Aquarium of the Pacific : BLUE CARBON

Proposed Project Timeline

External Carbon Offsets

Looking at opportunities to invest in external offsetting projects to take action now

Seagrass Restoration

Identifying potential locations for volunteer-based seagrass restoration

Biodiversity Market

Reviewing options for stacking a blue carbon credit with a biodiversity credit

01 Opportunities in the Voluntary Carbon Market

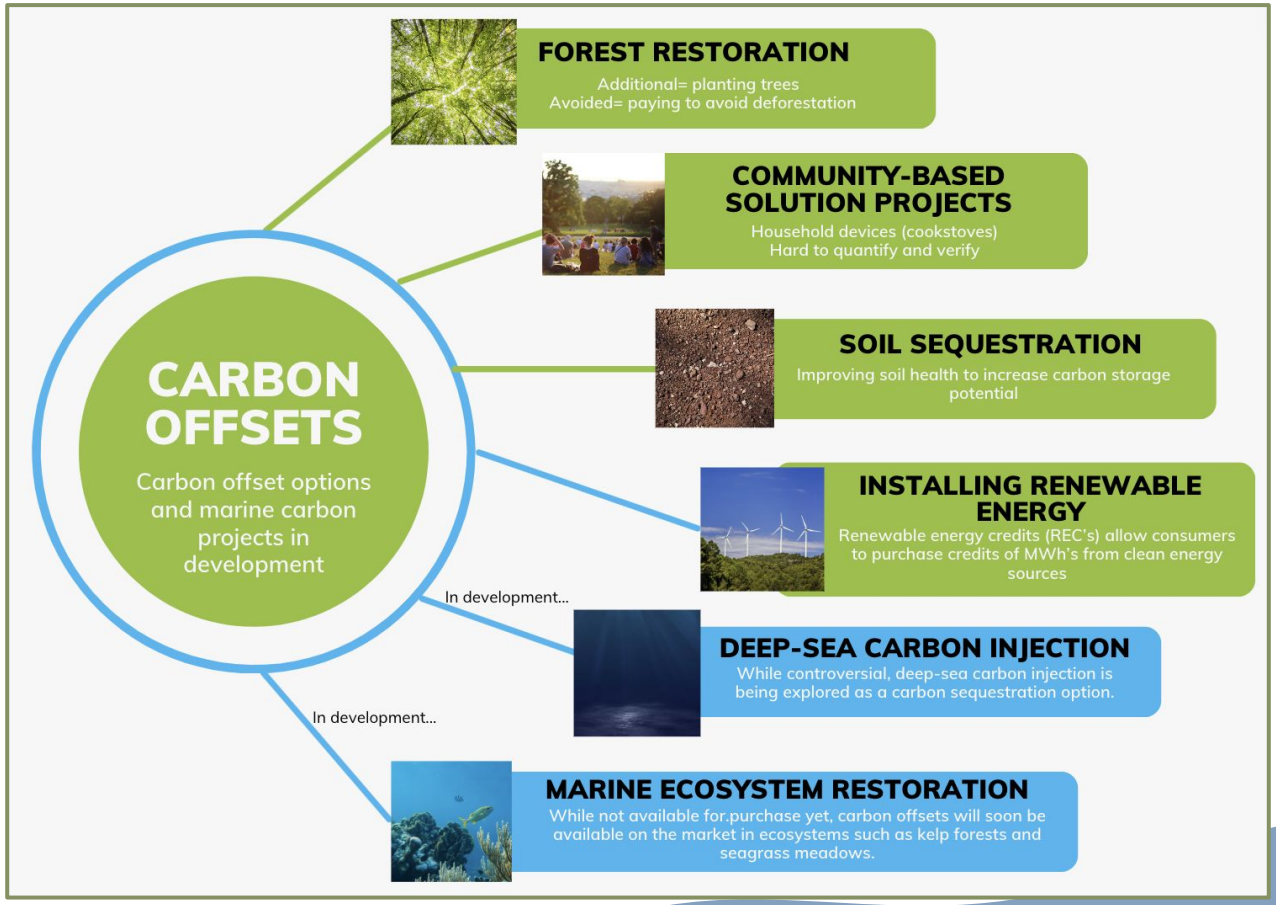
1. Opportunities for Carbon Credits
2. Emerging Blue Carbon Market

Today's Carbon Market

1 Carbon Credit = 1 **ton** of CO_2 sequestered/avoided

Example of a forest restoration approach: **Seattle Aquarium** and the Rimba Raya Project

There are many verification systems in place to hold distributors accountable for offsets they sell on the marketplace



Today's Carbon Market

In pursuit of Net Zero Emissions, it is clear at some point the aquarium will need to purchase offsets for the emissions that it is impossible or impractical to drive totally to zero. The bulk of the Aquarium's offsets will be accomplished by PPA's (Power Purchase Agreements), which by procuring renewable electricity from a new project, enable that project to be built and bring additional renewable energy onto the grid. This "additionality" offsets or displaces electricity that would otherwise be generated from fossil fuel sources.
However, to advance its mission of conservation, the Aquarium will also explore the option of carbon offsets through "blue carbon" or the carbon that is captured by kelp, seagrass, mangroves and other ocean-based biological processes. Blue carbon projects have the potential to generate funding for marine conservation, and the development of such projects represent an opportunity to advance conservation and inform the public of the value of nature-based solutions to climate change.

Blue carbon markets are nascent, but follow in the path of terrestrial voluntary carbon markets that have been operating for over twenty years. One carbon credit is recognized as one ton of CO_2 removed or avoided from the atmosphere, for this is the standard that has been used now for some time. There are two types of credits offered, avoidance and removal. Avoidance credits the most abundant and makes up for about 70% - 80% of the market as of now. Removal credits are less common on the market, but they are being developed rapidly due to high demand. Removal credits focus on ecosystem restoration and have the appeal of not just sequestering carbon, but also of potentially conserving other ecosystem functions and biodiversity. For this reason many global conservation non-profits have invested in reforestation not just for the sake of carbon, but also to create habitat for biodiversity.

Continued

Projects on the market are in theory verified through third party certifiers. In recent years, the verification system has received of criticism for issuing unverified credits and lack of transparency. In response to this criticism, the market is becoming more reliable.

Existing carbon offsets tend to be primarily: forest restoration, community-based carbon, soil sequestration, and installing renewable energy options. As the science has advanced it has become clear marine systems could also contribute to carbon offsets. The two marine options displayed in blue on page 2 are marine-based ecosystem restoration projects, and there is also investment being made into deep-sea carbon injection projects. There is not yet a significant blue carbon market, but experts expect this to grow in the near future, and the Aquarium has a role to play in supporting that growth.

Other aquaria are also investing in nature-based carbon projects – but these projects tend to be terrestrial in nature. For example, the Seattle Aquarium has invested in Rimba Raya, a terrestrial-based (forest) project located in Indonesia. They chose this project because it offered an investment opportunity in a region of the world that the Seattle Aquarium focuses heavily on (Coral Triangle), and in the future they hope to purchase offsets in a local project to complement the Rimba Raya project. The Seattle Aquarium is aware of the criticisms of forest carbon offsets, and chose Rimba Raya because there were a number of third-party certifications on the project to reduce concerns about the authenticity of the carbon credits.

