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Evaluation of the spiny lobster fishery in the Galapagos Marine Reserve

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Introduction

In the Galapagos Marine Reserve (GMR) two species of spiny lobster (red lobster - *Panulirus penicillatus* and green lobster - *P. gracilis*) are fished commercially. Historically the lobster fishery has been of great economic importance to Galapagos fishers. Unfortunately, today the fishery shows signs of overexploitation because of the overcapitalization of the fishing fleet (Hearn *et al.*, 2006; Moreno *et al.*, 2007).

Management measures for the spiny lobster fishery in the GMR are established in the Fishery Management Chapter of the GMR Management Plan. These measures include: an annual 4-month fishing season; authorized fishing methods such as the Hawaiian sling, surface supply diving, SCUBA and free diving; a minimum total length of 26 cm for harvested lobsters; prohibition of catching gravid females; and the establishment of a total permitted quota based on an annual evaluation of the fishery and a population assessment.

Moreno *et al.* (2007) produced the most recent multi-season assessment of the GMR spiny lobster fishery. Since then technical reports have been prepared by the Galapagos National Park Service (GNPS) and the Charles Darwin Foundation (CDF) for the 2008 and 2009 lobster fishing seasons (Reyes *et al.*, 2009; Reyes & Schuhbauer, 2010). Hearn (2004) also did a population assessment for red and green lobster and for slipper lobster.

This evaluation of the spiny lobster fishery in the GMR examines the evolution of the use of different fishery and socioeconomic indicators from 1997 to 2011.

Methods

To evaluate the spiny lobster fishery in the GMR, eight indicators were used from various information sources during different periods of time (Table 1). Fishing capacity was based on the number and type of active fishing vessels during each lobster fishing season. The ratios of the number of active fishing vessels and fishers to the numbers listed in the GNPS Fishing Register were also calculated.

We calculated the catch of lobster tail in metric tons for each fishing season and by species. The catch per unit effort (CPUE) for each fishing season was defined as the catch in kilograms of lobster tail obtained per diver per day. It is noteworthy that from 1995 to 2006, the CPUE was calculated based on onboard observations and from 2008 on, the data was collected at the landing docks. Therefore, the CPUE values between these two periods cannot be compared.

Table 1. Time periods and sources of information for the indicators used to evaluate the spiny lobster fishery in the GMR.

Indicator	Period	Source of information
Number of active fishing boats	1997-2006	Moreno *et al.* (2007)
	2007-2011	Monitoring records – GNPS
Number of active fishers	1997-2006	Moreno *et al.* (2007)
	2007-2011	Monitoring records – GNPS
Number of registered fishing boats	2000-2011	Fishing Register - GNPS
Number of registered fishers	2000-2011	Fishing Register - GNPS
Weight caught	1995-2006	Moreno *et al.* (2007)
	2007-2011	Monitoring records – GNPS
Catch per Unit Effort	1995-2006	Moreno *et al.* (2007)
	2006-2011	Monitoring records – GNPS
Price	2001-2011	Database – GNPS
Commercial weight sent to the continent	1998-2011	Transport registers – GNPS

In terms of marketing, we determined the total number of kilograms of lobster tail that was exported to mainland Ecuador and the total by species. We also examined the relationship between the weight exported and the weight sold locally for each fishing season. Finally we obtained the annual price of a pound of lobster tail.

Results

Fishing capacity of the spiny lobster fishery in the GMR began to increase in 1997, peaked between 1999 and 2001, and then declined. The number of active fishers decreased nearly three-fold from the year 2000 to the present (Figure 1). The number of small fishing craft (speedboats locally called launches or fibras and dinghies or pangas) decreased nearly two-fold since the peak in 2001 and the number of larger fishing boats declined seven-fold from their peak in 1991 (Figure 2).

By 2011, the proportion of registered but inactive boats and fishers (passive fishing capacity) had increased to 61% and 60%, respectively, of all those registered (Figure 3). The passive fishing effort included 256 registered boats and 615 registered fishers, while the number of active boats was 164 and the number of active fishers was 408.

