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 here, 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.

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Project design description (PDD)

Basic Information	
ID of project	91
Project name	Sea Cave® True Blue Carbon®, Baja California, Mexico
Project proponent	Fish Reef Project
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	01/08/2023 to 01/10/2024
Pre-registration date	02/01/2024
Version number of the PDDMR	2.10
Date of version	November 29 2024
Methodology(ies) applied and version number	☒ No ☐
Criteria for validation and verification	Val / Ver / Criteria ☐ ☐ ICR requirement document v.4 ☒ ☒ ICR requirement document v.5 ☒ ☒ ISO 14064-2 ☐ ☐ Applied methodology, please specify. ☐ ☐ Other, please specify.
Host country(ies)	Mexico
Host country approval	☐ Yes ☒ No
Sectoral scope of project activity	Afforestation/Reforestation and Transportation
Multiple project activities	☐ Yes ☒ No
Methodology(ies) applied and version number	NA
Type (CDR, avoidance, hybrid)	☐ CDR ☐ Avoidance ☒ Hybrid
MRV cycle:	1
Estimated annual average GHG emission mitigation (t CO2-e)	3752

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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	Transportation and Afforestation/Reforestation
Project type	Hybrid

1.3 Project

☐ 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

Sea Cave Reef project activities are currently responsible for 436 individual Sea Cave units installed within the project boundary. In the coming years, PP will continue to add Sea Cave units with the final reef containing 1000 Sea Cave units.

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 (See figure 1 in Sect 7 "Project Boundary"). 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 California
Geographic location	
Latitude	Decimal degree 30 29 30 N
Longitude	Decimal degree 116 06 10 W
Map link	https://www.google.com/maps/search/?api=1&query=isla+san+martin+baja+mexico

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 2). 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.

Algal Carbon Accumulation Models

Published data on net primary production (NPP) were used to derive a relationship between algal carbon accumulation and algal density. PP used publicly available data from the Santa Barbara Coastal Long Term Ecological Research (SBCLTER) program. From these data we selected measurements from mohawk ('MOHK") reef on giant kelp (*Macrocystis pyrifera*) from the Santa Barbara mainland from 2002 to 2017(Rassweiler et al. 2018; Rassweiler et al. 2022; Reed et al. 2009). We selected data from the summer growing season when water temperatures and productivity 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 < 0.001, 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 also used published values for the carbon accumulations rate for understory algal (Harrer et al., 2013) to estimate carbon removal on Sea Cave reefs within the project boundary. All parameter values, units, and descriptions can be found in Appendix section 1.

Fishing Travel Emissions Modeling

To estimate the baseline and project CO_2 emission from fishing vessels able to access the project boundary from San Quintin Harbor the PP used published values from a study focusing on carbon dioxide emissions from marine artisanal fisheries (Greer et al., 2019). Greer et al. 2019 provided three parameters; motorization capacity (MC), specific fuel rate (SFR), and emission factor (EF) for small scale motorized vessels ranging in length from 8 -15.9m that utilize standard gasoline. Greer et al. 2019 provided SFRs for 2 stroke and 4 stroke engine types, for our estimates we chose the more conservative 2 stroke SFR despite both motor types present within the fishing fleet. Note, the PP researched other emission standards (e.g. IPCC and EPA) however those programs provided more general estimates for a wider variety of vessels that were not appropriate for the current project. In most cases, these other sources provided larger emission estimations when compared with the parameters provided by Greer et al. 2019. The PP selected the more conservative parameters that were intended for artisanal fisheries GHG emission calculations. All parameter values, units, and descriptions can be found in Appendix Section 1.

1.7 Roles and responsibilities

1.7.1 Project proponent(s)

Organization Name	Fish Reef Project/IMMB INC.
Role in the project	Oversight of all project activities
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- 01/08/2022 to 31/07/2023
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 annually. Summary reports will be produced annually.
5. On site verification was completed by Earthood in March 2024 and technical review of the project description and monitoring report was completed in September 2024

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 is similar to 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 and the current monitoring period (August 2023 – October 2024) has a total GHG mitigations of 2409 t CO_2 e. Deployment is expected to continue over 24-36 months, with the final reef to contain 1000 Sea Cave® units within the 22 HA lease footprint.

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,

☒ No

Has the project been rejected by another GHG program

☐ Yes,

☒ No

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,

☒ 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,

☒ No

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?

☐Yes,

☒ No

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 CO_2 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 CO_2. 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

☐ Host country attestation

☒ No host country attestation

1.17 Additional information

Ocean assets such as tugs and offshore supply vessels may convert to liquid natural gas (LNG) reducing the transportation emissions associated with Sea Cave deployment. Custom marine concrete blend created with local supplier "CEMEX" has a 30% reduction in CO_2 from standard cement because the use of a "containment dome" that limits the release of GHG in cement production.

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

Sea Cave reefs present a novel hybrid GHG mitigation project that has a predicted life span of 500 years. This project includes both removals and reduction of GHG and warrants a 10-year crediting period with option to renew as long as Sea Cave are proven to be extant and function as GHG mitigation tools.

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 to 31/07/ 2033
Total estimated GHG emission mitigations during the crediting period (t CO2-e)	37526
Total number of years (yrs)	10
Annual average (t CO2-e)	3752

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 provided 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. No negative or socio-economic impacts were identified in the environmental impact assessment required by Mexican Government permitting agency; SEMARNAT.

3.3 Consultation with interested parties and communications

The current project activities identified stakeholder through interviewing local fishing Cooperativas and identifying who would be impacted by project activities. Through this process numerous Cooperatives were identified, however one group, "Rocas de San Martin", showed the strongest interest and subsequent involvement in project development (*see appendix 14*). Outside the fishing community, the PP engaged additional stakeholders from the local scientific community. Researchers from the Universidad Autónoma de Baja California (UABC) provided insights on the potential effects of Sea Cave reef project activities and will be involved in subsequent scientific studies related to project activities (*see appendix 10*). There was also a 90 public stakeholder notice provided to the local newspaper (*See appendix 9*). During this process no formal comments were received and the community generally responded positively to the proposed project activities.

The main action taken related to stakeholder involvement was the location of project activities (i.e., Sea Cave reef deployment locations). The fishing and scientific community provide insights on where fishable reefs would be most beneficial to maximize fisheries targets and minimize travel time. The Sea Cave reef team is in constant communication with "Rocas de San Martin" and other stakeholders as project activities are planned to continue well into the future. To date the effects of project activities on local stakeholders has been positive, with an increase in fisheries targets, reductions in travel time, and overall increases in marine biodiversity with the project boundary.

NOTE Sea Cave Reef project activities are designed to benefit local communities by expanding fishing ground and installing them closer to fishing ports in order to provide economic and food security. Additionally, project activities aim to increase and preserve marine biodiversity. Hence project activities are generally meet with positive feedback from stakeholders and the local communities.

3.3.1 Stakeholders and consultation

Stakeholder	Owner of local fishing co-op "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	Comprised of local fishers directly impacted by project activities.
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) (appendix 10) and the general public who have been notified as part of the federal permits via the new paper (appendix 9). 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 were shared with stakeholders and through stakeholder collaboration, exact locations were determined. *See Sect 3.3 for further discussion.*
Stakeholder input	Provided input on the most beneficial locations for project activities. *See Section 3.3 for further discussion.*

Free prior informed consent	We asked the main stakeholder to issue a formal letter of support (Appendix 14)
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 was required by the permitting agency, SEMARNAT (Secretaria de Medio Ambiente y Recursos Naturales). No negative impacts were found and permits were granted by the Mexican Government, SEMARNAT.

