

## **Marine refugia: Are we overlooking the important role aquaculture farm sites can provide?**

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### **- Introduction**

Oceans provide critical life support systems for Earth. They generate over half of the oxygen we breathe through the production of photosynthesizing phytoplankton, tiny marine plants that live at the ocean's surface. Oceans contain more than 97% of the Earth's water, over one billion cubic kilometers. Ocean currents regulate temperature and weather by distributing heat across the Earth, and they absorb approximately 90% of the heat and 30% of carbon dioxide emissions from human activities. Oceans play a vital role in food security accounting for up to 50% of animal protein in developing countries. Marine compounds extracted from the Earth's oceans are used in biomedical research, critical medications, and treatments. Ninety percent of global trade is carried by sea. Recreational activities and tourism are enjoyed in beautiful and inspiring marine regions and contribute greatly to local economies and communities.

Yet we do very little to protect these critical environments. Only 2.4% of the ocean is fully or highly protected from fishing impacts through Marine Protected Areas. (<http://mpatlas.org/zones/>). Only 6.2% of national jurisdictions have marine protection. Only 7 countries and territories have protected at least 10% of their marine areas in implemented and fully / highly protected zones.

The United Nations Sustainable Development Goals (SDGs) have a goal specifically related to Oceans. Embraced by a wide group of participants: governments, non-governmental organizations and the business sector, goal number 14 is of particular interest to those of us invested and involved in the Blue Economy, particularly in tropical locations where reliance on the oceans is a critical factor in developing and emerging economies.

The reasons for our collective lack of action to protect our oceans are varied and diverse. Overlapping and contested international jurisdictions, competing local interests, lack of sufficiently robust scientific data and concerns about equity and access have all conspired to make it incredibly difficult for international bodies, national governments and local authorities to establish and maintain Marine Protected Areas (MPAs).

### **- Aquaculture as a Tool for Conservation**

At Cuna Del Mar (CDM) we believe aquaculture, especially deep water/open ocean aquaculture, can be a part of the solution to these problems and a vehicle for protecting more of the earth's marine environments. Our interest in deep water open ocean systems developed in response to challenges being faced by aquaculture operations located in near-shore environments. CDM, through our four farm portfolio companies: Earth Ocean Farms, Blue Ocean Mariculture, Sol Azul and Open Blue; our technology company Innovasea, along with the Cuna del Mar research arm, the Center for Aquaculture Technologies are early-stage pioneers in deep water open ocean aquaculture/mariculture and have developed significant knowledge about the advantages and limitations of deep-water fish production. ***And most importantly here - all of our companies have become important components of local efforts to conserve ocean ecosystems.***

Earth Ocean Farms is a CDM portfolio company producing a variety of finfish species in the Sea of Cortez, in the Mexican state of Baja California Sur. In 1997 the Mexican federal government implemented a system of designated protected areas as part of a national strategy to promote wildlife

management, biodiversity conservation, and rural development in Mexico. These areas are called Wildlife Conservation Units, known by their Spanish acronym 'UMA.' Earth Ocean Farms is in a special UMA designed to protect species at risk such as the Totoaba (*Totoaba macdonaldi*). As part of that responsibility, EOF manages biodiversity on the farm, restricts access to fishermen and ensures marine life is protected through careful monitoring and management of their farm site.

Sol Azul, SA, another CDM portfolio company, is a leader in the oyster farming industry in Mexico. Its farms are located on the Pacific coast in the El Vizcaino Biosphere Reserve. This important conservation wildlife refuge is at the center of the Baja peninsula between the Pacific Ocean and the Sea of Cortez or the Gulf of California. Declared a national biosphere in 1988, El Vizcaino has a landmass of over 2.5 million hectares (143,600 square km). It is the largest wildlife refuge in all of Latin America and the most diverse. As with Earth Ocean Farms, Sol Azul is actively engaged in managing the natural environment on their farms and in the biosphere and is a member of the technical management committee for the Biosphere Reserve.

