Evaluating the role of an MPA on La Paz Bay, Baja California Sur, Mexico

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La Paz Bay Is located at southeastern coast of Baja California Peninsula into the Gulf of California. There is a wide continental shelf on the south, with deep waters on the north-central basin (Fig. 1). La Paz Bay is a semi closed body of water with the Espiritu Santo island separating the island from the Gulf of California. The island forms two mouths through which water flows inside-outside depending upon the seasonal currents in the Gulf of California.

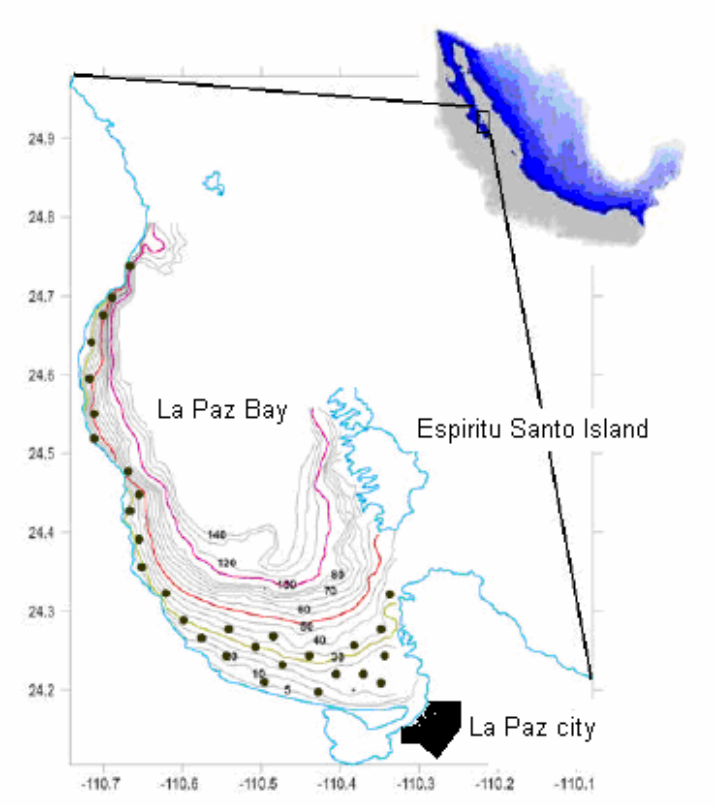

Fig. 1. Location of La Paz Bay showing isobaths of shallow waters

In November 2006 an area for protection of the biodiversity was established around the Espiritu Santo Island (Fig. 2) as a Espiritu Santo National Park (marine region); however there are not criteria to assess how such objective can be reached.

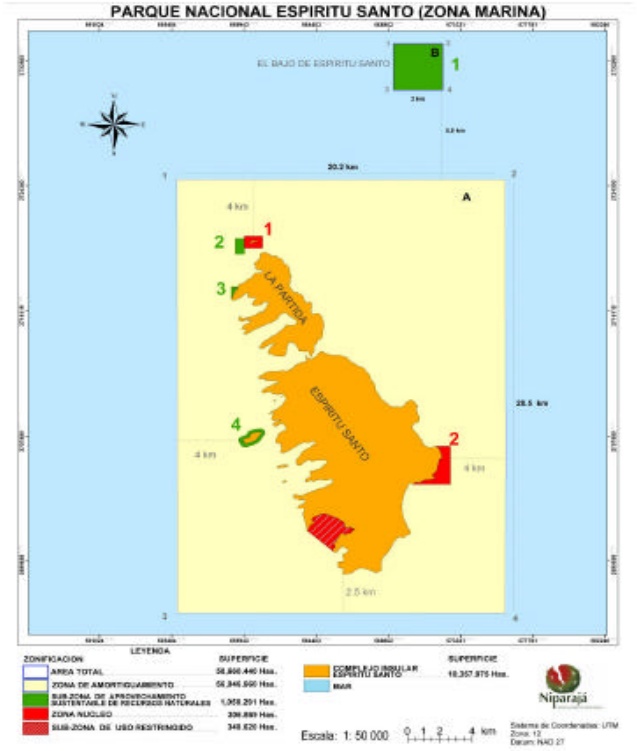

Fig.2 Area defining the Espiritu Santo National Park

It has been assumed that an indicator of conservation of natural diversity can be assessed through the measure of abundance of some “conspicuous” species such as sea lion, whales and birds, all of them uses for watching practices by tourism. However it is also expected that this MPA contributes to increase or at least keep stable the biomass of these key species, but also that fisheries banned in this areas will be reduced.

