

Requiem for the Galápagos sea cucumber fishery?

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After six years of uninterrupted legal commercial exploitation, the Galápagos sea cucumber (*Isostichopus fuscus*) fishery is showing signs of severe depletion. The fishery began in the Galápagos Islands in 1991 after the commercial extinction of this species in mainland Ecuador (Camhi 1995), and rapidly became the most profitable fishing activity in the islands (Murillo et al. 2004).

Since 1998, the Galápagos Marine Reserve (GMR) has been managed under a participatory and adaptive management scheme. The Participatory Management Board (PMB), locally known as “Junta” (Toral-Granda and Martínez 2004; Altamirano et al. 2004), includes the five members of the management board, who are directly involved in activities within the GMR: fishing, nature guides, tourism (Galápagos Tourism Chamber – CAPTURGAL), science/conservation (Charles Darwin Foundation – CDF), and the Galápagos National Park Service (GNPS) as the administrator of the GMR. In the PMB, decisions are consensus-based and later analysed by the Interinstitutional Management Authority (IMA). The IMA comprises different stakeholders at the national government level: Ministry of Environment (Chair), Ministry of Defense, Ministry of Tourism, Ministry of Fisheries, CEDENMA (Ecuadorian Committee for the Protection of the Environment), as well as some local users: Galapagos Chamber of Tourism, fish-

ing sector, and GNPS (Secretary). The CDF acts as the scientific advisor for the IMA, and is primarily responsible for advising managers of the fishery on the state of the sea cucumber population in the GMR. In the IMA, all decisions are made by voting, and later put into effect by the GNPS (for further detail, see Altamirano et al. 2004, Toral-Granda and Martínez 2004).

The first legal fishery in 1994 took between 3 and 6 million sea cucumbers (De Miras et al. 1996), and then an illegal fishery persisted until the reopening of a legal fishery in 1999 (Piu 1998, 2000; Martínez 1999), when all stakeholders became involved in the process of scientific data collection, analysis and dissemination of stock assessment findings. The total number of sea cucumbers captured was 4.4 million in 1999, 4.9 million in 2000, 2.7 million in 2001, 8.3 million in 2002 and 5.0 million in 2003 (Murillo et al. 2004). Overall, more than 25.3 million sea cucumbers (over 6800 tonnes live weight) have been extracted legally from the GMR since 1999 (Murillo et al. 2004).

Every year, before and after each fishing season since 1999, teams of managers, scientists, nature guides and fishers have surveyed sea cucumber populations at sites off six islands where legal fishing occurs (Fig. 1) (Toral-Granda and Martínez 2004). For these trips, monitoring sites were chosen

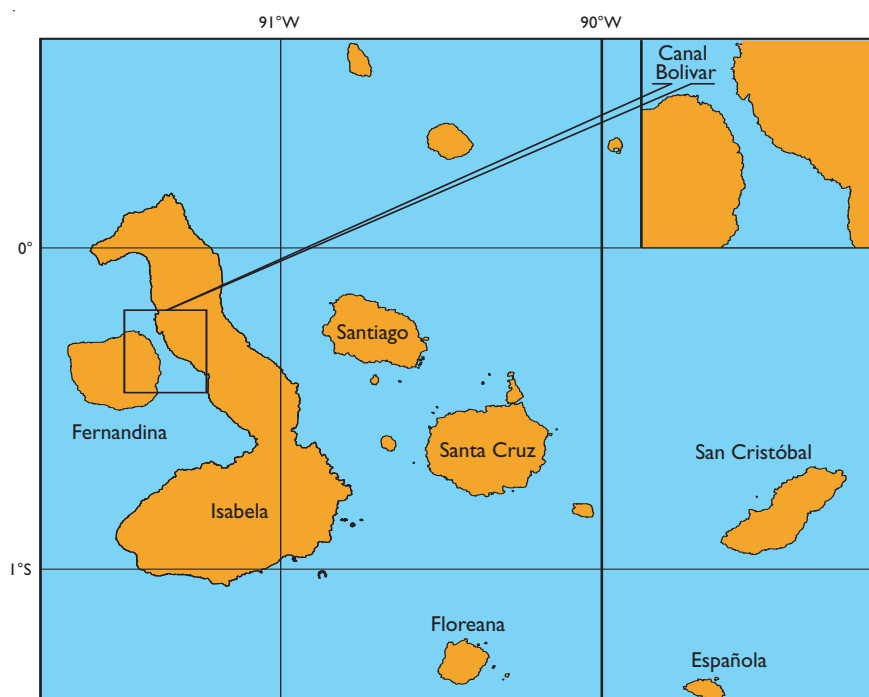


Figure 1. Sea cucumber population surveys include several sites in Española, Floreana, San Cristóbal, Santa Cruz, Western Isabela and Fernandina. The Bolívar Channel has been recognised as a sea cucumber nursery ground and has remained closed to fishing activities for the last three fishing seasons.

