

Illegal fishing of the sea cucumber *Isostichopus fuscus* is rampant in the Gulf of California, Mexico

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Abstract

The brown sea cucumber, *Isostichopus fuscus*, has been harvested in the Mexican Pacific since 1988 but the fishery was closed in 1994 due to overfishing, and the species was listed as at-risk in the Official Mexican Standard (NOM-059). In 2000, its status changed to under special protection and some permits to fish for this species were granted. However, illegal, unreported and unregulated fishing has always taken place in the Gulf of California where *I. fuscus* is more abundant. This work shows that the mean density of this sea cucumber has decreased from 15 ind. 100 m⁻² in 2007 to 2.8 in 2016, a reduction of more than five fold, and that the reductions are largely due to illegal fishing. Official sources report that between 2013 and 2018, 1,024,813 individual sea cucumbers were confiscated in the region, so the illegal catch is certainly much larger. It is essential to increase surveillance in the field and law enforcement at borders, otherwise this species will soon become commercially extinct.

Keywords: poaching, unreported, illegal fishing, *Isostichopus fuscus*, protected area, Mexico, Gulf of California

Introduction

One of Mexico's most valuable marine resources is the brown sea cucumber *Isostichopus fuscus* Ludwig, 1875. This precious commodity is exported to Asia where there is a huge demand for sea cucumbers,² and species such as *I. fuscus* can fetch up to USD 1,030 kg⁻¹ (Purcell et al. 2014).

The sea cucumber fishery in the Gulf of California is a textbook example of a boom-and-bust cycle: from non-existent until 1988 when the fishery began (Singh-Cabanillas and Vélez-Barajas 1996), to a peak in 1991, followed by a sharp decrease in 1993 (Fig. 1). In 1994, *I. fuscus* was listed in the Official Mexican Standard (NOM) 059 as being a species at-risk (SEMARNAP 1994) and the fishery was totally banned until 2000 when its status changed to a species under special protection, and some permits to harvest it were granted. The use of *I. fuscus* is regulated by the General Wildlife Law (Ley General de Vida Silvestre) and its regulations, and can only be harvested if ad hoc technical studies show that the population will not be affected (SEMARNAT 2010). Moreover, it is listed as an endangered species by the International Union for Conservation of Nature³

and is included in the Convention on the International Trade in Endangered Species Appendix III⁴ as per the Government of Ecuador's request.⁵

Methods

Fieldwork

In 2005, at the request of Mexico's Secretariat of Environment and Natural Resources (Secretaría del Medio Ambiente y Recursos Naturales, SEMARNAT), we began conducting surveys along the east coast of Baja California to estimate the density of *Isostichopus fuscus*. Night surveys were conducted (during the day the sea cucumber hides among crevices, holes and rocks) using semi-autonomous diving gear, known as 'hooka', which consists of a compressor that supplies air through a hose to the diver. Despite the fact that at the time no permits were being issued, we frequently observed poachers boiling sea cucumbers in the islands.

Sampling consisted of band transects 2 m wide by 25 m long, so that a surface area of 50 m² was covered by each transect and two transects were made at each depth. If the site was more than 20 m deep,

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² <http://www.eluniversal.com.mx/articulo/periodismo-de-investigacion/2016/03/6/mafia-china-arrasa-con- pepino-de-mar>

³ <http://www.iucnredlist.org/details/180373/0>

⁴ <https://www.cites.org/eng/app/appendices.php>

⁵ *Isostichopus fuscus* has been found in: Colombia (mainland and Malpelo Is.); Costa Rica (mainland and Cocos Is.); Ecuador (mainland and Galápagos); El Salvador; Guatemala; Honduras; Mexico (Pacific coast and Revillagigedo Is.); Nicaragua; Panama; and Peru (Source: <https://www.iucnredlist.org/species/180373/1621878#geographic-range>)