By the other hand it is also well known that the island is used by fishers as base place from which they go to fish to different areas, some of them insidebut other outside from the MPA.

Under these circumstances our objective is to explore the use of Ecospace as a tool to evaluate the role of this MPA.

Based on two previous models by Arreguín-Sánchez (2005) and Díaz-Uribe (2007) an improved trophic model for the ecosystem of La Paz Bay (Fig. 1) was constructed by adding explicitly new 15 groups. New information consists of data on demersal communities that are captured through a shrimp trawl net operated by small scale boats with out-board

engines. Present model consists of a total of 48 groups; 29 fish, 3 marine mammals, 2 sharks, 1 marine bird, 5 macroinvertebrates including clams, shrimp and cephalopods; as well as 2 for bottom epiphauna, 2 zooplankton, 3 primary producers and 1 detritus. Within this, model also include 20 commercial stocks captuted by 5 gears, gillnet, hook-and-line, diving, drifting nets and longlines target shark and small-scale shrimp trawlingnets (Magdalena I).

Spatial modeling initiated wit habitat allocation for each functional group. Table 1 shows how habitats were distributed between 9 habitats:

Table 1: habitat allocation for functional groups n La Paz Bay.

Group \ Habitat #	All habitats	arenoso (0-30m)	lodoso (30m)	rocoso	manglar	30-70m	70-200	200-400	400	Golfo
aves marinas		+	+	+	+	+				
leon marino		+		+	+	+	+	+	+	+
rorcual						+	+	+	+	+
delfines		+	+	+		+	+	+	+	+
huachinango A						+	+			
huachinango J		+								
meros de prof						+	+			
tiburones		+		+		+	+	+	+	+
meros		+		+						
Jureles		+		+		+	+	+	+	+
pierna						+	+			
cazon		+		+		+	+	+	+	+
pargos		+		+	+					
cochito				+	+					
perico				+						
sardinas	+									
dorado		+		+		+	+	+	+	+
grandes pelágicos		+		+		+	+	+	+	+
burritos - Haemulidae		+	+	+	+					
Taetrodontidae				+	+					
dem profundidad						+	+	+	+	+
Labridae (vieja)		+		+						
Priacanthidae (cardenal)				+						
Gerreidae (mojarras)		+			+					
Diodontidae		+		+						
Rhinobatidae		+	+		+	+				
Triglidae		+				+	+			
Batrachoididae						+	+	+	+	

Sparidae			+			+				
Ophidiidae			+							
Synodontidae			+					+		
Sciaenidae			+					+		
Ariidae			+				+			
Paralichthydae y Pleuronectidae			+		+			+		
Urolophidae			+				+	+		
calamar gigante								+	+	+
chocolata			+		+			+		
camarón café			+					+		
almejas			+		+			+		
cangrejos y pulpos			+		+	+		+		
infauna			+		+	+		+		
poliquetos			+		+	+				
zooplancton	+									
zooplancton gelatinoso	+									
fitoplancton	+									
prod bent prim pastos			+							
prod bent prim arrecifes						+				
detritos	+									

The construction of the base map consists in define habitat distribution (Fig. 3)., whike the area of protection is shown in figure 4

