

# SUSTAINABLE MARICULTURE POTENTIAL OF INFIERNILLO STRAIT, SONORA

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April 17, 2015 Draft

## SUMMARY

Flowing between *Isla Tiburón* and the *Comca'ac Ejido* in Sonora, the *Infiernillo* Strait is a unique habitat containing the largest seagrass beds in the Mexican Pacific. The area once had dense populations of turtles, and of *totoaba* (a now endangered endemic fish), both of which were overharvested and are now rare. The seagrasses and sandy sea floor of the Strait, and the estuaries that adjoin them, have dense populations of shellfish, including the endemic *callo riñon* and *callo redondo* (scallop-like bivalves), oysters, and sea cucumbers. The rocky areas of *Tiburón* are harvested for lobster; and the estuary mangroves and seagrass are crucial juvenile nursery grounds for the important rock lobster catch. The *callo* appear to be harvested more or less sustainably by the *Ejido*, while the sea cucumber is currently protected from harvesting. This report makes suggestions on how these valuable economic resources could be managed by the *Comca'ac Ejido* for greater productivity through the use of modern mariculture methods.

## ENVIRONMENTAL CONDITIONS

The *Infiernillo* Strait contains a unique set of environmental conditions that result in an exceptionally productive marine ecosystem. *Infiernillo's* valuable biological resources were essential for the *Comca'ac* people in the past, but have been affected by overharvesting, and could be threatened by unwise development projects in the future. It is crucial for the *Comca'ac* to understand these facts, and to manage their resources for greater productivity in the future.

Differences in the large tides at each end of the long, narrow Strait cause *Infiernillo's* powerful currents to be forced through a winding channel created by sand erosion. These strong currents provide the potential for generating large amounts of clean and cheap tidal flow electricity, some of which could be used to desalinate water. A proposal by *Tiburón Agua y Electricidad* to do so could result in the use of the *Infiernillo* Strait as a major source of electricity and water for the *Ejido*, Bahía Kino, the State of Sonora, Northwest Mexico, Arizona, and southern California, depending on the scale of development.

Forceful currents through the channel draw in nutrient-rich water from the deeper basins at either end, especially during the upwelling season; and as the result of strong tidal pumping, nutrients are drawn into *Infiernillo* at both ends. The fruitful waters of the Strait are tinted green by large amounts of suspended organic matter that provide food for a highly productive filter-feeding ecosystem dominated by *callo redondo*, *callo riñon*, oysters in deeper waters, and lush seagrass beds growing on top of the large, shallow sand banks, providing habitat for turtles, sea cucumbers, and juvenile lobsters. *Infiernillo* also has ten estuaries with mangroves, which are essential sea cucumber, juvenile fish and lobster habitat. These estuaries are very unusual in that they receive very little land runoff and are entirely fed by nutrients entering from the *Infiernillo* Channel. Any increase in sediments or sewage and fertilizer nutrients coming from inland watershed development should be avoided, as well as dredging in the *Infiernillo* Channel—which could negatively impact the abundance, productivity, and habitat of these valuable renewable resources.

## MARICULTURE POTENTIAL

*Callo redondo* and *callo riñon* are discussed together because they grow and are harvested together, and are the most valuable marine resource in the region. They grow very fast, due to the large amount of food; but their growth rate is limited by access to food supplies (suspended organic matter in the water). The ones on top get most of the food. By hanging them in mesh bags, the entire water column can be made productive. Since the bags can be harvested from boats, there is no need for fishermen to risk exposure to toxic oil fumes while diving with improperly filtered air compressors. *Biorock* Technology would no doubt greatly increase the growth rate of this resource.

Oysters (*ostiones*), once a well known product of *Infiernillo*, have been overharvested. Good habitat remains for them. *Biorock* technology has demonstrated a significant improvement in oyster settlement, growth, survival, and resistance to stress, and could be used to develop a productive oyster mariculture.

Lobster (*langosta*) are harvested in traps off rocky shores, mostly around the far side of Tiburón, but mangroves and seagrasses are essential habitat for their juveniles. Studies need to be done to see if adult lobster populations will increase by making *Biorock* habitat that will allow vulnerable juvenile lobsters to thrive by protecting them from fish predation.

Sea cucumbers (*pepino de mar*) of some twenty species formerly densely inhabited the *Mar de Cortés*, but have been greatly overharvested. Populations in the *Infiernillo* Strait have been protected, and need to be managed by using the modern methods of sea cucumber propagation that have been developed by Erik Hagberg of Pacific Aquaculture Cooperatives, and used to grow millions of sea cucumbers in Pacific atolls.

*Totoaba* (*totoaba macdonaldi*), once the most valuable fish resource, is now endangered, having been fished to near extinction. Studies by Juan Carlos Barrera of WWF, in

Hermosillo, provide a fuller understanding of how to protect the habitat and populations of this valuable fish—allowing it to recover and be sustainably farmed.

Small, hard coral skeletons of the genus *Porites* were found at several locations on beaches on both sides of south *Infiernillo*, where they had been washed on shore with sponges and soft corals. These are the northernmost corals known to occur in the eastern Pacific; and studies need to be made of their abundance, as they are the leading edge of the northbound coral colonization caused by global warming. *Biorock* coral projects could grow coral reefs and coral reef fisheries habitat along *Tiburón* Island.

## RECOMMENDATIONS

A geophysical survey of the *Infiernillo* Strait should be conducted with bottom penetrating sonar to determine sediment thickness and bedrock depth. This is especially essential at all sites where footings for marine structures are proposed.

Much more detailed, current meter studies are needed, including measurements at other times of the year and use of moored instruments to measure changes over annual cycles.

Water quality studies are needed, focusing on changes in water temperature, salinity, oxygen, pH, suspended matter, chlorophyll, nitrate, ammonium, and phosphate.

An assessment of the sea cucumber resource and potential for sustainable management is needed. Erik Hagberg of Pacific Aquaculture Cooperatives is recommended.

An assessment of the potential for restoring the *totoaba* population is needed. Juan Carlos Barrera of WWF, in Hermosillo, is recommended.

Pilot projects should be set up in the Comca'ac Ejido to develop mariculture using *Biorock* methods for the propagation of *callo redondo*, *callo riñon*, oyster, and lobster, and to train fishermen in their application. *Biorock* Technology, Inc. is ready to provide training and materials needed for the Ejido.

*Biorock* seagrass habitat restoration could be practiced in areas of damaged or eroding seagrass, to bring back turtle habitat.

In order to protect these valuable living marine resources and turn them into a far greater source of income for future generations, the *Comca'ac Ejido* should focus its development on the export of electricity, fresh water from the sea, sustainably managed and grown marine resources, and do its utmost to preserve and maintain *Comca'ac* land as unspoiled as possible.

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