Precious coral industry applying science-based methodologies to enhance its sustainablity and ESG profile

By Vincenzo Liverino, President
CIBJO Coral Commission

Established in 2014, the CIBJO Coral Commission has now been serving the industry for 10 years, and once again reaffirms the promise of promoting sustainability, while navigating many challenges – few more evident than the continuing widespread lack of factual knowledge about the coral industry, from fishing to manufacturing, to its deep cultural footprint around the world.

In 2014, it was agreed that the very specific challenges of coral – a biogenic gem material typically fished in the wild – warranted the creation of a new commission within the World Jewellery Confederation (CIBJO). The late Roland Naftule, who then served as President of Sector A, responsible for gem materials in CIBJO, played a pivotal role

Vincenzo Liverino, President of the CIBJO Coral Commission.

by supporting the the coral industry and the development of tools necessary to better deal with the real sustainability challenges, as well as the dissemination of misinformation.

In 2015, the Coral Commission held its first official meeting at the CIBJO Congress in Salvador de Bahia, Brazil, with Vincenzo Liverino as President, and Pornsawat Wathanakul, then Director of the Gemological Institute of Thailand (GIT), and George Lu, managing partner of Chii Lih Coral, China, as Vice Presidents. The first edition of the Coral Blue Book was presented to delegates and the industry.

From its very early days, one of the primary objectives of the new commission was to clearly demonstrate the very substantial differences that exist between the corals used in the jewellery industry, set in precious metals, and most notably gold, and those sold in trinkets and tourist-like souvenirs. It has been a mission of this commission to properly explain to environmentally conscientious consumers that the white-to-pink-to-red corals that are the biogenic gem materials that have been set in jewellery for millennia are not the same as corals known to be suffering from the effects of climate change, and which have been shown to be under threat by UN studies.

But, while we have underlined the fact that deep-water precious corals should not be regarded in the same way as the shallow reef-corals, as a community that is a fully conscious of the necessity of conservation we share same global environmental concerns, and are committed to using the knowledge we have gained to conserve what remains in the shallow-water reefs and maybe revive what has been damaged in recent years.

Rui Galopim de Carvalho, Vice President of the CIBJO Coral Commission.

Kenneth Scarratt, Vice President of the CIBJO Coral Commission.

A decade of action

In 2016, the Italian Customs Agency requested from the commission to develop a guide that would assist its agents and other official agencies in the classification and identification of coral gem materials. The "Coral Guide for Customs - Classification & Identification of Coral Materials," was released in 2017, and was made available in English, Italian, Spanish, Thai and Japanese.

The guide provides clear and concise information on all the precious coral species, presenting information on their current CITES classification and status, updated taxa (genus and species names), accepted trade names, colour range, fishing geographic areas, depth of harvesting, branch shape, average height, average diameter of coral trunk and average weight. Also included are maps with the geographical plotting of the precious coral, known occurrences, and each species chart is illustrated with photographs of both fashioned and rough corals.

The guide also addresses the common coral species in terms of their description and general characteristics. It is coordinated with the information presented in the Coral Blue Book, and it serves as a user-friendly version of the CIBJO regulations for those who are not coral professionals.

