CORAL 3D: PROYECTO DE APRENDIZAJE ENFOCADO A LA RESTAURACIÓN Y CONSERVACIÓN DE HÁBITATS CORALINOS DE LA REGIÓN DE MURCIA MEDIANTE TECNOLOGÍAS DE IMPRESIÓN 3D Y EL EMPLEO DE RESIDUOS DEL SECTOR DEL MÁRMOL

Acción 6. Fuente de verificación FV6.1.

Copia de las presentaciones y libro de actas.

Asociación Empresarial Centro Tecnológico del Mármol, Piedra y Materiales

Departamento de Construcción Sostenible e Industria 4.0

CORAL 3D: Proyecto de aprendizaje enfocado a la restauración y conservación de hábitats coralinos de la Región de Murcia mediante tecnologías de impresión 3D y el empleo de residuos del sector del mármol.

Realizado con el apoyo de la Fundación Biodiversidad del Ministerio para la Transición Ecológica

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Las opiniones y documentación aportadas en esta publicación son de exclusiva responsabilidad del autor o autores de los mismos, y no reflejan necesariamente los puntos de vista de las entidades que apoyan económicamente el proyecto.

ÍNDICE

1. Objetivos

El objetivo de este informe es presentar la documentación generada en la presentación del proyecto en el congreso internacional ICYMARE 2021 (*International Conference for Young Marine Researcher's*), celebrado en Berlín del 21 al 24 de septiembre de 2021. La web del congreso puede consultarse en el siguiente link: https://www.icymare.com/conference/past-conferences/icymare-2021/). El cartel del congreso (Figura 1):

Figura 1. Cartel del congreso ICYMARE.

2. Trabajo presentado

Se presentó el trabajo realizado hasta la fecha del proyecto CORAL3D en formato e-póster Y charla virtual (Power Point) en el área del congreso denominada "*Interdisciplinary Approaches for Sustainable Coastal and Ocean Management*" El póster y la charla fueron presentados por la trabajadora del CTM Sara Campillo Marín.

2.1. Póster y charla presentados

A continuación, se muestra el e-poster elaborado (Figura2), captura de la charla presentada (Figura 3) y el resumen presentado para el Book of Abstracts del congreso (Figura 4). Todos los originales pueden consultarse en los anexos de la FV6.1 (Anexo I, II, III, IV y V).

El póster fue presentado en la sesión del 21 de septiembre de 2021 a las 16:15h. Por su parte, la charla del proyecto se llevó a cabo el 22 de septiembre de 2021 a las 11:40h.

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Coral3D

A pilot project for restoration and conservation of Mediterranean corals using an artificial reef produced with residues from the marble industry

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PURPOSE

Mediterranean corals are heavily affected by the acidification of waters caused by climate change, as it influences the precipitation of calcium carbonate through which they build their skeletons. Moreover, they are exposed to bleaching, ripping out of colonies, burying, emerging diseases, chemical pollution and fishing gears impact (Aguilar, 2007). The main objective of CORAL3D project is the design of an artificial reef for the settlement of Mediterranean coral species in the Marine Reserve of Cabo Tiñoso (Region of Murcia, Spain). This action not only creates a habitat for corals, but also benefits other species which are intrinsically dependent on them. In addition, the concept of circular economy is applied by using limestone residues (Figure 1) from a quarry located in the northwest of the Region of Murcia, Spain (Figure 2).

Figure 1. Limestone quarry in the municipality of Moratalla, northwest of the Region of Murcia, Spain.

Figure 2. Location of the Region of Murcia, Spain (a) and project execution area inside the Region (b).

MATERIALS AND METHODS

▪ Digitization of the limestone residue

The digitizing of the residual limestone block for the creation of the artificial reef design was achieved by tomography. First, a photogrammetry of the limestone block was performed (Figure 3). Then, using Agisoft Metashape, AutoCAD and Autodesk 3ds Max software, a point cloud and the block texture were obtained (Figure 4), resulting in an .stl file with which the Computer Numerical Control (CNC) machinery could print the selected design (Figure 5).

Figure 3. Measurement of the limestone block (a, b) and photogrammetry of the limestone block for subsequent digitization (c).