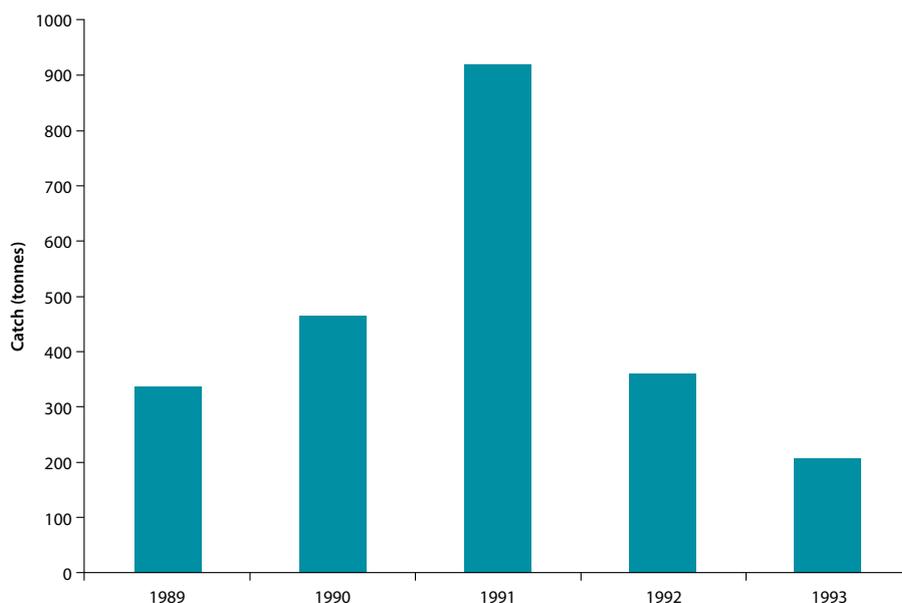


Figure 1. Historical catches of the sea cucumber *Isotihopus fuscus* from the Gulf of California.

two transects were made at maximum depth, two at medium depth, and two in shallow water (3–5 m). If that depth was not reached, then three dives were made at the greatest depth and three at a shallower depth, in order to complete six transects per dive. In all cases, two divers (previously trained professional fishermen) collected all specimens found, brought them on board for weighing and sizing, and threw them back in the sea afterward.

Estimation of illegal fishing

In order to gain a rough idea of how many sea cucumbers were illegally being caught, local press and official reports, mainly those of the Federal Attorney for Environmental Protection (Procuraduría Federal de Protección al Ambiente, PROFEPA), were reviewed for the period 2013 to April 2018.

Data analysis

The mean density and standard deviation for each polygon were fitted to a lognormal model of nonzero survey values (a delta-distribution), as suggested by Pennington (1996).

Results

During the surveys conducted between November 2005 and August 2007, the overall mean density was 15 ind.·100 m⁻², with values ranging from as low as 0.0065 to 0.6600 (Fig. 2).

By 2013 the mean density (\pm SD) had decreased to 7 (\pm 1) and the most recent data (October 2016) shows

that it is around 2.8 (Table 1), a substantial decrease in just three years.

A summary of press-reported confiscations of sea cucumbers is presented in Table 2. As can be seen, in just 11 reports found between May 2013 and April 2018, over a million pieces of sea cucumber from the Gulf of California have been confiscated. Taking an average of 38.5 g per dried piece⁶ means that over 26,618 tonnes of sea cucumber have been illegally caught in the region, according to official sources.

Discussion

Based on the evaluations carried out between 2005 and 2007, in 2008 SEMARNAT – through the General Directorate of Wildlife – (General de Vida Silvestre, DGVS), granted exploitation quotas to 10 permit holders. Those quotas were 4, 8, 17, 36, 46, 65, 80, 96, 114 and 225 tonnes (wet weight) to each permit holder, supposedly according to the granted area. It is difficult to obtain data after 2009 from DGVS, in part due to the frequent change of director, and because there are no reliable statistics of catches. While catches of any resource that is under the management of the National Commission for Fisheries (Comisión Nacional de Acuacultura y Pesca, CONAPESCA) must be reported, the sea cucumber is under the management of SEMARNAT, which does not publish harvesting data.

