



SUMMARY

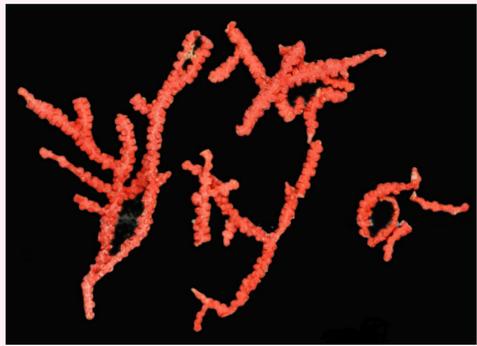


Figure 1. Skeletal fragments of an Eritrean *Melithaea erythraea* colony. 3.7 x 2.5 cm (largest fragment). National Museum of Natural History, Paris. Object no. MNHN-1K-2005-1. CC BY 4.0.

Prospective laboratory culture of *Melithaea erythraea* (Fig. 1) offers emerging platforms for targeted aquacultural development of coastal regions benefitting ecosystems, economies, and biological research. We present the **PRECORA v1.0** dataset compiling predicted and established water and husbandry parameters for the aquaculture of 166 species of *Corallium*, *Hemicorallium*, *Pleurocorallium*, *Diodogorgia*, and *Melithaea* spp. precious and semiprecious octocorals.



Figure 2. String of beads (detail). Unknown artist, Coptic, 4th-7th Century CE. Glass and coral. 20 cm (length, entire object). Metropolitan Museum of Art, New York City. Object no. 31.8.6. PDM 1.0.

BACKGROUND

Corals have captivated human cultures for millennia (Fig. 2). Today, octocorals in the genera *Corallium*, *Hemicorallium*, and *Pleurocorallium* remain among the most valuable living commodities by weight, intensifying extractive pressures on reefs and mesophotic coral ecosystems already stressed by warming and pollution. This bio-cultural-commercial entanglement calls for interdisciplinary conservation approaches that benefit ecosystems, economies, and science. We focus on *Melithaea erythraea*, a Red Sea octocoral and Lessepsian migrant reportedly expanding into the Mediterranean. This meta-analysis evaluates captive aquaculture of this and other basal Metazoa as a multi-pronged One Health strategy. Cultivation programs and public aquaria can generate skilled employment and renewable biomaterials while alleviating pressure on wild populations. We argue that aquacultured corals should replace harvested materials and propose the "Coral Economy" framework, complementing "Green," "Blue," and "Circular" economic paradigms. Finally, we present the **PRECIOUS CORAL Aquaculture dataset (PRECORA v1.0)**, an ongoing project compiling predicted and/or established husbandry parameters for 166 precious and semiprecious octocorals belonging to the genera *Corallium*, *Hemicorallium*, *Pleurocorallium*, *Diodogorgia*, and *Melithaea*.



Figure 3. Rapier (detail). Unknown artist, Neapolitan, ca. 1675. 105 cm (length, entire object). Iron, steel, copper, and coral. Rijksmuseum, Amsterdam. Object no. NG-NM-10403. PDM 1.0.

Long considered to be a precious material, coral has been fashioned into pommels, baubles, and pendants for thousands of years (Fig. 2-5). The traditionally "precious" corals belonging to genera *Corallium*, *Hemicorallium*, and *Pleurocorallium* are notable for their highly pigmented endoskeletons, possessing gemological Mohs Hardness Scale values ranging from 3.0-4.0 (Fig. 6).^[1] Cured skeletons of *Corallium rubrum*—the traditional Mediterranean red coral—and many other octocorals can be directly polished to a brilliant luster (Fig. 7).

Recently available in consumer coral goods within the last three decades, so-called "sponge" or "spongy" corals originate from the processing and occasional resin impregnation of *Melithaea ochracea* and *Melithaea* spp. corals, among other taxa. "Sponge" corals are characterized by their porous, textured skeletons in their raw forms. These corals are sometimes considered to be "semiprecious" due to this generally more porous skeletal quality.^[2] We present the **PRECORA v1.0** dataset to support ethical aquaculture of precious and semiprecious octocorals.



Figure 4. Diadem comb. Unknown artist, French (?), ca. 1820-1825. Gilt copper and coral. 8 x 14 x 3 cm. Rijksmuseum, Amsterdam. Object no. BK-NM-10140. PDM 1.0.



Figure 5. Medallion pendant. Unknown artist, Dutch/Spanish (?), ca. 1675-1700. Gold, coral, turquoise, and enamel. 8.2 (diameter) x 1.2 cm. Rijksmuseum, Amsterdam. Object no. BK-1965-12. PDM 1.0.

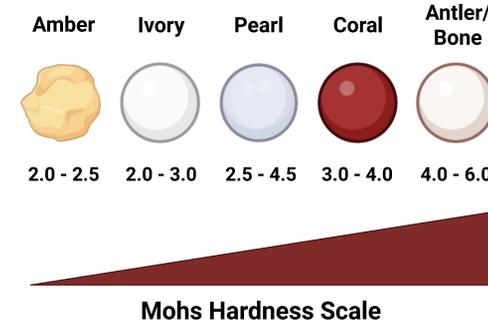


Figure 6. Mohs Hardness Scale value ranges of various gemstones and materials of biological origin. The coral is displayed next to the hardness range of *Corallium rubrum*. A preliminary Mohs Hardness Scale test comparing samples of *Corallium rubrum* (?) to *Melithaea ochracea* (?) indicated that the *Corallium* sample can scratch and is therefore harder than the *Melithaea* sample (data not included). Figure created with BioRender.com.



