Coastal fishery resources in the Marine Reserve are declining

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Coastal fisheries in Galapagos

Fishing in Galapagos has focused historically on coastal species. Over the last decade, the most lucrative resources have been the spiny lobster (*Panulirus penicillatus* and *P. gracilis*) and the sea cucumber (*Isostichopus fuscus*), although the fishery for the endemic grouper "bacalao" has also been of great importance to many fishers, especially those operating out of San Cristóbal. Although sea cucumbers were harvested in an unregulated fashion since the early 1990s, beginning with the arrival of Asian merchants and then the official opening of the sea cucumber fishery in 1999, the fishery has caused accelerated growth in the fishing sector.

From 2002 to 2006, fishing activities were managed by a Five-Year Fishing Calendar (FYC), approved by the Inter-institutional Management Authority (IMA). It includes the timing of each fishing season as well as specific biological indicators for each resource, with reference points and emergency measures. In general, the indicators can be summarized as follows:

- Catch (the amount of resource extracted, in weight or number of individuals, per fishing season)
- CPUE or Catch per Unit Effort (the amount of resource extracted by one fisher over a given period of time, usually one hour or one day)
- Density (the number of individuals of a given resource in a specific area)
- Mean size of individuals caught

The values for these indicators are obtained by means of participatory monitoring programs.

Despite the efforts of authorities to generate a sustainable framework for fisheries, the reality is very different - both spiny lobster and sea cucumber resources are showing significant declines in their populations.

Fisheries monitoring

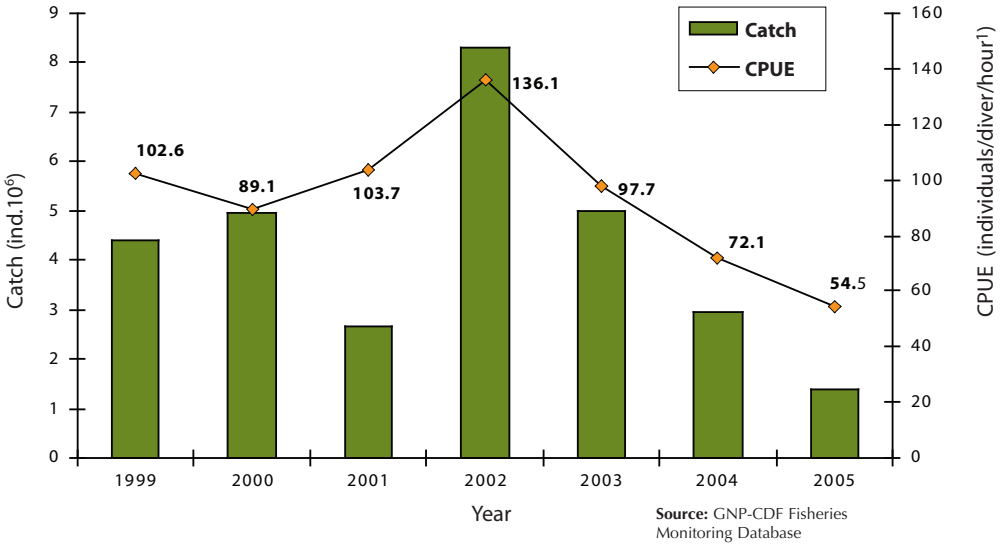
Fisheries monitoring consists of a series of steps to register information regarding fishing activity. This process includes a program of onboard observers who take measurements *in situ*; monitoring at landing sites by staff of the Galapagos National Park Service (GNPS) who certify the catch, and finally, product inspection by GNPS staff prior to leaving the islands for the continent, at which time the merchant receives a transport permit, thus completing the chain of custody for the resource.

Population surveys are mainly carried out for the sea cucumber resource. To obtain information on size structure and densities of populations before and after each fishing season, participatory sampling, using circular transects of 100 m^2, is carried out at different sites around the archipelago.

Does the sea cucumber fishery have a future?