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jointly amongst the participative team, and included extractive and non-extractive areas of the provisional zoning scheme. All data gathered during the trip is distributed to all stakeholders straight after the trip. Furthermore, the data is analysed jointly amongst all the sectors and later on delivery to the PMB, who evaluates the information given and decides on a total allowable catch (TAC) or, to close down islands that show signs of depletion or have significant numbers of juveniles. This decision is later evaluated by the IMA, which decides on the final regulations for the fishery.

The last population survey (November 2004) revealed an alarming continuing decline. Population densities of *I. fuscus* declined to a historical minimum, although populations were “presumably robust” after a five-year fishing ban that ended in 1999 (Fig. 2). The densities of legal size individuals (≥ 20 cm TL) were the lowest ever registered (Fig. 3). The 2000–2001 recruitment pulse is now almost fished out, with no new recruitment pulse evident, either in the western islands (Hearn et al.

submitted) or elsewhere. A joint CDF/GNPS fisheries research program has gathered valuable information, all indicating a highly depleted state of the resource (Murillo et al. 2004; Shepherd et al. 2004). Average catch per unit of effort (CPUE) has decreased over time from 37 kg diver⁻¹ day⁻¹ in 1999 to 22 kg diver⁻¹ day⁻¹ in 2003 (Murillo et al. 2004) (Table 1). Areas that were previously important fishing sites (i.e. sites that yielded high catches) are now seldom visited due to the low numbers of sea cucumbers there. But, the average CPUE is maintained by the exploitation of new fishing sites where more individuals can be found. Hence CPUE is now exhibiting hyperstability in the face of declining populations and changing behaviour of divers, who now concentrate their searches in the few places where sea cucumbers remain. In this situation, CPUE has little value as an indicator of abundance, and can be quite misleading, as often noted for benthic sedentary or strongly aggregating stocks (Orensanz et al. 1998). Additionally, the mean size of individuals harvested has decreased from 25.2 cm total length in 1999 to 20.9 cm in 2003

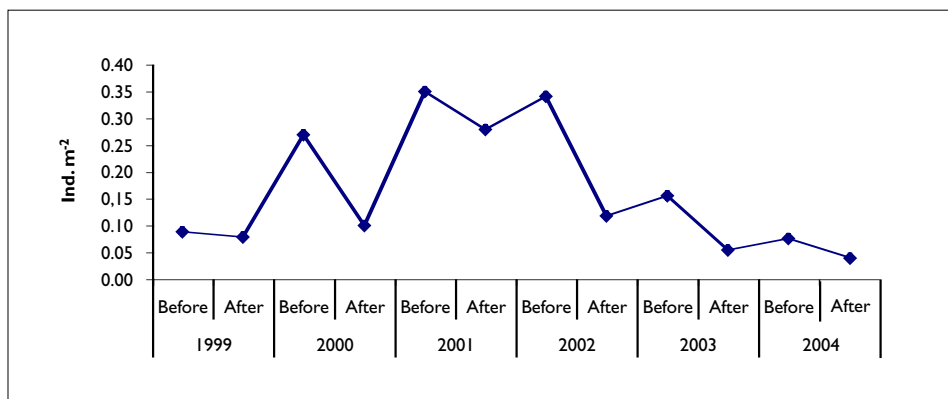


Figure 2. Mean values (\pm SE) of population density of *I. fuscus* before and after the fishing seasons. Information was collected in participatory surveys between 1999 and 2004.