In a previous study conducted in the same region, Glockner-Fagetti et al (2016) pointed out that, according to interviewees, poaching is the major

⁶ Assuming, according to Glockner-Fagetti et al. (2016) that the mean wet weight is 303 g and the dried weigh is 12% (after Ngaluafé and Lee 2013).

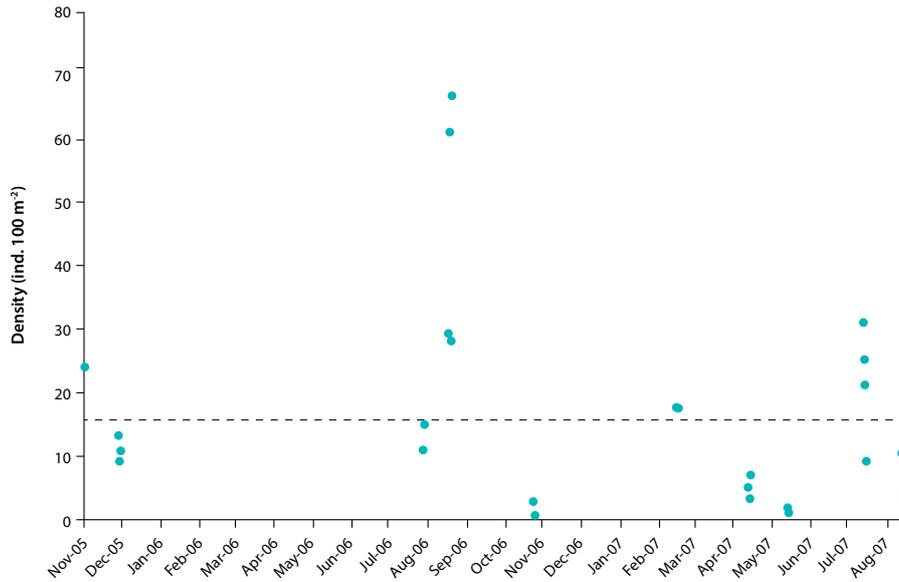


Figure 2. Mean density of the sea cucumber *Isotichopus fuscus* found in surveys conducted along the east coast of Baja California between November 2005 and August 2007. The dotted line is the overall mean density.

threat to the sea cucumber *Isotichopus fuscus*. Illegal, unreported and unregulated fishing is a significant issue all over the world (Agnew et al. 2009) and due to their high value, illegal sea cucumber fishing happens everywhere (Conand 2018). Mexico is not exempt from this problem and in a global analysis of all fisheries, Cisneros-Montemayor et al. (2013) estimate that illegal sea cucumber fishing in Mexico accounts for twice the number of reported catches. Considering that in less than 10 years the relative abundance of *I. fuscus* has decreased in number from 15 ind.·100-m⁻² in 2007 to 2.8 in 2016, the only possible explanation is excessive poaching in the region.

Finally, from the results of this work, the following management recommendations are proposed:

1. Restrict fishing to daylight hours only. It is well known that the sea cucumber *Isotichopus fuscus* is nocturnal and hides in hollows during the day. Banning nightly harvesting has two advantages: i) everyone who fishes at night will clearly be illegally fishing, and ii) it will work as a precautionary measure. Recent work (Reyes-Bonilla et al. 2016) shows that, on average, 15% of the organisms in a place go unnoticed during the day.
2. Limit catches to the 30-m isobath. This measure also has a double purpose: 1) to safeguard the lives of divers, and ii) to protect the proportion of the sea cucumber population that is found at greater depths.

Table 1. Central coordinates of the sampling area, total number of transects conducted (n), transects with the presence of organisms (P) and density (ind. 100 m⁻², delta mean) of the sea cucumber *Isotichopus fuscus* in the Gulf of California.