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 sea surface temperature (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
Risk 5	Earthquake and Tsunami	The project boundary lies within the Pacific tectonic plate region and is potentially prone to earthquakes and large wave events (Tsunamis). In the event of an earthquake and/or large wave event the site will be inspected as soon as possible to assess the condition of project activities. Any Sea Cave reefs that are completely destroyed or removed will not be included in subsequent crediting periods and emission mitigation estimates.

3.5.1 Additional information on risk management

We expect minimal measurable impact or risk beyond SCUBA (self-contained underwater breathing apparatus) safety surrounding monitoring activities. All SCUBA divers will be certified and trained in underwater data collection.

The identified risks are not anticipated to affect the permeance of past carbon reductions and removals. For example, there is no evidence that elevated sea surface temperatures will affect carbon that has been deposited in marine sediments.

4. Methodology

4.1 Reference to applied methodology and applied tools

The Sea Cave® True Blue Carbon® is the reduction, removal of atmospheric CO_2 as a function of the placing of biogenic Sea Caves combined with guaranteed marine life generation and presents a novel hybrid GHG project. The project proponent (PP) researched numerous other afforestation and reforestation style methodology, in particular those focusing on the restoration of wetland and degraded mangrove habitats (AR- AMS0003 and AR-AMS0014, Clean Development Mechanism (CMD) methodology reference numbers), but none were directly applicable. Hence the PP developed numerous tools including; monitoring techniques, methods for estimating bassline scenarios, algal carbon accumulation models, emission reduction estimation models, and other methods for accurately measuring GHG mitigation efforts.

4.2 Applicability of methodology

N/A

4.3 Deviation from applied methodology

N/A

4.4 Other Information relating to methodology application

N/A

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 targets, 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 (Gibson et al., 2007; Torres-Moye et al., 2013).

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

N/A

5.6 Level 4b – Financial additionality II

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. ICC carbon revenues allow IMMB INC to enjoy wider funding interest from the general investment community.

5.7 Level 5 – Policy additionality

Currently there is 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

Algal Growth Prior to Project Activities

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.

Baseline GHG Emissions Associated with Fisher Behavior

To estimate the emission associated fishing effort the PP used independent third parties to provide a vessel census and interviews with local stakeholders on the nature of the fishery prior to project activities. The PP will use the best available information on the location of fishing grounds prior to project activities, including the distance from port to the various areas fished, the size and range of vessel utilized by the fishery, average travel time of fishing expeditions, and the number of days fished per year. PP shall use this information, along with the best available data on GHG emission factors, to estimate the baseline emissions associated with fisher behavior (*See Technology Applied, Section 1.6 for description of the GHG emission parameters and models used*).

Vessel Census
The director of fishing from the department of fishing and aquaculture for state of Baja California, Mexico provided the independent third-party verification for the number of fishing vessel in San Quintin harbor that could access and benefit from project activities. The vessel census conservatively estimated 220 vessels as the baseline size of the fishing fleet (See Appendix Section 13).

Nature of the fishery
Interviews with local stakeholders and cooperative fishing community revealed that day to day fishing behavior was variable but vessels from San Quintin Harbor regularly accessed fishing ground within a 60-mile (~95 km) radius of port. This 60-mile radius represent the fishing project boundary and can be found on Figure 1B in section 7. Trip length varied depending numerous variables including weather and targeted species, but fish trips generally ranged between 5-10hrs with an engine run time of 4-8hrs. For our baseline emissions estimate we used a value of 6hrs of engine run time. The economic security and food security of the surrounding area relies heavily on the artisanal fishing community in San Quintin Harbor; hence fish effort is constant with vessel fishing almost daily. The limiting factor, that keeps vessels from fish is inclement weather. Here we estimate that fishing activity is occurring during 90% of the monitoring period, however we feel this is potentially higher.

7. Project boundary

The Sea Cave® Reef at Isla San Martín is located along at 10 – 15 m depth along the southeast side of the island (Figure 1). 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 (Degrees and decimal minutes):

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

The boundaries of these coordinates are available in the .kmz file submitted along with this PDMR and are shown in the yellow hatch box on Figure 1D.

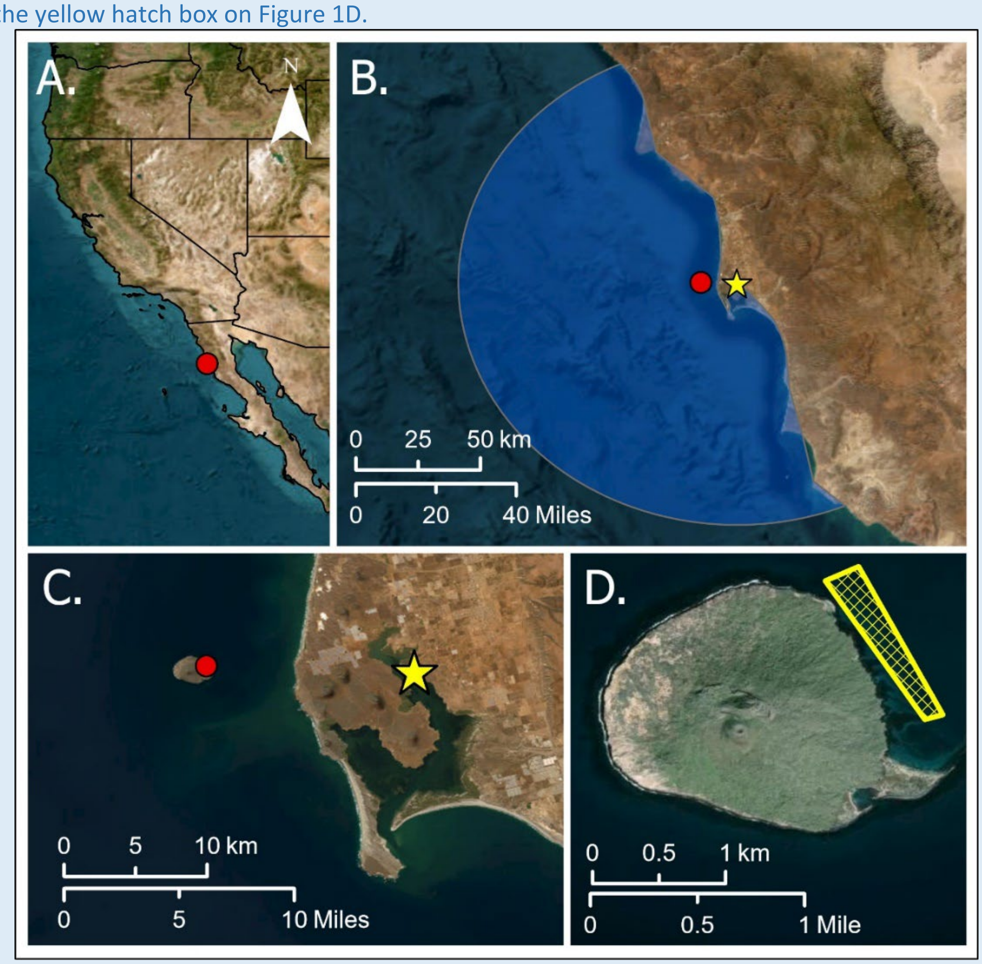


Figure 1A. Map showing the west coast of North America, with the red dot representing the location of project activities in Baja California, Mexico. **Panel B** shows the location of project activities (red dot) and the location of San Quintin harbor (yellow star). San Quintin harbor is the central port from which fishing activity originates and the blue buffer represents the 60 mile range that fishing vessels regularly access. **Panel C** shows the close proximity (~20mil) of project activities and San Quintin harbor. **Panel D** shows the map of Isla San Martin with the yellow hatched polygon representing the current project boundary.