Verdis Recommendations

Verdis

- Provides sustainability and climate action planning services
- Specialize in conducting scope 1, 2, and 3 greenhouse gas inventories

Further Notes:

- Consider PPA
- Use the Oxford Principles when considering which offsets to buy

Criteria for a Carbon Offset Project

- Dealbreakers:
  - Must be verified
  - Must be a vintage of the last 3 years
  - “High quality” offset in the $15-$25 range
- Potential criteria depends on the client and what is important to them

Other Considerations

- Locally based
- Community/social co-benefits
- Permanence
- Additionality

Verdis Recommendations

Verdis, the consulting agency with which the Aquarium developed its sustainability plan, has provided several recommendations for the Aquarium of the Pacific. They emphasized that when purchasing carbon offsets, the Aquarium should prioritize verified credits, credits with a vintage within the last three years, and high-quality credits. "Vintage" refers to the year in which the emission reduction occurred and was verified, and Verdis evaluates quality based on the price range of the carbon credit. High quality offsets tend to fall within the $15-$25 range for 1 credit, or 1 ton of carbon sequestered or avoided. Other considerations for carbon offset purchasing can be guided by the Aquarium's preferences, such as the region where the offset is located, the type of project, or the species it supports.

When we consulted with the Verdis team, they encouraged us to adhere to the Oxford Principles when selecting a particular carbon offset. The Oxford Principles, developed by Oxford University, recommend prioritizing emission reductions, regularly reviewing portfolios as best practices evolve, and ensuring the environmental integrity of credits. The team also emphasized the preference for "additionality" offsets over "avoidance" offsets. Additionality refers to removal offsets, where the carbon reduction would not have occurred without the purchase of the offset. These are considered more impactful than avoidance offsets because, in many cases, it is not possible to guarantee that the avoidance projects had the impact they are selling.

Verdis Recommended Projects

CarbonCURE

Goal: assists the concrete industry in achieving net zero emissions by injecting CO_2 into concrete, which ensures the mineralized CO_2 never returns to the atmosphere

Verification: Records the amount of CO_2 that leaks out of the concrete following the production and usage of the concrete

American Forest Foundation

Goal: support family forest owners in maintaining the health of their forests

Verification: Offsets are verified by the carbon accounting methodology developed under Verra Carbon Standard

Native Energy

Goal: to help design and build a natural resource or renewable energy projects customized for each company

Verification: 1) Supply team conducts a background check 2) Third-party verification for the potential project 3) Third-party verification while the project is operating

Verdis Recommended Projects

Verdis suggested three different carbon offset projects to the Aquarium. The first is CarbonCURE, a project that injects carbon dioxide into concrete. This injection mineralizes the carbon dioxide, ensuring it does not return to the atmosphere. The permanence of this sequestration is a major benefit of purchasing offsets from CarbonCURE.

The second recommendation is the American Forest Foundation. This program aims to enable family forest owners to access climate finance from carbon markets, empowering them to address climate change while earning income from their land. The project is verified by Verra, a global carbon credit verification service. Since the project focuses on increasing the health of already existing forests, it is considered an additionality project.

Finally, Native Energy offers a range of both local and international carbon offset projects, including wind and solar energy projects and grassland conservation initiatives. Native Energy supports its projects with a buffer pool of carbon offsets that the company does not sell. This strategy is intended to ensure that more carbon is stored than sold.

Cost of External Offset Investments

Removal Scenario: assumes companies can **only** buy **removal** offsets to achieve net-zero goals

Voluntary Market Scenario: assumes nothing fundamentally changes

Bifurcation Scenario: with a smaller market for expensive **high-quality** credits and a larger market for everything else.

Cost of External Offset Investments

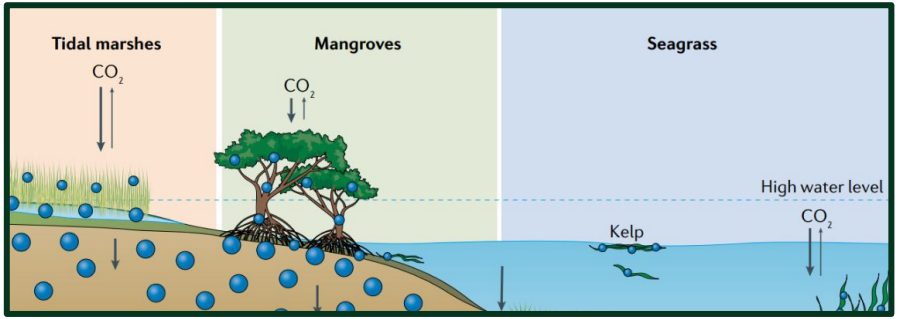
As we think about the cost of carbon in 5 - 10 years, it is very difficult to predict prices per ton of carbon.

The 2023 forecasting report by Bloomberg, which projects the market under three different scenarios, examines how the market may evolve in the coming years. A crucial insight from this forecast is the recognition of the substantial demands necessary for the market to transition fully to removal-based projects. This transition will take time and be costly. Although the price of high quality carbon removal projects is quite high at the moment, sources predict that these prices will drop as technologies advance, which requires both patience and flexibility.

At COP28, there was a great deal of discussion regarding the need to shift into a more removal- based carbon market. Attendees emphasized the importance of investing exclusively in high-quality credits, consequently elevating the recognition of this critical need.

Understanding Blue Carbon

Blue Carbon:
process by which CO_2 is absorbed from the atmosphere and stored into the ocean.



Carbon Capture Methods

Mangrove/ Seagrass Restoration

Restoring highly efficient coastal ecosystems

Transporting Biomass

Sinking carbon rich biomass to the ocean floor

Direct Ocean Capture

Utilizing novel technologies to directly remove the CO2

Understanding Blue Carbon

Blue carbon refers to the sequestration of CO_2 via coastal and marine ecosystem. Currently, there are numerous methods of capturing CO_2 from the atmosphere, with the most common being via mangrove restoration and conservation sites. Such projects often offer multiples benefits beyond just carbon sequestration, for they are also capable of enhancing the health of the surrounding ecosystem and increasing biodiversity. Mangroves, seagrasses, and kelp are great examples of blue carbon-sequestering species that exhibit exemplary sequestering rates and capabilities.

The emergence of such forms of carbon capture are continuously improving and becoming more efficient with time. Currently, true blue carbon offsetting investments are not as readily available in the voluntary carbon market as forest carbon projects. Many aspects of blue carbon sequestration are still being researched to ensure that blue carbon credits meet the highest possible standards.