N	W	n	P	Mean	SD
29.50964	-113.57037	24	17	2.41	39.31
29.09823	-113.15294	16	8	1.86	22.9
29.11297	-113.27457	40	30	3.69	36.94
29.19238	-113.63514	32	25	2.69	45.29
28.95545	-113.48222	98	76	3.57	34.54
28.94544	-113.42378	48	13	1.56	25.61
28.81920	-113.21543	56	38	2.62	35.24
28.56816	-113.11781	12	10	2.46	40.37
28.36875	-112.85321	46	37	2.91	41.51
29.37953	-113.74209	14	11	2.71	43.19
29.28451	-113.28955	60	38	2.74	28.13
29.05177	-113.51384	34	24	3.15	31.7
28.61218	-112.80464	18	15	3.56	33.82

3. Establish a minimum size of 20 cm and a minimum weight of 500 g. The only way to avoid overfishing is to ensure that sea cucumbers have had a chance to reproduce at least once (Pañola-Madrigal et al. 2017).
4. Set a quota on the number of individual sea cucumbers. This measure would discourage the capture of young and subadult organisms, which, in addition to having very low market prices, would lead to overfishing and no or little recruitment.
5. Close the fishing season from the beginning of May to the end of October. A recent study (Pañola-Madrigal et al. 2017) shows that in September there are still reproductively active organisms, so fishing for them could negatively affect recruitment.
6. Establish a standardised pre-season monitoring programme. For the allocation of harvest quotas, it is necessary to know the current state of the stock. It is also necessary that the evaluation of all sites is done in the same way systematically.
7. Establish non-fishing zones to ensure reproduction and recruitment. Although it is a difficult measure to implement due to the possible reluctance of the person assigned to the federal land, it is necessary for ensuring the sustainable use of this resource.
8. Strengthen surveillance. Illegal fishing of sea cucumbers (and many other species) is a well-known and poorly addressed problem. Surveillance needs to be strengthened and carried out at all steps of the trade, from harvesting to marketing.

Conclusion

It is very difficult to prove an incidence of illegal fishing. However, everyone in the fisheries sector recognises that this is a very serious problem. Moreover, many acknowledge that they themselves sometimes fish illegally, arguing that the process of getting a permit is cumbersome, expensive and dependent on the good-will of a bureaucrat. Because sea cucumbers are an export commodity, more attention should be focused at customs and borders. Nonetheless, this species is listed in Convention on the International Trade in Endangered Species Appendix III and, therefore, the international trade of this species is allowed only on presentation of the appropriate permits and/or certificates. It is a race against time: either illegal fishing stops immediately, or the sea cucumber *Isotichopus fuscus* will soon be commercially extinct.

Table 2. Date of operation, number of sea cucumber pieces confiscated in the Baja California peninsula by source of information.

Date	Number of pieces confiscated	Source
25/05/2013	898,660	http://www.profepa.gob.mx/innovaportal/v/5078/1/mx.wap/asegura_profepa_millonario_cargamento_ilegal_de_pepino_duro_de_mar__hipocampos_y_buche_de_totoaba.html
10/11/2014	58,115	https://www.gob.mx/profepa/prensa/dicta-juez-federal-auto-de-formal-prision-a-1-persona-por-posicion-ilegal-de-58-115-ejemplares-de-pepino-de-mar-en-baja-california
20/02/2016	8,263	https://www.gob.mx/profepa/prensa/semar-profepa-y-sea-shepherd-conservation-society-liberan-ballena-jorobada-atrapada-en-una-red-en-el-alto-golfo-de-california-84803
27/03/2016	229	https://www.gob.mx/profepa/es/prensa/la-profepa-y-semar-aseguran-cargamento-de-229-pepinos-de-mar-y-presentan-ante-el-mpf-a-tres-personas-en-baja-california-85669?idiom=es
22/06/2016	40,396	https://www.gob.mx/profepa/prensa/asegura-profepa-cargamento-de-40-396-ejemplares-de-pepino-de-mar-en-baja-california
29/09/2016	871	https://www.gob.mx/profepa/prensa/asegura-profepa-y-policia-municipal-de-ensenada-baja-california-cargamento-de-871-ejemplares-de-pepino-de-mar-presentan-a-una-persona-ante-el-mpf
21/02/2017	200	https://www.gob.mx/profepa/prensa/asegura-profepa-200-ejemplares-de-pepino-de-mar-en-b-c-s
23/04/2017	15,764	https://www.gob.mx/profepa/prensa/aseguran-profepa-15-764-ejemplares-de-pepino-de-mar-en-tijuana-que-pretendian-enviar-ilegalmente-a-e-u-a
26/04/2017	1,540	https://www.gob.mx/profepa/prensa/asegura-profepa-1-540-ejemplares-de-pepino-de-mar-en-sonora
15/06/2017	256	https://www.gob.mx/profepa/videos/asegura-profepa-sedena-y-semar-cargamento-de-256-piezas-de-pepino-de-mar-en-baja-california-114443
09/04/2018	519	http://www.elvigia.net/911/2018/4/9/decomisan-metanfetaminas-pepino-300672.html

