

## **The Terra Sub Aqua aquaculture business model as a Commercial Sanctuary**

MPAs or SPAs are limited in the USA due to pressure from the needs of fishing interests, while there are unutilized ("motor through") zones adjacent to the reefs lacking cover for reef life. These desolate areas consist of flat beds of hash, sand, and silt which are usually deep enough to be capable of supporting vertically inserted supports like iron rebar that can withstand catastrophic storms. We use rebar supported rock stacks for high quality live rock production, configured into robust tripod structures 1-2 m tall above the bottom, with equal rebar insertion depths, filled with drilled substrate rocks, and arranged into highly productive reeflike spurs and patch areas reminiscent of the stands of *Acropora* that once dominated the Keys reefs.

The ecosystem responds to the higher relief substrate we install by first attracting settlement from the planktonic stages of marine life such as sponges, bryozoans, algae, shellfish, etc. As the substrate is gradually colonized, fish appear, using the structure for cover from predators, grazing, cleaner stations, spawning aggregations and brood nurseries, and over a 3-5 year period the area develops into a fully functioning ecosystem complete with apex predators such as Barracuda, rays, sharks, diverse reef fish, and numerous coral colonies. The aquaculture site is managed by us without fish collection so that biodiversity, abundance, and environmental services approaching those of the natural reefs are maintained or exceeded, benefitting our product quality. The site is also advantaged by being slightly deeper and further from shore than the adjacent reefs, which helps avoid land-based pollution and bleaching from excessive hot and cold weather spells. In this way the Terra Sub Aqua project sustainably provides reef habitat and environmental services as it improves live rock aquaculture. We supply the best quality live rock to zoos and educational aquaria for living reef displays.

We lease the sites we use from the U.S. Dept. of Interior, are permitted by NOAA, NMFS, FWC, and FL Dept. of Agriculture, and the area is patrolled by FWC, FMP, Coast Guard, and FKNMS personnel, whose efforts help us by inspections at sea. The requirement for any commercial vessel on the site is to have an original permit for that aquaculture site on board.

With over 25 years of experience, it occurs to us that the best long-term prospect for the success of this additional habitat might be as an MPA. This would further improve environmental services, onsite food fish production would spill over into the surrounding waters, and reef connectivity would be enhanced with more cover for marine life.

See [www.terrasubaqua.com](http://www.terrasubaqua.com) for some background, also at social media sites on Facebook and Google under the Terra Sub Aqua name. The developer is reached at [timbirth@gmail.com](mailto:timbirth@gmail.com), and collaborators are welcome. We are grateful for the early work of Ken Nedimeyer in live rock aquaculture, and for the encouragement of Dr. Sylvia Earle, that helps inspire our work.