Table 1 *Identification of GHG SSRs*

SSR		Controlled/ related/ affected	GHGs	Included? Y/N	Justification/ explanation	Coordinates
Baseline	Source 1	related	CO_2	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	CO_2	Y	Total macroalgal growth in the project area before project implementation	30 29.896’, 116 6.398’
Project	Source 1	related	CO_2	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	CO_2	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®. Note that the fabrication and transportation of Sea Cave reefs results in some GHG emissions, however those emission are only discounted in year 1 of crediting and not throughout the life span of the project.

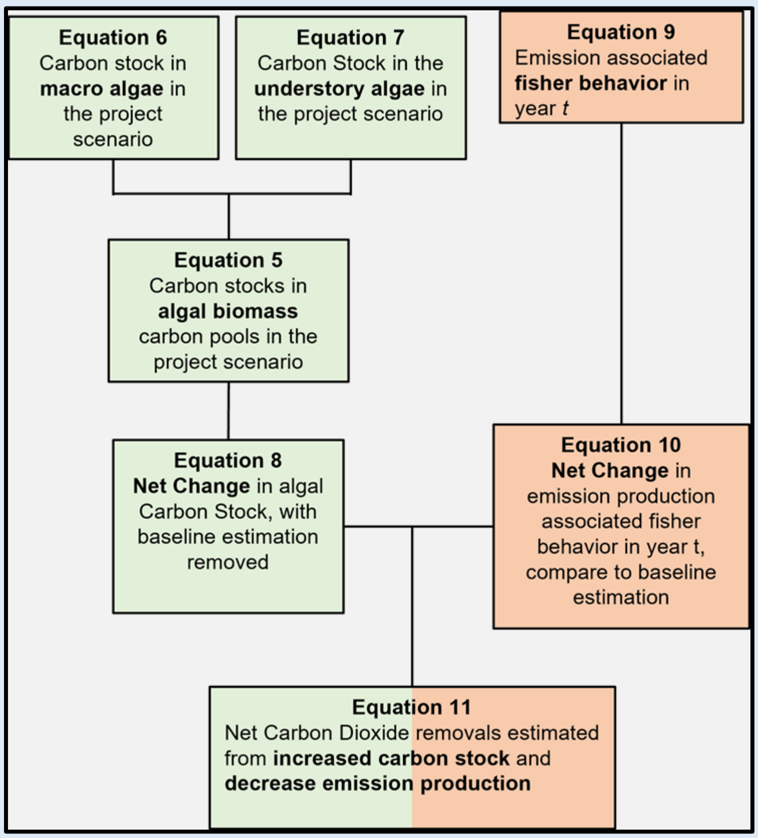


Figure 1 Equation diagram showing the summary of calculations used to estimate the changes in carbon stock related to algal NPP (green boxes) and GHG emission reductions associated with changes in fish behavior (orange boxes).

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)

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

Where:

$C_{bsl\ t-1}$ = 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:

$C_{bsl\ t-1}$ = **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)

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

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 tons, 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:

(3)

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

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 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:

$$C_{algae\ t} = (C_{ma\ t} + C_{ua\ t}) \times A_{pa} \times (44/12) \quad (5)$$

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:

$$C_{ma,t} = (CA_{MA} \times SD \times D) \times 0.000001 \qquad (6)$$

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 ($gC \cdot m^{-2} \cdot day^{-1}$) 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; $t\ C \cdot meter^{-2}$
CA_{ua} = Carbon Accumulation Rate of understory algae; $gC \cdot m^{-2} \cdot day^{-1}$
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:

$C_{ua\,t}$ = $0.0009855\ tC \cdot meter^{-2}$
CA_{ua} = $2.7\ gC \cdot m^{-2} \cdot day^{-1}$
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)

$$EP_t = EP_{baseline} * (1 - FRF_t)$$

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		

Emissions from Sea Cave Fabrication and Transportation

The fabrication and transportation of Sea Caves results in some GHG emitting process. These GHG are only discounted in year 1 of the Sea Cave Reefs crediting period. Emission productions associated with fabrications and transportation should be calculated as follows:

Fabrication:

$$C_{SC\_Fabrication} = Cement_{SeaCave} * EF_{cement} * RF_{dome}$$

Where:

$C_{SC\_Fabrication}$ = Total CO_2 emissions associated with the fabrication of 1 Sea Cave; kgs CO_2
$Cement_{SeaCave}$ = Cement required for Single Sea Cave; (kgs)
EF_{cement} = Cement production emission factor; (Kgs CO_2 * Kgs $Cement^{-1}$)
RF_{dome} = Emission reduction factor from cement 'Containment dome'

Ex-Ante Parameters and estimates:

$C_{SC\_Fabrication}$ = 158.9 kgs CO_2 * $SeaCave^{-1}$
$Cement_{SeaCave}$ = 227 kgs
EF_{cement} = 1 Kg CO_2 * Kgs $Cement^{-1}$
RF_{dome} = .30

Transportation:

$$C_{SC\_transportation} = (Diesel_{transport} * EF_{diesel}) / SC_n$$

Where:

$C_{SC\_transportation}$ = Total CO_2 emissions associated with transportation of 1 Sea Caves; $kgCO_2$ * $SeaCave^{-1}$
$Diesel_{transport}$ = Diesel consumed during transportation; liters
EF_{diesel} = Emission Factor for Diesel; kg CO_2 * liter $Diesel^{-1}$
SC_n = Number of Sea Caves per Vessel Trip; Sea Cave

Ex-Ante Parameters and estimates:

$C_{SC\_transportation}$ = 40.878 $kgCO_2$ * $SeaCave^{-1}$
$Diesel_{transport}$ = 2271 liters
EF_{diesel} = 2.7 kg CO_2 * liter $Diesel^{-1}$
SC_n = 150 Sea Caves

Total emission from Transportation and Fabrication

$$C_{total\_emission\_productions} = ((C_{SC\_Fabrication} + C_{SC\_transportation}) * SC_n)/CF$$

Where:

$C_{total\_emission\_productions}$ = Total emission production associated with Sea Cave fabrication Transportation, to be discounted in year 1 of project activities; tCO_2

$C_{SC\_Fabrication}$ = Total CO_2 emissions associated with the fabrication of 1 Sea Cave; kgs CO_2

$C_{SC\_transportation}$ = Total CO_2 emissions associated with the transportation of 1 Sea Caves; $kgCO_2$

SC_n = Number of Sea Cave Reef units deployed in the current monitoring period; Sea Cave

CF = Conversion factor from kg to tonnes; kg * $tonnes^{-1}$

Ex-Ante Parameters and estimates:

$C_{total\_emission\_productions}$ = 199.78 tCO_2
$C_{SC\_Fabrication}$ = 158.9 kgs CO_2
$C_{SC\_transportation}$ = 40.878 $kgCO_2$
SC_n = 1000 Sea Cave
CF = 1000 kg * $tonnes^{-1}$

NOTE: The GHG emission discounts related to the transportation and fabrication of Sea Cave reefs is only accounted for in year one of deployment and we provide the calculations here. We did not include them in the section below "Net Carbon Dioxide Removals" because we wanted consistency with table 2. *See Table 2 footnote for further discussion.*

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 occurring over sandy / soft bottom habitats that have no historical algal growth. 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:

$$CR_t = \Delta C_{net\_algae} + \Delta EP_t \tag{11}$$

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	=	**4028.07 t CO_{2e}**
$\Delta C_{net\_algae\_t}$	=	354.75 t CO_{2e} *See Equation 8*
$\Delta EP_{net\_fisher\_t}$	=	3,673.32 t CO_{2e} *See Equation 10*

Table 2: Aggregated GHG Emission Mitigations. The table below provides ex-ante estimates of GHG mitigations associated with Sea Cave Reef project activities. The ex-ante calculations here represent the project activates working towards a 1,000 Sea Cave unit reef, complete by the year 2025. The Baseline emissions represent the emissions associated with fishing behavior for vessel that are able to reach the project boundary. The project emissions represent the GHG emissions associated with the fabrication and transportation of Sea Cave reefs (accounted for in 2023 and 2025). The reductions represent the changes in fisher behavior (i.e., reduction is travel time and fuel burn) associated with project activities and are modeled at 7.5% reduction for 2023 and 2024, then modeled at 15% reduction for the remainder of the crediting period. We predict that reductions will increase because fishing activity will increase as project activities expand and fisheries targets increase. Removals represents the GHG removed via algal growth/photosynthesis related to project activities.

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)
08/01/2023 to 31.12.2023	11,183	87	0	839	64	816
1.1. 2024 to 31.12.2024	24,889	0	0	1837	155	1,992
1.1.2025 to 31.12.2025	24,889	112	0	3673	355	3,916
1.1.2026 to 31.12.2026	24,889	0	0	3673	355	4028
1.1.2027 to 31.12.2027	24,889	0	0	3673	355	4028
1.1.2028 to 31.12.2028	24,889	0	0	3673	355	4028
1.1.2029 to 31.12.2029	24,889	0	0	3673	355	4028
1.1.2030 to 31.12.2030	24,889	0	0	3673	355	4028
1.1.2031 to 31.12.2031	24,889	0	0	3673	355	4028
1.1.2032 to 31.12.2032	24,889	0	0	3673	355	4028
1.1.2033 to 31.7.2033	16,734	0	0	2510	97	2607
Total	**248,317**	**199**	**0**	**34,572**	**3,154**	**37,526**
Annual average	**24,832**	**20**	**0**	**3,457**	**315**	**3,752**

** The GHG discounts related to the fabrication and transportation of Sea Cave is included in year 2023 and 2025 as Sea Caves were deployed within the project boundary. For clarity we did not include these discounts in the ex-ante "8.2.1 Net Carbon Dioxide Removal" estimations because those estimations reflect the annual GHG mitigations for the majority of the crediting period (years 2026 – 2032).*

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. To account for this uncertainty, we include a 20% reduction in the carbon removal by algal growth.

The growth of giant kelp on Sea Cave reefs and other temperate marine environments is seasonal, and each year the Sea Cave reef team will determine the amount of algal growth. Hence risks identified such as increased Sea Surface Temperature and changing oceanographic conditions will only influence future GHG mitigation levels, not past algal growth. For example, a 'hot' year with El Nino conditions may see reduced algal growth for that year and that will be accounted for in yearly monitoring reports. There is no evidence that 'hot' years will affect carbon that has already been deposited in marine sediments. Overall, the identified risks have the potential to influence yearly removals estimates but we have found no evidence that they will affect past carbon removal.

Permanence risk (%)	20

9. Monitoring

9.1 Monitoring plan

Algal Growth Related to Project Activities

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.

Changes in Fisher Behavior Associated with Project Activities

PP received confirmation from local fishing cooperatives that Sea Cave reef project activities are benefiting the San Quintin fishing community and have become a regular, dependable component of the fishery (Appendix 14). The Sea Cave reef project represent a novel hybrid GHG removal and reduction project that is the first of its kind, hence many of the tools and methods for estimating change are still in development. The Sea Cave reef team is currently working with its partners to develop the tools and best practices for accurately and efficiently estimating changes in GHG emissions associated with project activities.

The PP is currently exploring dock side sampling and vessel interviews that gather information on fishing locations, travel times, and vessel types. Additionally, PP is testing drone-based surveys over the project boundary to directly measure the fishing effort occurring within the project boundary. PP is also exploring using long-term hydrophones moored within the project boundary to acoustically measure vessel visitation rates. As project activities expand in the future these methods will be refined to provide the most accurate GHG mitigation estimates. For the current monitoring period we are estimating a 7.5% reduction in fishing travel time from the San Quintin based fishing vessels. We believe that this estimate is conservative and the most recent reports have shown that numerous vessels are regularly fishing within the project boundary. (See Appendix 16 for a photo from Sept 2024 with five vessel fishing withing the project boundary). We believe that as tools and methods are refined reductions in fisher travel time will be greater than current estimates.

Sustainable Development Goals monitoring plan:

The sustainable development goals (SDGs) outlined in section 1.1 5 will be affirmed by Socio economic studies complied locally by an accredited body including the Autonomous University of Baja California. The results from these studies will be included in monitoring reports when applicable.

9.2 Data and parameters remaining constant

Data / Parameter	Macroalgal Carbon Accumulation Rate
Unit	gC * stipe^{-1} * day^{-1}
Description	Macroalgal carbon accumulation rate represents the daily growth (net primary production) of Giant kelp (*macrocystis pyrifera*) in units of stipes per day. This parameter allows us to estimates the uptake of CO_2 and relate it to observed algal densities.
Origin of data	The parameter was modeled from published values on kelp growth (*See section 1.6 Technology applied for further discussion*)
Value applied	This parameter allows us to estimates the uptake of CO_2 and relate it to observed algal densities and is set to 0.81 gC * stipe^{-1} * day^{-1}.
Justification of choice of data or description of	The parameter was developed from extensive, published work by the Santa Barbara Long-term Ecological Research (LTER) group at the University of California, Santa Barbara and represents the best available estimate for macroalgal carbon

measurement methods and procedures applied	removal. The data used to fit the model was collected across a 15-year period that encompass substantial variation and the authors of the study believe that the relationships found are relatively robust and can be used to estimate the net primary production of Giant Kelp (Reed et al., 2009).
Purpose of Monitoring	☐ Calculation of baseline emissions ☒ Calculation of project emissions ☐ Calculation of leakage
Comments	