Figure 7. Skeletal colony of *Corallium rubrum* (polished). 24 x 20 cm. Naturalis Biodiversity Center, Leiden. Object no. RMNH.COEL.42325. CC0 1.0.

METHODS

Meta-analysis synthesizing:

- Academic sources^[3-4]
- Hydrological data^[5]
- Hobbyist databases^[6]
- Museum collections^[7-10]

Other techniques:

- Mohs Hardness Scale test
- Species discovery analysis
- Compilation of the **PRECIOUS CORAL Aquaculture dataset (PRECORA v1.0)**:

Category	Field				
ID	Scientific Name	Common Name[s]	Trade Name[s]	Taxonomy	Date Discovered
Biology/Status	Azooxanthellate/Zooxanthellate	Distribution	Depth	Conservation Status	CITES Status
Materiality	Colony Size	Skeletal Rigidity	Growth Form[s]	Branching Architecture[s]	Color (Live/Treated)
Husbandry Parameters	Aquaculture Status	Temp.	Salinity	Light	Toxicity
	DO	pH	Flow	Feed	

Figure 8. Overview of selected fields included in the **PRECORA v1.0** dataset. Figure created with BioRender.com.

RESULTS

Melithaea spp. versus Corallium spp. Colonies, Skeletal Materials, and Treatment Processes

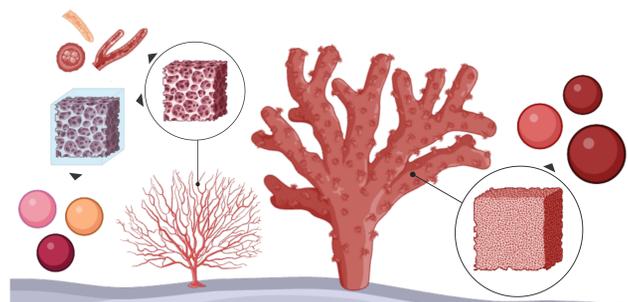


Figure 9. Comparison of *Melithaea* spp. colonies, skeletal material (circled), and treatment methods (left) to those of *Corallium rubrum* (right). *Melithaea* spp. may occasionally be resin-impregnated, but material from both genera can also be polished directly or left unpolished and sold as "raw" or "natural" once cured. Figure created with BioRender.com.

Economic Venn Diagram



Figure 12. Venn diagram delineating relationships and overlap between the Blue (B), Coral (C), Circular (O), and Green (G) Economies. Figure created with BioRender.com.

Number of Described Species in Precious and Semiprecious Genera

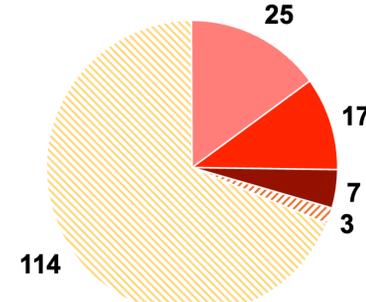


Figure 10. Pie chart depicting the relative sizes of the genera included in this study alongside the number of described species in each genus. Color scheme is as follows: yellow (*Melithaea*, 114), orange (*Diodogorgia*, 3), burgundy (*Corallium*, 7), red (*Pleurocorallium*, 17), and salmon (*Hemicorallium*, 25). Solid color represents traditionally "precious" genera, while striped color represents "semiprecious" genera.

- PRECORA v1.0 dataset (Fig. 8)**
 - Framework for future commercial optimization of aquaculture of [semi]precious octocorals (Fig. 9)
 - Includes 166 species of precious and semiprecious octocorals (Fig. 10-11)

Species Discovery Plots and Projections

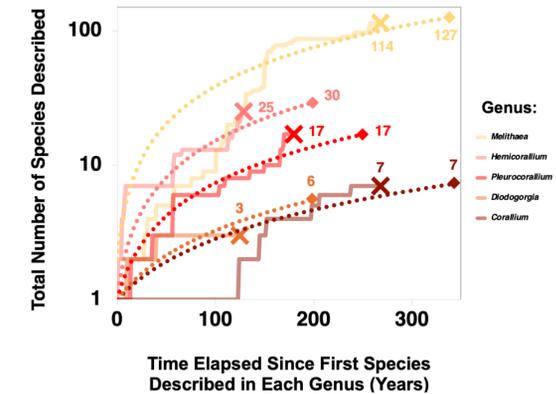


Figure 11. Species discovery plots of accepted and described species from the five genera included in this study. Crosses represent the number of species discovered and described presently (year 2026), while diamonds represent future projections of total described species based on linear extrapolation to the year 2100. Dotted lines represent linear lines of best fit for species accumulation calculated by applying linear regression methods of Flather, 1996^[11] and plotting the lines through the origin. The ordinate is scaled logarithmically.

- "Coral Economy" defined (Fig. 12)**
 - Encapsulates sale and trafficking in coral goods (jewelry, etc.), live corals (live aquaria), and fossilized coral materials ("coral stone")
 - Overlaps with the "Blue," "Green," and "Circular" Economies

DISCUSSION/CONCLUSIONS

- Melithaea* has 114 described species, making it larger than all combined precious coral genera (49 described species across 3 genera) (Fig. 10)
- Melithaea* possesses the highest projected species count at year 2100 (127) and the highest projected gain in species from present (13) (Fig. 11)
- Melithaea* are generally found in shallower, warmer waters than traditionally "precious" corals; *Melithaea* are also generally faster-growing
 - These traits make *Melithaea* spp. good candidates for aquacultural development, both for commercial purposes and laboratory research
- The "Coral Economy" requires regulation across all sectors to thrive

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