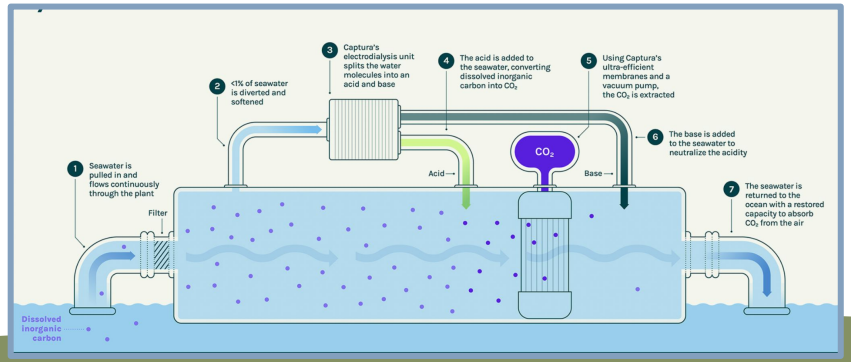
Blue Carbon : Pre – Issuance

Captura (2021) : utilize renewable energy to remove CO_2 directly from ocean

- Prioritizes scale and environment
- Partnership w/ Equinor : Fall 2024
- Expect costs to be less than $100/ ton CO_2

Running Tide (2017) : transferring CO_2 from fast to slow carbon cycle

- Based in Portland, Maine
- First **ocean - based carbon removal credit** to **Shopify**



Seafields (2021) : domesticating sargassum farms to transport biomass to deep ocean

- Carbon amounts for around 30% of the mass of dry Sargassum
- Partnered w/ Just Carbon to offer credits soon

Blue Carbon: Pre- Issuance

Given the values and ideals of the aquarium, it's important that any and all external investments are going towards projects that are in alignment with such values. Many nature-based investments currently focus on carbon avoidance projects. There is a prevalent and growing shift towards carbon removal projects, though this transition is still in its early stages. In the process of doing our research, we have discovered various ocean based carbon removal projects that would be of interest for the Aquarium to get involved in. Such projects offer pre-issuance credits, which are credits that can be purchased in advanced prior to the actual caron removal to aid in technological and methodological advances.

1. **Captura** was founded in 2021 by a team of students at CalTech. They are using a new variation of electrodialysis to create an imbalance, causing the ocean to draw down carbon dioxide from the atmosphere to compensate for the one it lost. This coming fall, they will be launching a new project in Norway to experiment with scale and credit feasibility.

2. **Running Tide** was created in 2017 by CEO Marty Odlin, for this company is trying to move carbon from the fast to slow cycle. They source waste wood from forestry professionals , mix alkaline minerals with it, and then deploy the plume into the ocean and track its movement. The intent is that the wood will eventually become waterlogged and sink to the ocean floor and store carbon there in the slow cycle.

3. **Seafields** is a UK-based aquaculture business whose mission is to utilize the ocean to grow huge amounts of sargassum biomass for carbon dioxide removal (CDR). Essentially, they are working on domesticating sargassum farms to harvest this biomass and eventually sink it into the deep ocean, where the carbon can be stored for thousands of years.

Why Invest in Blue Carbon?

Issues	Voluntary Carbon Market (VCM)	Blue Carbon Market
Additionality	Current market consists of avoidance projects that have unreliable additionality.	Opportunity to invest in more direct ocean carbon removal projects that guarantee additionality.
Permanence	Natural disturbances, human activities, and temporal impermanence threaten credibility and integrity of VCM.	Less vulnerable to natural disturbance and longer-term carbon storage.
Transparency and Accountability	Lack of transparency and accountability can lead to greenwashing and false claims about the environmental impact of offset projects.	Opportunity to redefine blue carbon metrics that ensure transparency. Complete disclosure when reporting data, progress, and expectations.

Why Invest in Blue Carbon?

Given the novelty of the blue carbon market, investors and project developers have significant freedom to establish new standards that are currently lacking in the Voluntary Carbon Market (VCM).These include challenges such as additionality issues and permanence concerns.

By focusing on natural carbon sinks like mangroves and seagrasses, Blue Carbon projects inherently address additionality as they enhance existing carbon capture capabilities.

The long-term stability and resilience of coastal ecosystems also provides a more reliable solution to permanence issues compared to some current REDD+ deforestation projects. Such ecosystems are less vulnerable to natural disasters like wildfires, which release stored carbon back into the atmosphere. Insect or disease outbreaks can do the same. Overall, the current challenges faced by the VCM can serve as valuable lessons for establishing a new, verifiable, reliable, and trustworthy market precedent.

References

Cost of Offsetting:

- Cool Effect : Project Pricing
- SeaTrees:
- S&P Carbon Indices: Carbon Indices
- Total Issuance Figure: World Bank Group - Carbon Pricing
- Bloomberg NEF: Long-term Carbon Offset Outlook - 2023.
- Current Market Prices: Carbon Credit Pricing - 8billiontrees
- REDD+ Credit Avg. : Carbon Streaming
- IFC Deep Blue Ocean FInancing: Blue Carbon Financing

Carbon Verification

- CarbonCURE: Carbon Credit Deliveries - CarbonCure
- NativeEnergy: Carbon Offset Certifications | NativeEnergy
- American Forest Foundation: New Approach to Forest Carbon Accounting Aims to Enhance Accuracy & Transparency

Blue Carbon

- Running Tide 2023- A look into the process: 2023 In Review
- Running Tide x Shopify
- Seafields: How and Why
- About - Captura
- CDR: Captura CEO Steve Oldham
- Seafields: Timeline

03 Restoration and The Potential for Carbon Capture

- Restoring seagrass beds can be used to soak up CO_2 emissions
- What seagrass is and why it is important

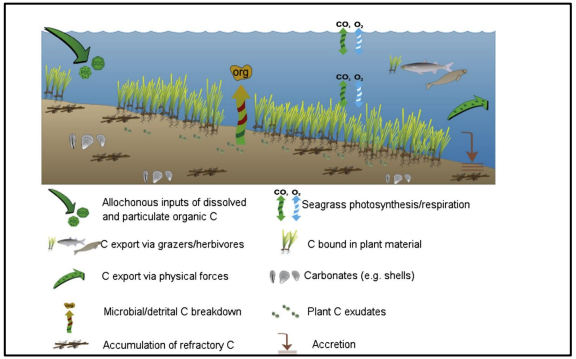
What Once Was Lost

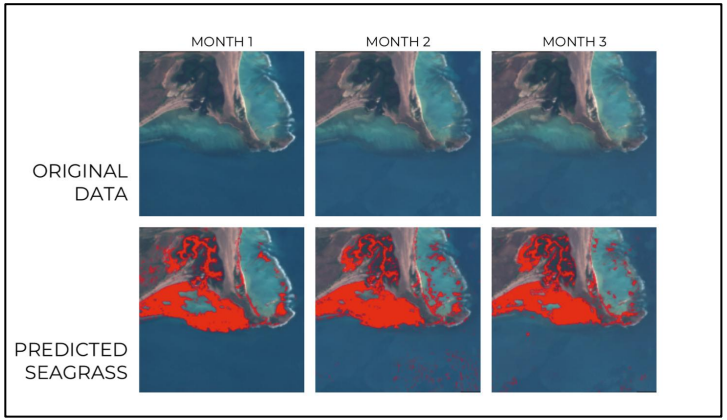
While prevention is undoubtedly the best approach to environmental disasters and harm, restoring formerly lost habitats is also crucial. Particularly in the case of eelgrass, taking donor sprouts and planting them in designated restoration sites can help rebuild natural ecosystems, in addition to generating benefits such as carbon credits and other ecosystem services. Specifically for the Aquarium of the Pacific, based in California, eelgrass is preferable compared to other popular choices such as mangroves and kelp. If the Aquarium is looking to generate blue carbon credits and additional benefits on top of conservation and restoring habitats, eelgrass and eelgrass restoration sites are worth investing into.