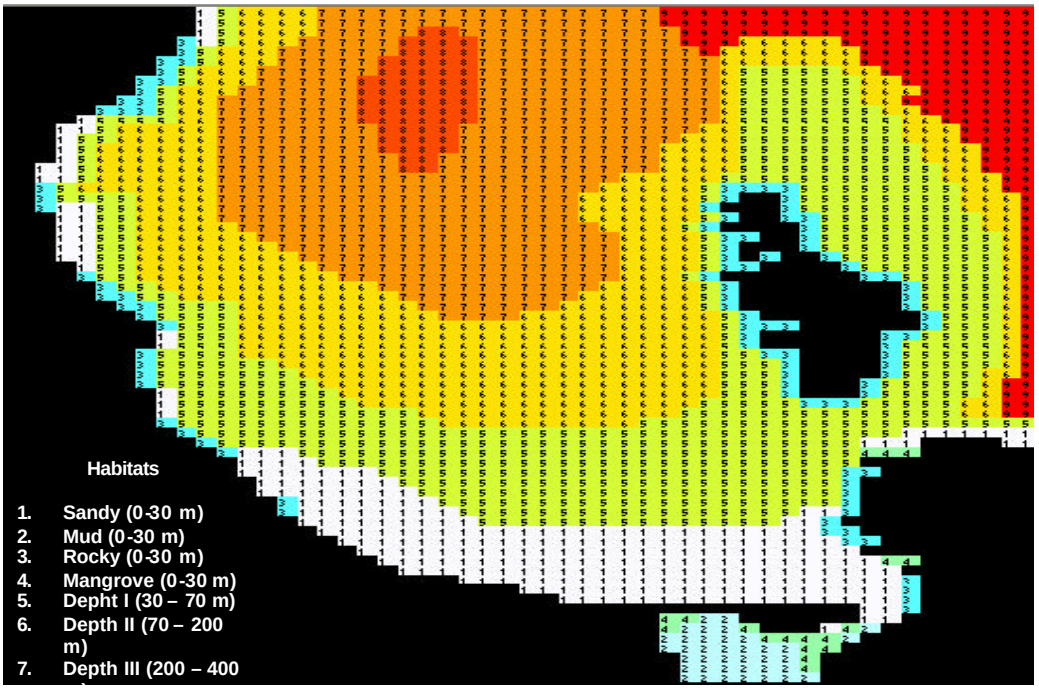

Fig. 3. Representation of habitat distribution in La Paz Bay.

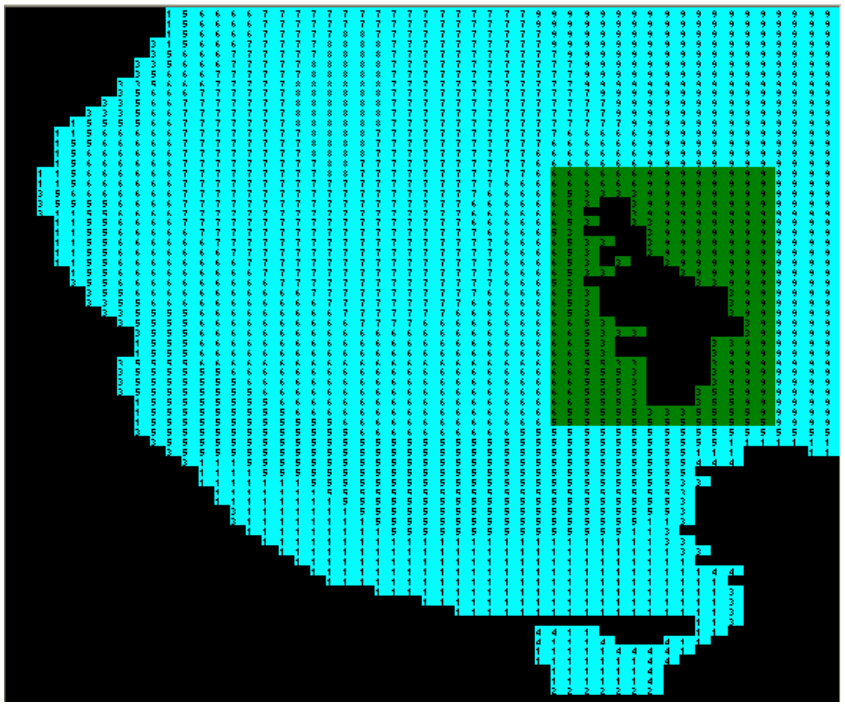

Fig. 4 shows the protected area for Espiritu Sano Islands (green area around the Island).

In order to consider the type of bottoms, particularly for demersal a species, we included y map of distribution of sediments considering them as regions (figure 5).

