Sea Cave® True Blue Carbon®, Baja California, Mexico

Joint project design description and monitoring report

Abstract

Sea Cave® represents a two-fold approach to atmospheric CO_2 reduction by passively removing CO_2 through macroalgae photosynthesis and reducing carbon emitting process associated with fishing and boating behavior. Atmospheric carbon reduction directly attributed to ecological processes around Sea Cave® includes carbon capture by algal growth and the carbon storage in the biomass of living organisms produced by these novel reefs. Reefs are anticipated to amass targeted fish and invertebrate biomass, creating new fishing and tourism grounds that are closer to home ports. Hence the novel reefs are anticipated to reduce overall travel time and emissions associated small scale fishing vessels and tourism. Outside of the carbon reduction benefits described in this methodology, project activities will prevent trawling activities and preserve carbon in sediments near Sea Cave® reefs, increase food security for local communities, and preserve marine biodiversity.

Dr. Ryan Jenkinson
rsj.sdsu@gmail.com

Project design description (PDD)

Basic Information	
ID of project	91
Project name	Sea Cave® True Blue Carbon®, Baja California, Mexico
Project proponent	Project Proponent
Representative	Chris Goldblatt, CEO Fish Reef Project
Statement by the project proponent	The Project Proponent states he is responsible for the preparation and fair presentation of the Monitoring Report and all accompanying documentation provided.
Monitoring period	08/01/2023 to 05/01/2024
Pre-registration date	
Version number of the PDDMR	1
Date of version	May 31th 2024
Methodology(ies) applied and version number	☐ No x Yes, Sea Cave® True Blue Carbon® V1
Criteria for validation and verification	Val / Ver / Criteria ☐ ☐ ICR requirement document v.4 ☐ x ICR requirement document v.5 x ☐ ISO 14064-2 ☐ ☐ Applied methodology, please specify. ☐ ☐ Other, please specify.
Host country(ies)	Mexico
Host country approval	x Yes ☐ No
Sectoral scope of project activity	Transport and Afforestation/Reforestation
Multiple project activities	☐ Yes x No
Methodology(ies) applied and version number	Sea Cave®True Blue Carbon® V1
Type (CDR, avoidance, hybrid)	☐ CDR ☐ Avoidance x Hybrid
MRV cycle:	1
Estimated annual average GHG emission mitigation (t CO2-e)	4028.08

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1. Project description

1.1 Purpose, objectives, and general description of the project

This project- Sea Cave® True Blue Carbon®, Baja California, Mexico- seeks to increase carbon sequestration in shallow water marine habitats while simultaneously providing a variety of ecological and social benefits. Nearshore marine ecosystems have been shown to be effective carbon capture and sequestration tools by passively removing CO_2 through algal photosynthesis. Sea Caves® present an opportunity to install biogenic reefs in highly productive areas, maximizing algal growth and CO_2 removal, while also amassing fish and invertebrate biomass in areas that would otherwise be void of life (e.g. sandy soft-bottom sediments). Along with CO_2 removal, this project presents a hybrid greenhouse gas (GHG) reduction plan by altering the transportation habits of fishermen. Afforested Sea Cave® reefs strategically placed near local subsistence or sport fishing ports will dramatically reduce transportation time (i.e. fuel burn) and increase overall resource availability for local stakeholders.

Sea Caves® are composed of a specialize concrete that attracts sea life while not polluting or impacting growth or larval settlement. Each Sea Cave® unit is 2 m circumference and 1.5 m tall, weighing almost 1000 kg. When deployed, the caves are lowered with a specially designed crane made to hold 8 caves in a 2 x 4 rectangular pattern. These eight caves are referred to as a Sea Cave® “cluster” and cover a total area of 78.54 m². Each cluster is placed ca. 3-4 m apart, creating important channels within the larger reef structure. A single Sea Cave® reef consists of 1,000 individual units, comprised of 125 Sea Cave® clusters. The exact configuration of a Sea Cave® reef will depend on local conditions, bathymetry, and substrate type. Prior to deployment, the benthic habitat is soft bottom sediment with minimal infaunal life and almost no carbon capture abilities.

While the Sea Cave® reef model is expected to be implemented across the Baja peninsula and moving forward, globally, for the purposes of this PDD we will describe the current project activities located at Isla San Martín located 5 miles offshore of the nearby “Volcanoes” region near San Quintin, Baja Norte, Mexico. The Project will occur in shallow waters on the east side of the island. The boundary coordinates of the current project activities are:

A. 30 29.838’ N 116 6.524’W
B. 30 29.896’ N 116 6.389’W
C. 30 29.296’ N 116 6.048’W
D. 30 29.277’ N 116 6.121’W

The baseline scenario of emissions sources and associated GHG reduction (i.e. algal growth) are minimal for afforestation of marine habitats. Sea Cave® reefs will be installed on sandy, soft bottom habitats that do not provide the consolidated, hard substrate needed for algal growth. Hence the carbon capture capability prior to marine afforestation is negligible and provides essentially 100% additionality. The baseline scenario of emissions sources for altering the transportation habits of fisherman is related to the number of boats, average run time to natural fishing grounds, and number of days spent fishing per crediting period. Using generally conservative estimates, a single Sea Cave® unit could be responsible for the reduction of 3 - 4 tons of atmospheric CO_2 per year. This corresponds with a reduction of ~32 tons of atmospheric CO_2 for a single Sea Cave® cluster (8 Sea Cave units) and a reduction of up to 4000 tons of atmospheric CO_2 for a single Sea Cave® reef (1,000 Sea Cave units) respectively.

1.2 Project type and sectoral scope

Sectoral scope	Transport and Afforestation/Reforestation
Project type	Hybrid GHG

1.3 Project

x Single location/area or installation
☐ Bundled project (multiple locations/areas or installations)
☐ Grouped project (locations/areas or installations added post validation)
☐ Bundled and grouped project.

1.3.1 Eligibility criteria for grouped project

N/A (not grouped)

1.4 Location

Isla San Martin is a small rocky island approximately 1.8 km in diameter and is located 5 km off the Baja California Norte Pacific coastline west of San Quintin, Mexico. The volcanic island falls under the municipality of San Quintin. The Sea Cave® Biogenic Reef at Isla San Martín will be placed at 10 – 15 m depth along the southeast side of the island. The bathymetry of this site is generally flat with a gentle slope eastward into deeper water. The entire reef, once completed, will cover approximately 22 HA of sea floor.

The oceanographic characteristics of the site are not distinct from the rest of the island, or the entire Pacific coastline of Baja Norte, Mexico. Ocean temperatures are governed by the southward flowing California Current which brings cool, nutrient rich waters from the north, leaving water temperatures significantly cooler at 30 ˚latitude here than at similar latitudes around the planet. This cool water, coupled with the warm terrestrial temperatures of the peninsula, lead to a thick fog layer present for much of the year along this coastline, particularly in the summer months.

Address	Isla San Martin - 2 miles off San Quintin
County/province	Baja Norte
Country	Mexico
Region	Baja

Geographic location	
Latitude	Decimal degree 30 29 30 N
Longitude	Decimal degree 116 06 10 W
Map link	https://earth.google.com/earth/d/1ARBugewSYW4bKyNJc0h0sSH6N9b461h4?usp=sharing

1.5 Conditions prior to implementation

General Condition Prior to implementation

Sea Cave® reefs will be installed on sandy/soft bottom marine habitats. These habitats tend to have significantly less fish, algal, and invertebrate biomass compared to reefs with hard consolidated substrate. In these locations Sea Cave® reefs will provide hard substrate for macroalgal and understory algal growth, resulting in a significant increase in photosynthetic CO_2 removal. The Sea Cave® True Blue Carbon®, Baja California, Mexico reefs will ultimately foster the primary production needed to support a highly prolific marine ecosystem.

Prior to initiation we have and will be engaging with local communities and strategically choose sites that both increase resource availability while reducing travel time (i.e. fossil fuel burn and GHG emissions) to fishing sites. These estimates will vary quite significantly depending on location, reef type (temperate vs tropical), local target species, and fishing pressure/effort, but minor reduction can have dramatic effects.

Conditions Prior to Implementation within Project Boundary, San Quintin, Isla San Martin

Prior to installation of the Sea Cave® reef, Dr. Ryan Jenkinson and team performed underwater visual surveys and vessel-based sonar surveys. The Fish Reef science team conducted SCUBA surveys in 2022 to assess the site pre-deployment. Stratified random benthic surveys within all secrets of the site were conducted and all transect locations were randomly chosen once on the bottom. The physical characteristics of the site are not expected to vary seasonally.

Uniform point contact (UPC) surveys were conducted along 30m transect lines. The depth at the beginning and end of each transect was noted. The substrate type, any living algae or encrusting animals, and the relative change in height between that point and the next half meter were noted (to help assess site rugosity).
A total of 10 transects, covering 300 m^2 of area, were surveyed.

Over 97% of the substrate was classified as sand, with rugosity not observed greater than 10 cm between any two points. The depths surveyed ranged between 23 and 46 feet. Overall, we found the site to be flat and almost completely sand bottom. A few batches of low relief rock sand boulders were observed at the south end of the study area but were not captured during the random transects.

Benthic surveys at the proposed site were conducted in a random stratified pattern in an attempt to cover as much of the Project area as possible. Once on the bottom, the divers randomly chose survey start locations. Standard benthic swath survey methods were used to survey for algal species. Each transect was 30 m in length, with 1 m on each side of the transect searched and all species encountered recorded. Thus each transect covers a total of 60 m^2. A total of 10 transects were conducted within the project area.

Because the survey area is primarily sand bottom, algal abundance and diversity was low. The southern and most shallow parts of the proposed site did contain seagrass (*Zostera marina*) beds. Averaged across the proposed site, we found a density of about 1 *Z. marina* plant per m^2. In comparison, the eelgrass beds inside nearby Bahia de San Quintin average between 50 – 100 plants per m^2. The reef units are sited outside of these beds. The small chainbladder kelp (*Stephanocystis osmundacea*), which can attach to loose sand substrate, was the other common algal species found. Only a few small, single blade Macrocystis plants were observed, although this supports the likelihood that Macrocystis will recruit and grow on the artificial reef at the site.

The proposed site, because it is found on primarily soft sand habitat (see above), is devoid of most of these species. Instead, we observed very low densities of common soft bottom species of the Pacific coast: anemones, marine snails, and hermit crabs. These animals were found in low abundances, and this Project is not located in any kind of refuge, recruitment, or nursery type habitats for these species. In fact, the addition of the reef units, and the resulting increase in marine algae biomass, will likely increase the abundance of these sand bottom species as well.

Ten 30 x 2 m swath surveys were conducted in a random stratified pattern across the Project area. The most common macroinvertebrates encountered were small Cnidarians (anemones) and Kellett's whelk, a large gastropod. The faunal biomass and densities were extremely low, as expected in this habitat type.
The fish assemblage at the Project site was also surveyed by the dive team. Fish surveys were stratified random in design. Along the transect, the diver swam 2 m above the transect line, and scanned a survey area within a 2 m x 2 m square in front of them, while continually moving forward. This gives a total survey area of 120 m^3 per transect, and a total of 1,200 m^3 area surveyed within the site.

As expected, fish densities were extremely low. This is a product of the sandy bottom of the site. We did observe small numbers of the common temperate reef fish common to the region. Fish sizes were not estimated on the surveys, but years of experience along the Baja coastline allowed qualitative assessment. Overall, we observed smaller sized individuals (of the common reef fish) than we would have on the nearby hard bottom reef sites.
(*See Baseline sect 6 for details & "SeaCave_Reef_Permit_Application_IslaSanMaitin.pdf"*).
Interviews with local stakeholders and fishing cooperatives found no fishing had historically occurred with the project boundary and that the area within project boundary was not used for any other socioeconomic purposes.

1.6 Technology applied

Sea Cave Reefs Technology
Sea Caves® are composed of a specialize concrete that both attracts sea life while not polluting or impacting growth or larval settlement. Each Sea Cave® unit is ca. 2 m diameter and 1.2 m tall, weighing almost 1000 kg (see schematic in Appendix). The construction of the Sea Cave® units will occur at a preexisting warehouse in Ensenada, Baja Norte, Mexico. No housing or other works will be constructed for this project. The deployment barge will be based out of Ensenada.

Monitoring Technology
Monitoring will be conducted on SCUBA using standard subtidal monitoring methodologies. This includes "SWATH" style benthic surveys that count mobile and sessile invertebrates and algal species within a 2m X 30m band transect. Also, fish surveys will be employed to count all fishes along a 2m x30m band transect. Finally, a uniform point contact (UPC) survey will be used to characterizes the benthic cover with the project boundary. These protocols are directly adapted from "PISCO" style surveys and represent the standard temperate rocky

reef monitoring protocols and can be used by any diver with local knowledge of species present. More background for these survey techniques can be found at https://piscoweb.org/kelp-forest-sampling-protocols.

Additional survey equipment will include remote cameras and side scan sonar systems to provide visual evidence of Sea Cave Reef deployment and biological growth.

