

# Revisiting the Lobsters of Cayos Cochinos, Honduras After 20 Years of Protection

## Repaso a las Langostas de Cayos Cochinos, Honduras Después de 20 Años de Protección

### Revisiter les Homards de Cayos Cochinos, Honduras Après 20 Ans de Protection

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#### ABSTRACT

In 1993, the Honduran government designated Cayos Cochinos, Honduras and the surrounding sea a Marine Biological Reserve. Some areas within the Reserve were designated as no-fishing areas for lobsters. In 1997, a study was conducted to assess the condition of the lobster (*Panulirus argus*) population (Tewfik et al. 1998). In 1997, SCUBA divers counted, sexed, and measured the carapace length (CL) of all lobsters on 57 transects in coral habitat each covering 300 m<sup>2</sup>. In 2013 and 2014, we repeated the study with minor changes to the survey locations, and we increased transect area to 500 m<sup>2</sup> to reduce the probability of transects with no lobsters. The density of *P. argus* in 1997 was 19.9 lobsters/ha, and in 2013 and 2014 lobster density was 59.7 and 50.0 lobsters/ha, respectively. Increased abundance of lobsters in no-fishing areas was primarily due to increased abundance of lobsters below 60 mm CL; although, lobster density also increased slightly in the 60 - 80 mm and above 80 mm CL size categories. The average size of *P. argus* in the Reserve remained below the minimum legal size of 76.2 mm CL and the maximum size lobster observed in 1997, 142 mm decreased to 110 mm CL in our surveys. The size structure of *P. argus* observed in the no-fishing areas during both studies was more typical of fished than non-fished areas. The higher density of small lobsters in recent surveys suggest either less fishing pressure or better compliance with minimum size regulations; although changes in lobster recruitment or other ecological factors could produce similar lobster populations. Measurable changes in the density and size structure of lobster populations can occur in just a few years following the reduction or elimination of fishing. The increased abundance of lobsters and decreased presence of large lobsters in the Monumento Natural Marino Archipiélago Cayos Cochinos may reflect the typical dynamics for lobster populations in relatively small reserves with high fishing pressure in the surrounding waters.

KEY WORDS: Spiny lobster, Cayos Cochinos, marine protected area

#### INTRODUCTION

Caribbean spiny lobsters (*Panulirus argus*) are a dominant species on Caribbean coral reefs and have long been an important source of food for artisanal fishermen throughout the Caribbean. The high demand and high value of lobsters has resulted in decades of high fishing pressure may have been a factor in the decline of Caribbean-wide landings since 2000 (FAO 2007). The introduction of new technologies and fishing gear not compatible with coral environments have increased the degree and speed with which lobsters can be harvested leading to overfishing and damage to habitat. The Caribbean-wide trend in overfishing lobsters have their origins at the level of local fishery practices. Efforts to rebuild the regional lobster fishery might also benefit from better management at the local level. Sustainable harvest of lobsters was part of a broader ecosystem restoration plan for the Cayos Cochinos archipelago, Honduras; and after 20 years of adaptive management, we reassessed the lobster population and evaluated the effectiveness of the local lobster resource management effort.

According to local communities in the Cayos Cochinos archipelago, fishing declined in the 1980s and 90s when after several decades of artisanal and subsistence fishing, industrially-scale capture of fish, lobster, and conch for export increased (Andraka et al. 2004). Overfishing was implicated as the primary cause of diminished productivity in the area and the decline in the standard of living of the fishermen (Andraka et al. 2004).

Cayos Cochinos was declared a protected area in 1992, and the *Monumento Natural Marino Archipiélago Cayos Cochinos* was established in 2003. In 1992 in addition to many other resources protection measures, fishing for lobster was restricted by seasonal closures and prohibition of certain types of fishing gear and scuba tanks. Additionally, traditional communities were provided exclusive access to some areas (Arronne and Galo 2014). The main focus of the fishery management for the area is to maintain the natural structure and function of ecosystems and their productivity, while incorporating the human factor (Rico and Medina 2010).

The first fishery independent assessment of the lobster population in the Cayos Cochinos archipelago was conducted by Tewfik et al. (1998). Tewfik et al. (1998) produced what is now useful as a baseline survey to compare both lobster size and population abundance. A survey by Biosphere Expeditions in 2006 included a general survey of marine fauna and included density estimates for spiny lobster (Cubas et al. 2006). A fishery dependent survey of lobster size and catch frequency from traps was conducted in 2008 by Cayos Cochinos MPA personnel. This trap-based data will be very useful to compare lobster size and catch data from potential future trap-based surveys or data collected from interviews of fishers that utilize traps. The trap-based data was collected with sufficiently different methodologies and from different habitats that comparisons with the current diver-based surveys were not appropriate.