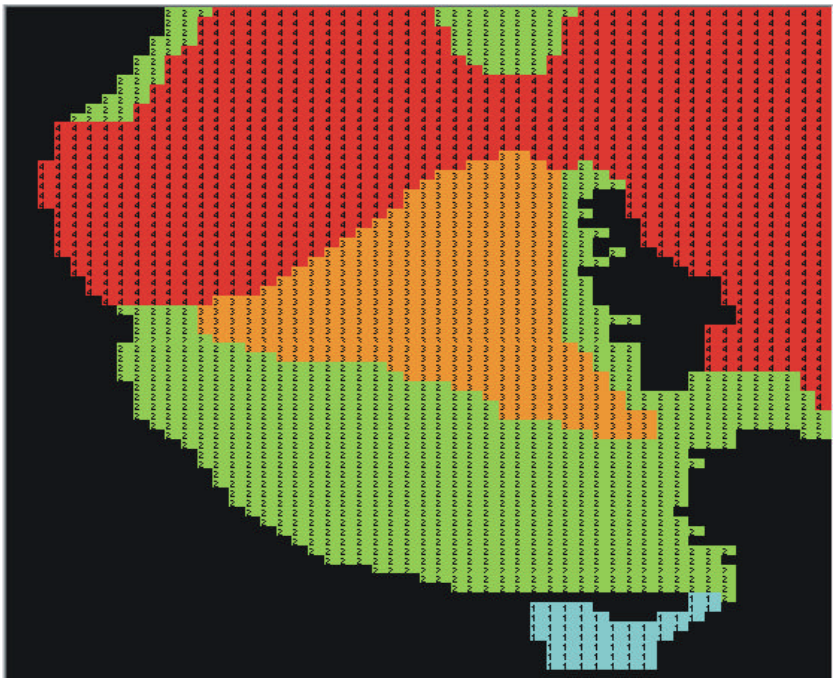

Fig. 5 Map representing regions within La Paz Bay, defined by the type of bottom. 1. Fine sand, 2. Gross sand, 3. Lime and 4. Not Defined (deeper areas with influence of the Gulf of California waters.

Using definition of the base map, two scenarios were developed in order to valorate the role of the MPA, a scenario without the MPA and another with implementation of the MPA.

Figure 6 shows distribution of biomasses for each functional group for the two scenarios, while figure 7 shows resulting distribution of fishing gears.

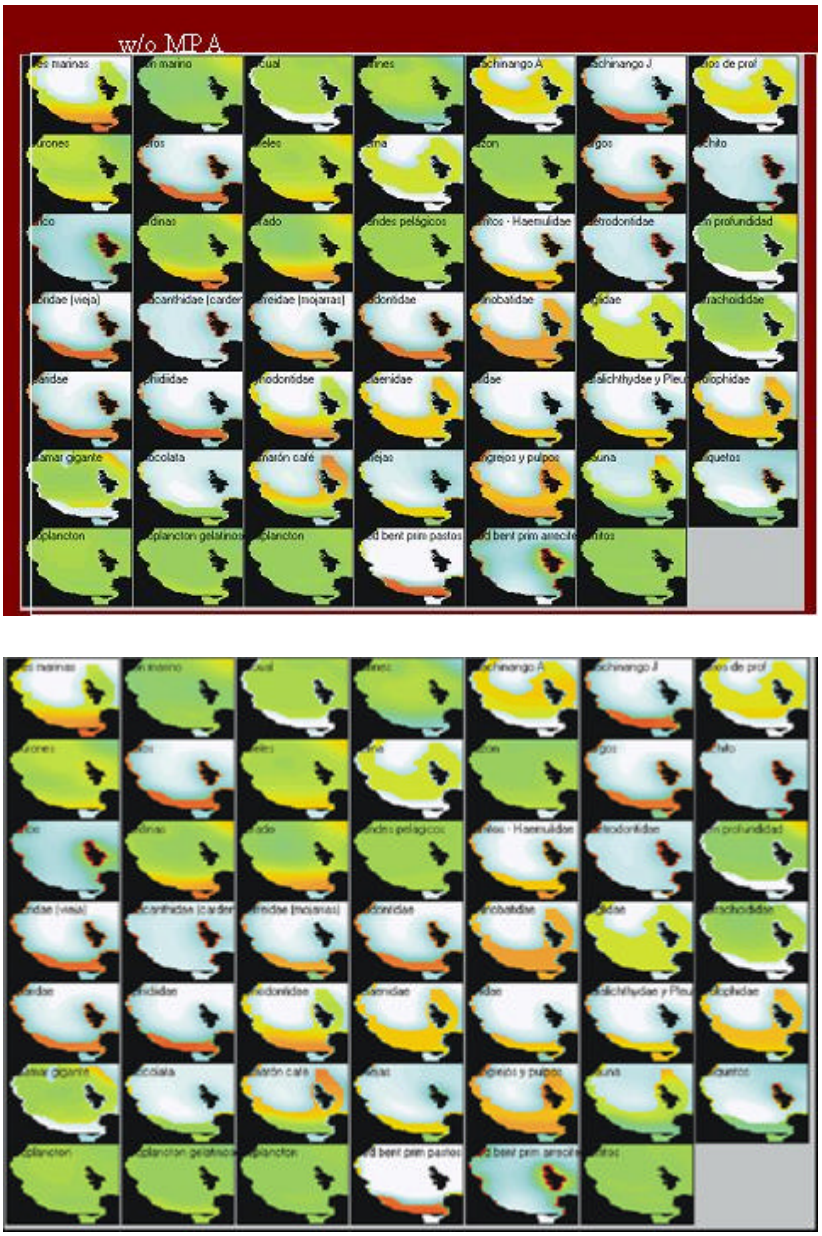

Fig. 5 Maps showing biomass distributions for the functional groups in La Paz Bay. Top panel whitout MPA (as defined in figure 4), bottom panel biomasses distribution with MPA.