Data / Parameter	Understory Carbon Accumulation Rate
Unit	$gC \cdot m^{-2} \cdot day^{-1}$
Description	Understory carbon accumulation rate represents the daily growth (net primary production) of various species of understory algae that play a role in marine carbon capture. This parameter allows us to estimates the uptake of CO_2 and relate it to observed algal densities.
Origin of data	The parameter was modeled from published values on understory growth (*See section 1.6 Technology applied for further discussion*)
Value applied	This parameter allows us to estimates the uptake of CO_2 and relate it to observed algal densities and is 2.7 $gC \cdot m^{-2} \cdot day^{-1}$.
Justification of choice of data or description of measurement methods and procedures applied	The parameter was developed from extensive, published work by the Santa Barbara Long-term Ecological Research (LTER) group at the University of California, Santa Barbara and represents the best available estimate for understory algal carbon removal. The study from which these parameters were derived occurred at 8 locations across 4 years and encompasses a robust amount of year-to-year variability in NPP/algal growth, hence we believe that it is the best available data to estimate growth throughout the 10-year crediting period.
Purpose of Monitoring	☐ Calculation of baseline emissions ☒ Calculation of project emissions ☐ Calculation of leakage
Comments	NA

9.3 Data and parameters monitored

Data / Parameter	**Number of Sea Cave® reef units**
Unit	Sea Cave® reef
Description	Physical structures deployed within project boundary to create hard substrate. *See appendix section 2 and 7 for description and images*
Origin of data	Provided by PP and verified with side scan sonar images
Value applied	Provides area of hard bottom created from project activities and is current set to 436
Justification of choice of data or description of measurement methods and procedures applied	Side Scan sonar provides a visual image of each Sea Cave reef unit on the sea floor and can be independently verified and provides a permeant record. *See appendix section 12 for side scan sonar from current monitoring period.*
Monitoring frequency	Annually
Purpose of data	☐ Calculation of baseline emissions ☒ Calculation of project emissions ☐ Calculation of leakage
Quality assurance and control	*See section 9.1*
Comments	Current project activities are planned to expand in the coming years and the total number of Sea Caves will increase, with the goal of 1,000 total Sea Caves.

Data / Parameter	**Macroalgal Density**
Unit	Stipes per meter^2
Description	Stipe counts of individual Macrocystis plants encountered during monitoring surveys on Sea Caves® reefs and represent GHG removal associated with project activities.
Origin of data	Monitoring surveys and/or imagery from within project boundary
Value applied	Provides an estimate macroalgal growth and is set to 30 stipes * meter^{-2}
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	☐ Calculation of baseline emissions ☒ Calculation of project emissions ☐ Calculation of leakage
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	**Number of Vessel able to access project boundary**
Unit	Fishing boat
Description	Represents the number of vessels able to access the project boundary and benefit from project activities.
Origin of data	Fishing boat census is completed and verified by independent third parties. *See appendix 13 for current vessel census.*
Value applied	Provides value from which baseline emission for the number of vessel fishing in the area can be calculated and is currently set to 220 vessels.
Justification of choice of data or description of measurement methods and procedures applied	These data provide the best estimates for emissions associated with artisanal fishing effort from San Quintin Harbor.
Monitoring frequency	Annually
Purpose of data	☒ Calculation of baseline emissions ☐ Calculation of project emissions ☐ Calculation of leakage
Quality assurance and control	Vessel Data is collected and verified by independent third parties.
Comments	NA

Data / Parameter	**Fishing Reduction Factor (FRF)**
Unit	Percent reduction
Description	Represents the estimated percent reduction in fisher travel time for vessel originating from San Quintin Harbor, Baja Mexico related to project activities.
Origin of data	For the current monitoring period the FRF is based on discussion with local fishing cooperatives that are currently using and befitting from project activities. From those discussion, they are estimating the Sea Cave Reef project activities are reducing travel by 10% - 20%.
Value applied	To be conservative, the PP is only estimating a 7.5% reduction in travel across the San Quintin fishing fleet.
Justification of choice of data or description of measurement methods and procedures applied	Monitoring GHG emission reduction associated with project activities will be a central focus for the PP during the current crediting period. (See Section 9.1 Fish behavior Monitoring Plan). For the initial monitoring period we are forced to rely on interviews and discussions with fishers that are actively fishing within the project boundary and benefiting from Sea Cave reefs. Initial feedback is that project activities reducing fisher travel by 10-20%, however in an attempt to be conservative, we have reduced these initial estimates by half and are estimating a 7.5% reduction in fuel burn.
Monitoring frequency	Annually
Purpose of data	☐ Calculation of baseline emissions ☒ Calculation of project emissions ☐ Calculation of leakage
Quality assurance and control	Reduction in travel time and GHG emissions associated will be verified in the future by multiple data sources that are still in development but could include interviews, drone based arial surveys, and other methods (*See Section 9.1*).
Comments	

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 monitoring period is from 01/08/2023 – 01/10/2024 and includes 427 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. See appendix 12 for Side Scan sonar image showing the deployment and configuration of Sea Caves within the project boundary. We also have evidence of robust macroalgal growth and understory algal growth on Sea Caves within the project boundary from June 22, 2024 showing the presences of giant kelp and understory algae growth during the crediting period (*Appendix 15*).

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 (*Appendix 13*). Based on interviews and discussions with local stakeholders (e.g. fishing cooperative "Rocas de San Martin") fishers have been actively fishing the project boundary (*Appendix 14*). 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 5-10 hours away. We are currently developing a more refined method for measuring these emission reductions (*See Sect 9.1 Monitoring Plan for details*) but based on initial feedback from the local fishing community it is approximately 15% - 30% reduction in travel time/fuel burn. 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 – 1/10/2024) is 427 days and to be conservative we are estimating the fishing activity is occurring on only 384 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

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

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--$_{bsl\_ma}$)

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

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

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

Ex-post calculation:

C_{bsl_ua} = 0 tC · meter $^{-2}$.

CA_{ua} = 2.7 gC · m^{-2} · day^{-1}

D = 365 days

0.000001 = Conversion rate from grams to metric tons, unitless

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

Baseline Emission Production Factor for Fishing Activities

$$EP_{baseline} = MC \cdot SFR \cdot EF \cdot B_t \cdot FD_{baseline} \cdot H_{fd\ baseline} \tag{4}$$

Ex-post calculation:

$EP_{baseline}$ = **31,345.7 tCO_2**
MC = 58.7 kW · $boat^{-1}$
SFR = 0.00035 tFuel · kW H^{-1}
EF = 3.01 tCO_2 · $tFuel^{-1}$
B_t = 220 *t*; fishing boats
H_{fdb} = 6 H · day^{-1}
$FD_{baseline}$ = 384 boat days

10.2 Project emissions

GHG Removal by Marine Algae

$$C_{algae\ t} = (C_{ma\ t} + C_{ua\ t}) \times A_{pa}\ X \tag{5}$$

Ex-post calculation:

$C_{algae\ t}$ = **181 tCO_{2e}**
$C_{ma\ t}$ = 0.0104 t C · $meter^{-2}$; *See equation 6*
$C_{ua\ t}$ = 0.00115 t C · $meter^{-2}$; *See equation 7*
A_{pa} = 4280 $meter^2$
44/12 = Ratio of molecular weight of carbon dioxide to carbon (unitless)

Macroalgal Carbon Accumulation

$$C_{ma,t} = (CA_{MA} \times SD \times D) \times 0.000001 \tag{6}$$

Ex-post calculation:

$C_{ma,t}$ = **0.0104 t C · $meter^{-2}$**
CA_m = 0.81 gC · $stipe^{-1}$ · day^{-1}
SD = 30 stipes · $meter^{-2}$
D = 427 days
0.000001 = Conversion rate from grams to metric tones, unitless