In Panama, CDM owns Open Blue, a producer of Cobia located on Panama's Atlantic Coast. On the Pacific side of the Panamanian Isthmus is the Cordillera de Coiba Managed Resource Area, which was established by Panama's Ministry of the Environment (MiAmbiente) and the Smithsonian Tropical Research Institute (STRI), and with the participation of MigraMar Foundation. With this science-based initiative, 30% of the Panamanian marine surface on the Pacific coast is under some degree of protection. The Open Blue farm sites on the Atlantic Coast of Panama provide a parallel, albeit smaller, protected area. There, the environment is carefully monitored and the several hundred hectare ocean concessions are protected from any form of fishing or other extractive use.

Blue Ocean Mariculture, is a CDM portfolio company operating in Hawaii, USA. Blue Ocean Mariculture produces *Seriola* in offshore pens and, like Open Blue in Panama, has an additive effect to the state's effort to protect portions of its' marine environment. In Hawaii, Marine Protected Areas (MPAs) are a subset of Marine Managed Areas and focus on protection, enhancement, and conservation of habitat and ecosystems. In Hawaii, forms of MPAs such as marine life conservation districts have been in use for over 40 years. Blue Ocean's concession is managed similarly (restricting commercial fishing and other extractive uses), effectively adding to Hawai'i's inventory of MPAs.

In short, all of the CDM portfolio farm companies are either (in the case of Earth Ocean Farms and Sol Azul), actively participating in the management of an existing protected area or (in the case of Open Blue and Blue Ocean Mariculture) creating de facto MPA's that add to the inventory of protected area in a given jurisdiction with over 11,000 hectares as protected farm concessions.

#### **- The Benefits of Marine Protected Areas, and Aquaculture's Role.**

MPAs have many benefits for marine ecosystems. They protect important habitat and biodiversity in a natural state, provide refuge for juvenile fish to grow and recruit to fisheries, and create a spillover effect which increases fish populations in adjacent areas. But are there other benefits? And how do aquaculture operations fit into the MPA puzzle?

Proper siting of deep-water ocean farm sites requires that farms are located in areas of the ocean with minimal existing habitat. Open ocean farms are in areas devoid of reefs, seagrass meadows, and other natural habitats. This avoids displacing marine life because of the farm operations. ***This also means that aquaculture operations themselves become productive habitats.*** Structures associated with farming (pens/anchors/etc) provide shelter for marine organisms. Diverse species colonize the areas around the farm where formerly there was minimal habitat (1) (2). It is important to note that these habitat benefits extend beyond teleost fish.

There is good consensus among conservationists and fisheries managers that the physical environment created by oil rigs no longer in use creates biodiverse habitats that should be maintained and nurtured after rigs are retired. Through the United States Rigs to Reefs program as of December 2021, 573 platforms previously installed on the U.S. Outer Continental Shelf have been reefed in the Gulf of Mexico to support fish habitat.

Similarly, it is widely recognized that pelagic species associate with natural structures in the open ocean, such as logs or seaweed. Known as fish aggregating devices (FAD), these man-made structures are designed specifically to attract fish. At CDM farms we regularly observe marine mammals, sharks, seabirds and other organisms utilizing the environment around our farms. Effectively then, our farms serve as a form of FAD. Importantly, however, our farms cannot be targeted by fishing vessels. Moreover, fish farms can attract much larger biodiversity and biomass density than other habitats, including most MPAs, making them more effective in their role of protecting fish stocks and creating biomass overflow.

Some MPA's have very few fishing restrictions and allow sustainable fishing, while others restrict all fishing and are "no take" areas. At all the CDM farm sites, commercial fishing is forbidden by local law, making them the most protective form of MPA. Thus, in addition to the habitat benefits discussed above, the farm sites become refugia for all the species present on the sites. Moreover, the establishment of farms as no-take areas allows research personnel to track, measure, and study populations of fish and other organisms utilizing the sites without the confounding influence of fishing pressure. This can provide a source of valuable data for the scientific community.