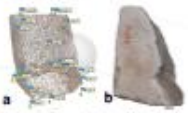


Figure 4. The point cloud (a) and the block texture (b) obtained.

Figure 5. CNC technology printing of the design for the artificial reef (a, b)

▪ Study of hydrodynamics

In order to find a suitable location for the anchoring of the artificial reef, a study of hydrodynamics was carried out at 8 points located in cell D of the marine reserve. The study was repeated three times during the month of August 2020. Each of these three times corresponded to different wind conditions (nº1: southeast, nº2 east and nº3: southwest). To carry out this study, plaster of Paris pieces (clod cards) were used. They were manufactured following the methodology of Doty (1971), which considers the weight loss of these clod cads as an estimation method to measure hydrodynamism. In each day of the study, the clod cards were placed at different heights (from 0.5 to 2 m) on metal structures, that were left at the sea bottom during 24 h (Figure 6). The differences between the final and initial weight of the clod cards were calculated after this, in order to have an indicative value of the intensity of the currents at each point The temperature at the locations was also measured using a diving computer.

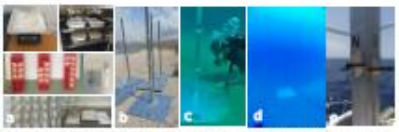


Figure 6. Process of elaboration of clod cards (a), their placement on the metallic structures for anchoring (b), the placement of structures on the seabed (c, d) and the collection after 24 hours (e).

RESULTS AND DISCUSSION

▪ Design and construction of the artificial reef

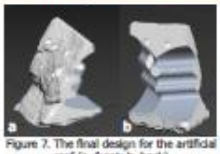


Figure 7. The final design for the artificial reef (a, front; b, back)

Figure 8. The artificial reef built with the CNC machinery (a, front; b, back)

Among the different design prototypes produced, the most heterogeneous one was selected, that was the one with different slopes, orientations, cavities and textures (Figure 7). The result produced by printing the limestone block with CNC machinery can be seen in Figure 8.

▪ Study of hydrodynamics and location of the artificial reef

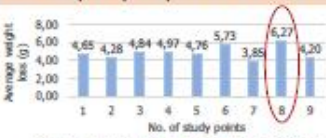


Figure 9. Comparison of the average weight loss at the points of the study of hydrodynamics performed.

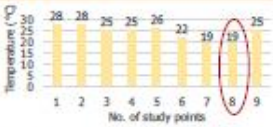


Figure 10. Comparison of the temperatures of the different points of the study of hydrodynamics performed.

The results of the study of hydrodynamics in the Marine Reserve of Cabo Tiñoso (Figure 9) indicated that clod cards corresponding to point 8 experimented the greatest weight loss (6.27g) if we compared the average weight loss from the total studies. On the other hand, point 8 also had an average bottom water temperature of 19ºC, one of the lowest of the 8 locations (Figure 10).

CONCLUSIONS

The selected artificial reef design provides different conditions for the potential development of Mediterranean coral species: several shelter possibilities, areas for both shade and exposure and various slopes and textures. The study of hydrodynamics determined that point 8, at a depth of about 25 m and located at the geographical coordinates 37.544506, -1.172374, was the most suitable due to its higher level of hydrodynamics. The point 8 of the study of hydrodynamics was also characterized by a maximum temperature suitable for most of the Mediterranean coral species in one of the hottest months of the year. The area of the point 8 is characterized by an absence of meadows or rocky habitats, where the presence of the artificial reef could increase the biodiversity of communities.

REFERENCES

Aguilar, R. (2007). *Los corales del Mediterráneo*. Madrid (Spain): OCEANA.