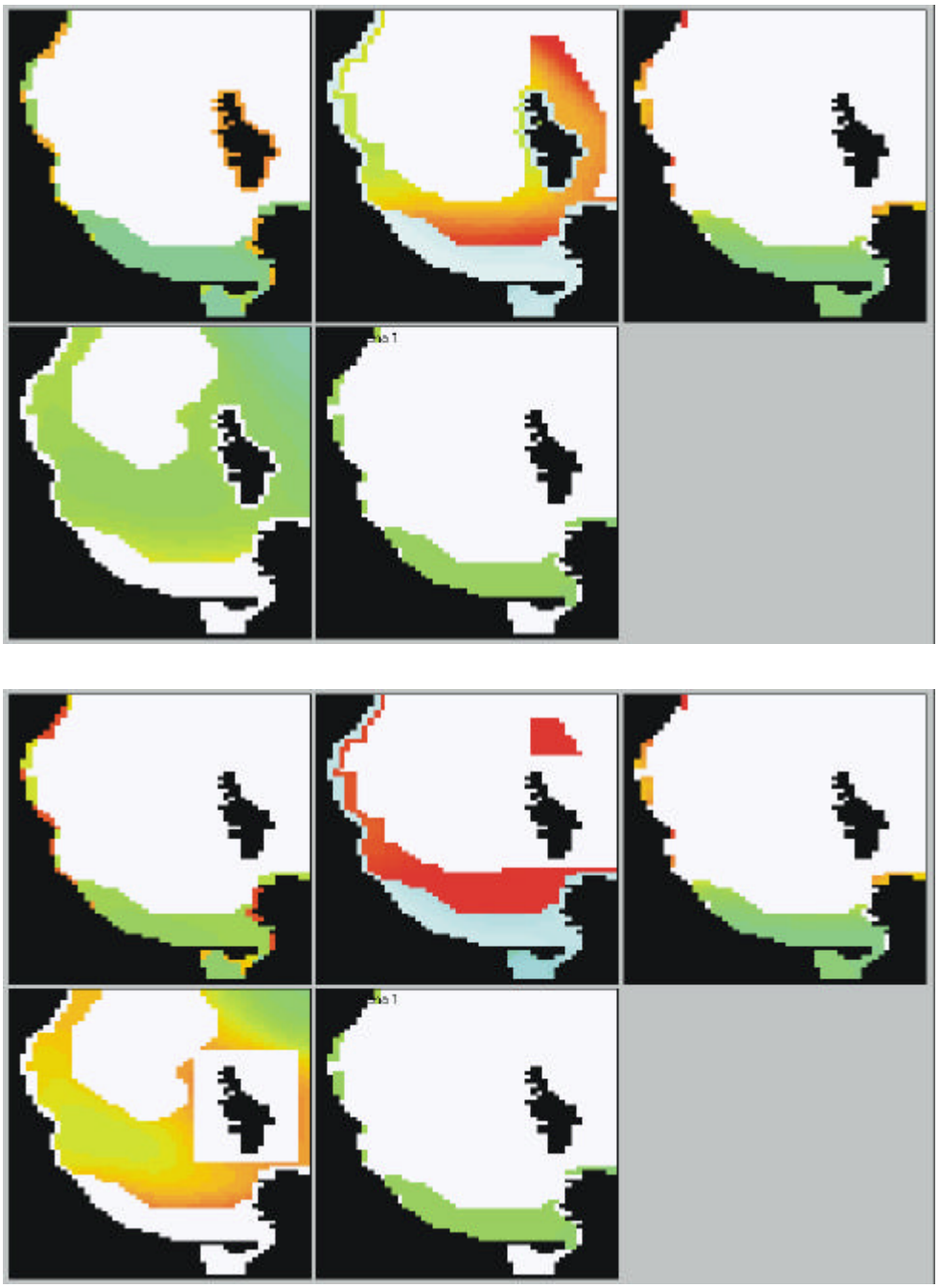

Fig. 7 Distribution of effort by fishing gear; without MPA (top<9<. And with MPA (bottom). From the left to right initiating on the top: 1) gillnet, 2) hook-and-line, 3) diving, 4) drifting nets and longlines target shark and5) small-scale shrimp trawlingnets (Magdalena I).