1.7 Roles and responsibilities

1.7.1 Project proponent(s)

Organization Name	Fish Reef Project/IMMB INC.
Role in the project	CEO
Contact person	Chris Goldblatt
Title	CEO
Address	315 Meigs Rd Ste A Santa Barbara CA 93109
Telephone	+1 310 488 6100
Email	chris@fishreef.org

1.7.2 Others involved in the project

Organization name	Fish Reef Project
Role in the project	Science lead, oversight of monitoring activities, data collection, and synthesis
Contact person	Dr. Ryan Jenkinson
Title	Lead Scientist
Address	315 Meigs Rd Ste A Santa Barbara CA 93109
Telephone	+1 619 840 7626
Email	rsj.sdsu@gmail.com

1.8 Chronological plan/implementation

1. Start date- 01 August 2023
2. Baseline period- 08/01/2022 to 07/31/2023
3. Termination of the project - no anticipated end date- Sea Caves® do not degrade over time
4. Monitoring of the Sea Cave® reef complex will occur biannually. Summary reports will be produced annually.
5. Validation and verification activities are currently underway.

1.9 Eligibility

The Project meets eligibility criteria due to the ability of Sea Caves® to facilitate the reduction of GHG emissions from local commercial fishing activities as well as GHG sequestration primarily via macroalgal growth on the hard substrate provided by the Sea Caves® in previously uninhabitable and depauperate habitat. This Project and methodology fall under previous terrestrial afforestation/reforestation but conducted in nearshore marine systems. The crediting period does not start before January 1, 2020. Lastly, there is no double counting of GHG reduction estimates. Project activities also meet the ICR threshold of additionality described in section 5.

1.10 Funding

No public funding was received.

1.11 Ownership

IMMB INC. is the actual master project/credit owner and then subcontracts with Fish Reef Project and its agents to carry out Sea Caves® related work. All permits for Mexico are filed under the entity name Fish Reef Project Mexico. Sea Cave IP is owned by Chris Goldblatt and licensed to IMMB Inc. and Fish Reef Project.

1.12 Implementation status of the project

The preliminary stages of the project, including collaboration with the local fishing cooperativa, physical assessment and surveys of the proposed site, and procurement of investment funding, occurred January – May 2022. Construction of Sea Cave® units began in the late summer / early Fall of 2022 and is ongoing. Reef deployment began early 2023. The current 436 Sea Cave® reef was completed in August 2023. Deployment is expected to continue over 24-36 months, with the first 250 units within the 22 HA lease footprint used to establish efficacy of the reefs for kelp growth and the final reef to contain 1000 Sea Cave® units.

To establish an accurate carbon stock baseline underwater visual surveys, vessel-based sonar surveys and historic remote sense imagery (>30 year time series in some locations) will be used to quantify the current and historical carbon stock. The initial subtidal site surveys were carried out in April 2022. This baseline will provide a multiyear spatiotemporal estimate of carbon stock and underwater visual surveys immediately prior to deployment to estimate standing stock of carbon within the project boundary.

We do not foresee a formal termination date for any marine afforestation projects. Sea Caves® are made using non-toxic and long lasting materials that should remain viable over an estimated ca. 500 years life span. After installation, they do not require maintenance and have zero associated carbon emitting process to continue passively removing atmospheric CO_2 via macroalgal photosynthesis and will continue to serve as nearby fishing grounds for communities, reducing fuel burn.

There is sufficient macroalgal growth on the reefs by the end of the first year of deployment to permit all verification actions necessary. For temperate systems we expect well established macroalgal biomass at this time. This may also be demonstrated in remote sensing imagery of the macroalgal canopy reaching the surface. Surveys of the reefs are expected to continue annually for the remainder of the project, with reports on status, growth, and estimates of carbon accumulation in macroalgal standing stock and changes to fishing behavior produced annually.

1.13 Other certifications

N/A

1.14 Double counting, issuance and claiming

This project is not seeking registration under other programs or projects at this time. Estimates of GHG mitigation do not contain double counting.

1.14.1 Other registration and double issuance

Is the project registered or intends to be registered with another GHG program?

☐ Yes, (provide evidence on how double issuance will be prevented)

x No

Has the project been rejected by another GHG program

☐ Yes, (provide information on the reason for rejection and how the argument is not relevant for ICR registration)

x No

If the project is, has been or intends to be registered with another GHG program, evidences of the other registration shall be provided, i.e. registration ID, GHG program, link.

GHG program	
Project ID	
Link	
Status	Pre-registration, Issuance, Crediting period ended.

1.14.2 Double claiming and other instruments

Are the project activities also included in a GHG emissions trading program or subject to binding emission limit?

☐ Yes, (provide information on how double claiming is prevented)
x No

Has the project activity applied for, received, or is planning to receive instruments from another GHG-related environmental crediting system, e.g. IREC or Guarantees of Origin.

☐ Yes, (provide information on how double claiming is prevented)
x No
If the project is, has been or intends to be registered with another GHG related environmental crediting system, evidence of the other registration shall be provided, i.e. registration ID, GHG program, link.

GHG program	
Project ID	
Link	
Status	Pre-registration, Issuance, Crediting period ended.

Do project activities affect GHG emissions accounted for within a value chain (goods/service, i.e. scope 3 emissions and the project proponent or Authorized representative a buyer or a seller of such goods/services?

x Yes, (provide information on how double claiming is prevented, e.g. a public statement for such deduction/addition in reported GHG emissions, reporting to suppliers within proponents value chain)
☐ No

Cement production is a known source of GHG emission and we have included this emission in our estimate of net GHG mitigations estimates for the project. These emissions (i.e. cement production required for a Sea Cave unit) only need to be accounted for once and will not be included in subsequent crediting periods. Cement production and Sea Cave fabrication is all done locally, near the project site, so GHG emission associated with transportation are considered to be de minis over the life of the Sea Cave (~500 years). See Appendix section 13 for further discussion GHG emission estimates. The GHG discounts are applied in Sect 10.4 equation 12 and 13.

1.15 Other Benefits

SDG impacts during the monitoring period				
SDG target	**Indicator (text from the SDG indicator)**	**Net impact (implemented activities to increase or decrease)**	**Current contributions**	**Lifetime contributions**
1. No poverty	Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation, in order to provide adequate and predictable means for developing countries, in particular least developed countries, to implement programmes and policies to end poverty in all its dimensions	Decrease in poverty due to jobs, exports, food availability.	Sea Caves® create habitat that supports multiple targeted fisheries species in closer proximity to local communities. This provides increased economic opportunities and food security that only increases the longer the reefs remain in place.	The economic and resource contributions of Sea Cave® reefs actually increase over time, and are expected to continue in perpetuity.
1.1	By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters	Increase in resilience to economic and environmental shocks.	Sea Caves® create habitat that supports multiple targeted fisheries species in closer proximity to local communities. This provides increased economic opportunities and food security that only increases the longer the reefs remain in place. This increase in habitat also provides resilience in the face of climate and oceanographic changes.	The economic and resource contributions of Sea Cave® reefs actually increase over time, and are expected to continue in perpetuity. This provides resilience to changes in economic and environmental changes over time.

2. Zero Hunger	By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round	Increased food security can decrease hunger.	Sea Cave® create habitat that supports multiple targeted fisheries species in closer proximity to local communities. In turn this can create and enhance sustainable fisheries.	The food security contributions of Sea Cave® reefs actually increase over time, and are expected to continue in perpetuity.
2.1	By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons	Marine sources of protein are high value and can decrease malnutrition.	Sea Cave® create habitat that supports multiple targeted fisheries species in closer proximity to local communities. In turn this can create and enhance sustainable fisheries and decrease malnutrition.	The food security and value contributions of Sea Cave® reefs actually increase over time, and are expected to continue in perpetuity.
8.9	By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products	Increased opportunities for sport fishing and eco tourism at the Project site	Sea Cave® will lead to a large reef structure that increases fish biomass and attracts sport fishing opportunities for local communities. In addition, SCUBA related eco tourism will increase as the newly functional and diverse reef matures over time.	Biodiversity, fish abundance, and ecosystem health will increase over time leading to long term tourism and job opportunities.
13. Climate action	Take urgent action to combat climate changes and its impacts	Decreased atmospheric CO2 via photosynthetic sequestration while also providing benthic reef ecosystems more resilient to climatic changes	Sea Cave® allows for growth of foundational Macrocystis reefs leading to increased atmospheric CO2. Increased reef area and benthic biodiversity allows for resilience to changing oceanographic and climatic conditions.	Sea Cave® have been demonstrated to withstand major oceanographic forcing factors including hurricanes and large swell events, and will last throughout all oceanographic conditions.

14.2	By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans	Direct facilitation of sustainable, long lasting coastal marine ecosystems which increases ocean health	Sea Cave® most directly addresses this SDG and facilitates healthy, resilient, productive marine ecosystems.	The ecosystem functions of Sea Cave® reefs actually increase over time, and are expected to continue in perpetuity.
14.3	Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels	Both reduce emissions and remove GHG from the ocean.	Sea Cave® are placed strategically for use by fishers whereby fuel burn is greatly reduced. As an additional Sea Cave® are habitat for GHG reducing organisms.	The reduction and removal opportunities of Sea Cave® reefs actually increase over time, and are expected to continue in perpetuity.
14.b	Provide access for small-scale artisanal fishers to marine resources and markets	Increase local access for small-scale fishers to marine resources	Sea Cave® are designed and placed to opportunistically facilitate access for local communities to increase both opportunity and fisheries yield	The fisheries value and opportunities of Sea Cave® reefs actually increase over time, and are expected to continue in perpetuity.

1.16 Host country attestation

x Host country attestation

☐ No host country attestation

1.17 Additional information

Ocean assets such as tugs and offshore supply vessels may convert to LNG. Custom marine concrete blend created with supplier CEMEX for a 30% reduction in CO_2 from standard cement.

1.17.1 Confidential/sensitive information

Project information is public.

2. Crediting

2.1 Project start date

Project start date	01/08/2023

2.2 Expected operational lifetime or termination date

Sea Cave® reef structures do not have an "expiration" date. It is expected that these biogenic reefs will remain in place for 500 years or more. As such, there is no termination date for the project.

2.3 Crediting period

Start date of crediting	08/01/2023
Crediting period	☐ Five years, renewable twice. ☐ Ten years, fixed. x Fifteen years, renewable twice (CDR only). ☐ Other, provide information on how that conforms with ICR requirement document.

2.4 Calendar year of crediting

Calendar year of crediting	Estimated GHG emission mitigations (t CO2-e)
DD/MM/YYYY to 31. December YYYY	01.08.2023 – 01.05.2024
Total estimated GHG emission mitigations during the crediting period (t CO2-e)	60,978
Total number of years (yrs)	15
Annual average (t CO2-e)	4065.2

3. Safeguards

3.1 Statutory requirements

Permits were approved and issued by the Secretariat of Environment and Natural Resources (SEMARNAT, https://www.gob.mx/semarnat), Mexican Government with approval from the Mexican Navy and Coast Guard (See appendix 8.1 for copy of approved permit).

The permit application is provide in a .PDF titled "*SeaCave_Reef_Permit_Application_IslaSanMaitin.pdf*"

3.2 Potential negative environmental and socio-economic impacts

We do not anticipate any negative environmental or socio-economic impacts to the Sea Cave® reefs. In fact, the objective of the reefs is to facilitate and enhance both things. One possible issue would be the reefs acting as a navigational hazard, but they are low profile enough (<2m) and placed in deep enough water (> 10 m) that they will not act as a hazard in any way.

3.3 Consultation with interested parties and communications

Within the Cooperativa fishing system of Baja California, no work within a region can occur without full support from the local fishers. All work on the project is conducted in close collaboration with the Cooperativas. Local fishermen at each proposed reef location are contacted and engaged before any work is to begin. The local fishermen are particularly vital to finding the locations for Sea Cave® reefs that are most likely to maximize both ecological and socio-economic benefits.

3.3.1 Stakeholders and consultation

Stakeholder	Owner of local fishing coop Rocas De San Martin" and local charter vessels, general public
Legal rights	They have the right to fish on the reefs for legal sport and commercial purposes
Diversity	
Location	San Quintin Baja, Mexico
Effects	Increases access to more robust nearshore fishery and dive tourism
Date of consultation	5/1/22
Stakeholder engagement	We have formal agreements with both the local fishing cooperative "Rocas de San Martin", plus local sportfishing operators and the University (UABC) (letters attached) and the general public who have been notified as part of the federal permits via the new paper (attached). The project deeply involves all four entities on many levels and enjoys strong support. Rocas De San Martin and Local Sport fishing assists us with vessel support for our dive team.
Consultation	Detailed reef plans and locations were shared with stakeholders.
Stakeholder input	All agreed it was a good plan.
Free prior informed consent	We asked the main stakeholder to issue a formal letter of support (see attached)
Conclusion	Everyone is unified in support of the project.
Ongoing consultation	We meet with stakeholders annually and engage with them to assist with data collection.

3.3.1 Public comments

Comments received	Action taken
There were no public comments	

3.4 Environmental impact assessment

A full EIA is enclosed with the SEMARNAT permit application.

3.5 Risk assessment

	Risks identified	Mitigation measures
Risk 1	Oceanographic perturbation, such as El Nino driven storm events	Once Sea Caves®are placed there has been no evidence of movement or destruction due to storm events. In case some are destroyed, new Sea Caves® will be placed in the abandoned locations on the reef as soon as possible afterwards.
Risk 2	Increased SST associated with changing oceanographic conditions	Cannot mitigate oceanographic conditions, so continued monitoring of reef health will provide insight to changing conditions.
Risk 3	No growth on the Sea Caves®	In all trials and examples this has not been the case. If observed, possible to "seed" or outplant Macrocystis to the Sea Caves® to facilitate growth
Risk 4	Overfishing of the Sea Caves® leading to decreased production	Increase education on the long-term management and conservation of marine species, provide tools and data to increase effectiveness

3.5.1 Additional information on risk management

We expect minimal measurable impact or risk beyond SCUBA safety surrounding monitoring activities.