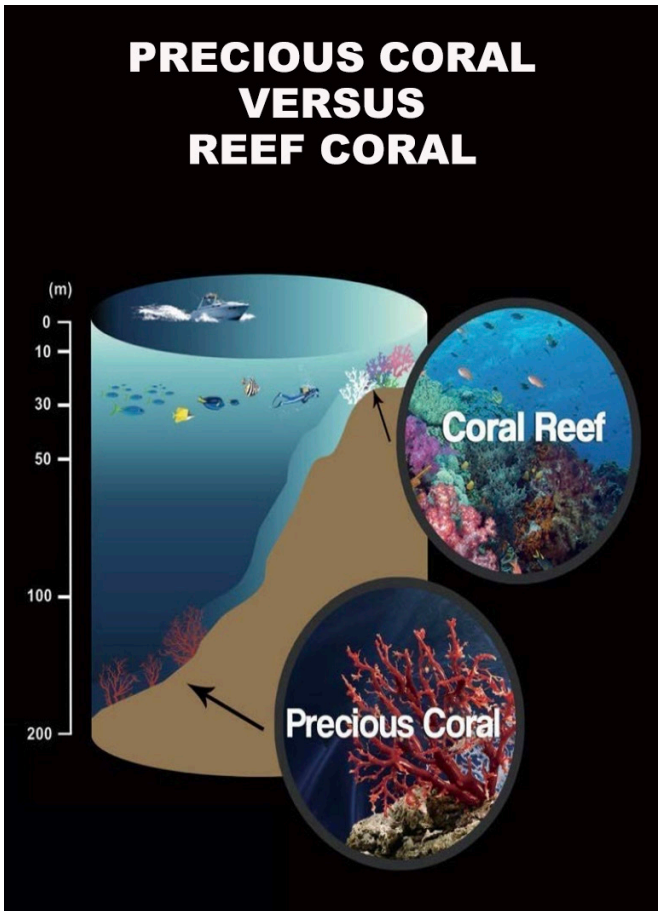
In 2018, the tag line "A Promise of Sustainability" was proposed in our pre-congress Special Report, in anticipation of the upcoming CIBJO Congress in Bogota, Colombia, to underscore our commitment to continue identifying and tackling the relevant issues associated with environmental, economic and cultural sustainability.

In 2019, acknowledging that there was a considerable lack of understanding of the many aspects of precious corals, including terminology, history and trade facts, the Coral Commission decided to release the "CIBJO Information Sheet – Background about Coral for Educators." It provided information about precious and reef coral, and their differences, trade definitions, nomenclature and standard references, according to the guidelines provided in the CIBJO Coral Book (2017 edition). Educational organizations and teachers could select, edit, organise and present the information provided according to the needs of their particular student audiences. The document was distributed worldwide via the CIBJO Secretariat.

In 2020, in accordance with the CIBJO's Jewellery Industry Greenhouse Gas Measurement Initiative that was launched by the CIBJO Marketing and Education Commission in 2014, Enzo Liverino, the Coral Commission President, set an example by adopting a net-zero carbon strategy for his business, and invited all members of the industry to do likewise so as to meet the climate change challenge.

In 2021, the ICA GemLab in Bangkok undertook a project in close coordination with the Coral Commission, to describe the colour of the Mediterranean coral (*Corallium rubrum*). The goals was to develop simple methods of accurately communicating colour descriptions in precious coral.

More recently, the commission has engaged in producing a guide that will present in a simple manner more relevant information about precious corals as biogenic gem materials. It addresses their occurrences, the very strict fishing regulations in many parts of the world that have been contributing to a more sustainable management of this natural resource, and an overview of the economic, social and cultural impact precious corals have in many communities around the "world."



A key mission of the Coral Commission has been to educate both the trade and the consuming public about the differences between precious coral varieties and reef coral varieties. Most reef corals are located at depths of between 8 metres and 20 metres below sea level, while precious coral, like the "aka" coral seen above, can be found at depths of between 50 metres and 300 metres and more.

New precious coral species

CONTRIBUTION BY DR. LAURENT CARTIER, SSEF

In 2020, the first major scientific study was published that detailed a methodology to identify the species of precious coral used in jewellery, using minute amounts of DNA that had been recovered (Lendvay et al, 2020[1]). This research showed that the ability to trace precious corals back to their species-related and geographic origins can support the precious coral industry, as well as supply important scientific information for the documentation of modern and historic items. Significantly, the study also led to the discovery of new precious coral species, previously unreported in the jewellery industry.