Simulations were conducted over a period of 20 years to evaluate the possible effect of the MPA. Figure 8 shows the tendencies in biomass for both scenarios for those species with interest for conservation.

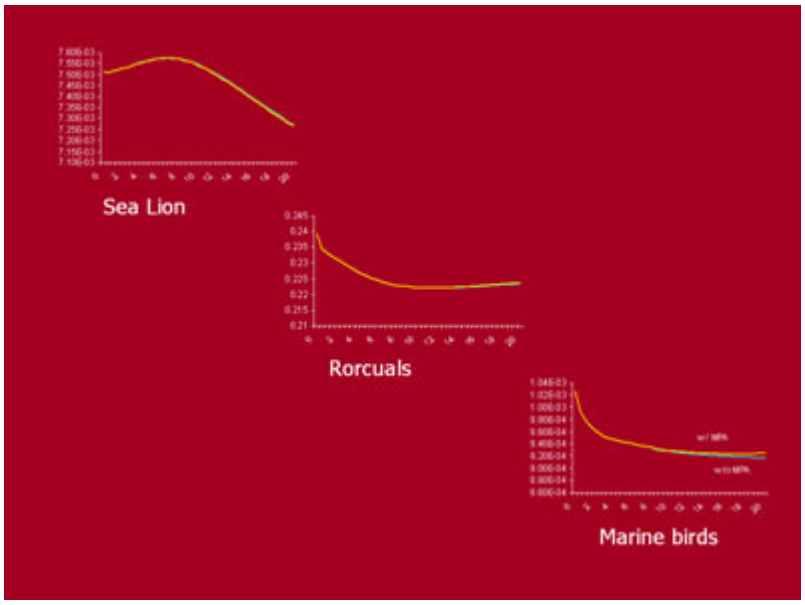

Figure 8. Changes of biomass with (orange) and without (blue) MPA for three species of interest for conservation in La Paz Bay

By the other hand figure 9 illustrates scenarios resulted on species with commercial interest with and without MPA.

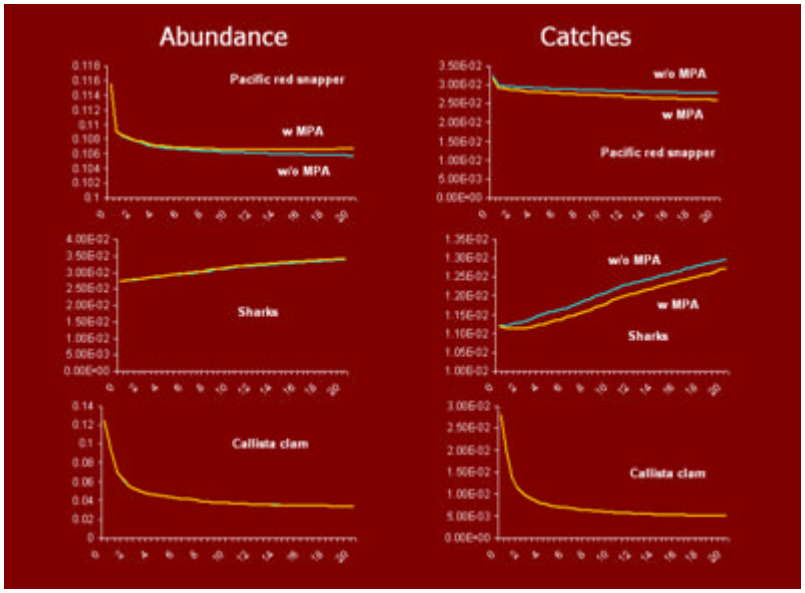

Fig 9. Changes of biomass with (orange) and without (blue) MPA for three commercially important species in La Paz Bay

Figures above show that the MPA as stated does not contribute with changes of the species of La Paz Bay ecosystem. There were only one species that exhibits positive changes in biomass with MPA, the Pacific red snapper, which is one of the most important commercial species.; however its catches decrease. This is probably because the prohibition of catching within the MPA. For other species, like sharks, apparently its catches are higher without MPA; this means basically that without an MPA sharks are more vulnerable.