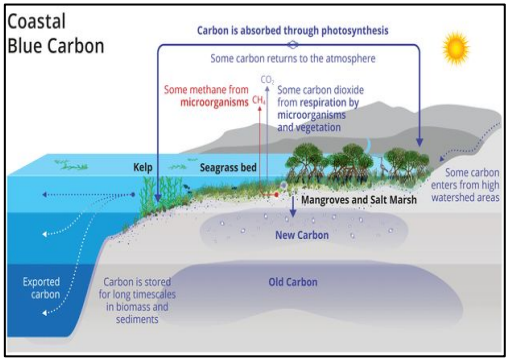
Carbon Collection Methods

- Utilizing a sum of above-ground carbon, below-ground carbon, and soil carbon; thus creating a carbon stock range

- **Machine learning** method established from Australia







Carbon Collection Methods

Within the research being conducted on seagrass restoration projects by scientists globally, there was little to no data on carbon storage. The methodology is well established enough to be set in stone and replicated for carbon stock ranges for all climates and species of seagrass. In order to set such a range, carbon must be collected within the water column, above the soil, in the soil as well as in the seagrass in order to create a complete range. In North Carolina, seagrass beds are declining at a rate 1.5% faster than the global average. And in turn developed North Carolina's first GGI for seagrass beds. They were able to do this by estimating the total extent of seagrass habitats by year, estimating carbon emissions and removals, and accounting for uncertain estimates. In 2021, seagrass in North Carolina sequestered 55 kilotons of Carbon. Future plans involve figuring out whether data is reliable enough to cover for years when there is lack of data. Based on what range is estimated, it can be implemented into this machine learning algorithm that will be adopted by the aquarium. It has the ability to portray the progression of seagrass extent in accordance to the speed rehabilitation from field data in tandem with climatic conditions and biodiversity fluctuation in order to generate a prediction map of seagrass month by month.

Benefits of Seagrass Restoration

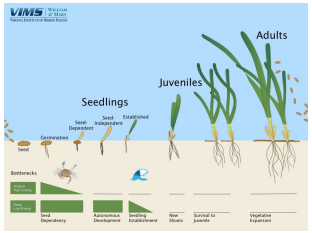
- 0.83 to 1.78 metric tons of Carbon per hectare per year sequestrated
  - Can store between 600-1000 metric tons long term
- Biodiversity
  - Improved water quality and coastal protection
- Blue carbon credits has a higher market price
  - Blue carbon credits: $20-40
  - Terrestrial carbon credits: $5-20
- Community and educational benefits
  - Future projects on seagrass restoration could involve volunteers from the community/help from schools

Benefits of Seagrass Restoration

Using multiple different sources such as the National science Foundation and the United States Environmental Protection Agency we averaged out the potential of carbon sequestration and found that on average seagrass sequesters 0.83 to 1.78 metric tons of carbon per hectare per year. This seagrass has a very high rate of sequestration when looking at the long term benefits. Carbon can be sequestered in seagrass for a couple hundred of years to over thousands of years. And the maximum carbon that the seagrass can hold is around 600-1000 metric tons of carbon per hectare. Volunteer help and the potential of that means the community can help become engaged along with various youth groups and students. All the while biodiversity benefits can be very high and help with the local ecosystem of the seagrass. Ecosystem benefits can be seen as protecting against storm surges, helping nurture the fish, and clean the waters. It can help clean the waters through keeping the sediment around the seagrass in a stable environment. Nurturing the fish can be through allowing the fish to prosper in an environment that also protects them from predators.

Complexities of seagrass restoration

- **Rate of seagrass growth and carbon sequestration**
  - At what maturity is the seagrass being harvested?
  - Growth at locations with no previous existing seagrass beds is unknown
- **Other Species can alter growth of seagrass shoots**
- **Effects on water quality and habitat loss**
- **construction**
  - Sediment will be moved around which could temporarily affect turbidity.
  - Effect on donor beds?
- **Cost?**
  - Where donor seagrass is harvested? Volunteer/community help? Do you monitor the donor bed environments? Long term maintenance?

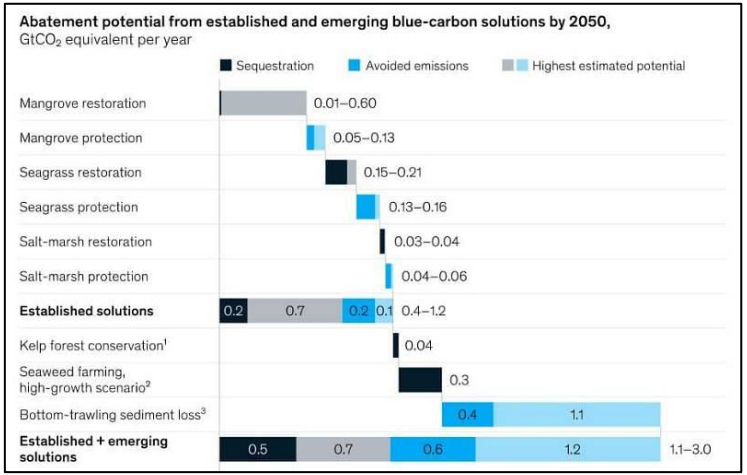


Complexities of seagrass restoration

There are many complexities of seagrass restoration and how it is going to be translated into carbon credits but also how consistent and efficient doing seagrass restoration is. Many issues of seagrass restoration revolve around how adaptable is the seagrass to the environment it is being taken to. In the channel islands restoration project done through the Santa Barbara Channelkeeper, there was a very high rate of failure as in a couple projects saw the death of every single seagrass shoot that was transported over. That was due to a couple of different factors such as other species knocking over the seagrass shoots or the seagrass being too mature and not being able to adapt to its environment due to it being too old and already has its niche environment that it is accustomed to. One of the issues that's talked about in the projects locally in Long Beach is the effects of urban activity. Kicking up sediment from construction which could affect turbidity and different annoyances such as boats or docks in the area affecting the seagrass in various ways of light pollution and actual pollution from humans in the surrounding area. Cost is also another big factor and will be crucial to see how that affects the possibilities of seagrass restoration given that there is many different processes for doing seagrass restoration effectively and efficiently while ensuring a probable rate of success for the seagrass.