Since July 1, 2008, imports and exports of *Pleurocorallium elatius, Corallium japonicum, Pleurocorallium konojoi* and *Pleurocorallium secundum* have required appropriate CITES Appendix-III documentation. Appendix III covers a species included at the request of a country (in this case China). The only major precious coral species not to be covered by CITES was the oldest and most commonly known variety of precious coral used in jewellery, *Corallium rubrum*, or Mediterranean coral.

The four precious coral species listed required species-specific and country-of-origin documentation when being traded and transported across international borders. For the customs authorities examining the merchandise, the colour and morphology of a coral specimen had prior to the DNA study been the main indicator for ascertaining its biological species identity. However, different coral species can have similar colour ranges, and this frequently caused difficulties when trying to conclusively identify the specific species of coral contained in a jewellery item.

Following the study, collaboration with Swiss customs authorities (Lendvay et al, 2022[2]) demonstrated that genetic testing can also be a useful tool for customs agencies when faced with complex precious coral identification cases. This most recent research was carried out in collaboration with SSEF, the University of Zürich, the University of Bologna, Rissho University (Japan) and NOAA (USA).

Precious coral taxonomy is quite complicated (Tu et al., 2015[3]) and more research is thus required to elucidate the phylogeny and identification of the different species. It is also important to combine genetic results with other available gemmological methods (including radiocarbon age dating). For example, samples identified genetically as originating from the *Corallium japonicum* species complex, could be one of three closely related species: *C. japonicum* (CITES-listed), *Corallium nix* and *Corallium tortuosum* (both non-CITES-listed).

The red-coloured *Corallium japonicum* is commonly harvested from waters off Japan and Taiwan. *Corallium nix* has a white skeletal axis and has only been reported from a single scientific survey in the Norfolk Ridge (New Caledonia), where commercial coral fishing has never occurred. *Corallium tortuosum* has a white or pale pink skeletal axis and is found in areas around the Hawaiian Islands, New Caledonia, and Taiwan. Although it is the most abundant precious coral in Hawaiian waters, it is less likely to be fished for commercial purposes due to its small size and usually deformed axis.

Therefore, if an object is red and identified as originating from the *Corallium japonicum* species complex, it could be assumed to be from the CITES-listed *Corallium japonicum* species.

In the case of samples identified as originating from the *Pleurocorallium elatius* species complex, there are three morphologically similar species: the red-pink *Pleurocorallium elatius* and the mainly white *Pleurocorallium konojoi* (both CITES-listed), and the red *Pleurocorallium carusrubrum* (non-CITES-listed). The first two species have been harvested in large quantities from Japan and Taiwan. The latter has been found exclusively in the waters of northern Taiwan, and its material is expected to be mixed in stocks of *Pleurocorallium elatius* in the market. Therefore, if a sample is white or pink, it is presumptively from the CITES-listed *Pleurocorallium konojoi* or *Pleurocorallium elatius*, respectively, while if red, it could be either *Pleurocorallium elatius* or *Pleurocorallium carusrubrum*.