4. Methodology

4.1 Reference to applied methodology and applied tools

The Sea Cave® True Blue Carbon® presents a novel hybrid methodology for GHG projects.

The aspects of Sea Cave® True Blue Carbon® methodology related to the removal of GHG through marine algal photosynthesis will follow a similar scheme as the afforestation and reforestation project activities implemented on wetlands and degraded mangrove habitats (AR- AMS0003 and AR-AMS0014).

The aspects of Sea Cave® True Blue Carbon® methodology related to the reduction in GHG related to changes in fisher behavior present a novel GHG project and we could not find any current GHG methodologies that were appropriate and/or comparable to our current project activities. Hence, we have begun to develops tool and protocols for characterizing baseline conditions and reductions associated with project activities.

Type (methodology, tool, module)	Reference ID	Version	Title
Methodology	TBD	1	Sea Cave® True Blue Carbon®

4.1 Applicability of methodology

The Sea Cave®True Blue Carbon® methodology is still in development. However, we aim to produce tools that will standardize the baseline, additionality, and monitoring for particular projects. This tool set, similar to ones found in the afforestation methodologies, will allow for the worldwide application of Sea Cave reefs in GHG projects.

Methodology ID	Applicability condition	Justification
TBD	Direct applicability	Methodology specific to this Project

4.3 Deviation from applied methodology

We do not anticipate drastic deviation from the described methodologies. However, each particular AMH project will have slight deviation from the methodology depending on various aspects including macroalgal species growth rates, Sea Cave® reef configuration, fishing behavior, oceanographic conditions at each site, and other biogeographic variability inherent in regional projects.

Methodology ID	Requirement	Deviation	Justification
TBD	A/R	none	

4.4 Other Information relating to methodology application

Sea Caves® True Blue Carbon® is a new Methodology that does not currently require modifications. These may become apparent as the Project continues however, and the Methodology will be updated accordingly.

5. Additionality

According to ISO 14064-2 standards, additionality for the project activities has been established through meeting with local stakeholders such as the fishing cooperative "Rocas de San Martin" and local sport fishing clubs, about conditions prior to Sea Cave® Reef project activities. The success and future expansion of Sea Cave® Reef project activities within the project boundary is also dependent on the sale of carbon credit as financial support. Interviews with local government officials and marine managers shows that Sea Cave® Reef project activities go beyond Mexico's current GHG mitigation plan.

5.1 Level 1 - ISO 14064-2 GHG emissions additionality

Interviews with local stakeholders and cooperative fishers that are familiar with the local marine system and marine habitat within the project boundary confirmed that the area lacks consolidated substrate and that kelp and understory algae have never been present within the project boundary. Any kelp growth within the project boundary is therefore considered additional. This is supported by the baseline subtidal survey data that showed zero algal growth within the project boundary prior to project activities.

Additional interviews with the local cooperatives fishers identified the location for project activities as the ideal area for a large-scale Sea Cave® Reef in order to reduce travel time from port. Relying on the local knowledge of the cooperatives, the project boundary was identified as an area with the correct depth, water movement, and nutrients to potentially support a robust kelp forest and fisheries targetes, while also being in close proximity to local ports. Interviews also concluded that prior to project activities no fishing was occurring within the project boundary and all fishing activities were occurring on natural reefs at various distances from port. Any reduction in fisher travel time that is occurring on or near project activities should be considered additional and related to project activities.

Note that all algal growth will come from species that are naturally occurring on local, nearby reefs and within their native ranges.

5.2 Level 2a – Statutory additionality

Interviews with local government officials and fisheries managers found that prior to project activities there were no statutory requirements to deploy Sea Cave Reefs or any other type of 'artificial reef' within the project boundary. All Sea Cave® Reef project activities should therefore be considered additional to any statutory requirement.

5.3 Level 2b – Non-enforcement additionality

N/A

5.4 Level 3 – Technology, institutional, common practice additionality

N/A

5.5 Level 4a – Financial additionality I

Sea Cave® Reef project activities are capital intensive. Only revenues from the sale of carbon credits will allow more Sea Caves® to be produced, deployed, and studied. This includes future expansion of Sea Cave® Reefs within the project boundary. ICR blue carbon revenues allow IMMB INC to enjoy wider funding interest from the general investment community.

5.6 Level 4b – Financial additionality II

N/A

5.7 Level 5 – Policy additionality

Currently there is also no aspect of Mexico's climate action plan related to expanding their available marine habitats in order to augment the growth macroalgae and understory algae as carbon capture tools. Similarly there is no aspect of Mexico's climate action plan related to reducing fisher transportation time through the use of Sea Cave or any other artificial reefs. Project activities related to Sea Cave Reefs can be considered additional and outside the scope of current climate policy in Mexico.

6. Baseline scenario

Marine afforestation projects will target sandy/soft bottom marine habitats that lack consolidated substrate required for the growth of marine macroalgae. Without the primary production associated with algal growth and the three-dimensional structure provided by marine macroalgal, soft bottom habitats generally have very low algal, invertebrate, and fish biomass compared to rocky reefs. Hence these systems are generally carbon neutral and do not meaningfully contribute to global carbon budgets nor act as carbon sinks.

Prior to installation of a Sea Cave® reef the team will perform underwater visual surveys, vessel-based sonar surveys and use historic remote sense imagery (>30-year time series in some locations) will be used to quantify the current and historical baseline carbon stock.

At the primary Isla San Martin site the Fish Reef science team conducted SCUBA surveys in 2022 to assess the site pre-deployment. Stratified random benthic surveys within all sectors of the site were conducted and all transect locations were randomly chosen once on the bottom. The physical characteristics of the site is not expected to vary seasonally.

Uniform point contact (UPC) surveys were conducted along each 30m transect line. The depth at the the beginning and end of each transect was noted. The substrate type, any living algae or encrusting animals, and the relative change in height between that point and the next half meter were noted (to help assess site rugosity).

A total of 10 transects, covering 300 m meters of area, were surveyed. Over 97% of the substrate was classified as sand, with rugosity not observed greater than 10 cm between any two points. The depths surveyed ranged between 7 m - 14 m depth. Overall, we found the site to be flat and almost completely sand bottom. A few batches of low relief rock sand boulders were observed at the south end of the study area but were not captured during the random transects.

The marine life of the shallow waters adjacent to Isla San Martin, including the algal assemblages, are governed by the same oceanographic and biotic forces that impact the entire California Current Ecosystem, particularly the temperate reefs found south of Point Conception, California. The iconic kelps of this region, those huge, brown, forest forming algae are unique to this area in their growth rates and size, fed by the nutrient rich, upwelled waters of the California Current. The macroalgal assemblage at the island is the same as that found along the mainland and offshore islands throughout Baja Norte.

Benthic surveys at the proposed site were conducted in a random stratified pattern in an attempt to cover as much of the Project area as possible. Once on the bottom, the divers randomly chose survey start locations. Standard benthic swath survey methods were used to survey for algal species. Each transect was 30 m in length, with 1 m on each side of the transect searched and all species encountered recorded. Thus each transect covers a total of 60 m^2. A total of 10 transects were conducted within the project area. Because the survey area is primarily sand bottom, algal abundance and diversity was low. The southern and most shallow parts of the proposed site did contain seagrass (*Zostera marina*) beds. Averaged across the proposed site, we found a density of about 1 *Z. marina* plant per m^2. In comparison, the eelgrass beds inside nearby Bahia de San Quintin average between 50 – 100 plants per m^2. The reef units will be sited outside of these beds. The small chainbladder kelp (*Stephanocystis osmundacea*), which can attach to loose sand substrate, was the other common algal species found. Only a few small, single blade Giant Kelp (*Macrocystis pyrifera*) plants were observed, although this supports the likelihood that Giant kelp and other understory algae will recruit and grow on Sea Cave® reefs installed within the project boundary.

The fauna of the nearshore reefs of Isla San Martin, like the algae, are similar to the assemblages found along the Pacific coast of Baja Norte, Mexico. This includes both invertebrate and fish species. These communities vary in species abundance, growth rates, diversity, and seasonal abundance based a wide variety of biotic and abiotic factors. However, most rocky reef sites in Baja Norte hold a similar assemblage of animals, and Isla San Martin is not an exception. The common large macroinvertebrates , including spiny lobster, sea urchins, and abalone, are the primary targets of the local fisheries of Baja Norte. One of the primary goals of the project is to increase the abundance, by providing additional ecosystem building substrate, of these species for the economic gain of the local fishing community. The proposed site, because it is found on primarily soft sand habitat (see above), is devoid of most of these species. Instead, we observed very low densities of common soft bottom species of the Pacific coast: anemones, marine snails, and hermit crabs. These animals were found in low abundances, and this project is not located in any kind of refuge, recruitment, or nursery type habitats for these species. In fact, the addition of the reef units, and the resulting increase in marine algae biomass, will likely increase the abundance of these sand bottom species as well.

As expected, fish densities were extremely low. This is a product of the sandy bottom of the site. We did observe small numbers of the common temperate reef fish common to the region. Fish sizes were not estimated on the surveys, but years of experience along the Baja coastline allowed qualitative assessment. Overall, we observed smaller sized individuals (of the common reef fish) than we would have on the nearby hard bottom reef sites.

7. Project boundary

The Sea Cave® Reef at Isla San Martín will be placed at 10 – 15 m depth along the southeast side of the island. The bathymetry of this site is flat with a gentle slope eastward into deeper water. The entire reef, once completed, will cover approximately 22 HA of sea floor. The reef site will be contained within the following coordinates:
NE: 30 29.896’ N 116 6.389’W
NW: 30 29.838’ N 116 6.524’W
SE: 30 29.296’ N 116 6.048’W
SW: 30 29.277’ N 116 6.121’W

Table 2 Identification of GHG SSRs

SSR		Controlled/ related/ affected	GHGs	Included? Y/N	Justification/ explanation	Coordinates
Baseline	Source 1	related	CO2	Y	Estimates of the total vessel use (time, outboard type) of fishers within the project area	30 29.896’, 116 6.398’
	Source 1		CH4	N	Conservative to exclude	
	Sink 2	related	CO2	Y	Total macroalgal growth in the project area before project implementation	30 29.896’, 116 6.398’
	Reservoir 3		CO2	N	N/A	
Project	Source 1	related	CO2	Y	Estimates of the total vessel use (time, outboard type) of fishers within the project area, can compare to changes (decreases) due to reef implementation	30 29.896’, 116 6.398’
	Sink 1	related	CO2	Y	Total macroalgal growth in the project area after project implementation	30 29.896’, 116 6.398’

8. Quantification of GHG emission mitigations (ex-ante)

8.1 Criteria and procedures for quantification

Sea Cave reef projects will quantify both the removal of GHG through algal photosynthesis and reduction in fisher transportation. The general outline of calculations and sequential steps to quantification are shown in figure 1. The ex-ante estimates provided in section 8 are based on 1 year (365 days) of algal growth and project activities at a scale of 1,000 individual Sea Caves®.

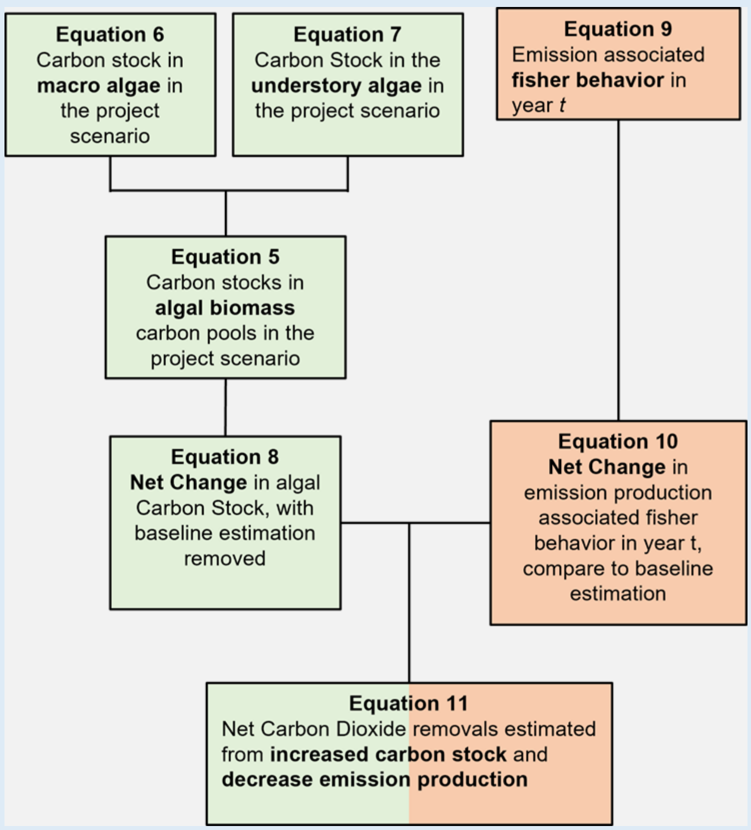


Figure 1 Equation diagram showing the summary of calculations used to estimate the changes in carbon stock related to algal NPP (green boxes) and GHG emission reductions associated with changes in fish behavior (orange boxes).