Seagrass Restoration → Carbon Credits

- Multiplying the estimated minimum and maximum seagrass ecosystem extent with the corresponding areal carbon stock range
- Incorporating regional and/or county-specific carbon data
- The European carbon credit market price for one ton of CO_2 was 67.71 EUR, while the California market price was 26.93 EUR (September, 13th, 2022)

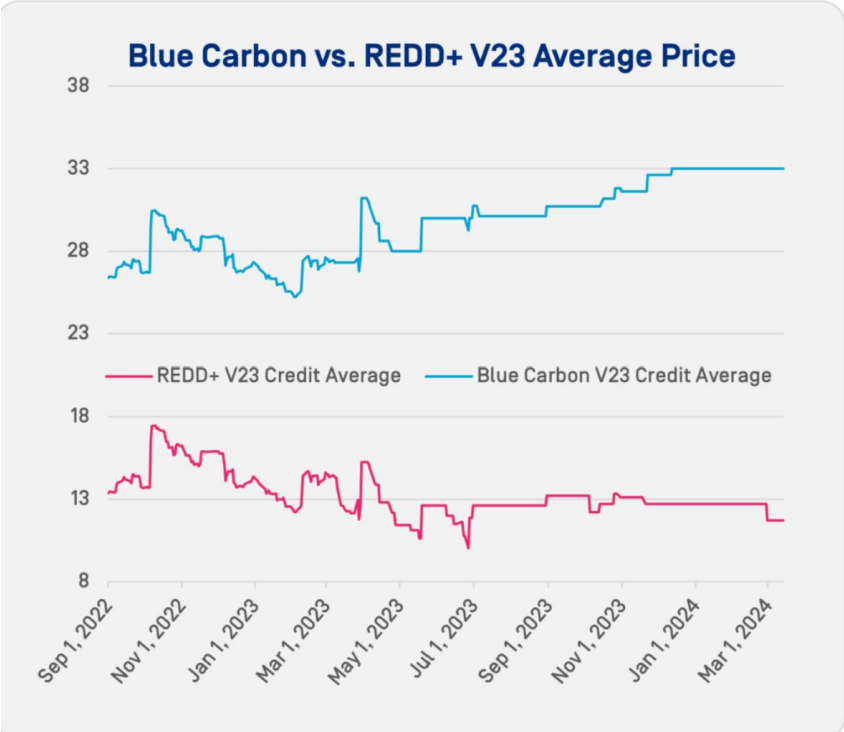


Seagrass Restoration → Carbon Credits

Existing blue carbon credits appear to command price premiums, suggesting that the potential of BC to raise finance could be substantial. The average price traded for BC credits is between USD 13 - USD 35, with some credits as high as USD 40 a tonne.[12] Our analysis of carbon pricing using data from Xpansiv CBL markets finds a weighted average price of USD 11.50 for forestry credits transacted in 2022.[13] This is consistent with other industry findings on the topic.[14] Owing to the small sample size of BC projects, we could not draw conclusions from the blue carbon credit price data in our own analysis. This is due to the distinct climates of the regions research, as it they are not identical to the temperate areas of our coast. The way seagrass fits into the greater scheme of blue carbon was estimated by researchers in the Caribbean and conducted a chart of abatement potential from all avenues by 2050. From that paper it also allowed for a greater range of potential for carbon credit prices for the sites we have in mind. The success of the restoration projects taken on are expected be able to reach the maximum potential for seagrass sequestration and the projections of abatement.

Seagrass Restoration and Carbon Credits Today

- Japan Blue Economy
  - Companies are offsetting their emissions through seagrass restoration
- North Carolina
  - University North Carolina created the first Greenhouse Gas Inventory (GGI) for seagrass beds in 2021
- Average cost of blue carbon credits have risen $5 since September 2022
  - Early stages of blue carbon result in wide range of prices per metric ton



Seagrass Restoration and Carbon Credits Today

Japan Blue Economy or the JBE is an example of a responsible way to kickstart blue carbon initiatives in a country. Many companies have already gotten involved with this program to offset their emissions. Companies such as J-Power in Japan used 16 tons worth of carbon credits through nurturing their own seagrass and had it authenticated through the JBE. Three companies bought carbon credits authenticated through the JBE and built by other parties were sold at around 500 dollars per credit which is a very steep price.

North Carolina was an example of blue carbon initiatives in the United States. University of North Carolina created the first greenhouse gas inventory for seagrass beds in 2021. This was important because it allowed for the quantification of carbon sequestration potential along with helping the advancement of blue carbon credits.

The average cost of V23 forestry carbon credits was around 13 dollars compared to the average V23 blue carbon credit which was 33 dollars. This number has risen over 5 dollars in just the past year. As blue carbon is still very new the average price will continue to vary amongst carbon credits compared to forestry carbon credits which appear to keep decreasing. Blue carbon credits will very soon find a median pricing.

Ideal Restoration Sites

Site	Organization	Pros	Cons
Santa Monica Bay	THE BAY FOUNDATION	- Current project - Potential for biodiversity credits - Detailed proposal	- No existing seagrass beds on chosen site
Alamitos Bay	COASTAL RESOURCES MANAGEMENT	- Location - Community aspect - Multiple projects? - Potential for biodiversity credits	- Size of existing beds - Populated area which may affect seagrass
Channel Islands	Santa Barbara CHANNELKEEPER®	- Size and scope of the project - Existing seagrass beds	- 2 decades since last project - Invasive species

Ideal Restoration Sites

The Bay Foundation project in Santa Monica Bay is a good project to look at. This is because its more recent, proposed in late 2021, and it takes around 306 sq meters to go to three different areas in Santa Monica bay. There are no existing beds in the area chosen for restoration, but pre-restoration baseline monitoring will occur prior to the implementation of the restoration project to allow a comparison of the pre- and post-project conditions of the area. Limitations are that even existing beds take a while to see growth. Non existing beds may take much much longer. How do past projects factor in? Can you sell carbon credits from last year that was restored.

Orange county coastkeepers did their project from 2011-2015. It is a Community project, and has existing beds to use proximity. SCCWRP and its partners have begun working to validate a newly developed computer modeling tool that predicts how algal blooms and turbidity in Newport Bay in Orange County can be expected to limit the potential for seagrass restoration at sites across the estuary. This species of seagrass grows in many areas of Alamitos Bay between the ocean entrance channel and the Cerritos Channel After the new dock is installed, eelgrass will be located within the boat slip section of the dock (Figure 3) and may be adversely affected by dock and vessel-related shading effects that in the long-term, may reduce the amount of on-site eelgrass. Based on the presence of eelgrass during the July 2008 eelgrass survey, 82 ft sq of eelgrass may be adversely affected by shading

Channel islands is also the site for a restoration project from decades ago. The Santa Barbara Channelkeeper was the group that ran this project and have restored acres of seagrass but not at a very high success rate. The seagrass restoration sites on the channel islands have had issues with the adaptability of the seagrass proving that there was not enough research done that resulted in the failure of seagrass growth. This project is old but also shows how important the site is and if it can promote healthy seagrass growth.

