work without the burden of funding cycles. However, being part of a business also means we need to hit our indicators and show strong value for money invested.

Partnerships are an option to support restoration programs. In 2021, Sheba — one of Mars's leading purpose-led brands — launched Hope Grows, a global program designed to inspire people to take action to restore coral reefs. It is a decade-long financial commitment that will eventually be one of the largest coral reef restoration programs in the world. We aren't the only restoration practitioners working with brands though. Another great example is the Coral Nurture Program, which has partnered with ReefTip — an Australian spiced rum that



Newly installed Reef Stars in Pulau Bontosua, Indonesia. Credit: Mars, Inc.

Reef Stars providing substrate for coral recruitment in Pulau Bontosua, Indonesia. Credit: Mars, Inc.

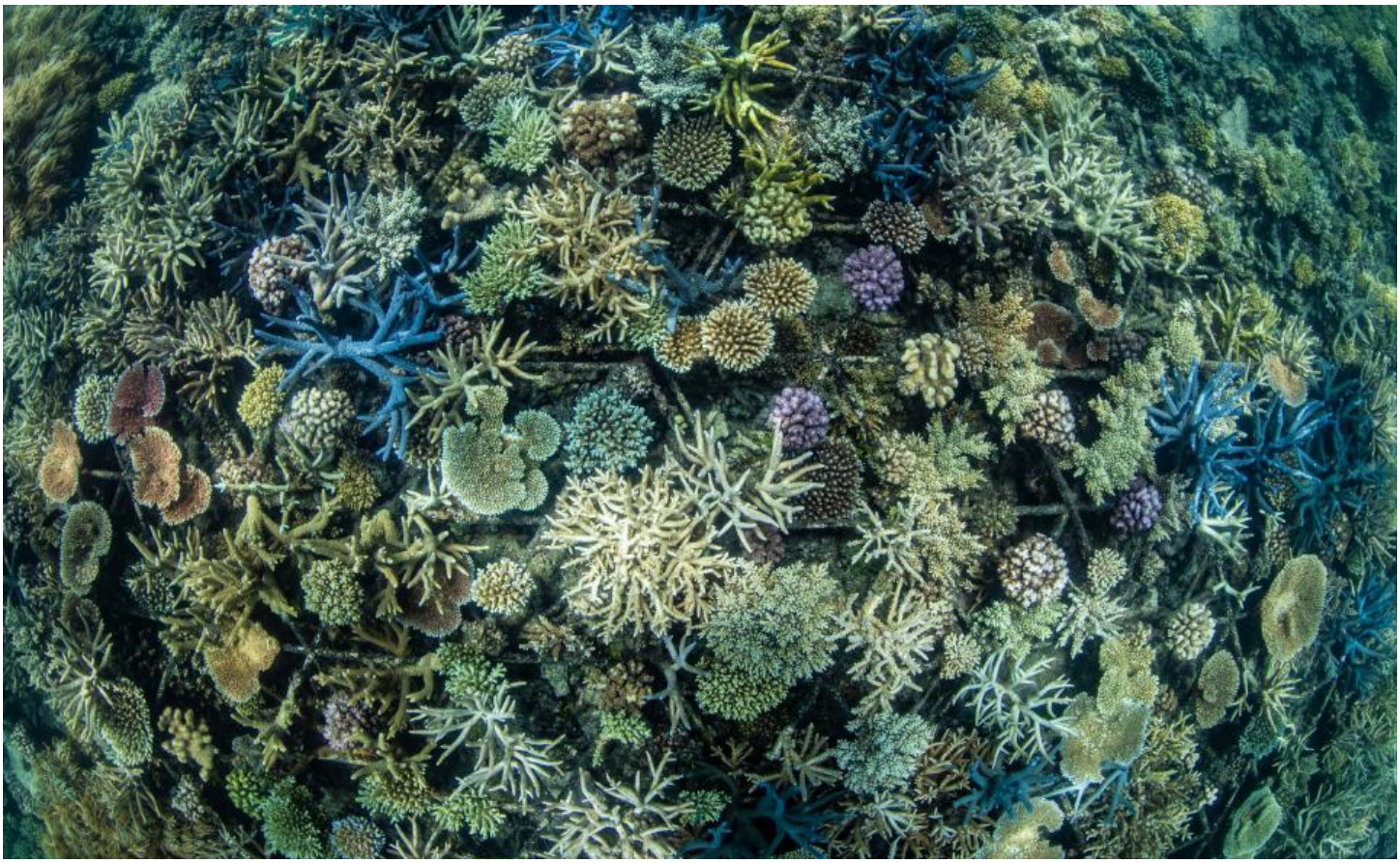
Reef Stars with several years of coral growth in Pulau Bontosua, Indonesia. Credit: Mars, Inc.

donates 10% of profits to reef restoration. In-kind support can be extremely valuable as well and may come in the form of free transportation to reef sites, staff assistance in collecting and entering monitoring data, or even creating connections with organizations and philanthropists that restoration practitioners might not normally have access to.

SCALING UP IS THE LARGEST BOTTLENECK

Everyone in the restoration sphere is looking for ways to scale up restoration, and the marine restoration sector is facing the same problem. We know that coral reef restoration can be successful, and we have demonstrated success at the hectare scale, but how do we turn that into a scale that can equal the rate of coral reef loss that spans several thousand hectares per year?

We still don't have the mechanisms, systems, and protocols in place to address this level of restoration, but we have made a start. We must work together to find global solutions to reef loss and ensure that successful restoration projects form the backbone of future endeavors. Reaching the scale we need will require us to work collaboratively, utilize numerous restoration approaches, and increase global capacity to deliver the right type of restoration in the most relevant and important regions of the world. We can look to other restoration practitioners across disciplines to learn what works and how best to adapt restoration strategies to increase the potential for success across multiple scales. We can also require new actors to engage in restoration and help develop new effective technologies and approaches that will provide reefs with the best chance of surviving the next 30 years or so. We need to ensure what we restore will stand the test of time and build in the best approaches to restore climate resilient reefs. There is a lot for us to learn and for us to collectively do, but we need to act now – time is running out.



Reef Stars with 18 months of coral growth at Moore Reef, Australia. Credit: Mars, Inc.

REFERENCES

Hein MY, Staub F (2021) Mapping the Global Funding Landscape for Coral Reef Restoration. International Coral Reef Initiative.

Jordan III WR, Lubick GM (2011) *Making Nature Whole: A History of Ecological Restoration*. Island Press, Washington, DC USA.

Plass-Johnson JG, Ferse SC, Jompa J, Wild C, Teichberg M (2015) Fish herbivory as a key ecological function in a heavily degraded coral reef system. *Limnology and Oceanography* 60: 1382-1391.

Sawall Y, Jompa J, Litaay M, Maddusila A, Richter C (2013) Coral recruitment and potential recovery of eutrophied and blast fishing impacted reefs in Spermonde Archipelago, Indonesia. *Marine Pollution Bulletin* 74: 374-382.

Smith A, Hancock B, Cook N, Vaughan DE (2020) History of Reef Restoration. In: D. Vaughan (Ed) *Active Coral Reef Restoration: Techniques for a Changing Planet*. J Ross Publishing.

Smith DJ, Mars F, Williams S, van Oostrum J, McArdle A, Rapi S, Jompa J, Janetski N (2020) Indonesia: Mars Assisted Reef Restoration System. In: D. Vaughan (Ed) *Active Coral Reef Restoration: Techniques for a Changing Planet*. J Ross Publishing.