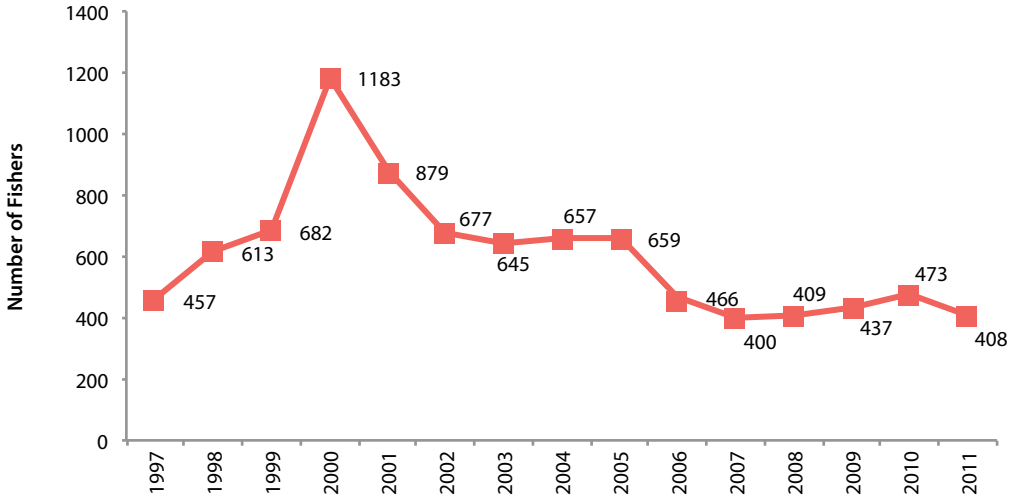

Figure 1. Number of active fishers during the lobster fishing seasons 1997-2011.

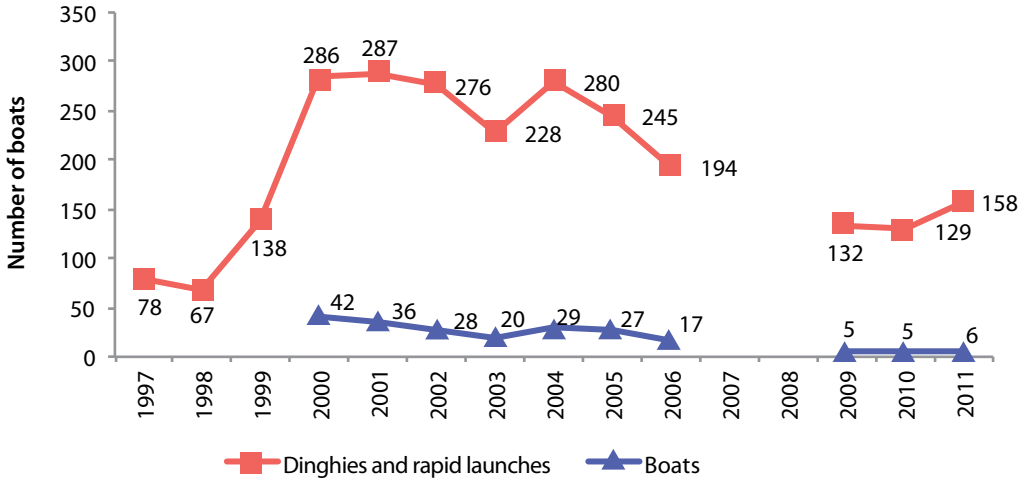

Figure 2. Number of active fishing boats during the lobster fishing seasons 1997-2011.