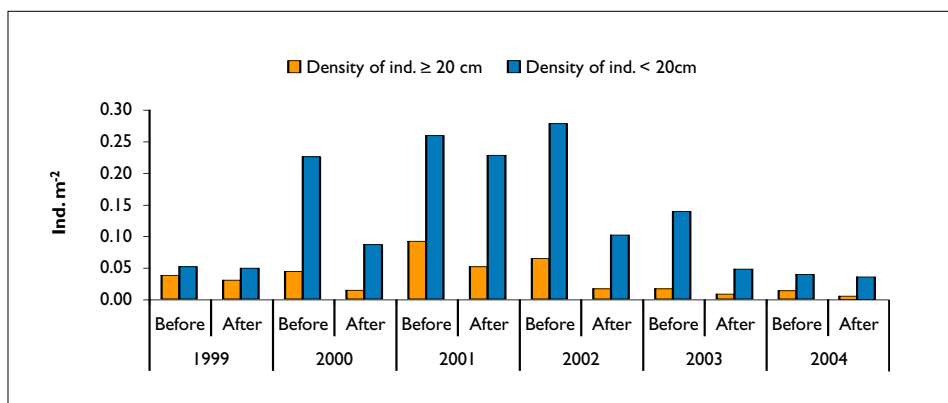


Figure 3. Population density of individuals ≥ 20 cm and < 20 cm total length of *I. fuscus* throughout the participatory surveys between 1999 and 2004.

Table 1. Catch per unit of effort (kg diver⁻¹ day⁻¹) of *I. fuscus* in the last five fishing seasons, 1999–2003 (adapted from: Murillo et al. 2004).

	1999	2000	2001	2002	2003
Western Isabela	33	32	38	41	26
Fernandina	54	°	44	39	26
Española	46	21	°	29	°
Floreana	-	20	32	16	°
North and East Isabela	-	34	20	29	23
South Isabela	32	21	22	36	17
San Cristóbal	26	19	15	°	15
Santa Cruz	29	24	21	°	27
Average	37	24	27	32	22

- no data available; ° no-fishing zone

(Murillo et al. 2004), showing a possible growth overexploitation. Yet despite the scientific findings and warnings, the fishery has been opened each year, in large part for political reasons and due to socioeconomic pressures.

The 2004 season was due to open on 31 May 2004 for 60 days, subject to the following regulations: a TAC of 4 million individuals, minimum landing size of 20 cm (total length), landing exclusively in fresh state, and fishing permitted only in Española, Floreana, Western Isabela, Santa Cruz, and San Cristóbal (Fig. 1). Fernandina and the Bolívar Channel (Fig. 1) were to remain closed due to their high importance as nursery grounds and the fact that most of the individuals present were below minimum landing size. However, the artisanal fishing sector presented a lawsuit against the agreed regulations; and after many incidents, including rioting and the invasion and occupation of the Galápagos National Park Service offices, the fishing season was postponed until 12 August. In addition, the regulations of this season were modified: Fernandina Island was to remain open instead of Floreana, and sea cucumbers were allowed to be landed in brine, with a minimum size of 7 cm. The 2004 fishing season closed on 10 October. Results show that the TAC was not met, as only 2.9 million individuals were caught during this fishing season.

Although data from the 2004 fishing season have yet to be analysed, preliminary observations and results show that CPUE is lower than in previous years. CPUE may have been influenced by the oceanographic conditions prevailing during the 2004 season, and by the fact that the lobster fishing season was opened on 1 September, hence possibly splitting the fishing effort. In other fishing seasons, most of the catches have originated from the west-

ern macrozones (Murillo et al. 2004) but in 2004, the fishing effort was concentrated in these zones during the first month only. Many fishers preferred to make daily fishing trips to nearby sites, rather than investing in long trips to the west, where not many sea cucumbers are left. Eighteen decompression illnesses were registered during this season, with one fatality. This number is likely to be underestimated as many sea cucumber fishers performed “domestic” decompression dives at nearby sites without medical supervision. Upon recognition of decompression sickness symptoms, the fishers decided on the depth and period underwater to eliminate the symptoms. In most cases, these fishers continued fishing immediately after their decompression dives.

The market price for *I. fuscus* in the Galápagos has fluctuated during the season. At the beginning, an average of USD 30.25 were paid per kg of sea cucumber in brine, while at the end of the 2004 fishing season, a kg of sea cucumber in brine fetched USD 33.9. In the 2003 season, the average price paid was USD 22.8 per kg of sea cucumber in brine (Murillo et al. 2004), indicating a market trend to higher prices as the supply diminishes.

CDF's efforts to persuade users and managers of the precarious state of *I. fuscus* populations in the Galápagos Islands have largely gone unheeded to date. Despite much progress in co-management, it is clear that more community and educational work must be done if this species is not to continue declining to commercial extinction. Moreover, additional research is required on many aspects of the sea cucumber's biology and ecology, which can only be achieved through increased capacity building and funding. CDF's efforts to conserve biodiversity within the Galápagos Islands and the GMR

are presently at risk due to funding constraints. Also, increased global awareness is probably necessary before managers of the *I. fuscus* fishery are convinced to conform to a comprehensive management plan that gives priority to the conservation of the resource according to the best scientific evidence available.

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