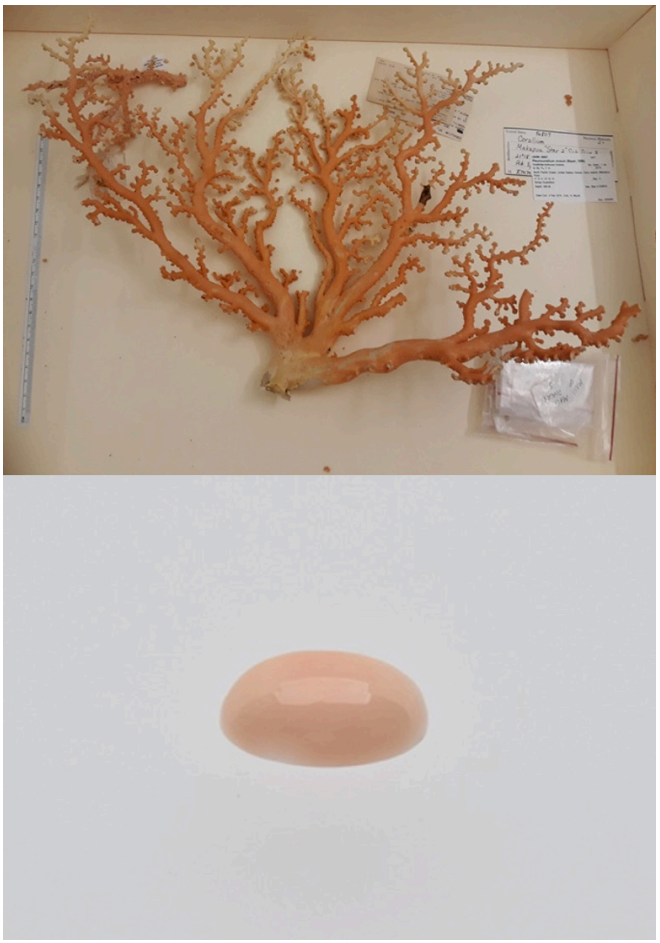
One of the main findings was the discovery of a new species (*Pleurocorallium niveum*, from the Hawaiian archipelago) that has never before been reported in the jewellery industry, but was identified in several submitted coral cabochons tested in different studies.

Results of our ongoing research show that *Pleurocorallium niveum* (non-CITES-listed) corals were often mistakenly identified as *Pleurocorallium secundum* (CITES-listed). Clearly,

1. Lendvay, B., Cartier, L.E., Gysi, M., Meyer, J.B., Krzemnick, M.S., Kratzer, A., Morf, N.V. (2020), ‹DNA fingerprinting: an effective tool for taxonomic identifcation of precious corals in jewelry›, Scientific Reports, 12 ,(8287) 10.

2 Lendvay, B., Cartier, L.E., Costantini, F., Iwasaki, N., Everett, M.V., Krzemnicki, M.S., Kratzer, A., Morf, N.V. (2022), ‹Coral-ID: A forensically validated genetic test to identify precious coral material and its application to objects seized from illegal traffic›, Forensic Science International: Genetics, 102663 ,58.

3 Tu, Tzu-Hsuan, Dai, Chang-Feng, and Jeng, Ming-Shiou (2015), ‹Phylogeny and systematics of deep-sea precious corals (Anthozoa: Octocorallia: Coralliidae)›, Molecular Phylogenetics and Evolution, 84-173 ,84.



Photos of samples of the newly discovered Pleurocorallium niveum *species. ABOVE:* Pleurocorallium niveum *from Hawaii at the Smithsonian Institution's National Museum of Natural History in Washington, D.C.. BELOW: A precious coral cabochon that was submitted as* Pleurocorallium secundum *but was identified as* Pleurocorallium niveum *using DNA fingerprinting. Photos: Bertalan Lendvay and SSEF.*

there is still much to learn scientifically about precious corals. Ongoing research is seeking to further elucidate precious coral genetics and allow for more even more conclusive separation of species on a genetic basis.

A sustainability report for the coral fishing and manufacturing industry

COMPLIMENTARY CONTRIBUTION BY PROF. ROBERTO VONA, PROF. MAURO SCIARELLI, OF THE FEDERICO IL UNIVERSITY, ITALY, BOTH CIBJO CORAL COMMISSION MEMBERS SINCE 2017. SPECIAL THANKS ALSO TO DR. LORENZO TURRIZZIANI.

The fishing and processing of Mediterranean red coral (Corallium rubrum) represents one of the oldest and most significant economic activities in the Mediterranean basin and adjacent Atlantic coastal areas, with deep cultural and social roots that go back thousands of years.

Over time, this industry has proven to be able to combine tradition and innovation, playing a fundamental role in promoting sustainable practices aimed at the conservation of the marine environment and the economic development of coastal communities. In recent years, the introduction of stringent regulations, such as the Italian National Red Coral Management Plan, has fostered a transformation of the sector towards more responsible management, minimizing the risks associated with mining and promoting environmental, social and governance (ESG) sustainability.