#### METHODS

Lobster survey methods were based on those developed by Tewfik et al. (1998). These methods included completing 57 transect surveys. Shallow and deep transects were completed at each site and the transects were 100 m long and 3 m wide, covering a total area of 300 m<sup>2</sup>. All surveys were conducted in reef habitat in what is now the *Subzona de No pesca de*

*Langosta* (SZC3) (Figure 1).

Survey design for the current project was modified from Tewfik et al. (1998) and included a slightly larger transect area intended to reduce the probability of not encountering any lobsters on the majority of transects. Data with an overabundance of zero counts of lobster can lack homogeneity of variance and have a highly skewed distribution prohibiting some rigorous analyses. Each transect was 50 m long by 10 m wide for a total transect area of 500 m<sup>2</sup>. In general, two random-direction transects were completed at each site. Forty-two transects were completed in 2013, and 38 transects were completed in 2014.

As for Tewfik et al. (1998), surveys for this project were conducted in coral habitat. Stratifying surveys by habitat type allows for greatly increased efficiency of sampling. Lobsters are nearly obligate-daytime residents of reef or other highly structured habitat during daytime. Many of the same sites as sampled by Tewfik et al. (1998) were sampled in the management zone *Subzona de No pesca de Langosta* (SZC3- No lobster fishing area), and we also sampled in two additional management zones:

*Subzona de pesca de escama y langosta restringida* (SZC5- Free diving area) and *Macrozona de Amortiguamiento* (Buffer zone).

Tewfik et al. (1998) captured all lobsters encountered and measured several morphometric parameters. This project visually assessed lobster sex, size, and reproductive condition of lobsters while underwater. Assessment of lobster size to the nearest 5 mm carapace length was facilitated with the use of rulers laid along the dorsal surface of each lobster (Figure 2). All divers were trained in this technique, and carapace lengths were verified by a second diver until lobster length was estimated consistently.

## RESULTS AND DISCUSSION

Lobster density was measured in the no-fishing zone in both the Tewfik et al. (1998) surveys and in this project in 2013 and 2014. It is preferable to measure lobster population parameters in multiple years, as lobster populations in fished areas can be highly dependent on a single year class and annual recruitment can be highly variable. Overall lobster density in 1997, which was essentially prior to the recognition of fishery management efforts, was 19.86 lobsters/ha in coral habitat (Table 1).