Understory algal carbon accumulation

$$C_{UA} = (CA_{UA} \times D) \times 0.000001 \tag{7}$$

Ex-post calculation:

$C_{ua\,t}$ = **0.00115 t C · meter $^{-2}$**
CA_{ua} = 2.7 gC · m^{-2} · day^{-1}
D = 427 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} = **181 t $CO_{2\text{-}e}$**
$C_{algae\ t}$ = 181 t CO_{2e} *See Eq 5*
$C_{bsl\ t-1}$ = 0 t $CO_{2\text{-}e}$ *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)

$$EP_t = EP_{baseline} * (1 - FRF_t)$$

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 = **28,995 tCO_2**
$EP_{baseline}$ = 31,346 tCO_2 *See Equation 4*
FRF_t = 0.075

Net Changes in emissions

(10)

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

Ex-post calculation:

$\Delta EP_{net\_fisher\_t}$ = **2351 t CO_{2e}**

$EP_{baseline}$ = 31,346 tCO_2 *See Equation 4*

EP_t = 28,995 tCO_2 *See Equation 9*

t = 1

Emissions from Sea Cave Fabrication and Transportation

The fabrication and transportation of Sea Caves results in some GHG emitting process. These GHG are only discounted in year 1 of the Sea Cave Reefs crediting period. Emission productions associated with fabrications and transportation should be calculated as follows:

Fabrication:

$$C_{SC\_Fabrication} = Cement_{SeaCave} * EF_{cement} * RF_{dome}$$

Where:

$C_{SC\_Fabrication}$ = Total CO_2 emissions associated with the fabrication of 1 Sea Cave; kgs CO_2

$Cement_{SeaCave}$ = Cement required for Single Sea Cave; (kgs)

EF_{cement} = Cement production emission factor; (Kgs CO_2 * Kgs $Cement^{-1}$)

RF_{dome} = Emission reduction Factor from ‘Containment dome’ used in cement production

Ex-Post calculations:

$C_{SC\_Fabrication}$ = 158.9 kgs CO_2

$Cement_{SeaCave}$ = 227 kgs

EF_{cement} = 1 Kg CO_2 * Kgs $Cement^{-1}$

RF_{dome} = .30

Transportation:

$$C_{SC\_transportation} = (Diesel_{transport} * EF_{diesel}) / SC_n$$

Where:

$C_{SC\_transportation}$ = Total CO_2 emissions associated with the transportation of 1 Sea Caves; $kgCO_2$ * Sea $Cave^{-1}$

$Diesel_{transport}$ = Diesel consumed during transportation; liters

EF_{diesel} = Emission Factor for Diesel; kg CO_2 * liter $Diesel^{-1}$

SC_n = Number of Sea Caves per Vessel Trip; SeaCave

Ex-Post calculations:

$C_{SC\_transportation}$ = 40.878 $kgCO_2$* Sea $Cave^{-1}$

$Diesel_{transport}$ = 2271 liters

EF_{diesel} = 2.7 kg CO_2 * liter $Diesel^{-1}$

SC_n = 150 Sea Caves

Total emission from Transportation and Fabrication

$$C_{total\_emission\_productions} = ((C_{SC\_Fabrication} + C_{SC\_transportation}) * SC_n)/CF$$

Where:

$C_{total\_emission\_productions}$	=	Total emission production associated with Sea Cave fabrication Transportation, to be discounted in year 1 of project activities; tCO_2
$C_{SC\_Fabrication}$	=	Total CO_2 emissions associated with the fabrication of 1 Sea Cave; kgs CO_2
$C_{SC\_transportation}$	=	Total CO_2 emissions associated with the transportation of 1 Sea Caves; $kgCO_2$
SC_n	=	Number of Sea Cave Reef units deployed in the current monitoring period; Sea Cave
CF	=	Conversion factor from kg to tones; kg * $tonnes^{-1}$

Ex- Post Calculations:

$C_{total\_emission\_productions}$	=	87.10 tCO_2
$C_{SC\_Fabrication}$	=	158.9 kgs CO_2
$C_{SC\_transportation}$	=	40.878 $kgCO_2$
SC_n	=	436 Sea Caves
CF	=	1000 kg * $tonnes^{-1}$

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 Sea Cave reef team did not identify any risks to permanence during this round of monitoring, however do to the uncertainty around permanence (see section ## for further discussion) we are including a 20% reduction in macroalgal derived carbon.

10.5 Net GHG emission mitigations

Quantification of Net-GHG emissions

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

CR_t = **2,445 t CO_{2e}**

$\Delta C_{net\_algae\_t}$ = 181 t CO_{2e} *See Equation 8*

$\Delta EP_{net\_fisher\_t}$ = 2351 t CO_{2e} *See Equation 10*

$C_{total\_emission\_productions}$ = 87 t CO_{2e} *See Equation 12*

Table 3 *Net GHG Emission Mitigations*

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 31.12.2023	11,183	87	0	12.9	839.0	64.4	803.5
01.01.2024 to 01.10.2024	20,162	0	0	23.2	1512.2	116.1	1605.1
Total	**31,346**	**87**		**36.1**	**2351**	**181**	**2409**

10.6 Comparison to estimated GHG emission mitigations

Table 4 Comparison to estimated GHG emission mitigations

Year	Ex-ante estimation (tCO_2e)	Monitored impacts (tCO_2e)	%	Explanation
01.08.2023 to 31.12.2023	**803.5**	**803.5**	**0**	The ex-ante estimation and monitored impacts(ex-post) are the same because we used data from the current monitoring period to parameterize our models for ex-ante estimations. These real-world parameters provide the most accurate forecast of future GHG mitigations associated with project activities.
01.01.2024 to 01.10.2024	**1605.1**	**1605.1**	**0**	*See Explanation above*
Total	**2409**	**2409**	**0**	