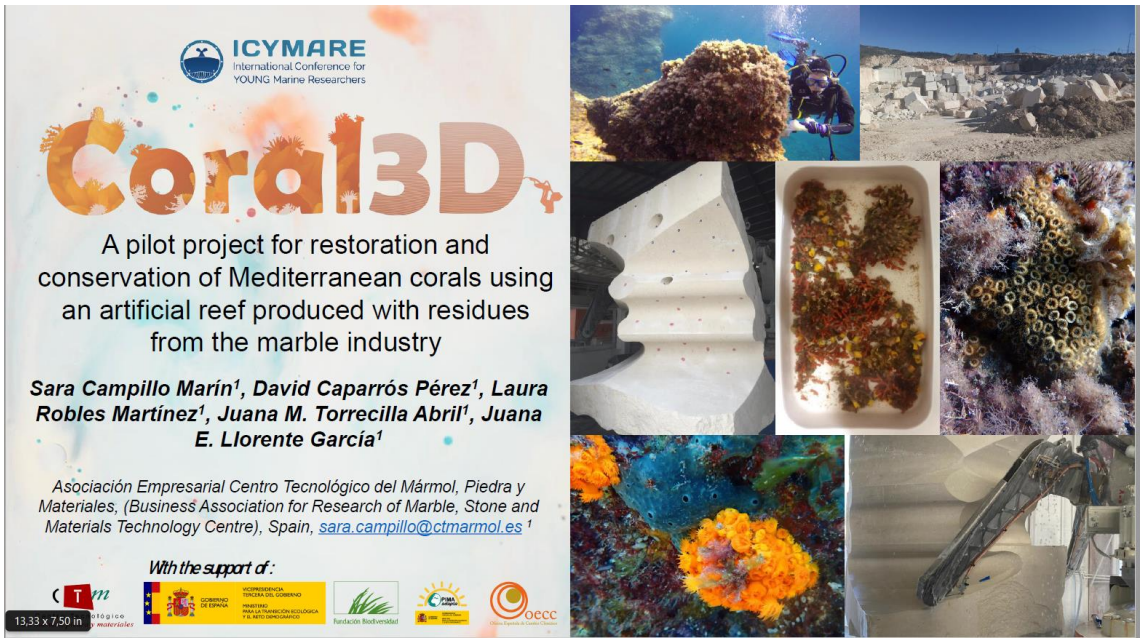
Doty, M. S. (1971). Measurement of Water Movement in Reference to Benthic Algal Growth. *Botanica Marina, 14* (1), 32–35. https://doi.org/10.1515/botm.1971.14.1.32

With the support of:

Centro Tecnológico del mármol, piedra y materiales

Figura 2. Póster virtual presentad en el congreso ICYMARE 2021.

CORAL 3D: Proyecto de aprendizaje enfocado a la restauración y conservación de hábitats coralinos de la Región de Murcia mediante tecnologías de impresión 3D y el empleo de residuos del sector del mármol. *Con el apoyo de la Fundación Biodiversidad del Ministerio para la Transición Ecológica y el Reto Demográfico*