This section of the 2024 Coral Commission Special Report will focuses on the analysis of the positive externalities generated by the coral fishing and processing sector, highlighting how this activity can have a positive impact in the three dimensions of ESG – environmental, social and governance.

1. The environmental dimension: Innovation and conservation practices for the protection of marine ecosystems

The coral sector is particularly sensitive to the environment, given the close connection with marine ecosystems. The introduction of innovative practices and the adoption of specific regulations have made it possible to mitigate the risks associated with the overexploitation of natural resources and to protect marine biodiversity.

Protection of marine biodiversity

Red coral is an endemic species in the Mediterranean and adjacent Atlantic, with a crucial role in biodiversity. The sustainable management of coral fishing, as set out in the GFCM (General Fisheries Commission for the Mediterranean of FAO – Food and Agriculture Organisation of United Nations) in all the countries bordering the Mediterranean, has implemented key measures such as regulating fishing areas and imposing limits on the minimum diameter of harvestable colonies. These measures ensure that only the most mature specimens are collected, allowing coral populations to regenerate. In addition, the plan prohibits fishing in marine protected areas and establishes minimum depths for collection (50 metres), thus protecting the most vulnerable areas.

Development of less invasive fishing techniques

The manual ice axe collecting method using licensed scuba divers, currently required by the legislation, represents a

Mediterranean coral, Corallium rubrum, as raw and finished material. © Liverino 1894

selective and low-impact technique that has replaced more invasive practices of the past, namely the use of the ingegno in dragging the sea floor. This approach allows for the selection of only the most mature corals for collection, thus preserving the most delicate marine ecosystems, and allowing the long-term natural regeneration of resources. While this technique has proven effective, the possibilities of integrating new technologies into the extraction process could further improve efficiency and reduce environmental impact.

Research and development of advanced technologies could complement the manual method, allowing for the more accurate mapping of the seabed and precise identification of the coral colonies. The use of autonomous underwater drones, advanced detection tools, and real-time monitoring systems could help make coral fishing even more targeted, minimising disruption to surrounding ecosystems. These innovative technologies would make it possible to better identify sensitive areas to be protected, while ensuring that only fully developed corals in selected areas are collected.

In addition, the adoption of these technologies could improve significantly operator safety, reducing the risks associated with complex diving bellow 50 metres. Supporting technologies, such as lightweight exoskeletons or automated guidance systems, could make divers' work easier, reducing fatigue and the time required for extraction. This integrated approach would promote more responsible management of coral resources, safeguarding both the marine environment and the health of operators.

In summary, the development of cutting-edge technologies, combined with the expertise and precision of manual harvesting, represents a promising direction for the coral industry. This combination could ensure even more sustainable mining, minimizing environmental impact, increasing operator safety, and improving the industry's ability to adapt to future challenges.

Conservation and adaptive management

Genetic monitoring of red coral populations, as demonstrated

by studies conducted in Sardinia, provides crucial data to assess the state of resources and guide management decisions. This adaptive approach, which is based on scientific evidence, makes it possible to implement management plans that take into account the dynamics of populations, ensuring their resilience in the long term.

2. Social dimension: Economic development, cultural preservation and intergenerational solidarity in coastal communities

The coral sector is not only an economic activity, but also represents a social and cultural pillar for many coastal communities in the Mediterranean and Atlantic, namely in Italy, France, Spain Morocco, Algeria, Tunisia, Greece, Croatia, Albania and Cape Verde. Coral fishing and manufacturing practices have deep historical and cultural roots, and the sector actively contributes to the preservation of these traditions, while ensuring the economic development of local communities.

Economic support and development of coastal communities
The coral manufacturing sector provides stable employment opportunities for thousands of people in coastal areas. Through artisanal coral processing, communities can benefit economically from a local resource while promoting sustainable practices.