8.1.1 Baseline emissions

8.1.1.1 Baseline Quantification of Carbon Stock from Marine Macroalgae

Once the PP has gathered all available information on past growth and abundance of marine algae with the project boundary the PP shall use the single best data source to calculate the baseline scenario. In most cases this will be the in-water surveys that directly measured the abundance of marine algae. Baseline carbon stock will be calculated as follows:

(1)

$$C_{bsl\ t\text{-}1} = (C_{bsl\_ma} + C_{bsl\_ua}) \times A_{pa}\ \ X$$

Where:

$C_{bsl\ t\text{-}1}$ = Baseline carbon dioxide removed by sinks in year t-1, prior to project activities; t CO_{2e}.
C_{bsl_ma} = Typical carbon stock in macroalgal biomass within the project boundary in year t estimated from underwater visual surveys; t C.
C_{bsl_ua} = Typical carbon stock in baseline understory algal biomass within the project boundary in year t estimated from, underwater visual surveys, t C.
A_{pa} = Hard Area of project activities, meter^2
44/12 = Ratio of molecular weight of carbon dioxide to carbon (unitless)
t-1 = year 1,2,3… One year prior to the project start date.

Ex-Ante parameters and estimates:

$C_{bsl\ t\text{-}1}$ = **0 t CO_{2e} · meter $^{-2}$**
C_{bsl_ma} = 0 t CO_{2e} · meter $^{-2}$ *See equation 2*
C_{bsl_ua} = 0 t CO_{2e} · meter $^{-2}$ *See equation 3*
A_{pa} = 220,000, meter^2 (22 HA)
44/12 = Ratio of molecular weight of carbon dioxide to carbon (unitless)
t-1 = 1

Baseline Macroalgal Carbon Biomass

The protocols for calculating the baseline scenario macroalgal carbon stock will be the same as outline in the project scenario. Baseline macroalgal carbon stock is calculated as follows:

(2)

$$C_{bsl\_ma} = (CA_{MA} \times SD_{t\text{-}1} \times D) \times 0.000001$$

Where:

C_{bsl_ma} = Carbon stock in macroalgal biomass in year t -1 ; t CO_{2e} · meter $^{-2}$.
CA_{ma} = Carbon Accumulation rate for macroalgae; gC · stipe^{-1} · day^{-1}
SD = Average stipe density in year t-1; stipes · meter $^{-2}$
D = Days, 365
0.000001 = Conversion rate from grams to metric tones, unitless
t = 1,2,3… , t years elapsed since the project start date

Ex-Ante parameters and estimates:

C_{bsl_ma} = 0 t CO_{2e} · meter $^{-2}$
CA_{ma} = 0.81 gC · stipe^{-1} · day^{-1}
SD = 0 stipes · meter $^{-2}$
D = 365 days
t = 0

8.1.1.2 Baseline Understory algal carbon accumulation

The protocols for calculating the baseline scenario understory carbon stock will be the same as outlined in the project scenario. Baseline understory carbon stock is calculated as follows:

$$C_{UA} = (CA_{UA} \times D) \times 0.000001 \tag{3}$$

Where:

C_{bsl_ua} = Carbon stock in understory algal biomass in year t; t C · meter $^{-2}$.
CA_{ua} = Carbon Accumulation Rate of understory algae; gC · m^{-2} · day^{-1}
D = Days, 365
0.000001 = Conversion rate from grams to metric tones, unitless
t = 1,2,3… , t years elapsed since the project start date

Ex-Ante parameters and estimates:

C_{bsl_ua} = 0 t C · meter $^{-2}$.
CA_{ua} = 0 gC · m^{-2} · day^{-1}
D = 365 days
0.000001 = Conversion rate from grams to metric tones, unitless

8.1.2 Baseline Quantification of Emission Production Factor for Fishing Activities

The PP shall estimate the typical number of boats that can access the area of project activity each year. The PP shall also estimate the typical amount of time (hours per day and days per year) spent fishing, the type and size of said vessels, and the average number of days spent fishing by said vessels. These data will then be used to estimate the baseline emissions production factor (EP) associated with fishing activities for that year. The baseline scenario will be calculated as follows:

(4)

$$EP_{baseline} = MC \cdot SFR \cdot EF \cdot B_t \cdot FD_{baseline} \cdot H_{fd\ baseline}$$

Where:

$EP_{baseline}$ = Baseline carbon emission production associated with fishing behavior within the project boundary; tCO_2
MC = Motorization capacity coefficient; $kW \cdot boat^{-1}$
SFR = Specific Fuel Rate; $tFuel \cdot kW\ H^{-1}$
EF = Emission factor; $tCO_2 \cdot tFuel^{-1}$
B_t = The number of fishing boats able access the area of project activity in year *t*; fishing boats
H_{fdb} = Typical run time, in hours, within a single fishing day measured prior to project activities; $H \cdot day^{-1}$
$FD_{baseline}$ = Typical number of active fishing days in a give year prior to fishing activities; boat days
t = 1,2,3… , t years elapsed since the project start date

Ex-Ante parameters and estimates:

$EP_{baseline}$ = **24,488.8 tCO_2**
MC = 58.7 $kW \cdot boat^{-1}$
SFR = 0.00035 $tFuel \cdot kW\ H^{-1}$
EF = 3.01 $tCO_2 \cdot tFuel^{-1}$
B_t = 220 fishing boats
H_{fdb} = 6 $H \cdot day^{-1}$
$FD_{baseline}$ = 300 boat days

8.1.2 Project emissions

8.1.2.1 Green House Gas Removal by Marine Algae

Changes in the carbon stock within the project boundary will be measured as the change in algal biomass growing with the project boundary after project activities. The changes in algal biomass will be quantified in two separate carbon pools; Macroalgae and Understory algae. The project carbon stock change in year t is estimated as follows:

(5)

$$C_{algae\ t} = (C_{ma\ t} + C_{ua\ t}) \times A_{pa} \times (44/12)$$

Where:

$C_{algae\ t}$ = Carbon stock by sinks in year t; $t\ CO_{2e}$
$C_{ma\ t}$ = Carbon stock in macroalgal biomass in year *t*; $t\ C \cdot meter^{-2}$
$C_{ua\ t}$ = Carbon stock in understory algal biomass in year *t*; $t\ C \cdot meter^{-2}$
A_{pa} = Area of project activities; $meter^2$

44/12 = Ratio of molecular weight of carbon dioxide to carbon (unitless)

Ex-Ante parameters and estimates:

$C_{algae\ t}$ = 354.755 t CO_{2e}

$C_{ma\ t}$ = 0.0088695 tC · meter $^{-2}$ *See equation 6*

$C_{ua\ t}$ = 0.0009855 tC · meter $^{-2}$ *See equation 7*

A_{pa} = 9817.5 meter^2

44/12 = Ratio of molecular weight of carbon dioxide to carbon (unitless)

Macroalgal Carbon Biomass

Carbon accumulation within the macroalgal pool shall be calculated using published values of net primary production (NPP) for Giant Kelp (*macrocystis pyrifera*). NPP represents the rate of carbon uptake per day, in the form CO_2, by algae that is stored as algal biomass. The carbon accumulation rate was derived from published values on Giant Kelp and is a function of stipe density (Lter et al. 2022). All parameters and parameter descriptions are provided in monitoring plan and macroalgal carbon stock is calculated as follows:

(6)

$$C_{ma,t} = (CA_{MA} \times SD \times D) \times 0.000001$$

Where:

$C_{ma,t}$ = Carbon stock in macroalgal biomass in year t; t C · meter $^{-2}$

CA_m = Carbon Accumulation rate for macroalgae; gC · stipe^{-1} · day^{-1}

SD = Average stipe density; stipes · meter $^{-2}$

D = Days, 365

0.000001 = Conversion rate from grams to metric tones, unitless

t = 1,2,3… , t years elapsed since the project start date

Ex-Ante parameters and estimates:

$C_{ma,t}$ = 0.0088695 t C · meter $^{-2}$

CA_m = 0.81 gC · stipe^{-1} · day^{-1}

SD = 30 stipes · meter $^{-2}$

D = 365 days

0.000001 = Conversion rate from grams to metric tones, unitless

Understory Algal Carbon Biomass

Published values of mean NPP from a natural system were used for ex-ante calculations of carbon accumulation within the understory algae carbon pool. The literature did not provide a relationship between understory plant density and NPP, as was available for macroalgae (e.g. stipe density). Hence a mean published value for understory algae NPP (gC · m^{-2} · day^{-1}) during the early summer months is used for ex-ante calculations (Harrer et al. 2013). All parameters and parameter descriptions are provided in appendix table 1 and ΔC_{--ua} is calculated as follows:

(7)

$$C_{UA} = (CA_{UA} \times D) \times 0.000001$$

Where:

$C_{ua\ t}$ = Carbon stock in understory algal biomass in year t; t C · meter $^{-2}$
CA_{ua} = Carbon Accumulation Rate of understory algae; gC · m^{-2} · day^{-1}
D = Days, 365
0.000001 = Conversion rate from grams to metric tones, unitless
t = 1,2,3… , t years elapsed since the project start date

Ex-Ante parameters and estimates:

$C_{ua\ t}$ = 0.0009855 tC · meter $^{-2}$
CA_{ua} = 2.7 gC · m^{-2} · day^{-1}
D = 365
0.000001 = Conversion rate from grams to metric tones, unitless

Net changes in carbon stock

The next changes in carbon stock related to project activities will be calculated as follows:

(8)

$$\Delta C_{net\_algae} = C_{algae\ t} - C_{bsl\ t-1}$$

Where:

ΔC_{net_algae} = Net changes in carbon stock by sinks in year t; t CO_{2-e}
$C_{algae\ t}$ = Carbon stock in algal sinks in year t; t CO_{2-e}
$C_{bsl\ t-1}$ = Baseline carbon stock in algal sinks in year t-1, prior to project activities; t CO_{2-e}
t = 1,2,3… , t years elapsed since the project start date

Ex-Ante parameters and estimates:

ΔC_{net_algae} = 354.8 t CO_{2-e}
$C_{algae\ t}$ = 354.8 t CO_{2e} *See Eq 5*
$C_{bsl\ t-1}$ = 0 t CO_{2-} *See Eq1*
t = 1

8.1.2.2 Emission Production Associated with Fisher Behavior

Changes in GHG emissions due to project activity will be measured by the percent reduction of engine run time across the entire fleet of fishing vessels that are able to access the project boundary. Emission reductions associated project activities will be calculated as follows:

(9)

$$EP_{t} = EP_{baseline} * (FRF_{t})$$

Where:

EP_t = Emission production associated with fishing behavior within the project boundary during year *t*; tCO_2

$EP_{baseline}$ = Baseline carbon emission production associated with fishing behavior within the project boundary; tCO_2

FRF_t = Fisher reduction factor, percent reduction in fisher transportation time

Ex-Ante parameters and estimates:

EP_t = 20,815.5 tCO_2

$EP_{baseline}$ = 24,488.8 tCO_2 *See Equation 4*

FRF_t = 0.15%

Net Changes in Emissions from Fisher Transportation

The net changes in GHG emissions between baseline scenario emission production and project scenario emission production in year *t* is estimated as follows:

(10)

$$\Delta EP_{net\_fisher\_t} = EP_{baseline} - EP_t$$

Where:

$\Delta EP_{net\_fisher\_t}$ = Change in emission production due to project activities, ($t\ CO_{2e}$)

$EP_{baseline}$ = Baseline carbon emission production associated with fishing behavior within the project boundary; tCO_2

EP_t = Emission production associated with fishing behavior within the project boundary during year *t*; tCO_2

t = 1,2,3…, t years elapsed since the project start date

Ex-Ante parameters and estimates:

$\Delta EP_{net\_fisher\_t}$ = 3,673.3 tCO_{2e}

$EP_{baseline}$ = 24,488.8 tCO_{2e} *See Equation 4*

EP_t = 20,815.5 tCO_{2e} *See Equation 9*

t = 1

8.1.3 Leakage

Leakage for all project activities is set equal to zero. It may be assumed that ecological leakage does not occur in projects meeting the applicability conditions of this methodology. Project activities will not produce any algal growth outside project boundaries and will not displace any pre-existing natural reefs and leakage effects are assumed to be de minimis.

Activity-shifting leakage related with the reduction in fishing activity emissions is set equal to zero. Project activities will not cause increased fishing activities outside project activities and leakage effects are assumed to be de minimis.

8.2 Quantification of Net-GHG emissions and/or removals

8.2.1 Net Carbon Dioxide removal

The net carbon dioxide removal for project activities will be calculated as follows:

$$CR_t = \Delta C_{net\_algae} + \Delta EP_t \quad (11)$$

Where:

CR_t = Carbon dioxide removals from project activities in year t, t CO_{2e}
$\Delta C_{net\_algae\_t}$ = Net changes in carbon stock by sinks due to project activities in year t; t CO_{2e}
$\Delta EP_{net\_fisher\_t}$ = Change in emission production due to project activities in year t, t CO_{2e}

Ex-Ante parameters and estimates:

CR_t = **4028.08 t CO_{2e}**
$\Delta C_{net\_algae\_t}$ = 354.75 tCO_{2e} *See Equation 8*
$\Delta EP_{net\_fisher\_t}$ = 3,673.3 t CO_{2e} *See Equation 10*

Table 2: Aggregated GHG Emission Mitigations

	Year	Baseline emissions (tCO_2e)	Project emissions (tCO_2e)	Estimated leakage (tCO_2e)	Reductions (tCO_2e)	Removals (tCO_2e)	Total GHG emission mitigations (tCO_2e)
Algal Growth	01.08.2023 to 01.8.2024	0	0	0	0	354.75	354.75
Fisher Transportation	01.08.2023 to 01.8.2024	24,488.8	0	0	3,673.3	0	3,673.3
	Total						**4028.08**
	Annual average						**4028.08**

8.3 Risk assessment for permanence

The majority of carbon reduction related to project activities comes as reductions in fisher transportation time, where even small reductions can have large impacts due to the large number of vessels able to access project boundaries and the frequency and length at which the fisher are running their vessels. By reducing travel time we are reducing the GHG emitting process and these reductions can be considered permanent and there is no foreseeable risk of reversal.