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

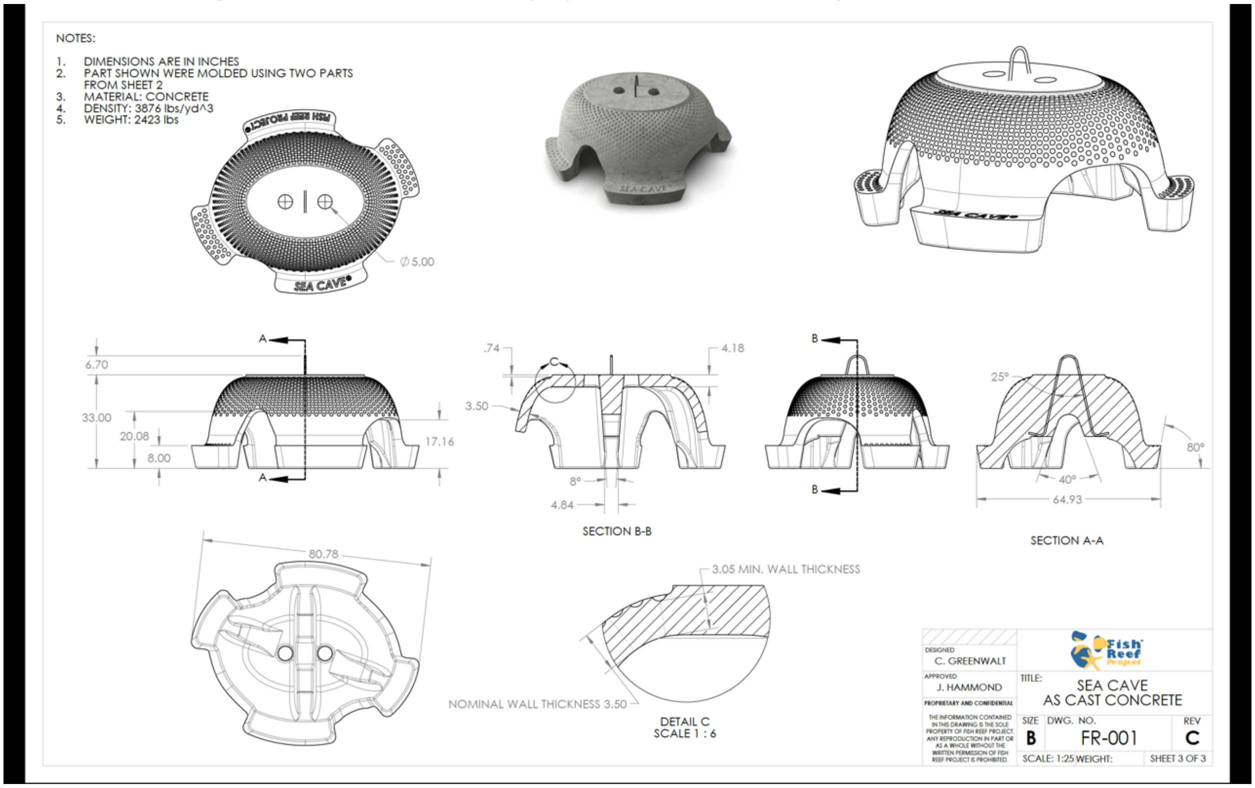
Model parameters and descriptions for estimating carbon GHG emissions mitigations associated with Sea Cave Reef project activities in Baja California, Mexico.

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.
Cement required	227	Kgs per Sea Cave	The amount of cement needed to produce 1 sea cave unit.
Cement emission production	1	Kg CO_2 / Kg Cement	Estimate of emission associated with cement production. These values were adapted from Hendriks et al. 1998 and Fayomi et al. 2019, however these two sources cite the emission factor at .9 Kg CO_2/ Kg Cement but we chose to use 1.0 to be conservative. NOTE the facility used to purchased cement has a GHG containment dome that reduces emissions by %30.
Diesel Consumed during Sea Cave Transport	227	Liters Diesel	This is the estimated amount of diesel consumed for a round trip vessel deployment of 150 Sea Caves to the project boundary.
Diesel emission Estimate	2.7	Kg CO_2 / liter diesel	Conversion rate used to calculate emissions associated with Sea Cave transportation. This emission factor was from the US Environmental Protection Agency 2005.

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

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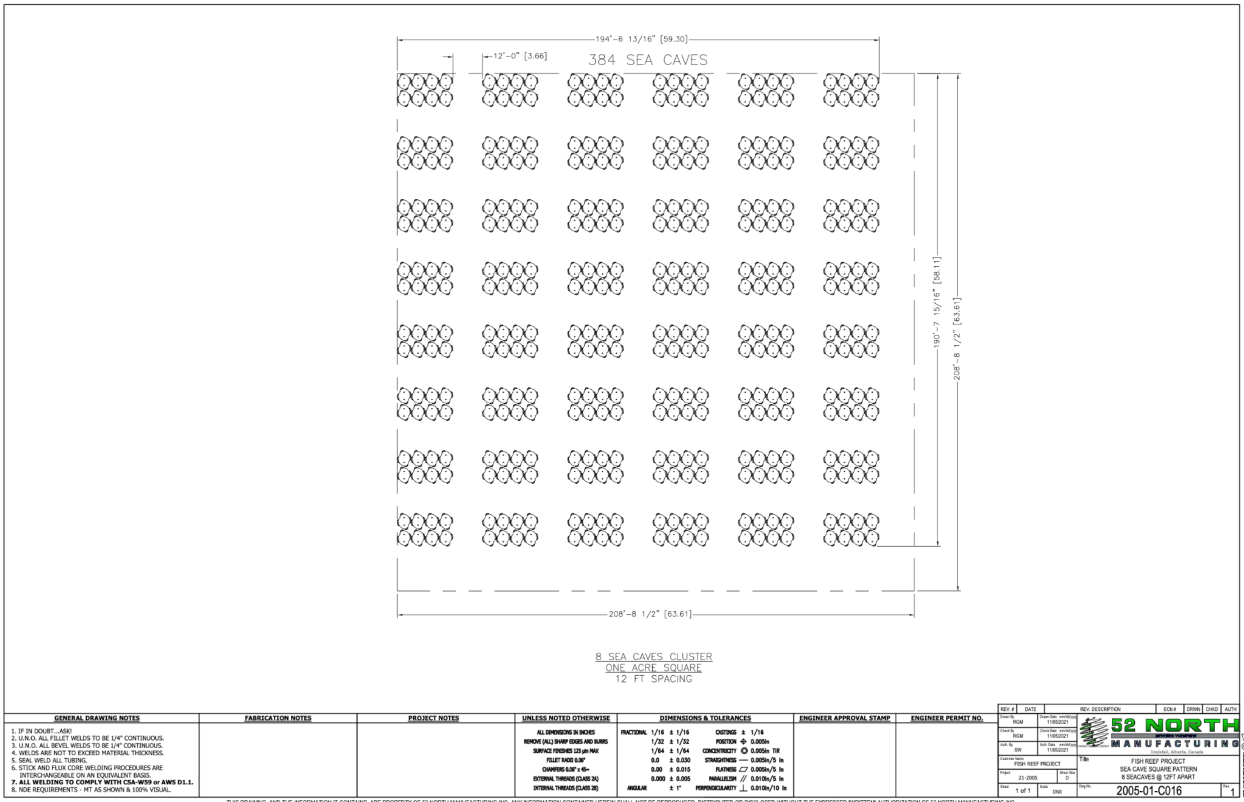
Appendix 6

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. Teléfono 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.

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(Continued)

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

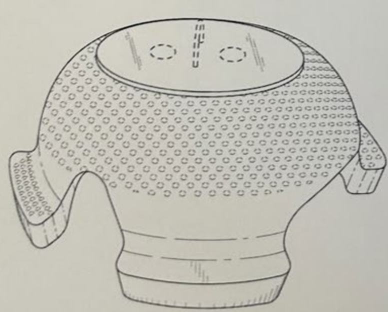
(57) **CLAIM**

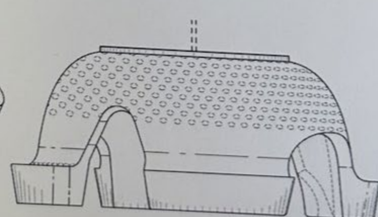
I claim the ornamental design for a domed structure, substantially as shown and described.

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 10

University Stakeholder Proof

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

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

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

- 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,

Rodrigo Beas

Dr. Rodrigo Beas
Professor
Facultad de Ciencias Marinas
UABC

Appendix 11

Proof of Deployment

SSM MARITIME

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.