Precious coral processing in Italy. © Liverino 1894.

Preservation of cultural heritage
The art of coral processing has a thousand-year history, especially in Southern Italy, where the tradition is handed down from generation to generation. The sustainability of the industry ensures that this artisanal tradition can continue to thrive without compromising natural resources. The earlier-mentioned Italian National Red Coral Management Plan sets precise limits on the amount of coral that can be fished each year, allowing communities to exploit this resource without depleting it.

Training and skills transfer
Recent vocational training initiatives promoted by the sector aim to improve the skills of local artisans, integrating modern technologies to ensure more efficient and sustainable processing. This not only increases the competitiveness of products on international markets, but also ensures the transfer of skills between generations, reinforcing the principle of intergenerational solidarity.

3. Governance dimension: sustainable and responsible management

The governance of the Corallium rubrum extraction and manufacturing sector is characterized by a strong commitment to transparency, regulation and compliance with international and European standards. The measures adopted by the National Red Coral Management Plan aim to ensure that the activity is carried out in accordance with the highest standards of sustainability.

Strict regulation
The national plan imposes strict regulations on the quantities of coral that can be fished, setting daily limits for each collector and defining the areas where collecting is allowed. In addition, protocols are established for the continuous monitoring of the resource, with the possibility of temporarily stopping activities in overexploited areas, ensuring the conservation of natural resources.

International collaboration
Red coral management benefits from collaborative agreements between several Mediterranean countries and GFCM, which coordinates efforts for the protection of marine resources in the wider area of the whole Mediterranean sea. This collaborative approach ensures that harvesting practices

are aligned with international sustainability standards and that common measures are taken to protect ecosystems.

Traceability and transparency

The industry is characterized by high traceability standards, which ensure that every piece of coral that is fished is legally certified and complies with current regulations. The monitoring system makes it possible to trace the entire coral supply chain, from the moment of harvesting to sale, ensuring that there are no illegal or undeclared practices.

Sustainable Coral Fishing Techniques in Japan and Hawaii

The strategies introduced Mediterranean basin and adjacent Atlantic coastal areas can be seen alongside those implemented in Japan and Hawaii.

In Japan, fishing for local red coral (*Corallium japonicum*), also known as "aka" coral or oxblood coral, and momo coral (*Pleurocorallium elatius*) is regulated by strict policies that aim to preserve this precious marine resource.

Japanese coral fishing techniques have evolved considerably in recent years, thanks to the introduction of technological innovations such as remotely operated underwater vehicles (ROVs), which allow for more precise and selective harvesting.

ROVs enable fishing for corals without damaging the delicate ecosystem of the seabed. This approach minimizes the environmental impact compared to traditional methods, such as trawls, which can cause irreversible damage to coral habitats.

Raw and polished Midway coral, Pleurocorallium secundum. © Liverino 1894.

Raw and polished aka coral, Corallium japonicum *© Liverino 189.4*

Japanese prefectural authorities impose strict restrictions on when and where coral fishing can be conducted. Fishing is prohibited during coral spawning periods, such as in January, February, June and August, to allow for the regeneration of populations. In addition, only corals larger than 7 millimetres can be harvested, and fishermen must return smaller specimens to the sea.

These conservation measures are complemented by a rotating harvesting system, which provides for fishing cycles and biological rest periods of at least 10 to 20 years to allow the recovery of exploited populations. Studies show that in regulated harvesting areas, commercially fished corals have an average age of 30 to 40 years, while in unexploited areas the average age can be as high as 50 to 60 years, highlighting the importance of these sustainable management practices.

Another significant example of sustainable coral fishing comes from Hawaii and the Midway Islands. Here, fishing for precious coral, such as Midway coral (*Pleurocorallium secundum*) and "garnet" coral (*Hemicorallium regale*), has been regulated through the Precious Corals Fishery Management Plan, which sets specific rules for harvesting in the very deep waters of the Pacific.