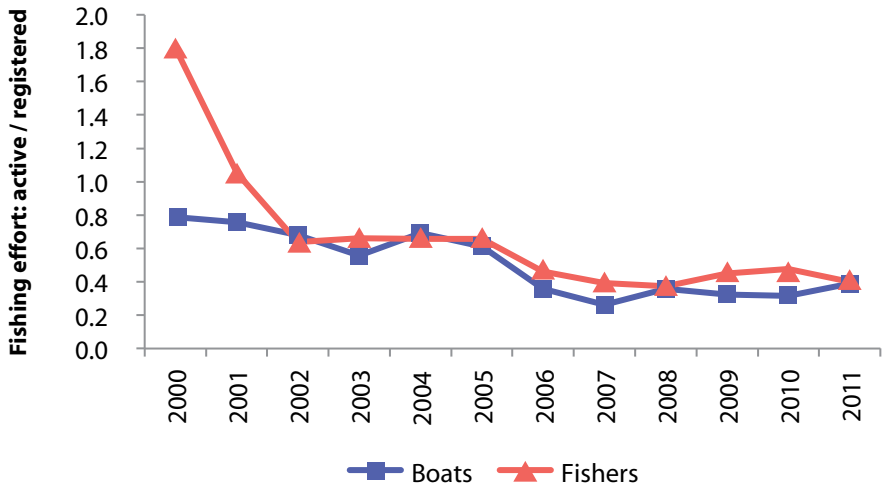

Figure 3. Ratio of active and registered fishing boats and fishers during the lobster seasons 2000-2011.

From 1995 to 2011, the average annual catch of spiny lobster in the GMR was 46.7 t. The last time that the catch was above the average was in 2003, although from 2009 to 2011 there was a surge in lobster catch (Figure 4).

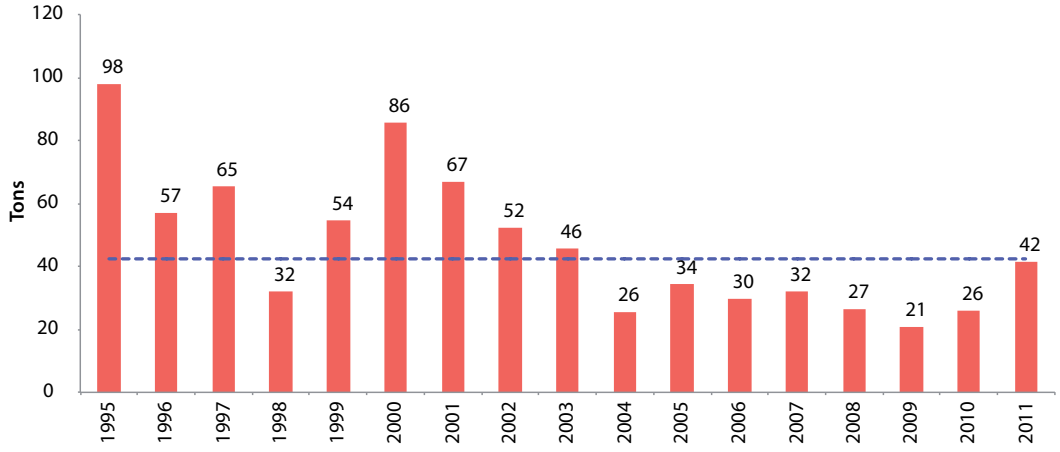

Figure 4. Total annual catch of spiny lobster tails from 1995 to 2011. Note: Pointed line indicates the average total catch during the period of study.

The CPUE for spiny lobster in the GMR decreased from 1995 to 2006 and then increased from 2008 to 2011.