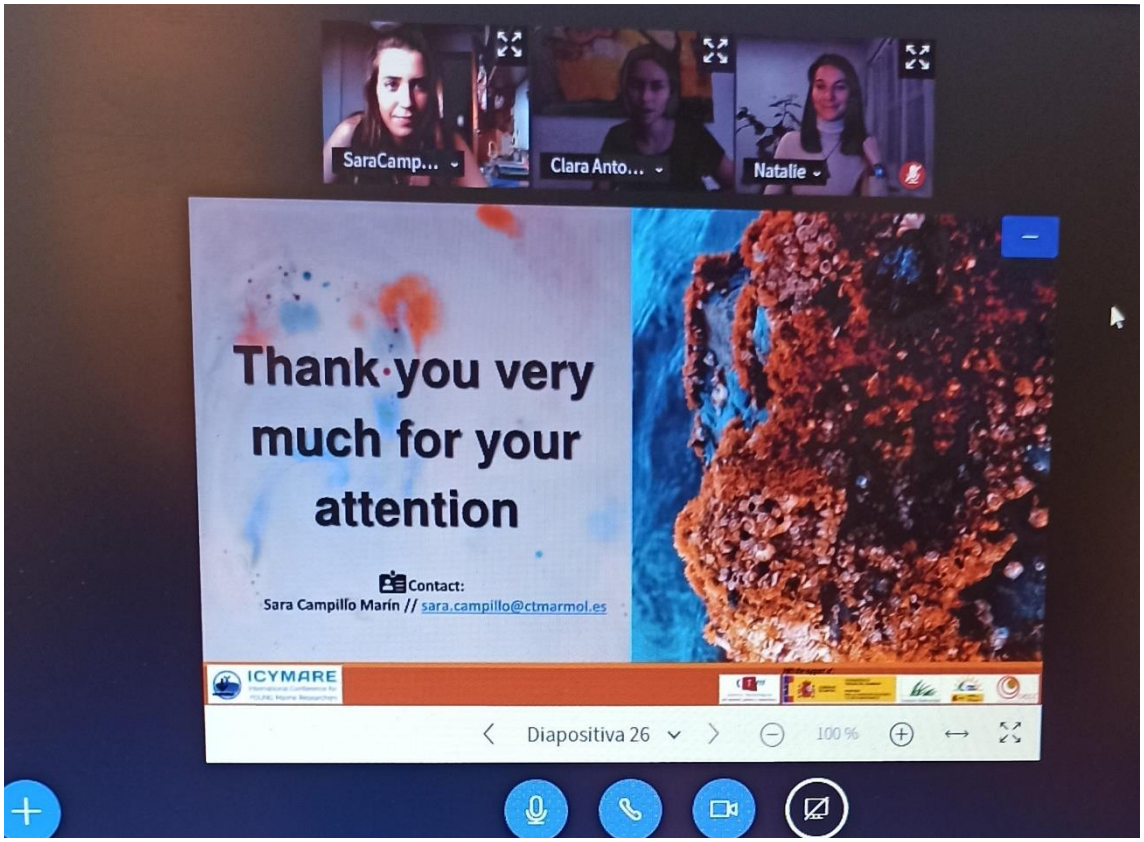


Figura 3. Fotografías de la charla llevada a cabo en el congreso ICYMARE.

CORAL3D. A pilot project for restoration and conservation of Mediterranean corals using an artificial reef produced with waste from the marble industry.

Sara Campillo Marin [1], David Caparrós Pérez [1], Laura Robles Martínez [1], Juana Maria Tordecilla Abril [1], Juana Esperanza Llorente García [1]

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Keywords: Invertebrates, biodiversity, habitat, climate change, circular economy

Mediterranean scleractinian corals are heavily affected by the acidification of waters caused by climate change, as it influences the precipitation of calcium carbonate through which they build their skeletons. Moreover, they are exposed to bleaching, ripping out of colonies, burying, emerging diseases, chemical pollution and fishing gears impact. The main objective of CORAL3D project is the design of an artificial reef for the settlement of Mediterranean coral species in the Marine Reserve of Cabo Tiñoso (Region of Murcia, Spain). This action not only creates a habitat for corals, but also benefits other species which are intrinsically dependent. Furthermore, the circular economy concept is applied so, to manufacture the artificial reef, a block of waste limestone and the Computer Numerical Control printing technology were used. For this purpose, the stone block was digitized, and softwares were used to create different types of reef structures. Finally, one was selected according to these design criteria: to provide shelter and to offer a suitable substrate and slopes for coral colonization. Corals that will settle on the reef are being collected around the marine reserve, from the sea bottoms, when they have fallen from rocky walls. Then, they are being transferred to a coral aquarium for maintenance. Once the reef is anchored, the corals will be placed on the structure. On the other hand, an experimental hydrodynamic study was performed to find the best location for the reef anchorage. Clod cards made of plaster of Paris situated at different heights along metal structures were used to estimate the currents at different ubications. As a conclusion of the study, a good location was found at a depth of about 25m, characterized by the absence of meadow or rocky habitats, where it is believed that the reef will offer potential conditions for the development of corals.

Figura 4. Captura del libro de resúmenes elaborado para el congreso.

2.2. Libro de actas

A continuación, se presentan varias capturas del libro de actas (Figura 5 y 6). Puede consultar en original también en los anexos.

Our order of presentations Session 1
Session hosts will briefly introduce session & do housekeeping at **9am** (Clara Antonia & Natalie) and give the stage to our presenters:

09:02 Fucus vesiculosus populations on artificial structures have reduced fecundity and are dislodged at greater rates than on natural shores
Veronica Farrugia Drakard

09:15 Sediment Profile Imagery (SPI): a tool for environmental impact assessment in shallow coastal environments
João Fernandes

09:28 Ecorisk: Ecosystem risk assessments with R
Helene Gutte

09:41 The meaning of success at the science-policy interface and how to achieve it
Denis B. Karcher