References

Seagrass Restoration Potential/Background:

- U.S National Science Foundation
- Bahamian seagrass extent and blue carbon accounting using Earth Observation
- Mangroves among the most carbon-rich forests in the tropics
- EPA Scientists Study the Carbon-Storing Power of Seagrass to Fight Climate Change

Blue Carbon:

- How North Carolina Incorporated Seagrasses Into Its Blue Carbon Inventory
- Why the Market for ‘Blue Carbon’ Credits May Be Poised to Take Off
- Carbon Storage in Caribbean Seagrass is Worth $88 Billion a Year
- J-Power, Apple and Mitsui O.S.K. give blue carbon credits a try
- High Costs, Geopolitical Risks Impede Blue Carbon Removal Projects

Restoration Sites:

- Santa Barbara Channelkeeper
- Ecoatlas
- Santa Monica Bay
- Orange County Coastkeeper

03 Biodiversity Credits

- What?
  - “An economic instrument that allow private companies to finance activities, such as forest conservation or restoration, that deliver net positive biodiversity gains” (WRI, 2024)
- Why?
  - Opportunity to increase funding (conservation)
  - Recognition for improving ecosystem health
- How?
  - Stacking!

Katie, Laila, Melissa, Vera

Voluntary Biodiversity Market

The voluntary biodiversity market is an emerging market throughout the world. Biodiversity credits would open the door for significant funding to be put towards conservation and restoration of our natural ecosystems, both terrestrial and marine. As of now, biodiversity credits are being approached as both mitigative for negative impacts companies may have on biodiversity, and voluntary. The mitigative side of nature credits can be quite dangerous, giving big companies the impression that they can damage the environment so long as they are offsetting it by restoring what they've damaged elsewhere. This can cause the destruction of vital ecosystems where the "fix" might be an incomparable restoration project. Companies like Verra and Plan Vivo ensure that the credits they are selling are of top quality, but there are other credits sellers that may not have the same dedication to our environment. We have been focusing on the voluntary aspect of nature credits, more specifically biodiversity credits. There are many buyers of credits, both large companies and individuals, that want to support positive nature outcomes for the benefits. Companies that invest in biodiversity can improve their reputation as environmentally conscious and retain customers. They also reduce their risk of regulatory exposure by being proactive on environmental protection, as new regulations are being introduced to move towards becoming a more sustainable country.

Where is the World at with Biodiversity Credits?

- Biodiversity credits
  - Not yet systematic
  - Companies navigating the market differently with different goals
  - Mitigation
- Terrestrial biodiversity credits are the main focus
  - Limited knowledge/research on crediting marine ecosystems
- Bloomlabs
  - Archives biodiversity credit methodologies
- Verra
  - REDD methodology
  - Baseline
  - Baseline for biodiversity credit standards
  - Rigor, transparency, robust

WORLD ECONOMIC FORUM

Global Pioneers

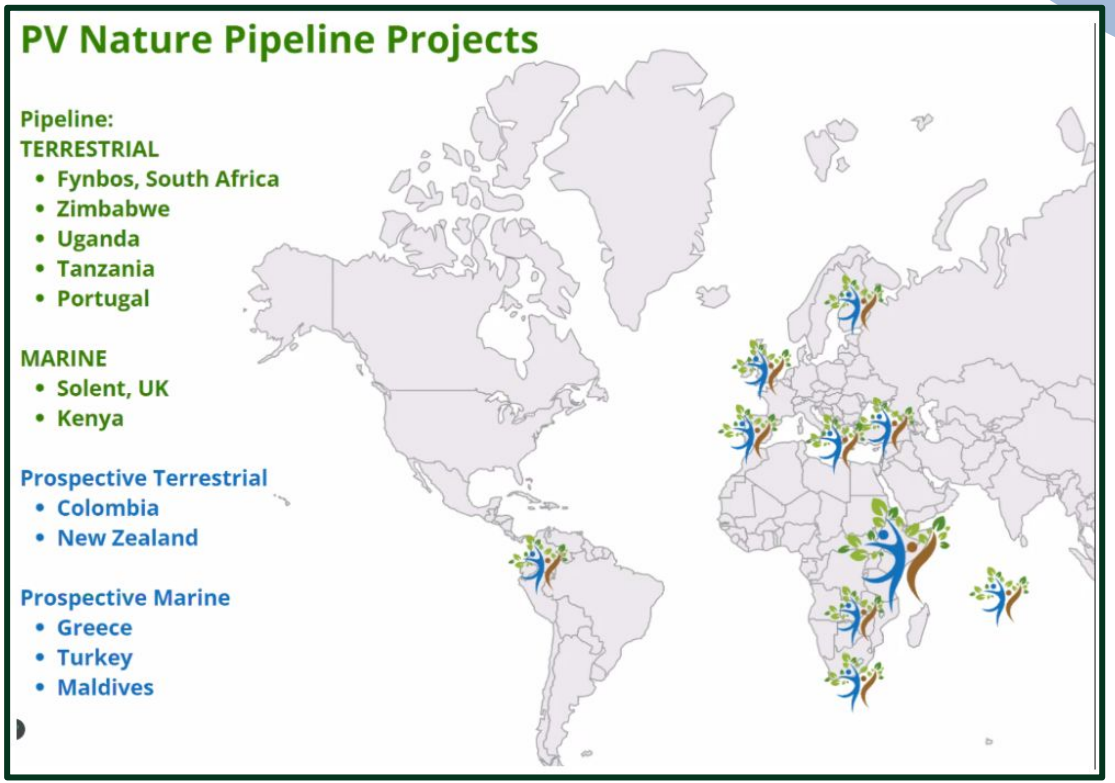
The Biodiversity Market is constantly developing and growing, even in the time we've been working on this project. Given this embryonic stage, there is not yet a systemic fashion to the crediting of biodiversity, especially when it comes to Marine Biodiversity Credits (MBCs). Different companies across the globe have varying goals. Wilderlands from Australia is looking towards the private land sector, encouraging landowners to protect land "One square metre at a time" to maintain biodiversity and the ecological services that come with it. A notable frontrunner for biodiversity markets is Verra, which is promoting a baseline for biodiversity gain and a standardized methodology that is robust in auditing and maintenance. Bloomlabs is another company that is interested in biodiversity credits, archiving methodologies that companies like Verra have created.

World cont.

Plan Vivo
- Also leading company
- Terrestrial and marine environments
  - Solent Seascapes
- Voluntary Carbon Market (VCM) Standard
- PV Nature Methodology

Biodiversity Credit Alliance
- Working with Verra, Plan Vivo, etc
- Cobenefit to carbon credits
- Biodiversity net gain in England

Terrasos
- Pilot projects selling biodiversity credits
- 12-square-yard plots, 30 euros per unit



More Emerging Companies

Another one of the companies in the forefront is Plan Vivo, who have made ventures into marine ecosystems. For one, the Solent Seascape project is a pilot project aimed at seascape recovery, which is taking place in the UK. There is also the mangrove restoration project in Honduras that is being used to test marine biodiversity credits as well. Plan Vivo's PV Nature biodiversity standard is aimed at delivering high integrity and quality biocredits in partnership with other companies: Fauna & Flora and Carbon Tanzania. Their Voluntary Carbon Market standard is also the longest standing standard in use for certifying smallholder and community projects, which makes them a very reputable trailblazer to reference. Looking south, we also see Terrasos performing pilot projects in selling biodiversity credits, using 12-square-yard plots and charging 30 euros per unit. The Biodiversity Credit Alliance is an organization that works with all of the previously mentioned companies as well as several others that aims to market biodiversity credits as a co-benefit to carbon credits. They are currently looking at biodiversity net gain and policies in England to modify their approach to biodiversity credits. While this is still a new and emerging field with few leads as to operating in marine environments, looking at the innovative companies helps guide our(and the aquarium's) decisions towards approaching biodiversity credits.