Equally important, deep water/open ocean farm sites can provide a source of energy for the local ecosystem. When sited and managed properly, fish waste (feces) is dispersed at a relatively steady rate into a high-energy oligotrophic environment, providing an additional source of Nitrogen and Phosphorus for resident phytoplankton communities. Ultimately these inputs can encourage the production of additional phytoplankton biomass, which can, in turn, create ecosystem benefits with positive follow-on impacts. Most obviously, increased levels of phytoplankton biomass create additional trophic resources that can be exploited by organisms higher up in the food web. (3). Additionally, enhanced phytoplankton production can result in the sequestration of additional CO<sub>2</sub> from the earth's atmosphere. In short, the nutrients in aquaculture effluent aren't necessarily 'pollution'. In fact, with properly sited, managed and monitored operations, there is considerable evidence that the nutrient flows from fish husbandry operations can have positive impacts on the local environment. This is perhaps a controversial idea in some quarters, and we recognize that not all aquaculture sites are created equal, but we believe that in the CDM family of companies, our farms have the potential to be net positives for the marine biosphere.

Finally, marine habitats have different connectivity patterns than terrestrial habitats due to the density of water and varying current patterns. Most marine organisms have a free-floating larval stage so any reproduction (of fish, bivalves, crustaceans and other invertebrates) from a high-current environment will distribute to more varied down current locations. In this fluid environment fish farms act as source habitats that can support larval recruitment by providing habitat and structural protection for very young organisms.

## **- Conclusion**

All Cuna del Mar farmers agree that we need to reduce and/or eliminate the negative environmental and social impacts of aquaculture. We are working hard to reduce disease and parasites, eliminate escapism, improve fish welfare, minimize benthic effects and user conflicts, and increase farming efficiencies.

We also understand that diligent monitoring and management of potential environmental impacts is critically important to sustaining both the farms and the marine life it nurtures, and for realizing the full potential of offshore/deep-water aquaculture for habitat protection. In conclusion, deep water open ocean farming provides environmental and fish health benefits that should be considered as marine refugia. These benefits require substantial baseline data to measure and monitor potential effects. (4) Ongoing monitoring is also required to assess changes over time so that mitigation measures can be taken if needed. A study to systematically record marine life surrounding the farm systems in the four farm locations would also be useful.

With these prerequisites in place, all of our farmers are similarly convinced that deep-water/open ocean aquaculture has the potential to be a significant contributor to the world's collective efforts to conserve the marine environment and produce a reliable source of protein for people. Responsibly managed deep-water/open ocean aquaculture sites are good for people, good for fish, and good for ocean ecosystems.

Despite these benefits the public discourse around responsible aquaculture and offshore aquaculture is generally negative. The environmental costs of farms are discussed endlessly but very few policy makers take the time to discover the important ecosystem benefits that well managed farms can provide. At CDM we believe it's long past time for the government, scientific and environmental communities to stop overlooking the benefits farming brings and start working with farmers to expand best practices that benefit our oceans and each other.

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Appendix

(1) Pirrodi et al. 2011. Marine open cage aquaculture in the eastern Mediterranean Sea: a new tropic resource for bottlenose Dolphins. *Marine Ecology Progress Series*, 440:235-266.

(2) Machine et al. 2006. Fish farming effects on local fisheries landings in oligotrophic seas. *Aquaculture*, 261:809-816.

(3) Pitta et al. 2009, 'Ghost Nutrients' from fish farms are transferred up the food web by phytoplankton grazers. *Marine Ecology Progress Series*. 374:1-6.

(4) Welch et al. 2019, 'The nutrient footprint of a submerged cage off-shore aquaculture facility. *Journal of the World Aquaculture Society*. Vol 50, Issue 2 :299-316