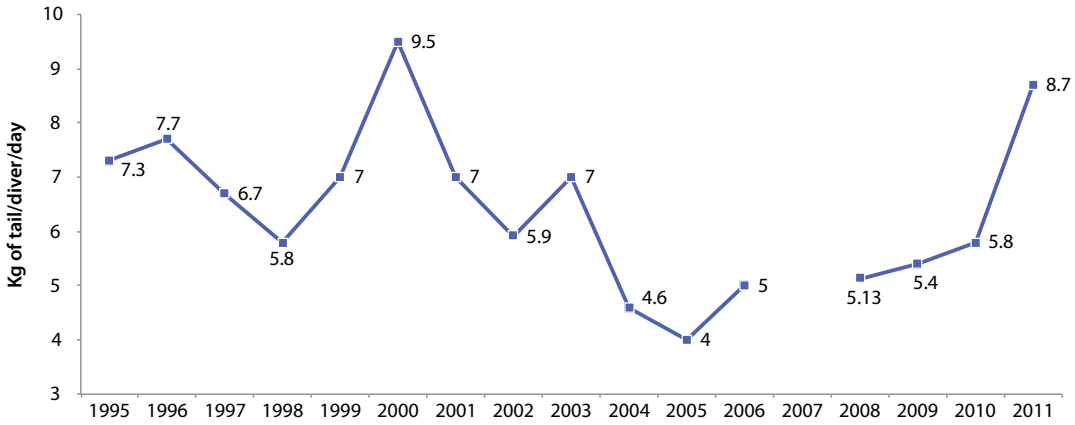

Figure 5. Changes in the CPUE of spiny lobster from 1995 to 2011 (unavailable data indicated by blank spaces). Data from 1995 to 2006 collected onboard and from 2008 to 2011 at the landing dock.

Until 2008 almost all lobster caught in Galapagos was marketed outside the archipelago. In the last three years this situation has changed with up to 53% marketed locally in 2009 (Figure 6).

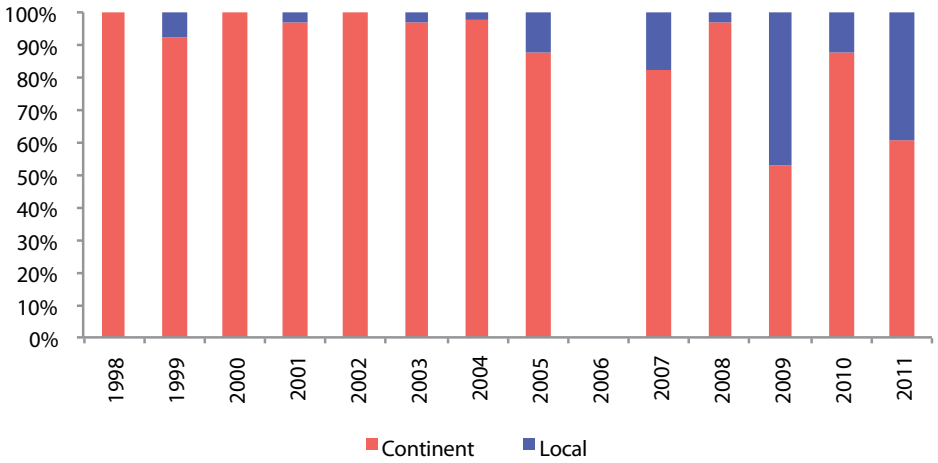

Figure 6. Proportion of commercial spiny lobster sent to continental Ecuador and sold locally from 1998 to 2011 (no information available for 2006).

Meanwhile, the average export price per pound of lobster tail in US$ in Galapagos decreased beginning in 2006, when the price reached its historical high of US$13 (Figure 7). The biggest drop in price occurred in 2009, when a pound of lobster tail cost only US$8. Since that time, the price has recovered slightly but not to historical levels.

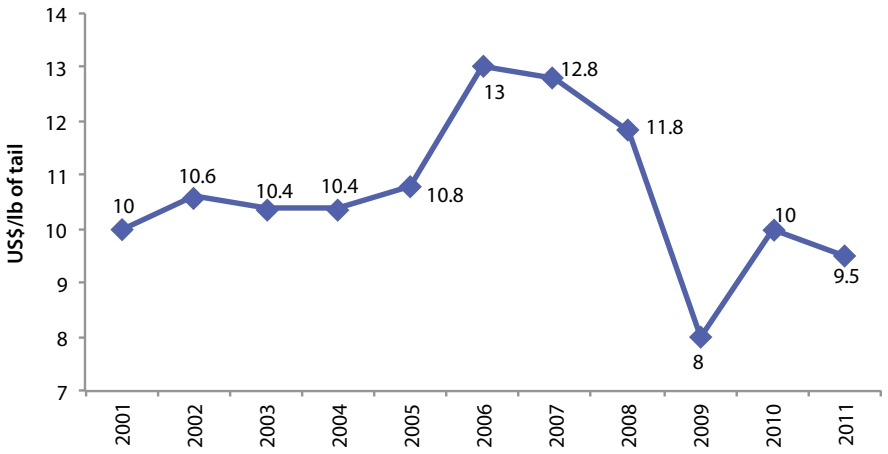

Figure 7. Changes in the price of spiny lobster tail from 2001 to 2011.