Marine Approach to Biodiversity (MBCs)

REGULATION

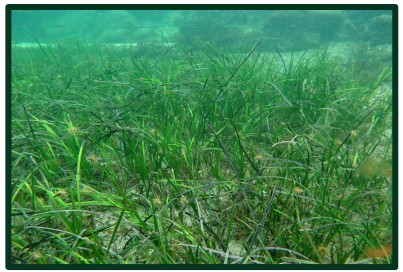
- Regulatory oversight
- Development of monitoring and enforcement protocols
- Routine inspections and audits
- Random sampling and data verification
- Refining monitoring and enforcement methods

POLICY

- Define clear objectives for MBC policy
- Develop legislation or regulatory instruments
- Engage w/ wide range of stakeholders
- Establish standardized methodologies for biodiversity accounting and credit generation
- Conduct public awareness campaigns and outreach activities

CONCEPTUAL

- Measuring seagrass species
- Ideally:
  eelgrass: *Zostera*
  surfgrass: *Phyllospadix*



DIFFICULTIES

- Visibility and mobility of species
- Technology not yet advanced enough
- No central database across projects for comparison

Steps for Marine Biodiversity Credits

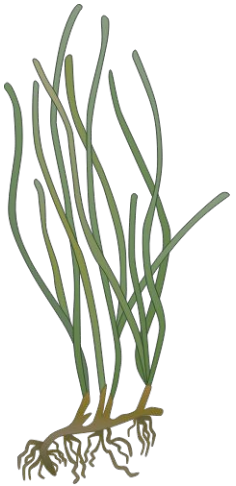
For the marine approach to biodiversity, which is also marine biodiversity credits or MBCs, there are currently no comprehensive global regulations specifically governing marine biodiversity credits or biodiversity credits in general, so regulation would require the creation of a specialized regulatory authority responsible for overseeing and ensuring that they're following at least the general credit regulations. This body would maintain strong oversight by conducting regular inspections, random sampling, and verifying data. It should also prioritize transparency by publicly sharing the monitoring outcomes and collaborating with stakeholders to improve regulatory efficiency. Refining monitoring and enforcement methods through adaptive management should tackle evolving issues and maintain the credibility of the MBC initiatives. The policy would aim to promote marine conservation, enhance biodiversity protection, and ensure sustainable use of marine resources.

Steps for Marine Biodiversity Credits cont...

Anyone aiming to use this method should be working on creating some new statutes or tweaking the ones we already have to make sure the MBCs are legal and fair. They would engage with a wider range of stakeholders from government agencies, industry reps, environmental organizations, indigenous communities, and the public. They would also set up criteria for assessing and measuring biodiversity, and figuring out who gets credit for what. Incentives will be used to get people excited about joining in and investing in marine conservation, these would be tradable credits, cash bonuses, tax breaks or subsidies. Public awareness campaigns and outreach activities should be conducted to raise awareness about marine biodiversity conservation and the role of MBCs, while adaptive management will ensure continuous review and refinement of the policy based on new scientific information, stakeholder feedback, and changing environmental conditions. Conceptually, they would be measuring the eelgrass species *Zostera* because it is most prevalent in the west coast and if needed, they could also potentially measure the surfgrass species *Phyllospadix* for the same reason however it is less prevalent than eelgrass. Some difficulties, as mentioned previously, is that their visibility and mobility make it difficult to accurately track and assess their populations. Current technology may not be advanced enough to effectively monitor and analyze them, limiting our ability to gather precise data on their distribution and abundance, and the absence of a centralized database across projects makes it challenging to compare data and assess trends in seagrass populations across different regions or time periods.

Blue Carbon and Biodiversity Credits

- The Santa Monica Bay Subtidal Eelgrass Restoration - The Bay Foundation
  - Assisting the credited restoration effort alters the process of receiving the credits as the aquarium is not simply offsetting biodiversity impacts
  - *What will be the aquarium's role?*
  - *Who will maintain the restoration site for credit permanence?*
  - *Would Coastal Commission approval be a problem?*
- Credit stacking and bundling in an emerging market
  - Blue Carbon + Biodiversity stacked credits