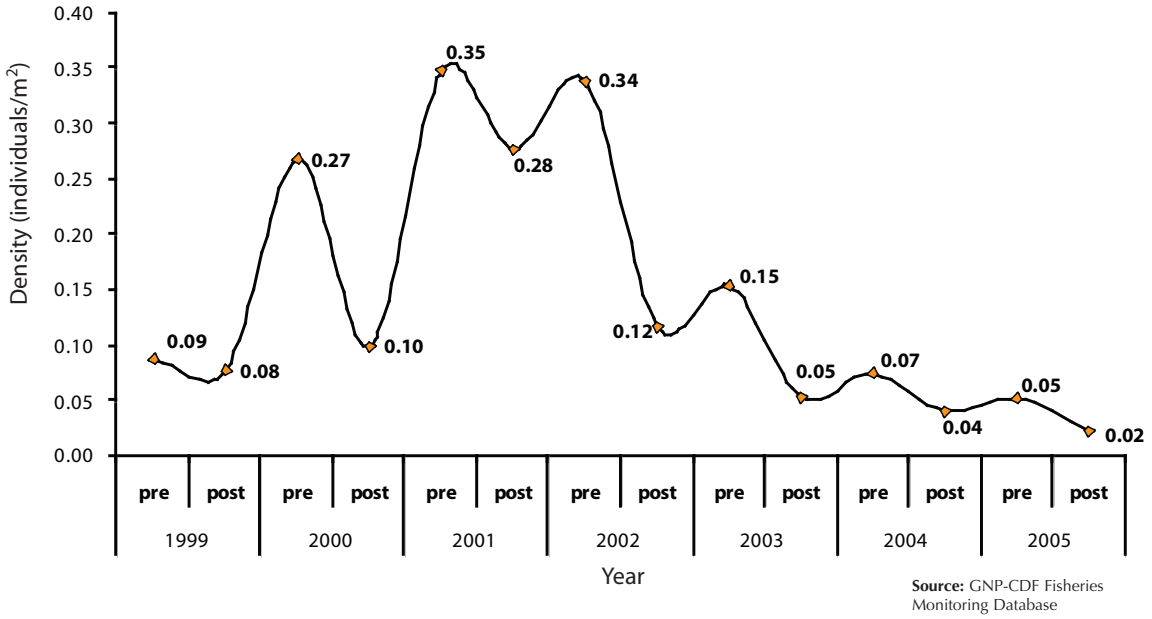
Since the official opening of the sea cucumber fishery in 1999, the maximum number of landings was registered in the 2002 season, when no quota was imposed. On the other hand, only around 3 million individuals were caught the year before, even though densities were higher. This was mainly due to the imposition of a catch quota per individual fisher by the Inter-institutional Management Authority (IMA). Of the over 8 million individuals caught in 2002, almost half were juveniles (smaller than the minimum legal landing size of 20 cm). After 2002 there was a steady decline in catch. By the 2004 and 2005 seasons, overall quotas were not reached (Fig. 1). At the same time, CPUE showed a decline, from 136 individuals caught per diver-hour in 2002, to 54 individuals per diver-hour in 2005. This resulted in an alarming decline in the cost-effectiveness of the fishery. For this reason, the authorities closed the fishery in 2006.

Figure 1. Catch and CPUE of sea cucumber during the 1999 to 2005 fishing seasons in the Galapagos Marine Reserve



Sea cucumber densities registered during population surveys have declined notably since the 2002 fishing season (Fig. 2). Since 2002, clear signs of overfishing have been detected during the post-fishery survey and populations have failed to recover during the no-take season. Sea cucumber density has followed a similar pattern to that of catch and CPUE. After 2004 the mean population density has been so low that no real changes in population have been detected.

Figure 2. Sea cucumber (*Isostichopus fuscus*) density before and after each fishing season, 1999 to 2005



Factors such as the excessive capture of under-sized lobsters and sea cucumbers, of egg-bearing lobsters, and fishing during no-take seasons, have impeded the recovery of these populations.

The lobster fishery is also in decline

Spiny lobster catches have declined steadily since 2000 (Fig. 3). The CPUE showed the same trend in 2004 and 2005, dropping below the threshold level of 5.8 kg of lobster tail per diver per day, registered during the 1998 El Niño event and subsequently adopted as a limit reference point. In 2004, the sea cucumber and lobster fisheries overlapped for six weeks, resulting in a lower lobster catch than expected because fishers were focused on the more lucrative sea cucumber.

The mean size of red spiny lobsters decreased steadily from 1997 to 2005, from 28.7 cm to 27.1 cm, a reduction of 1.6 cm in only 8 years (Fig. 4).

Figure 3. Capture and CPUE for spiny lobsters – the red lobster (*Panulirus penicillatus*) and the green lobster (*P. gracilis*) – during fishing seasons, 1995 to 2005