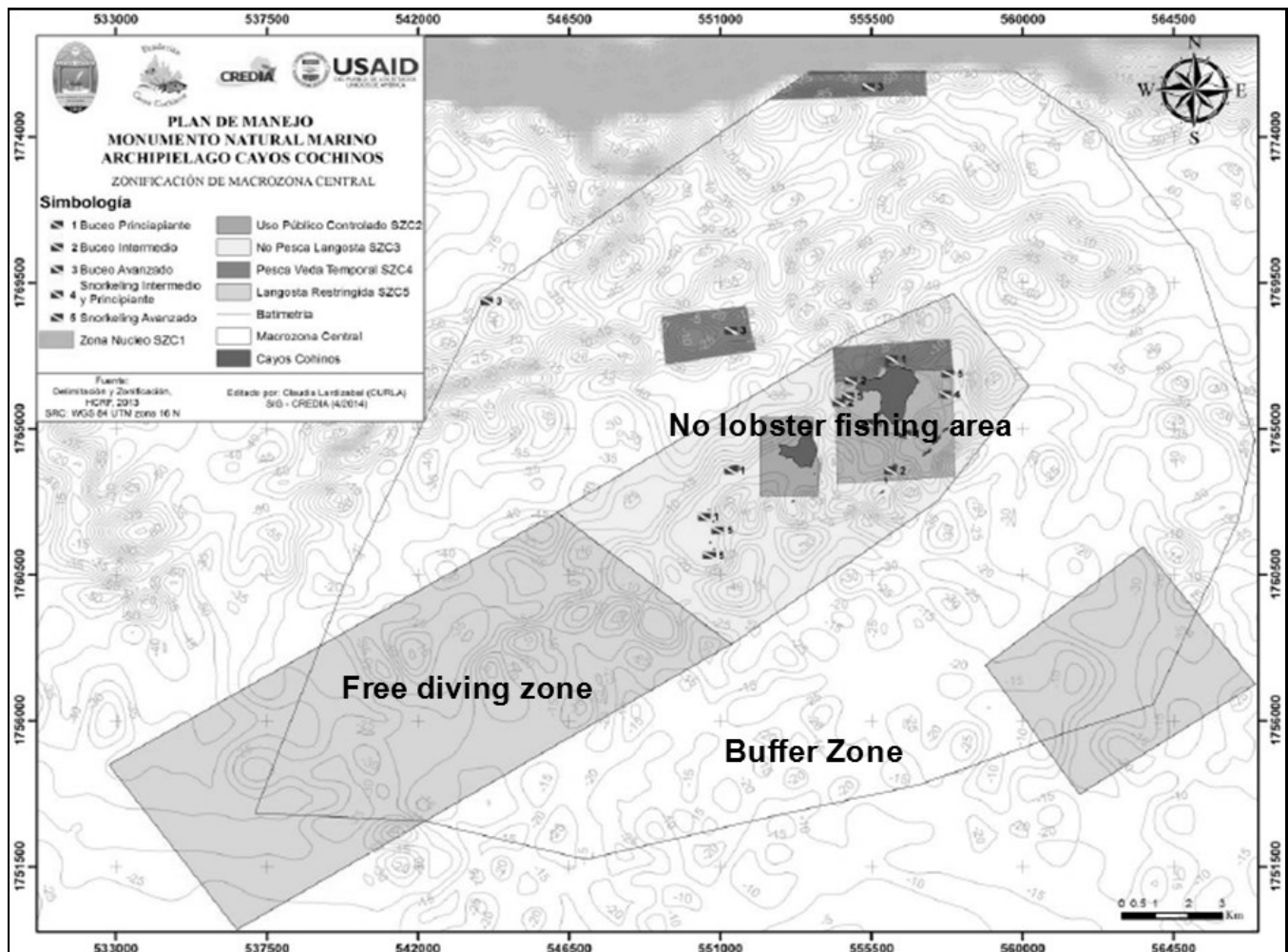


Figure 1. Management zones of the Monumento Natural Marino Archipiélago Cayos Cochinos.



**Figure 2.** Method to estimate lobster carapace length underwater.

This lobster density does not represent the entire no-fishing zone but only coral habitat in that zone. Habitat surveys of the Cayos Cochinos archipelago are insufficient to know the total area covered in coral so we cannot calculate the total number of lobsters in the no-fishing zone at this time. However, in the future, if better habitat surveys are developed we will be able to back calculate lobster abundance. Regardless, our surveys in 2013 and 2014 were sufficient to compare the relative change in lobster abundance from 1997. In 2013 we estimate lobster density was 59.7 lobsters/ha and in 2014 lobster density was 50.0 lobsters/ha.

Implementation of the no-fishing zone at Cayos Cochinos has resulted in a 2.5 to 3 fold increase in lobster abundance. The no-fishing zone has been described as predominantly an area for postlarval lobster settlement and juvenile lobsters (Andraka et al. 2004). The abundance of lobsters below 60 mm CL observed in both the Tewfik et al. (1998) and this survey support that characterization (Table 2). The greater than three-fold recovery of lobsters below 60 mm CL and intermediate size lobsters between 60 and 80 mm CL suggests that there has been increased protection for these lobsters that are predominantly below the current legal size 5.5 inch tail length, which is nearly equivalent to 76 mm CL. The lower recovery in abundance of legal-sized lobsters in the no-trap zone might be consistent with an area where lobster emigrate upon reaching maturity which can occur near the legal-size limit, but observations of fishing activity and observations of the remains of fished lobsters in the no fishing zone suggest

that fishing activity may still be preventing recovery of natural population abundance.

The natural abundance of lobsters is difficult to enumerate. Truly unfished populations of lobsters in areas of appropriate size to retain a lobster during its entire benthic life history are very rare. One of the oldest and largest established lobster no-fishing areas is the Dry Tortugas in Florida. Established in 1975 and encompassing some 26,000 ha, the Dry Tortugas National Park is occupied by predominantly adult lobsters and has a lobster density of 72 lobsters/ha (in coral habitat). Other smaller protected areas in Florida with predominantly adult lobster populations also had larger adult (lobsters over 80 mm CL) populations ranging from 69 to 145 lobsters/ha in Looe Key and the Western Sambos Ecological Reserve (Bertelsen et al. 2004). Abundance of lobsters in areas dominated by juveniles has been reported at much higher densities, but juvenile density is much more likely to be recruitment dependent, and direct comparisons of density between areas are likely less definitive.