Discussion

In recent years there has been an increase in CPUE for spiny lobster in the GMR. This indicator suggests that the resource has the potential to recover. While insufficient evidence exists to determine the exact causal relationship between each factor and the CPUE, it is possible that the increase in CPUE is related to the reduction in fishing capacity, the drop in international prices, and/or environmental factors.

The results did show a relationship between the decline of fishing capacity and the increase in the CPUE for spiny lobster. This reduction of fishing capacity may be due to several factors, one of which is the currently existing moratorium on new fishing licenses (except for direct descendants of fishers) or permits for fishing boats by the GNPS.

Despite this reduction in fishing capacity, it is critical to be aware that there is a passive fishing effort that could be reactivated at any time, which would negatively affect resource recovery. This passive fishing effort is a result of the high percentage of fishers listed in the GNPS Fishing Register that is not currently active (61%).

The declining market price of lobster is another factor that may have contributed to an increased CPUE. The decrease in this indicator showed a relationship with resource extraction, which suggests that enough lobsters were left in the ocean to enable population recovery. As the profitability of this fishery declined, many fishers decided to focus on other fisheries or on activities other than fishing (Castrejón, 2011*a*). However, at the time nearly all of the lobster caught was sold as lobster tails to the markets in the Ecuadorian mainland and therefore the income of fishers depended directly on the international price, whereas a local market, independent of the international price, might have provided greater income.

A change has been observed since 2009; when the price for lobster tail on the continent reached a record low, sales within the local market rose. Whole lobsters are primarily sold locally, at a price of US$10 to US$25 per lobster, depending on size (Velasco *et al.*, 2012). The study also indicated that the lobster market in Santa Cruz has high potential demand, resulting primarily from tourism, so it is very likely that the local demand will continue to increase.

If price determines the level of resource extraction, as has been suggested, then higher prices may result in increased lobster harvests, which in turn could negatively impact the recovery potential of the lobster population unless specific measures are taken. The main obstacle to resource recovery is the "race for fish" that currently prevails in the fisheries of the GMR. This race for fish occurs when fishers compete to harvest as much of the resource in as little time as possible. This results in short-term, individual interests (e.g., income) taking priority over long-term common interests (e.g., resource recovery) (Seijo *et al.*, 1997). Several authors suggest that it is necessary to implement measures that provide incentives for focusing fishing efforts on quality not quantity, to slow down or stop the race for fish (Charles, 2005; Defeo & Castilla, 2005). Castrejón (2011a) presented a proposal for a new system of user rights for the GMR that is designed to reduce the race for fish, which is supported by one of the goals of the Fishery Management Chapter of the GMR Management Plan.

Environmental variables were the third factor that may have contributed to the increase in the CPUE for lobster in the GMR. This is reinforced by the fact that in 2011 the high lobster catches that occurred in the Galapagos also occurred in other regions of the eastern Pacific, such as Baja California, Mexico, and Juan Fernandez, Chile (Crown, 2011; Pérez, 2011). Additional studies indicate changes in population parameters, such as mortality, growth, and size at maturity, that are directly related to sea temperature (Howell *et al.*, 2005; De Leon, 2005).

Recommendations

To take advantage of the recovery potential of the spiny lobster and to assure sustainable use of the resources of the GMR, we recommend the following:

- Structure the GMR Management System of the GNPS according to current fishing effort and current management of fishery resources.

- Stop the race for fish for spiny lobster in the GMR by encouraging quality over quantity using two methods: 1) add value to the whole spiny lobster in the local market following the recommendations of Castrejón (2011*b*) and Velasco *et al.* (2012), and 2) comply with the goal of the Fishery Management Chapter of the GMR Management Plan in terms of implementing a new system of rights of use following the recommendations of Castrejón (2011*a*).

- Conduct annual population monitoring of spiny lobsters in the GMR that are independent of the fishery and improve the GNPS's current collection of fisheries information, including biological and socioeconomic data as well as data on lobster catch. This will improve our understanding of the behavior of the stock and provide socioeconomic, fishery, and environmental indicators.

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Photograph: © Jorge Ramírez / WWF Galapagos Program

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