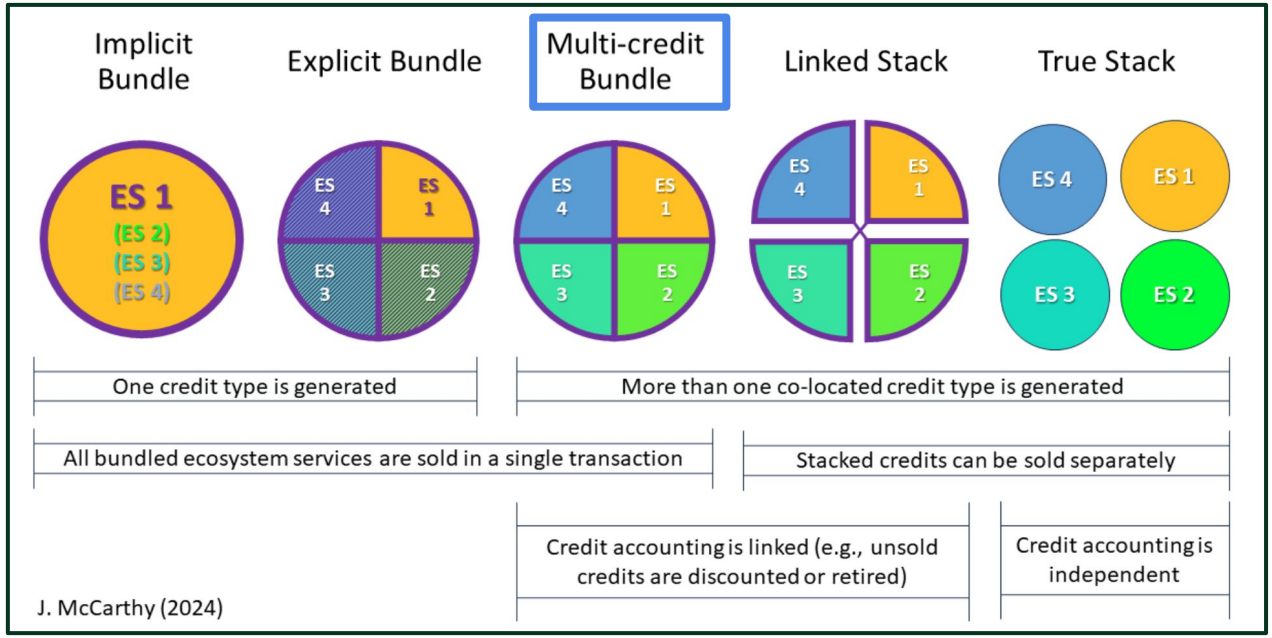


Potential Partnership

As per the Restoration Team's recommendations, The Bay Foundation is one of the Aquarium's best options for a restoration and crediting partnership as they have an existing relationship and invaluable experience in the field. The Aquarium is looking to assist the restoration of the eelgrass meadow, not simply purchase biodiversity credits to offset negative impacts. This alters the process of receiving credits because it is the Aquarium that will be funding and delivering the project, with prospects of partnering with another organization, such as The Bay Foundation. This pathway raises a few questions for the Aquarium to consider. *What will the Aquarium's role be?* The Bay Foundation has an understanding of how to establish a restoration site, but would the Aquarium be in charge of acquiring volunteers, or sourcing the eelgrass seeds/transplants? *Who will maintain the site for credit permanence?* The restoration site cannot be developed just to be left out for the elements. Ideally the site becomes self-sufficient in a number of years, but for now either the Aquarium or The Bay Foundation (or another chosen organization) would be required to maintain the site with new seeds, monitor for improved biodiversity, and ensure the longevity of the meadow in order to certify permanence of the restoration site. Without this permanence, there can be no blue carbon or biodiversity credits. *Would Coastal Commission approval be a problem?* We know that California Coastal Commission (CCC) can be a struggle to receive timely approval from, so those with experience working with CCC should consider any possible limitations that may arise in order to better mitigate the issues.

Stacking Without Unbundling

- Ensure the biodiversity credit cannot be exploited as we've seen in the carbon market
- "Address[es] the risks relating to lack of additionality, double dipping, and incomplete and asymmetrical accounting"
- One transaction and keeps the carbon and biodiversity credits together



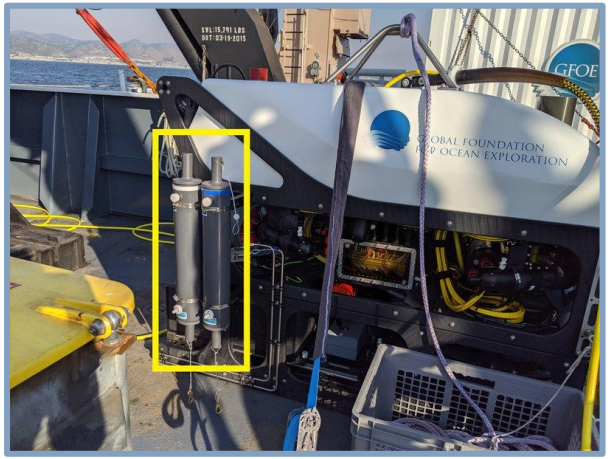
Stacking and Bundling

The most simple form of bundling is the implicit bundle. With an implicit bundle, the different credits are lumped into a single transaction since they are being developed at a single location, but they are not individually quantified. This means you cannot see the individual success of your credits.

What we would like to look into are multi-credit bundles. Another name for this type of bundle is “Stacking without unbundling.” This seeks more than one type of credit for the same location, or co-located, like our seagrass meadows providing blue carbon and biodiversity opportunity. Multi-credit bundles are also sold in a single transaction, but the accounting of the different credits are linked. This means that any credit that is not sold from the project site cannot be exploited and must be either discounted or retired. This method tries to mitigate any exploitative opportunities that have been observed in the carbon market such as double-dipping.
The ideal is to stack the blue carbon and biodiversity credits together because they come from the same site. If the credits were to be unbundled, or separated, there would be room for uncertainty and misuse of the credits. If we stack WITHOUT unbundling, the two credits are tied together for life and must remain so to avoid being taken advantage of.

Biodiversity Measurements

- Monitoring+methods
  - Important species
    - Video/Audio
    - Diving+visual
    - Counting eggs+juvenile species
      - e DNA
    - Fish sampling
- Difficulties
  - Visibility/mobility
  - Flush events in wetlands
  - Technology
  - Nomenclature/standard



Hypothetical Plans

Because there is no standard for biodiversity credits, that means that there isn't much guidance on what the aquarium should do when time comes to actually implement and pursue biodiversity credits. However, there are several key points that methodologies like Verra and Plan Vivo agree on. Important species(preferably keystone) should be monitored; in the case of eelgrass, juvenile fish and egg abundance would be a suitable direction. There are many different forms of motoring, such as video, net catching, or e-DNA. However, there are difficulties that come with these methods, particularly regarding that of aquatic environments. Most notably, visibility in marine ecosystems is low due to factors like turbidity. Marine species such as young fish also have high mobility and thus are harder to make visual recordings and data for. Wetlands also have seasonal flush events where mass deaths are seen in many species, which must be accounted for when considering project impacts on biodiversity. Technology is also not in the stage of mass production where equipment can be easily bought for a cheap price, and many monitoring systems will require larger portions of a hypothetical project budget. That being said, in order to ensure that an eelgrass restoration project can be used to generate biodiversity credits, a robust monitoring system such as sending divers to take visual count of fish species or using technology like e-DNA is necessary and beneficial in the long run, and can help restore habitats, in addition to generating future recognition and revenue for conservation projects.

References

Home | Biodiversity Credits. (n.d.). https://initiatives.weforum.org/financing-for-nature/home

Marine Biodiversity Protection Credit. (n.d.). Experiment - Moving Science Forward. https://experiment.com/projects/marine-biodiversity-protection-credit

NEWS | From Policy to Action: A Marine Biodiversity Credit Framework for the success of MPAs and Beyond - OpenEarth blog. (n.d.). https://www.openearth.org/blog/from-policy-to-action-a-marine-biodiversity-credit-framework-for-the-success-of-mpas-and-beyond

PDF: Biodiversity Credits: A Guide to Support Early Use with High Integrity WHITE PAPER DECEMBER 2023. https://www3.weforum.org/docs/WEF_Biodiversity_Credits_A_Guide_to_Support_Early_Use_with_High_Integrity_2023.pdf

PDF: State of Voluntary Biodiversity Credit Markets: A Global Review Of Biodiversity Credit Schemes. Pollination Group. December 2023. https://pollinationgroup.com/wp-content/uploads/2023/10/Global-Review-of-Biodiversity-Credit-Schemes-Pollination-October-2023.pdf

Plan Vivo launch pioneering Biodiversity Standard. (2024, May 29). Plan Vivo Foundation. https://www.planvivo.org/news/plan-vivo-launch-biodiversity-standard

Sarsfield, R. (2024, April 9). *Stacking and Bundling in Biodiversity Credit Markets — Environmental Policy Innovation Center*. Environmental Policy Innovation Center. https://www.policyinnovation.org/blog/beetles-in-a-pay-stack

Stawarz, S., & Stawarz, S. (2024, February 27). Biodiversity Credits and Conservation - The Conservation Foundation. *The Conservation Foundation -*. https://theconservationfoundation.org/biodiversity-credits/

Verra. (2023, December 19). *Setting the standard: Verra's Revolutionary New REDD Methodology - Verra*. https://verra.org/program-notice/setting-the-standard-verras-revolutionary-new-redd-methodology/