Lobster density in fished areas is often influenced by the number of under-sized lobsters and should be unaffected by the fishery. In the Florida Keys, the abundance of lobsters in fished areas was 69 lobsters/ha (Bertelsen et al. 2004). Lobster density in the free-dive zone and buffer zone in Cayos Cochinos MPA were one-third to half that density. This suggests both relatively high fishing pressure on not only legal-sized lobsters but also on undersized lobsters. The size frequency of lobsters in all zones is highly skewed towards smaller lobsters. Very large lobsters were also absent from the surveys in 2013 and 2014. Maximum lobster size in 1997 was 142 mm CL and in 2013 and 2014 maximum lobster size was 115 mm CL. We also did not observe any reproductive activity in 2013 and 2014. The absence of reproductive activity in Cayos Cochinos MPA is a concern but should likely not be over emphasized given the relatively small number of adult-sized lobsters observed.

Lobster density decreased further from the lobster nursery areas surrounding Cayos Cochinos and the number of large lobsters increased (Table 3). There were relatively similar numbers of small, medium, and large lobsters in the free diving zone, but generally there were only larger lobster in the buffer zone which was geographically the furthest from Cayo Cochinos nursery grounds. The relative size distribution of lobsters suggests that there is lobster emigration from the nursery areas in the no fishing zone to the free dive and buffer zones.

**Table 1.** Lobster density (lobsters per ha) in Cayos Cochinos management zones in each survey year.

Survey Year	No Fishing Zone	Free Zone	Dive Buffer Zone
1997	19.9	x	x
2013	59.7	20.0	x
2014	50.0	31.3	36.4

**Table 2.** Lobster density (lobsters per ha) by carapace length (mm) in Cayos Cochinos no-fishing zone in each survey year.

Survey Year	Lobster Carapace Length (mm)		
	< 60	60 - 80	> 80
1997	11.68	4.09	4.09
2013/2014	36.44	14.41	8.47

**Table 3.** Lobster density (lobsters per ha) in surveys conducted in 2013 and 2014 by carapace length (mm) categories in each fishing zone.

2013/2014	Lobster Carapace Length (mm)		
	< 60	60 - 80	> 80
No Fishing Zone	36.44	14.41	8.47
Free Dive Zone	2.54	5.93	4.24
Buffer Zone	0.85	0.00	5.93

### CONCLUSIONS

Rebuilding the lobster population to the level that may maintain the ecological function of lobsters in a tropical ecosystem supports the overall decree of the *Monumento Natural Marino Archipiélago Cayos Cochinos* to preserve representative samples of marine biodiversity. Although not part of the lobster stock assessment and this project, consideration of the local fishing activities and history is a required component of the management plan to balance resource protection objectives with cultural norms in the community. Overall there has been a general improvement in the lobster population and likely the ecological function of the Cayos Cochinos archipelago. Specifically:

- i) The implementation of the no-fishing zone has allowed the number of juvenile lobsters to double or triple and resulted in a significant increase in lobster density in the core protected area of the *Monumento Natural Marino Archipiélago Cayos Cochinos*.
- ii) Lobsters in the no-fishing zone likely emigrate into the fished areas, lessening the effective protection of adult lobsters and egg production in the area, but providing improved fishing opportunity and harvest in the surrounding areas.
- iii) Fishing pressure in the free dive and buffer zone has likely increased since 1997, and the management area lacks sufficient large lobsters, potentially reducing the egg production in the MPA and limiting the contribution of larvae to the regional and Caribbean-wide population.
- iv) Local indigenous fishers have likely experienced increased landings in the open fishing areas near the no-fishing zone, but significant illegal fishing in the no-fishing zone and the harvest of under-sized lobsters in the fished areas likely continues to reduce potential yield in the local fishery.
- v) Fishery regulations and the lobster fishery management plan include: a closed fishing season, minimum harvest size, a no-fishing zone to protect juvenile habitat, and escape gaps in traps to prevent the retention of under-sized lobsters. However, it appears relatively common that these regulations had poor compliance. Lobster fishers were observed fishing in the no-fishing zone and during the closed fishing season. Traps without escape panels are typical. Although a full stock assessment is not possible, given the general paucity of adult lobsters it appears likely that the lobster population is experiencing overfishing and is overfished.

- vi) Through their participation in this project, staff of the Honduran Coral Reef Fund and local volunteers received training in lobster monitoring and gained experience by taking part in all sampling. They now have field and management capacity to continue with monitoring efforts and work towards implementation of the management plan.

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