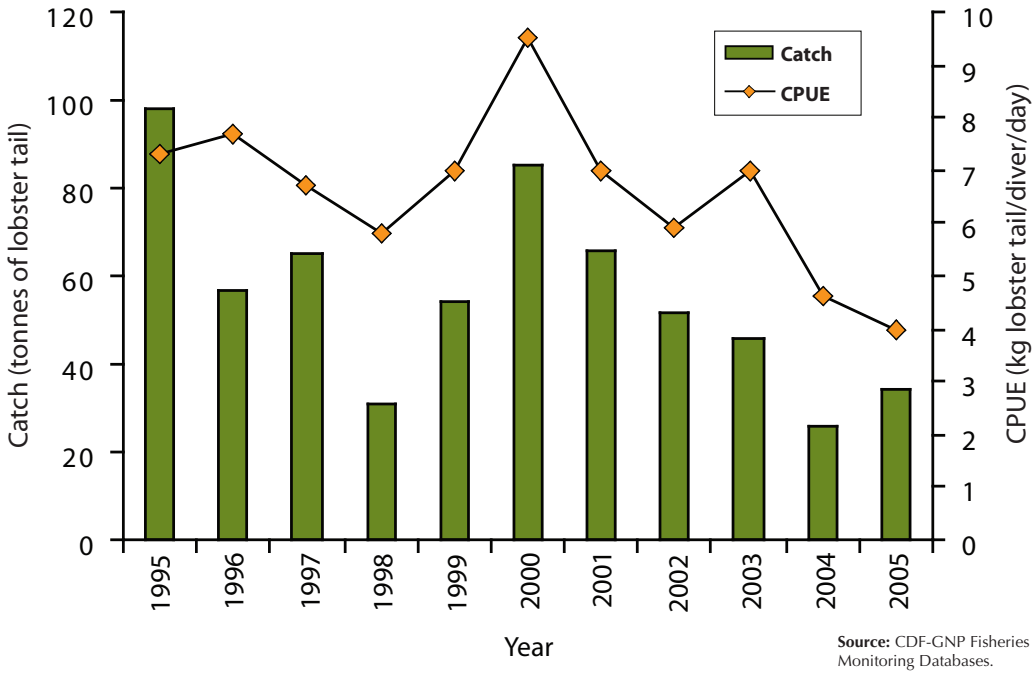
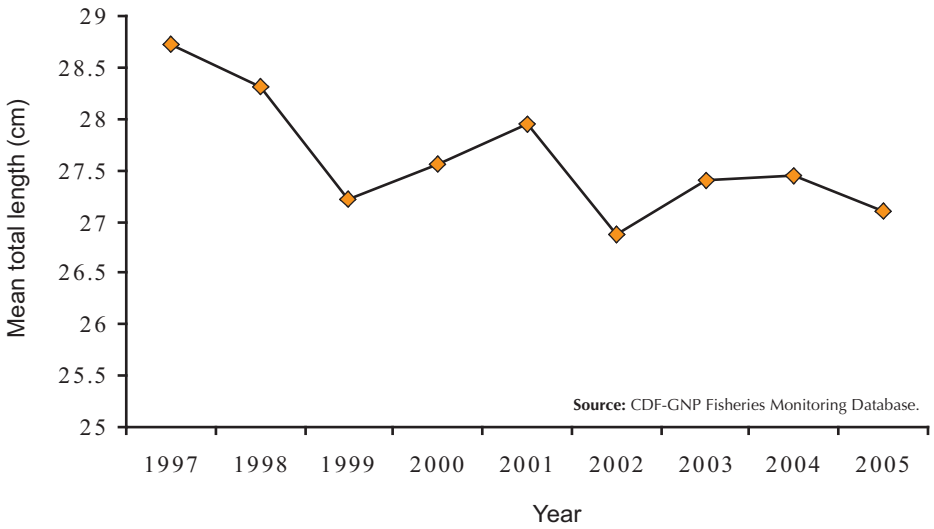


Figure 4. Mean total length of red spiny lobsters (*Panulirus penicillatus*) captured during the fishing season, 1997 to 2005



Why have the fisheries become uneconomical?

The indicators presented for both fishery resources show a significant decline in the populations despite the efforts of authorities to manage them within a sustainable framework. Factors, such as the excessive capture of undersized lobsters and sea cucumbers, of egg-bearing lobsters, and fishing during no-take seasons, have impeded the recovery of these populations, which are also affected by climatic events such as El Niño.

For example, lobster catches and CPUE increased in 1999 and 2000 (post El Niño). During the El Niño event of 1998, over 50% of females in the catch were egg-bearing, suggesting that it may have been beneficial to the fishery, as it may provide optimal oceanographic conditions for reproductive activity, larval survival, and post larval recruitment. This requires further study in future El Niño events in order to fully understand its effects on lobster recruitment in Galapagos.

To attain a truly sustainable fishery, using the precautionary principle and adaptive management, it is paramount to have mechanisms that identify "target reference points," which provide an important foundation for sound management decisions and subsequent action.

Despite the development of the 2002-2006 Fishing Calendar during a period when little information was available on the species in question, management measures were considered to ensure response to "critical reference points"– values for biological and fishery indicators which are undesirable. Negative trends for these indicators were also taken into account. In the case of the sea cucumber, density and CPUE indicators were incorporated, and in the case of lobster, CPUE. Additionally, emergency measures such as closures of areas, reduction of fishing effort, and quotas were established in case critical reference points were reached.

Although data collection efforts have been carried out in recent years through onboard observer programs, population surveys, and other studies, decisions have been based primarily on sociopolitical pressures rather than on technical information, making it impossible to slow down resource deterioration. As the resources have become less profitable, the economic situation of the fishing sector has worsened, with the fishers becoming even less inclined to adopt corrective measures. A vicious circle has been generated, resulting in the collapse of the sea cucumber fishery and the near-collapse of the lobster fishery.

For both resources, a recovery plan is urgently needed to return to an economically viable fishery. However, any corrective measure requires harvesting less, either by reducing effort, imposing quotas and size limits, or closing areas. In a participatory system such as the GMR, it will not be possible to carry out the necessary measures without the participation of the fishing sector and its understanding of the realities associated with these overexploited resources.

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