The risk of reversal of CO_2 removal related to algal growth is much more complex and is a focus of much of the blue carbon research around the world. The fate of kelp is highly variable and depends on water movement, number and type of herbivores present and numerous other factors. The carbon associated with kelp and other algaes that is consumed by marine herbivores is biosquested in tissues and/or deposited in sediments near by project activities. That carbon is effectively sequestered in these sediments because the deployment of Sea Cave reefs prevents any bottom trawling or disruption to the sediments. Kelp and algae that breaks off and becomes particulate organic carbon (POC) can be moved offshore by prevailing currents and can enter the pelagic carbon cycle. Here POC/DOC often gets 'pumped' downward through microbial processes or sinks into deep sea sediments and is effectively sequestered. The process underlying these two scenarios are complex and highly variable but it is part of the Sea Cave Reef long-term project outlook to study and understand the carbon cycle related to project activities. The pool of carbon related to kelp/algal growth is relatively low compared to emission reductions associated with project activities and because there are numerous pathways for kelp/algal carbon to be sequestered, we believe the permanence risk is negligible and can be set at zero.

Permanence risk (%)	0

9. Monitoring

9.1 Monitoring plan

Monitoring of the Sea Cave® reefs is an important component of the overall project. It will provide visual and empirical data demonstrating the effectiveness of the reefs in generating carbon sequestering kelp forests, subsidiary sequestration benefits, changing of local fisher behavior as it relates to overall fuel burn and emissions, and subsequent ecological and social benefits of the reefs. Parameters to be measured and monitored include:

- The physical structure and footprint of the reefs
- Total macroalgal biomass and growth
- Total animal biomass and growth in around the reefs
- Biomass and kelp coverage changes on nearby reefs
- Changes in fisher behavior
- Changes in local socioeconomics

Benthic SCUBA survey methods will include:

- Uniform point contact (UPC) surveys will be conducted along each 30m transect line. The substrate type, any living algae or encrusting animals, and the relative change in height between that point and the next half meter are noted (to help assess site rugosity).

- Benthic surveys conducted in a random stratified pattern in an attempt to cover as much of the Project area as possible. Once on the bottom, the divers randomly chose survey start locations. Each transect is 30 m in length, with 1 m on each side of the transect searched and all species encountered recorded. Thus each transect covers a total of 60 m².

- The fish assemblage at the Project site will be surveyed via stratified random swaths. Along the transect, the diver swims 2 m above the transect line, scanning a survey area within a 2 m x 2 m square in front of them, while continually moving forward. This gives a total survey area of 120 m³ per transect, and a total of 1,200 m³ area surveyed within in the site.

Baseline surveys will be conducted bi-annually to allow comparative estimates and provide data on

a) Total macroalgal growth (measure as total plants and via stipe counts)
b) Total biomass created on the reefs (via abundance counts during benthic swath and fish surveys)
c) Increases in target fisheries species

To measure changes in fisher behavior, pre-deployment interviews with the local cooperatives will allow for establishment of a baseline of fishing locations, effort, and fuel burn. Using these metrics, the same fishers will be interviewed annually, allowing for comparison between years and quantification of changes in fuel burn associated with the creation of the Sea Cave® reef.

All monitoring activities and data recording will be overseen by the Lead Scientist on the project. Data will be checked and reviewed by the Fish Reef Project science team for accuracy prior to dissemination. All data will be entered and stored electronically and maintained for the entirety of the project.

9.2 Data and parameters remaining constant

Data / Parameter	Data/Parameter
Unit	Location and position of Sea Cave® reef units. All other biological data collection will vary seasonally in growth rates and marine recruitment dynamics over the life of the reef.
Description	Side-scan sonar imagery for the reef structure, survey counts for flora and fauna.
Origin of data	Visual representation of reef structure
Value applied	none
Justification of choice of data or description of measurement methods and procedures applied	Side scan sonar
Purpose of Monitoring	Provide the value applied
Comments	Side scan sonar provides the most visually apparent rendering of the reef structure over time. Standard methods of subtidal data collection will be used (see references). All metrics (macroalgal standing stock, fish, and invertebrates) are standard for nearshore temperate marine research activities
	Baseline emission
	Additional comments

9.3 Data and parameters monitored

Table 4 Data and parameters to be monitored

Data / Parameter	Macroalgal carbon biomass
Unit	Stipes per square meter
Description	Stipe counts of individual Macrocystis plants encountered during monitoring surveys
Origin of data	Monitoring surveys
Value applied	Monitoring surveys

Justification of choice of data or description of measurement methods and procedures applied	Stipe counts are standard temperate water marine macroalgae counts methods- see work cited for examples.
Monitoring frequency	Bi-annually
Purpose of data	Project emissions
Quality assurance and control	*See section 9.1*
Comments	All data will be collected and overseen by a qualified, experienced team of reef research divers.

Data / Parameter	Understory algae biomass
Unit	Number of plants per transect
Description	Estimates of understory algae standing stock found on Sea Caves®
Origin of data	
Value applied	Monitoring surveys
Justification of choice of data or description of measurement methods and procedures applied	Understory counts are standard temperate water marine macroalgae counts methods- see work cited for examples.
Monitoring frequency	Bi-annually
Purpose of data	Project emissions
Quality assurance and control	See section 9.1
Comments	All data will be collected and overseen by a qualified, experienced team of reef research divers.

10. Quantification of GHG emission mitigations (ex-post)

Here we provide the best estimate for macroalgal growth and changes in fisher behavior currently happening due to project activities. The crediting period is from 8/1/2023 - 5/1/2023 and includes 274 days. Initial scouting of the 436 Sea Caves® within the project boundary has shown widespread macroalgal (Giant Kelp, *Macrocystis pyrifera*) and understory algal settlement and observed densities are in line with current parameters for stipe density and understory algal densities.

Documentation and testaments submitted along with this report confirm that 220 fishing boats currently have access to the Sea Cave reefs installed within the project boundary. Based on interviews and discussions with local stakeholders (e.g. fishing cooperative "Rocas de San Martin") fishers have been actively fishing the project boundary. The degree of fishing activity associated with project activities is highly variable and depends on target species, weather, vessels and numerous other factors. For example, one individual fishing boat will spend 1 day per week fishing within the project boundary instead of fishing on natural reefs that are 3 - 6 hours away. We are currently developing a more refined method for measuring these emission reductions but based on initial feedback from the local fishing community it is approximately 15% - 30% reduction in travel time. To be conservative we are using a 7.5% fishing reduction factor to parameterize our ex-post quantification of GHG emission mitigations. The crediting period (1/8/2023 - 1/6/2024) is 305 days and to be conservative we are estimating the fishing activity is occurring on only 274 days or 90% of the time. The number of actual fishing days is highly variable and dependent on weather, targeted species, and numerous other factors.

10.1 Baseline emissions

Baseline Quantification of Carbon Stock from Marine Macroalgae

$$C_{bsl\ t-1} = (C_{bsl\_ma} + C_{bsl\_ua}) \times A_{pa} \times (44/12) \quad (1)$$

Ex-post calculation:

$C_{bsl\ t-1}$ = 0 t CO_{2e} · meter $^{-2}$

C_{bsl_ma} = 0 t CO_{2e} · meter $^{-2}$ *See equation 2*

C_{bsl_ua} = 0 t CO_{2e} · meter $^{-2}$ *See equation 3*

A_{pa} = 4046.86 meter^2 (1 acre)

44/12 = Ratio of molecular weight of carbon dioxide to carbon (unitless)

t-1 = 0

Baseline Macroalgal Carbon Biomass (C--$_{bsl\_ma}$)

$$C_{bsl\_ma} = (CA_{MA} \times SD_{t-1} \times D) \times 0.000001 \quad (2)$$

Ex-post calculation:

C_{bsl_ma} = 0 t CO_{2e} · meter $^{-2}$

CA_{ma} = 0.81 gC · stipe^{-1} · day^{-1}

SD = 0 stipes · meter $^{-2}$

D = 365 days

t-1 = 0

Baseline Understory algal carbon accumulation

(3)

$$C_{UA} = (CA_{UA} \times D) \times 0.000001$$

Ex-post calculation:

C_{bsl_ua} = 0 $tC \cdot meter^{-2}$.
CA_{ua} = 2.7 $gC \cdot m^{-2} \cdot day^{-1}$
D = 365 days
0.000001 = Conversion rate from grams to metric tones, unitless
t = 1,2,3… , t years elapsed since the project start date

Baseline Emission Production Factor for Fishing Activities

(4)

$$EP_{baseline} = MC \cdot SFR \cdot EF \cdot B_t \cdot FD_{baseline} \cdot H_{fd\ baseline}$$

Ex-post calculation:

$EP_{baseline}$ = **22,366.5 tCO_2**
MC = 58.7 $kW \cdot boat^{-1}$
SFR = 0.00035 $tFuel \cdot kW\ H^{-1}$
EF = 3.01 $tCO_2 \cdot tFuel^{-1}$
B_t = 220 *t*; fishing boats
H_{fdb} = 6 $H \cdot day^{-1}$
$FD_{baseline}$ = 274 boat days

10.2 Project emissions

GHG Removal by Marine Algae

(5)

$$C_{algae\ t} = (C_{ma\ t} + C_{ua\ t}) \times A_{pa}\ X$$

Ex-post calculation:

$C_{algae\ t}$ = **129.24 $t\ CO_{2e}$**
$C_{ma\ t}$ = 0.0074115 $t\ C \cdot meter^{-2}$ *See equation 6*
$C_{ua\ t}$ = 0.0000325; $t\ C \cdot meter^{-2}$ *See equation 7*
A_{pa} = 5707.24 $meter^2$
44/12 = Ratio of molecular weight of carbon dioxide to carbon (unitless)

Macroalgal Carbon Accumulation

(6)

$$C_{ma,t} = (CA_{MA} \times SD \times D) \times 0.000001$$

Ex-post calculation:

$C_{ma,t}$ = **0.0074115 $t\ C \cdot meter^{-2}$**
CA_m = 0.81 $gC \cdot stipe^{-1} \cdot day^{-1}$

SD = 30 stipes · meter $^{-2}$
D = 305 days
0.000001 = Conversion rate from grams to metric tones, unitless

Understory algal carbon accumulation

(7)

$$C_{UA} = (CA_{UA} \times D) \times 0.000001$$

Ex-post calculation:

$C_{ua\ t}$ = **0.0008235 t C · meter $^{-2}$**
CA_{ua} = 2.7 gC · m^{-2} · day^{-1}
D = 305 days
0.000001 = Conversion rate from grams to metric tones, unitless

Net changes in carbon stock

(8)

$$\Delta C_{net\_algae} = C_{algae\ t} - C_{bsl\ t-1}$$

Ex-post calculation:

ΔC_{net_algae} = **129.24 t CO_{2-e}**
$C_{algae\ t}$ = 129.24 t CO_{2e} *See Eq 5*
$C_{bsl\ t-1}$ = 0 t CO_{2-e} *See Eq 1*
t = 1

Changes in fisher transportation

To model the emission reduction associated with changes in fisher behavior we used the reported value from the Director of Fishing in Baja California (CONAPESCA) of 220 boats. Fishing activities are already occurring on the 436 Sea Cave Reefs installed within the project boundary and initial reports suggest that the location and productivity of the reef could reduce travel time by as much as 15% - 30%. Here we parameterize our model with 7.5% reduction in travel time and we feel this is a conservative estimate given the initial feedback from local stakeholders and community members.

(9)

$$EP_t = EP_{baseline} * (FRF_t)$$

Where:

EP_t = Emission production associated with fishing behavior within the project boundary during year t; tCO_2
$EP_{baseline}$ = Baseline carbon emission production associated with fishing behavior within the project boundary; tCO_2
FRF_t = Fisher reduction factor, percent reduction in fisher transportation time

Ex-Ante parameters and estimates:

EP_t = **20,689.0 tCO_2**
$EP_{baseline}$ = 22,366.4 tCO_2 *See Equation 4*
FRF_t = 0.075

Net Changes in emissions

$$\Delta EP_{net\_fisher\_t} = EP_{baseline} - EP_t \tag{10}$$

Ex-post calculation:

$\Delta EP_{net\_fisher\_t}$	=	**1677.5 t CO_{2e}**	
$EP_{baseline}$	=	22,366.4 tCO_2	*See Equation 4*
EP_t	=	20,689.0 tCO_2	*See Equation 9*
t	=	1	

10.3 Leakage

Leakage for all project activities is set equal to zero. It may be assumed that ecological leakage does not occur in projects meeting the applicability conditions of this methodology. Project activities will not produce any algal growth outside project boundaries and will not displace any pre-existing natural reefs and leakage effects are assumed to be de minimis.

Activity-shifting leakage related with the reduction in fishing activity emissions is set equal to zero. Project activities will not cause increased fishing activities outside project activities and leakage effects are assumed to be de minimis.

10.4 Risk assessment for permanence

The majority of carbon reduction related to project activities comes as reductions in fisher transportation time, where even small reductions can have large impacts due to the large number of vessels able to access project boundaries and the frequency at which the fisher are running their vessels. By reducing travel time we are reducing the GHG emitting process and these reductions can be considered permanent and there is no foreseeable risk of reversal.