Coral fishing in Hawaii is limited by high operating costs and strict regulations, which include limits on the amount that can be fished and protection zones. This has significantly reduced the impact of fishing activity, while ensuring the conservation of local marine ecosystems.

In particular, in the waters of the Midway, precious corals are collected at depths ranging between 400 and 600 metres. Unlike other areas, harvesting in these areas is sporadic, mainly due to the high cost of operations and regulatory

restrictions. However, when it does, fishing is conducted using methods that minimise damage to surrounding habitats, such as the use of specialized equipment to catch corals selectively.

Regulations in place, both in Japan and Hawaii, reflect a global commitment to the sustainable management of marine resources. Thanks to these efforts, precious coral populations, which play a critical role in marine ecosystems and local economies, can be protected and conserved for future generations.

Conclusions

The sector of extraction and manufacturing of precious coral, in particular red coral from the Mediterranean, has shown a remarkable ability to evolve towards increasingly sustainable practices, combining the protection of marine ecosystems with the socio-economic development of coastal communities. The integration of new technologies has played a crucial role in this process, reducing the environmental impact and ensuring that the collection activity is selective and less invasive.

This transition to a more sustainable approach is not limited to the environmental dimension, but also extends to the social and cultural dimension. Coral harvesting and processing practices, rooted in millennia-old traditions, continue to thrive in local communities, preserving the so-called "material culture." This concept refers to the intangible heritage linked to the art of coral processing, a skill handed down from generation to generation that contributes not only to the local economy, but also to the cultural identity of entire communities.

The social sustainability of the sector is highlighted by the strong positive impact it has on the economic fabric of coastal areas, creating stable jobs and contributing to local economic growth. The induced activities generated by the coral sector, ranging from fishing to craftsmanship, support thousands of families and keep alive centuries-old traditions that enrich the cultural heritage of the regions involved. The industry's commitment to training new generations of artisans, through skills transfer programs, further strengthens this link between innovation, sustainability and tradition.

In summary, the coral sector represents a clear example of integrated sustainability, in which the protection of the marine environment is accompanied by economic development and the preservation of cultural traditions.

Through responsible resource management and the adoption of innovative technologies, this sector not only contributes to the conservation of marine ecosystems, but also enhances the cultural and intangible heritage of local communities, demonstrating how sustainability can be pursued holistically, while fostering economic growth and community resilience.

An update on coral projects in Japan

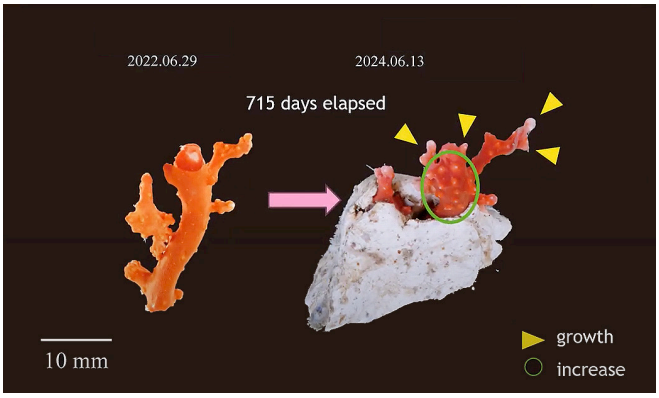
CONTRIBUTION BY THE PRECIOUS CORAL PROTECTION AND DEVELOPMENT ASSOCIATION, JAPAN

Since 2018 that the Precious Coral Protection and Development Association has been reporting on a highly relevant long-term research project in Japan, initiated by the Precious Coral Protection and Development Association and the Kuroshio Biological Research Foundation. This initiative, named the "Precious Coral Forest and Cultivation Project," was undertaken in a protected zone around Birou island, Kashiwajima, in the Kochi Prefecture, and is stems from a known phenomenon by which coral propagation into mature sized branches when relying on sexual reproduction is much slower than using tips of matured branches through transplanting and releasing the corals onto the seabed.