09:54 Social networks and mangrove forest management: A case study from the Northern Province of Sri Lanka
Thanne Walawwe Gedera Fathima Mafaziya Nijamdeen

10:07 A participatory modeling approach to analyte stakeholder perceptions of aquaculture as a social-ecological sytem
Ben Nagel

~ 1020– 1035 Coffee break where everyone can take a break & chat to each other
10:35 – 12:00 Session 1 (part 2) Session (lead by Lena & Ari), room blue

10:35 Mangrove ecosystem functions, goods, and services in Southern and North-western Sri Lanka; insight towards Ethnobiology and mangrove conservation
Ephrem Ngendahimana

10:48 A method to quantify trophic controls along the trophic levels through food-web modelling approach
Pasquale Ricci

11:01 Cumulative Impacts Assessment (CIA) on marine and coastal ecosystems: A review and future directions for integrated management of marine and coastal ecosystems
Christian Simeoni

11:14 The pential for a mesopelagic fishery by the current large scale Danish pelagic fishery; comparing economics and fishery dynamics
Berthe M. J. Vastenhoud

11:27 Transdisciplinary coastal research in the Global South: a systematic literature review
Lilly Baumann

11: 40 CORAL3D. A pilot project for restoration and conservation of Mediterranean corals using an artificial reef produced with waste from the marble industry.
Sara Campillo Marín
~12 PM Lunch Break

Figura 5. Captura de horarios de la sesión de charlas con la participación de Sara Campillo Subrayada en amarillo.

16[15] **Poster Session** Main Platform

Get in touch with awesome early career researcher and discuss latest marine science

CORAL3D. A pilot project for restoration and conservation of Mediterranean corals using an artificial reef produced with waste from the marble industry. Bar table E

Sara Campillo Marín

All that glitters is not plastic - difficulties of microplastics identification in zooplankton samples and digital tools to overcome them

Alena Sakovich

Conventional vs. biodegradable microplastics – effects of different plastic types on the digestive enzyme activities of the Atlantic ditch shrimp *Palaemon varians*

Franka Hemme

Occurrence of microplastics in commercial mid-trophic level fishes along the Portuguese coast

Maria I. Laranjeiro

Littorinid-assosiated microbiomes Bar table F

Elizaveta Gafarova

Ecotrophic effects on freshwater zooplankton and its composition due to a changing diet during growth of marine juvenile sticklebacks of the three-spined stickleback *Gasterosteus aculeatus* (Linnaeus, 1758)

Timur Ercan

Extractive activities and regulations of kelp in southern Peru during the 21st century

Katerin Sofia Guardia Luzon

The Seaweed Resources of Peru: current status and future perspectives

Jose Avila-Peltroche

Reaching society through a specialized communication program: the case of the Marine Observatory of Climate Change in the Canary Islands, the OMACC-PF. Bar table G

Oliva Pérez Silvia

Venomous weever fishes: a painful sting with biotechnological potential? A study on venom production, delivery and toxin characterization in *Echiichthys vipera*

Telma Luís

The biotechnological potential of marine bio-reactives: Exploring novel toxins from the Polychaeta *Glycera alba*

Sónia Campos

Figura 6. Captura de horarios de la sesión de posters con la participación de Sara Campillo subrayada en amarillo.

2.3. Certificado de participación en el congreso.

En la Figura 7 se puede observar el certificado de participación de la trabajadora Sara Campillo Marín en el congreso.

ICYMARE
International Conference for YOUNG Marine Researchers

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Tel (+49) 421 16038 153
E-Mail: hello@icymare.com

Date:
Bremen, 01 December 2021

Certificate of participation for virtual ICYMARE 2021

Dear Sara Campillo Marín,

We herewith confirm your participation at our annual scientific conference ICYMARE 2021 (21 – 24 September 2021, virtual).

We further confirm the presentation of your poster entitled CORAL3D. A pilot project for restoration and conservation of Mediterranean corals using an artificial reef produced with waste from the marble industry. in session 1) Interdisciplinary Approaches for Sustainable Coastal and Ocean Management

On behalf of the organizing committee,

Kind regards,

Dr. Viola Liebich Dr. Simon Jungblut Lena Heel

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Figura 7. Captura del certificado de participación en el congreso.