The risk of reversal of CO_2 removal related to algal growth is much more complex and is a focus of much of the blue carbon research around the world. The fate of kelp is highly variable and depends on water movement, number and type of herbivores present and numerous other factors. The carbon associated with kelp and other algaes that is consumed by marine herbivores is biosquested in tissues and/or deposited in sediments near by project activities. That carbon is effectively sequestered in these sediments because the deployment of Sea Cave reefs prevents any bottom trawling or disruption to the sediments. Kelp and algae that break off and become particulate organic carbon (POC) can be moved offshore by prevailing currents and can enter the pelagic carbon cycle. Here POC often gets 'pumped' downward through microbial processes or sinks into deep sea sediments and is effectively sequestered. The process underlying these two scenarios are complex and highly variable but it is part of the Sea Cave Reef long-term project outlook to study and understand the carbon cycle related to project activities. The pool of carbon related to kelp/algal growth is relatively low compared to emission reductions associated with project activities and because there are numerous pathways for kelp/algal carbon to be sequestered, we believe the permanence risk is negligible and can be set at zero.

10.4 Net GHG emission mitigations

Emissions associated with Sea Cave fabrication and Transportation

*See **appendix 13** for further discussion of GHG emissions associated with cement production*

$$C_{total\_emission\_productions} = C_{SC\_Production\_Transportation} * SC_n \quad (12)$$

Where:

$C_{total\_emission\_productions}$ = Total CO_2 emissions associated cement production

$C_{SC\_Production\_Transportation}$ = CO_2 emission associated with the cement production used for a single Sea Cave unit (See Appendix 13 for details). This upstream CO_2 emission only occurs once in Sea Cave life cycle and are only accounted for in year 1; tCO_2 per Sea Cave

SC_n = Number of Sea Cave Reef units deployed in crediting period; Sea Cave

Ex-Ante parameters and estimates:

$C_{total\_emission\_productions}$ = **69.32 tCO_2**

$C_{SC\_Production\_Transportation}$ = 0.159 tCO_2 per Sea Cave

SC_n = 436 Sea Caves

Quantification of Net-GHG emissions

$$CR_t = (\Delta C_{net\_algae} + \Delta EP_t) - C_{total\_emission\_productions} \quad (13)$$

CR_t = **1,737.42 t CO_{2e}**

$\Delta C_{net\_algae\_t}$ = 129.24 t CO_{2e} *See Equation 8*

$\Delta EP_{net\_fisher\_t}$ = 1677.5 t CO_{2e} *See Equation 10*

$C_{total\_emission\_productions}$ = 69.32 tCO_2 *See Equation 11*

Year	Baseline emissions/removals (tCO_2e)	Project emissions/removals (tCO_2e)	Leakage emissions (tCO_2e)	Buffer allocation (tCO_2e)	Reduction ICCs (tCO_2e)	Removal ICCs (tCO_2e)	Total ICCs (tCO_2e)
01.08.2023 to 01.05.2024 **Algae Growth**	0	129.24	0	0	0	129.24	129.24
01.08.2023 to 01.05.2024 **Fisher Transportation**	22,366.5	20,689.0	0	0	1,677.5	**0**	1,677.5
Emission associated with Fabrication and Transportation (year 1 only)		-105.10					-105.10
Total							**1701.6**

10.6 Comparison to estimated GHG emission mitigations

Year	Ex-ante estimation (tCO_2e)	Monitored impacts (tCO_2e)	%	Explanation
01.08.2023 to 01.05.2024	**4,028.07**	**1,701.6**	**42**	The Ex-ante estimation was for a 1-year (365 day) crediting period and modeled a 15% reduction in overall fisher transportation time across the entire fleet (220 boats). Our Ex-post model was over a shorter crediting period (274 days) and only included a 0.075% reduction in fisher transportation time across the entire fishing fleet. We believe the ex-post GHG reduction and removal model to potentially be conservative compared to actual CO_2 removal related to project activities.
Total	**4,028.07**	**1,701.6**	**42**	

11. Management of data quality

A data custodian will be employed full time to manage all data in transit or at rest. Data will be stored in the cloud and intermittent local backups will be performed for redundancy. Data will be collected manually by field scientists and will then be transferred via methods shown to maintain high data integrity. History of both pre-processed and post-processed data will be maintained. Any changes to previously recorded data will include versioning.

Appendix

Appendix 1

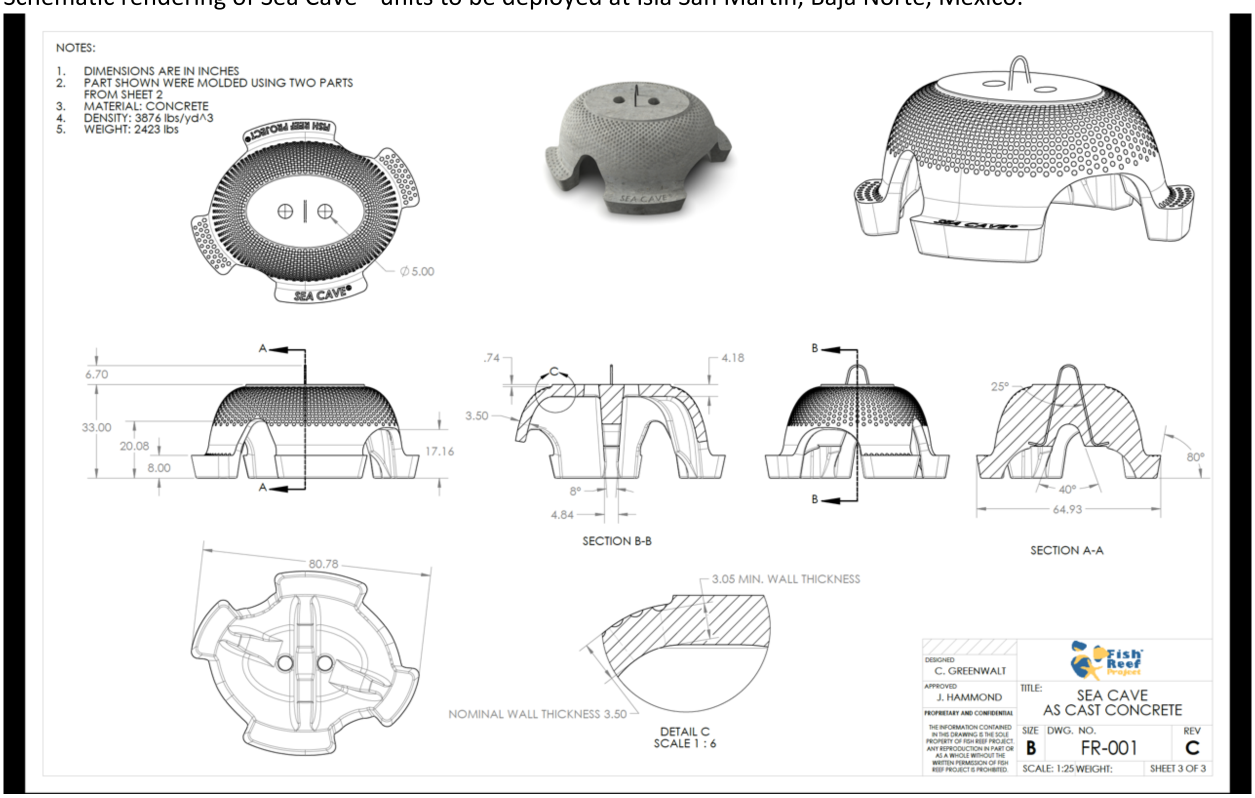
Model parameters and descriptions for estimating carbon accumulation rates of macroalgae and understory algae associated with Sea Cave®True Blue Carbon®, Baja California, Mexico.

Parameter	Value	unit	Description
CA_{ma}	0.81	$gC \cdot stipe^{-1} \cdot day^{-1}$	Carbon accumulation rate for macroalgae scaled to macroalgal stipe density. The relationship between carbon accumulation and stipe density was developed from published data on Giant Kelp NPP from one site in Santa Barbara California, USA. Data was selected from periods when water temperature and productivity were similar to conditions within project boundary. Data was from 2002 -2017 (Lter et al. 2022).
SD	30	$stipes \cdot meter^{-2}$	Stipe density based on pilot Sea Cave® reef projects within project boundary
$A_{seacave\_cluster}$	78.54	$meter^2$	Area of one Sea Cave® cluster
CA_{ua}	2.7	$gC \cdot meter^{-2} \cdot day^{-1}$	Carbon accumulation rate for understory algae from published values (Harrer et al. 2013).
MC (Motorization Capacity)	58.7	$kW \cdot boat^{-1}$	**Motorization Capacity (MC)** per fishing vessel was derived from published values (Greer et al. 2019), and represent the power generated per fishing vessel. MC is a function of vessel length and here we use the published value for small-scale motorized vessel ranging in length from 8 -15.9m.
SFR (Specific Fuel Rate)	0.00035	$tFuel \cdot kW\ h^{-1}$	**Specific Fuel Rate (SFR)** represents the amount of a certain type of fuel needed to generate 1 kWh of power and was derived form published values for small scale artisanal, subsistence, and recreational fisheries using 2or 4 stroke outboard engines (Greer et al. 2019). SFRs for 2 and 4 stroke engines were reported as 0.0004 $tFuel \cdot kW\ h^{-1}$ and 0.00035 $tFuel \cdot kW\ h^{-1}$, respectively. Here we used the more conservative for our GHG emission estimations.
EF Emission (Factor)	3.01	$tCO2 \cdot tFuel^{-1}$	**Emission Factor (EF)** of CO_2 for standard gasoline was used to estimated GHG emissions. Gasoline is the standard and most common fuel type used by small scale fishing vessels within the project boundary.
H_{fd}	6	$Hours \cdot day^{-1}$	Engine hours per day associated with fishing activity. We conservatively estimate that an average fishing day within the project boundary requires 6 hours of run time.

B_y	220	Boats	Number of active fishing boats within the project boundary
FD_y	300	Days · $year^{-1}$	Number of active fishing days per year. We conservatively estimate that fishing boat will be actively fishing 300 days out of the year. The number can be much higher for small scale artisanal and subsistence fisheries.
$C_{SC\_Production}$	0.159	tCO_2 per Sea Cave	The GHG emissions associated with the cement production of a single Sea Cave unit and is only applied in the year 1 crediting period. *See Appendix 13 for further discussion*

Appendix 2

Schematic rendering of Sea Cave® units to be deployed at Isla San Martin, Baja Norte, Mexico.



Appendix 3

Terms and Definitions

Sea Cave - A single Sea Cave® unit

Sea Cave cluster - A group of 8 Sea Cave® units in a 2x4 configuration

Sea Cave reef - A large-scale group of 125 Sea Cave® clusters (1,000 Sea Cave units). Specific configuration will depend on local bathymetry and project boundaries.

Macroalgae - Marine kelps and seaweeds composed of stipes and fronds. Many species exhibit indeterminate growth, with plants reaching the surface and creating dense canopies.

Understory algae - Marine kelps and seaweeds that have a determinate growth form. Plants often extend <1m from the benthos.

Net Primary Productivity (NPP) - The amount of carbon retained as biomass. It is equal to the difference between the amount of carbon produced through photosynthesis and the amount of energy needed for respiration.

Appendix 4

Methods for Carbon Accumulation Rate Model

Published data on net primary production were used to derive a relationship between carbon accumulation and algal density. We used publicly available data from the Santa Barbara Coast Long Term Ecological Research (SBCLTER) program. From these data we selected measurements from work done at mohawk (‘MOHK”) reef on giant kelp (Macrocystis pyrifera) from the Santa Barbara mainland from 2002 to 2017. We selected data from the summer growing season when water temperatures matched those observed within the project boundary. We fit a liner model to the relationship between stipe density and the NPP measure of carbon (gC · m-2 · day-1). The model fit was significant (p-value < 0.000, F = 39.31) and explained 73% of the variation in the data. The residuals of the model satisfied all normality assumptions. We used the resulting model to forecast NPP and carbon accumulation to stipe density that we observed at pilot Sea Cave reefs within the project boundary. We conservatively forecasted an algal density of 30 stipes · m-2, although at some locations we observed much higher densities.

Appendix 5

Works Cited

Bayley, Daniel, Paul Brickle, Paul Brewin, Neil Golding, and Tara Pelembe. 2021. "Valuation of Kelp Forest

Ecosystem Services in the Falkland Islands: A Case Study Integrating Blue Carbon Sequestration Potential." One Ecosystem 6 (May): e62811. https://doi.org/10.3897/oneeco.6.e62811.

Chung, Ik Kyo, Jung Hyun Oak, Jin Ae Lee, Jong Ahm Shin, Jong Gyu Kim, and Kwang-Seok Park. 2013. "Installing Kelp Forests/Seaweed Beds for Mitigation and Adaptation against Global Warming: Korean Project Overview." ICES Journal of Marine Science 70 (5): 1038–44. https://doi.org/10.1093/icesjms/fss206.

Duarte, Carlos M., Iñigo J. Losada, Iris E. Hendriks, Inés Mazarrasa, and Núria Marbà. 2013. "The Role of Coastal Plant Communities for Climate Change Mitigation and Adaptation." Nature Climate Change 3 (11): 961–68. https://doi.org/10.1038/nclimate1970.

Greer, Krista, Dirk Zeller, Jessika Woroniak, Angie Coulter, Maeve Winchester, M.L. Deng Palomares, and Daniel Pauly. 2019. "Global Trends in Carbon Dioxide (CO2) Emissions from Fuel Combustion in Marine Fisheries from 1950 to 2016." Marine Policy 107 (September): 103382. https://doi.org/10.1016/j.marpol.2018.12.001.