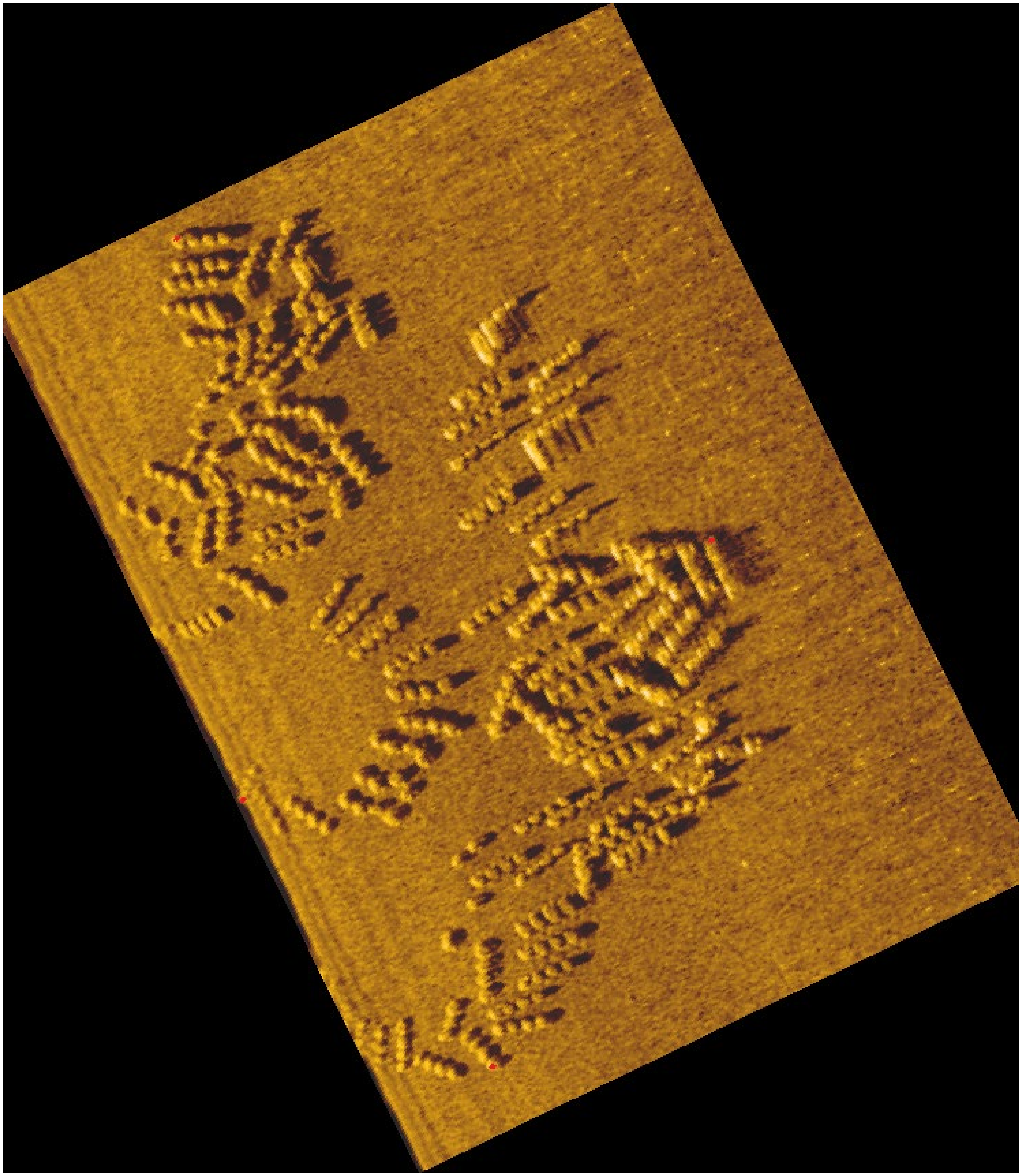
This letter is issued for the purposes applicable in the City and Port of Ensenada in Baja California, on the 16th day of August, 2023.

Atentamente / Sincerely

Ulises F. Uribe G.
Operaciones
SSM Maritime.

Appendix 12

Side Scan Sonar Imaging showing Sea Cave reefs in place off the coast of Isla San Martin. This image was taken in July 2023.



Appendix 13

The number of vessels in the fishing fleet able to access the project boundary. A .pdf file was submitted with this PDMR document.

C. Ulises Uribe:

Referente a tu solicitud te comento que, el esfuerzo estimado para la zona de San Quintín es de aproximadamente 220 embarcaciones comerciales, la información oficial sobre el esfuerzo pesquero se tiene a detalle en los datos abiertos de la CONAPESCA en la siguiente liga:

https://datos.gob.mx/busca/dataset/permisos-y-concesiones-de-pesca-comercial-para-embarcaciones-mayores-y-menores

En ella podrás encontrar todos los permisos emitidos para las diferentes pesquerías y filtrarlo a nivel localidad y puerto base.

De igual manera, en la página https://bajasport.fishing/prestadores-de-servicios-san-quintin/ podrás encontrar los prestadores de servicios turísticos que se encuentran legalmente establecidos en la zona así como información de interés para la pesca deportiva y su normativa. Para pronta referencia se enlistan a continuación:

PRESTADOR DE SERVICIOS TURÍSTICOS	TELEFONO
RENE DUARTE	616 107 1243
GENARO FLORES	616 165 6003
JAIME GARCIA	616 101 9056
KELLY & GEORGE CATIAN	616 109 1869
BERTOLDO GARCIA	616 101 9114
JOSE VILLAVICENCIO	616 101 9925
ALFREDO PERALTA	616 107 0358
ROSALINA AGUILAR	616 101 7086

Referente al consumo de combustible, no contamos con una referencia de ello toda vez que varía conforme a la pesquería y métodos de captura.

Sin otro particular, quedo de usted.

Appendix 14

Letter from “Rocas de San Martin”, a local fishing cooperativa attesting to the benefits of Sea Cave reef activities and fishing activity occurring within the project boundary.

Rocas de San Martín
San Quintín B.C.

San Quintín Baja California a 23 de abril del 2024

A quien corresponda

Presente

Reciba un cordial saludo de su servidor Ismael González Zacarias, Representante Legal de la empresa Rocas de San Martin SPR de RI, para reportar cómo nosotros y muchos pescadores nos hemos beneficiado satisfactoriamente del nuevo arrecife Sea Cave.

Con el desarrollo de el arrecife Sea Cave en Isla San Martin hemos notado un aumento de trafico de embarcaciones utilizando el nuevo arrecife (buceando, etc.), las embarcaciones están claramente redistribuyendo sus viajes para acceder al arrecife en lugar de pescar y operar más lejos en altamar. También está llenándose de diversas especies de peces y algas, especies pequeñas y larvas de diferentes productos como caracol, abulón, erizo lo cual nos llena de satisfacción ver el repoblamiento de diversas especies.

Sin mas por el momento me despido de usted no sin antes agradecerle su atención a la misma.

ATENTAMENTE

Ismael González Z

Ismael González Zacarias
Rocas de San Martin SPR de RL
Representante Legal

CALLE 6TA. #225 FRACC. SAN QUINTIN,CP. 22940, ENSENADA B.C. TEL. 6161652512.
CORREO: rocasdesanmartin@hotmail.com

Appendix 15

Underwater image taken on June 22, 2024 of a single sea cave reef with Giant kelp and understory algal growing on it.

Appendix 16

Image taken in September 2024 at Isla San Martin showing five vessels fishing within the project boundary. Fishing vessels are targeting marine species on Sea Cave reefs and would most likely be fishing further from their port of origin if project activities had not occurred.