The project began in 2016 with the transplantation of branches of the local "aka" coral, *Corallium japonicum*, and "momo" coral, *Plaurocorallium elatius*, which were provided by local fishermen, all measured and documented and then placed at 100-metre depths in specially designed propagation substrate media, namely concrete disks and shell-filled cages.

Thus far, from 2016 through 2024, 432 concrete substate discs were released, holding 726 branch tips, and 191 shell-cage units with 758 coral branch tips. The plan was to monitor the growth of the coral branches under controlled conditions.

Branches of coral transplanted on concrete disk, before being submerged in the sea, as part of the Japanese propogation study.

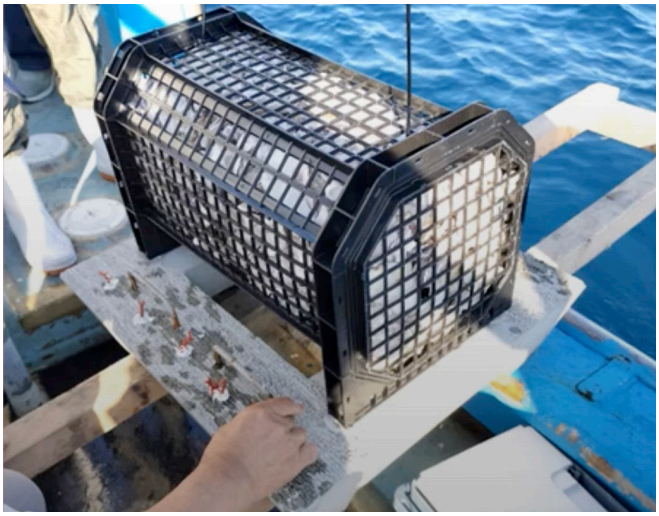


Branches of coral transplanted on concrete disk, before being submerged in the sea, as part of the propogation study

From 2017 through 2020, on shell-cage units 99.1 percent of the coral branch tips survived and in 96.4 percent growth was recorded. From 2022 until 2024, on concrete disk substrates, there was also growth in the size of the coral colonies.

The information collected by this project was meant to contribute to the basis for future reforesting of local seabeds, where harvesting is prohibited, contributing to precious coral repopulation. It possibly will also lead to the long-term creation of collection areas, some in areas where harvesting is currently not taking place.

Currently, the association is engaged in propagating activities by spearing both concrete discs and shell-cages with transplanted coral branch tips on the seabed.



Researchers lowering the transplanted coral in a cage, onto the seabed.

Research on aka coral sexual reproduction

The Precious Coral Protection and Development Association recently commissioned a research project to the Kuroshio Biological Research Foundation.

Using aka coral (Corallium japonicum), photographs were taken at intervals of one every 10 seconds of branch tips provided by local coral fishermen, in the aquarium of the Kuroshio Biological Laboratory, from the end of May 2021. These were edited together to create a video, and, the moment when the spermatozoa sac was released was captured. According to the foundation, it was the first time such a phenomenon was ever recorded on video.

Detail of the spermatozoa sac on **Corallium japonicum**, *in an aquarium © Kuroshio Biological Research Foundation.*

The results of the study suggest that future releases of aka coral fragments with small propagation substrates may accelerate coral growth. For sexual reproduction, the goal is to propagate using juveniles raised from eggs. By releasing genetically different parental stock into the neighbourhood where sexual and asexual reproduction propagation occurs, it is believed it will be possible speed up coral propagation and increase reproductive opportunities.

Japanese propagation are currently working to protect and nurture corals by using two methods. Understanding the optimal reproduction conditions is indeed critical to continue the project.

COVER PHOTO CREDIT
The Coral Museum – Liverino Collection, Torre del Greco, Italy