Harrer, Shannon L., Daniel C. Reed, Sally J. Holbrook, and Robert J. Miller. 2013. "Patterns and Controls of the Dynamics of Net Primary Production by Understory Macroalgal Assemblages in Giant Kelp Forests." Journal of Phycology 49 (2): 248–57. https://doi.org/10.1111/jpy.12023.

Hill, Ross, Alecia Bellgrove, Peter I. Macreadie, Katherina Petrou, John Beardall, Andy Steven, and Peter J. Ralph. 2015. "Can Macroalgae Contribute to Blue Carbon? An Australian Perspective." Limnology and Oceanography 60 (5): 1689–1706. https://doi.org/10.1002/lno.10128.

Krause-Jensen, Dorte, and Carlos M. Duarte. 2016. "Substantial Role of Macroalgae in Marine Carbon Sequestration." Nature Geoscience 9 (10): 737–42. https://doi.org/10.1038/ngeo2790.

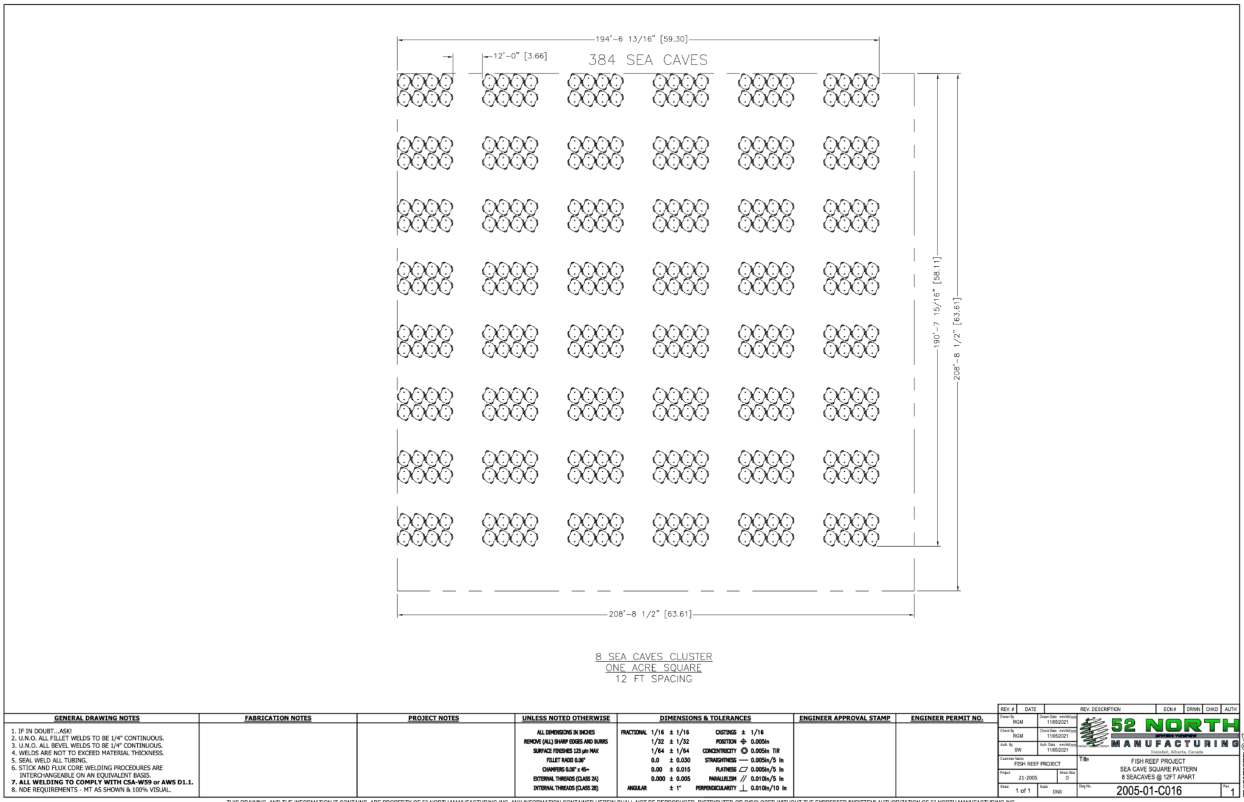
Krause-Jensen, Dorte, Paul Lavery, Oscar Serrano, Núria Marbà, Pere Masque, and Carlos M. Duarte. 2018. "Sequestration of Macroalgal Carbon: The Elephant in the Blue Carbon Room." Biology Letters 14 (6): 20180236. https://doi.org/10.1098/rsbl.2018.0236.

Lter, Santa Barbara Coastal, Andrew A. Rassweiler, Shannon Harrer, Daniel C. Reed, Clint J. Nelson, and Robert J. Miller. 2022. "SBC LTER: REEF: Net Primary Production, Growth and Standing Crop of Macrocystis Pyrifera in Southern California."

https://search.dataone.org/view/https%3A%2F%2Fpasta.lternet.edu%2Fpackage%2Fmetadata%2Feml%2Fknb-lter-sbc%2F112%2F6.

Appendix 6

Schematic rendering of Sea Cave® units to be deployed at Isla San Martin, Baja Norte, Mexico.



Appendix 7

Visual of Sea Cave® unit with Fish Reef Project CEO Chris Goldblatt for scale

Appendix 8

Approved Permit Applications, Proof of ownership of Project and IP.

Appendix 8.1 Secretariat of Environment and Natural Resources (SEMARNAT) Permit approval:

MEDIO AMBIENTE
SECRETARÍA DE MEDIO AMBIENTE Y RECURSOS NATURALES

2023 Año de Francisco Villa

OFICINA DE REPRESENTACIÓN EN BAJA CALIFORNIA
SUBDELEGACIÓN DE GESTIÓN PARA LA PROTECCIÓN AMBIENTAL Y RECURSOS NATURALES
UNIDAD DE GESTIÓN AMBIENTAL
DEPARTAMENTO DE IMPACTO Y RIESGO AMBIENTAL

OFICIO ORBC/SGPA/UGA/DIRA/1815/2023
BITACORA No. 02/MP-0674/01/23

DECIMOSEGUNDO.- El promovente deberá mantener en su domicilio registrado en la Manifestación de Impacto Ambiental, copias respectivas del expediente, de la propia la manifestación de impacto ambiental, así como de la presente resolución, para efecto de mostrarlas a la autoridad competente que así lo requiera.

DECIMOTERCERO.- Se hace del conocimiento al promovente, que la presente resolución emitida, con motivo de la aplicación de la Ley General del Equilibrio Ecológico y Protección al Ambiente, su Reglamento en Materia de Evaluación del Impacto Ambiental y las demás previstas en otras disposiciones legales y reglamentarias en la materia, podrá ser impugnada, mediante el recurso de revisión, dentro de los quince días hábiles siguientes a la fecha de su notificación ante esta Oficina de Representación, conforme a lo establecido en los artículos 176 de la Ley General del Equilibrio Ecológico y Protección al Ambiente, y 3, fracción XV, de la Ley Federal del Procedimiento Administrativo.

DECIMOCUARTO.- Notificar la presente Resolución a **FISH REEF PROJECT MÉXICO A.C.,** en su carácter de promovente, por alguno de los medios legales previstos por el artículo 35 y demás relativos y aplicables de la Ley Federal de Procedimiento Administrativo.

ATENTAMENTE
EL ENCARGADO DEL DESPACHO EN LA OFICINA DE REPRESENTACIÓN EN BAJA CALIFORNIA

SECRETARÍA DE MEDIO AMBIENTE Y RECURSOS NATURALES
DESPACHADO
10 JUL 2023
OFICINA DE REPRESENTACIÓN ENSENADA, B.C.

MTRO. RICARDO JAVIER CÁRDENAS GUTIÉRREZ.

SECRETARIA DE MEDIO AMBIENTE Y RECURSOS NATURALES
OFICINA DE REPRESENTACIÓN EN BAJA CALIFORNIA

Con fundamento en lo dispuesto por los artículos 6, fracción XVI; 32, 33, 34, 35 y 81 del Reglamento Interior de la Secretaría de Medio Ambiente y Recursos Naturales, en suplencia por ausencia definitiva del Titular de la Oficina de Representación de la SEMARNAT en el Estado de Baja California[1], previa designación, firma el Mtro. Ricardo Javier Cárdenas Gutiérrez, Subdelegado de Administración e Innovación.

1. De conformidad con el oficio Num. 00103 de fecha 16 de febrero de 2023, suscrito por la Mtra. Maria Luisa Albores González, Secretaría de Medio Ambiente y Recursos Naturales.

C.C.p.- ALMIRANTE C.G. D.E.M. RUBEN ALFONSO VARGAS SUAREZ.- Comandante de la Segunda Región Naval. Secretaría de Marina-Armanda de México. Boulevard Costero y General Agustin Sanginés s/n, Playa Ensenada, 22800 Ensenada, B. C.

C.c.p.- LIC. MARINA DEL PILAR ÁVILA OLMEDA. - Gobernadora del Estado Libre y Soberano de Baja California. - Mexicali, B. C.
C.c.p.- LIC. JORGE ALBERTO LÓPEZ PERALTA.- Presidente del Concejo Fundacional del Municipio de San Quintín .- San Quintín, B.C.
C.c.p.- MTRO. ALEJANDRO PÉREZ HERNÁNDEZ. - Director General de Impacto y Riesgo Ambiental. SEMARNAT. Ciudad de México.
C.C.P.-MTRO. ROMÁN HERNÁNDEZ MARTÍNEZ.- Titular de la Unidad Coordinadora de Oficinas de Representación y Gestión Territorial.- Ciudad de México.
C.C.P.-MTRO. EVERARDO MARIANO MELENDEZ.- Director Regional Península de Baja California y Pacífico Norte. CONANP. La Paz, B. C. S.
C.C.P.-BIOL. DANIEL ARTURO YAÑEZ SÁNCHEZ. Encargado de la Oficina de Representación de PROFEPA en Baja California.- Mexicali, B.C.
C.C.P.- MINUTARIO DE LA OFICINA DE REPRESENTACION.
C.C.P.-EXPEDIENTE DEL DEPTO DE IMPACTO Y RIESGO AMBIENTAL

RJCG/PELR/avfm

Página 58 de 58
Calzada CETYS No. 2799, Edificio "C", Local 19, Tercer Nivel, Colonia Rivera, Mexicali, Baja California. C. P.21259. Telefono 01 (686) 9-04-42-08
www.gob.mx/semarnat

Appendix 8.2 US Patent:

US0D1021141S

(12) **United States Design Patent**
Goldblatt

(10) **Patent No.: US D1,021,141 S**
(45) **Date of Patent: ** Apr. 2, 2024**

(54) **DOMED STRUCTURE**

(71) Applicant: **Christopher Fisher Goldblatt**, Santa Barbara, CA (US)

(72) Inventor: **Christopher Fisher Goldblatt**, Santa Barbara, CA (US)

(**) Term: **15 Years**

(21) Appl. No.: **29/809,738**

(22) Filed: **Sep. 29, 2021**

(51) **LOC (14) Cl.** **25-03**

(52) **U.S. Cl.**
USPC **D25/19**; D30/101

(58) **Field of Classification Search**
USPC D21/834–838; D25/13, 18, 19, 31; D30/101, 104–106, 118
CPC E04B 1/3211; A01K 61/00; A01K 61/70; E02B 3/00; E02B 3/046
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

D76,252	S	*	9/1928	McCreary	119/253
D79,231	S	*	8/1929	Gillinder	D26/128
D80,172	S	*	12/1929	Gillinder	D26/128
D97,041	S	*	10/1935	Desser	119/253
D125,884	S	*	3/1941	Daughtry	D30/101
D130,666	S	*	12/1941	Nichol	434/131
3,168,887	A	*	2/1965	Bodell	A01K 63/02 206/0.5
3,374,771	A	*	3/1968	Michie	A01K 63/003 222/453
D211,783	S	*	7/1968	Turner	D25/19
D231,677	S	*	5/1974	Miller	119/265
D245,348	S	*	8/1977	Haviland	D30/114
D252,588	S	*	8/1979	Spinner	D25/19
D255,949	S	*	7/1980	Robert	D30/105
4,304,068	A	*	12/1981	Beder	A01G 13/043 47/29.1
D264,695	S	*	6/1982	Mackes	D8/1
D268,705	S	*	4/1983	Clayton	D30/101
D270,950	S	*	10/1983	Walls	D25/1
4,434,590	A	*	3/1984	Wheeler	E04B 7/20 D25/13
4,536,997	A	*	8/1985	Heescher	E04C 2/36 D25/19
4,720,947	A	*	1/1988	Yacaboni	E04B 1/3211 D25/138
4,765,103	A	*	8/1988	Clarke	E04B 1/3205 D25/138
4,833,837	A	*	5/1989	Bonneau	E04H 15/20 D25/18
D311,264	S	*	10/1990	Stramel	D30/101
4,997,311	A	*	3/1991	Van Doren	E02B 3/046 119/221
D324,255	S	*	2/1992	Branton	D25/16
D363,993	S	*	11/1995	Johnson	D25/19
5,564,369	A	*	10/1996	Barber	A01K 63/006 405/23

(Continued)

Primary Examiner — T Chase Nelson
Assistant Examiner — Sydney Margaret Parsley

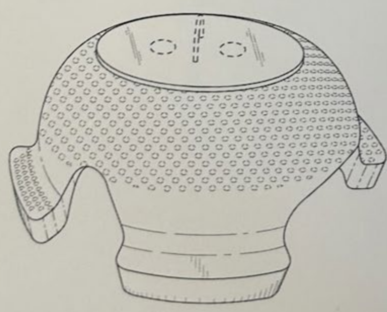
(57) **CLAIM**

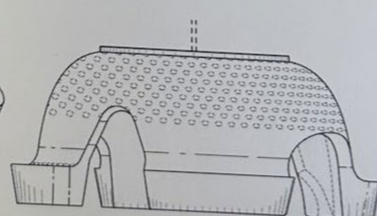
I claim the ornamental design for a domed structure, substantially as shown and described.

DESCRIPTION

FIG. **1** is a front perspective view of a domed structure in accordance with the present design;
FIG. **2** is a front elevational view thereof, with rear view being identical;
FIG. **3** is a right side elevational view thereof, with the left side view being identical;
FIG. **4** is a top plan view thereof; and,
FIG. **5** is a bottom plan view thereof.
The broken lines represent portions of the domed structure which form no part of the claimed design.

1 Claim, 5 Drawing Sheets





Appendix 8.3 Mexican Patent:

ECONOMÍA
SECRETARÍA DE ECONOMÍA

IMPI
INSTITUTO MEXICANO DE LA PROPIEDAD INDUSTRIAL

DIRECCIÓN DIVISIONAL DE PATENTES
SUBDIRECCION DIVISIONAL DE EXAMEN DE FONDO DE PATENTES AREAS MECANICA, ELECTRICA Y DE REGISTROS DE DISEÑOS INDUSTRIALES Y MODELOS DE UTILIDAD
COORDINACION DEPARTAMENTAL DE EXAMEN AREA DISEÑOS INDUSTRIALES Y MODELOS DE UTILIDAD

Expediente de Registro de Diseño Industrial **MX/f/2021/003720**

Asunto: Procede el otorgamiento.

Ciudad de México, a 24 de abril de 2023.

No. Folio: **39470**

Diego Brian SOLTAK
Apoderado de
Christopher Fisher GOLDBLATT
BOSQUES DE DURAZNOS 61
BOSQUES DE LAS LOMAS
11700, MIGUEL HIDALGO, Ciudad de México, México

REF: Su solicitud No. MX/f/2021/003720 de Registro de Diseño Industrial presentada el 6 de diciembre de 2021.

En relación con la solicitud indicada al rubro del presente, se le comunica que se ha realizado el examen de fondo señalado por los artículos 76 y 110 de la Ley Federal de Protección a la Propiedad Industrial; lo anterior, toda vez que la solicitud tuvo por satisfecho el examen de forma y que se ha efectuado su publicación en la Gaceta conforme lo disponen los artículos 76, 77 y 110 de la Ley en cita.

Como resultado de lo anterior, se desprende que su solicitud cumple los requisitos establecidos en la Ley Federal de Protección a la Propiedad Industrial y en el Reglamento de la Ley de la Propiedad Industrial (Reglamento que es aplicable a la Ley Federal de Protección a la Propiedad Industrial en términos de lo dispuesto por el artículo Cuarto Transitorio del DECRETO por el que se expide la Ley Federal de Protección a la Propiedad Industrial y se abroga la Ley de la Propiedad Industrial, publicado en el Diario Oficial de la Federación del 01 de julio de 2020).

En esa consideración, a efecto de otorgar el registro de diseño industrial, se le requiere para que efectúe el pago por la expedición del título de un registro de diseño industrial y sus primeros cinco años de vigencia, a que hace referencia el artículo 9g del Acuerdo por el que se da a conocer la tarifa por los servicios que presta el Instituto Mexicano de la Propiedad Industrial. Asimismo, deberá exhibir el comprobante de pago correspondiente ante este Instituto.

Para cumplir lo anterior, se le concede el plazo de dos meses, contados a partir del día hábil siguiente a la fecha en que se le notifique el presente oficio en términos de lo dispuesto por los artículos 21 y 110 de la Ley Federal de Protección a la Propiedad Industrial.

MX/2023/39470

Arenal 550, Pueblo Santa María Tepepan, C.P. 16020, Alcaldía Xochimilco, Ciudad de México, Teléfono: 55 5624 0400 www.gob.mx/impi

2023 Año de Francisco Villa

Appendix 9

Stakeholder Public Notice

RESUMEN
Manifestación de Impacto Ambiental
Modalidad Particular, Proyectos Acuícolas

Fish Reef Project México A. C. es una asociación sin fines de lucro que se dedica a la rehabilitación de ecosistemas marinos, su misión es ayudar a prosperar la vida marina mediante la creación de una red global de arrecifes artificiales formados por cuevas marinas diseñadas por la misma asociación para este fin. A nivel internacional cuenta con proyectos similares en los Estados Unidos de Norte América, Nueva Guinea, Jamaica, África y Hawái.

Actualmente se encuentra promoviendo el Proyecto *"Arrecife artificial Fish Reef México Project en la Isla San Martín, Baja California, México"* en aguas cercanas a la costa del cuadrante este de la Isla San Martín, Baja California, México por medio de la colocación de "Cuevas marinas" de formación biogénica diseñadas especialmente para este fin, sobre el lecho marino en un hábitat arenoso de densidad baja.

La Isla San Martín se encuentra dentro del Área Natural Protegida denominada Reserva de la Biósfera Islas del Pacífico de Baja California.

La ubicación del sitio se realizó en colaboración con personal de la Cooperativa Rocas de San Martín S. P. R. de R. L. y el equipo científico de Fish Reef Project México A. C.

Dentro de la zona elegida para el desarrollo del proyecto "Arrecife artificial Fish Reef Project en la Isla San Martín, Baja California, México" se desarrolla actividad pesquera desde hace más de 40 años, por lo que las condiciones del sitio en cuanto a diversidad y abundancia de organismos ha sido afectada, condición que se pudo comprobarse por medio de la evaluación realizada por buzos que forman parte del equipo de científicos de Fish Reef México Project A. C.

El proyecto se realizará por etapas, la primera etapa consiste en la colocación de 2,000 "Cuevas marinas" como fase piloto para obtención de datos por medio de monitoreos durante un año. Posteriormente y basados en los datos obtenidos, se procederá a la instalación de una segunda etapa y así sucesivamente hasta alcanzar un total de 27,000 "Cuevas marinas" en un periodo de 10 años.

El área requerida para el proyecto consiste 22.25 ha, la instalación de las "Cuevas marinas" se hará a razón de 1,064 unidades por hectárea en el cuadrante este de la Isla San Martín, Baja California, en una zona con superficie predominantemente plana y arenosa que se encuentra dentro del área concesionada por un periodo de 20 años a la Cooperativa **Rocas de San Martín S. P. R. de R. L. para desarrollar sus actividades pesqueras.**

Durante el hundimiento de las cuevas marinas, se prevé una alteración temporal en la calidad del agua, ya que el fondo marino está compuesto por arenas, por lo que el movimiento para la colocación de las estructuras provocará la suspensión temporal de sedimentos.

El fondo marino se verá modificado por la colocación de las cuevas marinas, sin embargo, la afectación será puntual, solo en los puntos de contacto de las cuevas marinas con el fondo del mar.

Los organismos bentónicos que pudieran encontrarse en el área del hundimiento se verán afectados por la colocación de las cuevas marinas, sin embargo, y tomando en cuenta los estudios realizados por el equipo científico de Fish Reef Project México A. C. y con base en los resultados de campo que muestran las características físicas del sustrato arenoso y que limitan el tipo y la cantidad de organismos que se puedan fijar al fondo marino, hay una baja diversidad y abundancia fauna y flora.

Una vez evaluados los impactos ambientales negativos generados por proyecto se consideran no significativos y temporales de corta duración.

Tomando en cuenta la naturaleza del proyecto, misma que consiste en la rehabilitación de un sitio afectado por actividades pesqueras no se considera necesario la aplicación de medidas de mitigación.

El proyecto no considera etapa de preparación del sitio, modificación de las condiciones iniciales ni la extracción y explotación de ningún recurso de la zona.

El proyecto traerá una serie de beneficios o impactos positivos (ofrecerá un espacio para organismos de flora y fauna marina propiciando el aumento de la abundancia de organismos ahora existentes, coadyuvando a rehabilitación del ecosistema y la protección de las especies nativas.

Appendix 11

University Stakeholder Proof

Universidad Autónoma de Baja California | Manejo de Ecosistemas por las Californias MEXCAL

October 2, 2023

Chris Golblatt
Founder Fish Reef

Dear Chris,

I hope this message finds you well. We are reaching out to request your support for the ongoing **Kelp Forest Restoration Program** in Baja California.

We are providing technical support to *El frente de Permisionarios Pesqueros de Baja California (El Frente)*. They have garnered government support and funding. We are helping them test innovative tools and strategies for kelp forest restoration and ecosystem enhancement. These efforts have the potential to significantly impact the health and resilience of our coastal ecosystems and the services they provide.

Our research group at UABC has dedicated over two decades to the monitoring and management of kelp forest ecosystems. We have a proven track record of success in this field, made possible through our strong partnerships with local fisher cooperatives and NGOs. We have also built a network for collaborators in both California and Baja California. We work not only with kelp, but an array of species associated with kelp forest such as lobster, abalone, sea cucumbers, etc. Check our site for more details https://mex-cal.org/

We are very excited that *El Frente* could integrate *Sea Caves* into the restoration strategies they are testing. These sea caves offer unique advantages for kelp restoration and marine biodiversity enhancement. To make this vision a reality, we kindly support their request to you to for donating eight sea caves to the Campo Kennedy project.

Why choose us to partner with El Frente?

- Expertise: With over 20 years of experience, we are at the forefront of kelp research and restoration in Baja California.
- Local Impact: Our strong connections with local communities ensure that our work directly benefits those who rely on these coastal ecosystems.
- Proven Success: Our track record demonstrates our ability to implement effective strategies and make a lasting impact.

Carretera Tijuana- Ensenada #3917 Col. Playitas, Ensenada BC, México c.p. 22860
Tel +52(646)239-2581 | rbeas@uabc.edu.mx | rodrigobeas.com | mex-cal.org | @robeas

1/1

Universidad Autónoma de Baja California | Manejo de Ecosistemas por las Californias MEXCAL

- Mutual Benefit: Partnering with us on this endeavor will not only contribute to the restoration of vital marine ecosystems but also enhance your company's reputation for environmental stewardship.

Your generous contribution will directly support the restoration efforts and strengthen our position as leaders in kelp research and restoration. This partnership between Fish Reef, *El Frente* and our research group promises to be mutually beneficial.

Your support will serve as a valuable proof of concept for our kelp restoration portfolio in Baja California. We appreciate your time and consideration in supporting this mission. If you have any questions or would like to discuss this further, please feel free to contact me directly.

Thank you for considering our request and for your commitment to environmental conservation. We look forward to the possibility of working together to make a positive impact on our coastal ecosystems.

Warm regards,

Dr. Rodrigo Beas
Professor
Facultad de Ciencias Marinas
UABC

Appendix 12

Proof of Deployment

Asunto: Vertimiento de 436 cuevas marinas
dentro de concesión FRP MX.

Crhis Goldblatt
CEO
Fish Reef Project México A.C.
Presente:

Por medio de la presente aprovecho la oportunidad para enviarle un cordial saludo. Asimismo, me complace informarle que el día de hoy se terminó el vertimiento de 436 cuevas marinas (Sea Cave®) fondo dentro del área concesionada para este fin en Isla San Martín en el arrecife conocido como "Tina Reef" en Baja California.

Para dicho trabajo fue utilizada una brigada de buceo "B" la cual consta de 1 supervisor y 4 buzos comerciales a bordo de la embarcación de abastecimiento "B/M Argos", dicho viaje ocurrió sin novedad.

La presente carta se emite para los efectos pertinentes en la ciudad y puerto de Ensenada en Baja California a los 16 días del mes de agosto del año 2023.

I hereby take this opportunity to send you warm regards. I am pleased to inform you that today the deployment of 436 marine caves (Sea Cave®) was completed within the concession area on San Martín Island, specifically at the reef known as "Tina Reef" in Baja California.

For this task, a diving brigade "B" was utilized, comprising 1 supervisor and 4 commercial divers aboard the supply vessel "B/M Argos". The journey occurred without incident.

This letter is issued for the purposes applicable in the City and Port of Ensenada in Baja California, on the 16th day of August, 2023.

Atentamente / Sincerely

Ulises F. Uribe G.
Operaciones
SSM Maritime.

Appendix 13

Estimating Emissions Associated with Sea Cave Fabrication and Transportation

Sea Cave fabrication does include some CO_2 emitting process and here we provide the best estimate of those upstream emission associated with project materials (e.g. low carbon, environmentally friendly cement). The discounts estimated here are only applicable in year 1 of deployment, hence we do not include them in our ex-ante GHG mitigation estimates or the project emissions estimates that represent long-term projections. We do account for them in the Net GHG removals in sect 10.4 equation 12 and 13 for the initial PD and MR.

The best estimate for CO_2 emissions associated with cement production is 1 kg CO_2 per 1 kg of cement, however we purchase cement from a producer that utilizes a GHG capture dome in production reducing the over GHG emissions by 30%.   Each Sea Cave unit uses 227 kgs of cement and with a 30% GHG reduction we estimate that cement production in 158.9 kgs CO_2 per Sea Cave. Cement production and Sea Cave transportation are all done locally, near the project boundary, hence GHG emission associated with travel are considered de minis in the life of a single Sea Cave (~ 500 years).