Acknowledgements

Data from 2005–2007 were gathered with the support of Fundacion PRODUCE (grant number 02-2006-5578) in 2013 by the Government of Baja California and in 2016 by the CONANP (PRO-CER O1SC). Thanks are due to A. Scanlan for proofreading.

References

- Agnew D.J., Pearce J., Pramod G., Peatman T., Watson R., Beddington J.R. and Pitcher T.J. 2009. Estimating the worldwide extent of illegal fishing. *PLoS ONE* 4 (2). <https://doi.org/10.1371/journal.pone.0004570>.
- Cisneros-Montemayor A.M., Cisneros-Mata M.A., Harper S. and Pauly D. 2013. Extent and implications of IUU catch in Mexico's marine fisheries. *Marine Policy* 39(1):283–88. <https://doi.org/10.1016/j.marpol.2012.12.003>.
- Conand C. 2018. Recent information on worldwide illegal fisheries for sea cucumbers. *SPC Beche-de-Mer Information Bulletin* 38:68–71.
- Glockner-Fagetti, A., Calderon-Aguilera L.E. and Herrero-Pérezrul M.D. 2016. Density decrease in an exploited population of brown sea cucumber *Isostichopus fuscus* in a biosphere reserve from the Baja California peninsula, Mexico. *Ocean and Coastal Management* 121:49–59. <https://doi.org/10.1016/j.ocecoaman.2015.12.009>.
- Ngaluafé P. and Lee J. 2013. Change in weight of sea cucumbers during processing: Ten common commercial species in Tonga. *SPC Beche-de-mer Information Bulletin* 33:3–8.
- Pañola-Madrigal A., Calderon-Aguilera L.E., Aguilar-Cruz C.A., Reyes-Bonilla H. and Herrero-Pérezrul M.D. 2017. Reproductive cycle of the sea cucumber (*Isostichopus fuscus*) and its relationship with oceanographic variables at its northernmost distribution site. *Revista de Biología Tropical* 65(1):S180–96. <https://doi.org/10.15517/rbt.v65i1-1.31687>.
- Pennington M. 1996. Estimating the mean and variance from highly skewed marine data. *Fishery Bulletin* 94(3):498–505.
- Purcell S.W., Polidoro B.A., Hamel J.F., Gamboa R.U. and Mercier A. 2014. The cost of being valuable: Predictors of extinction risk in marine invertebrates exploited as luxury seafood. *Proceedings of the Royal Society B* 281 (1781): 20133296. <https://doi.org/10.1098/rspb.2013.3296>.
- Reyes-Bonilla H., Ramírez-Ortiz G., Herrero-Pérezrul M.D. and Calderon-Aguilera L.E. 2016. Underestimation of the abundance of brown sea cucumber *Isostichopus fuscus* (Holothuroidea: Echinodermata) in daylight compared to nighttime surveys in the Gulf of California. [Subestimación de La Abundancia Del Pepino Café *Isostichopus fuscus* (Holothuroidea: Echinodermata) en muestreos diurnos con respecto a nocturnos en el golfo de California]. *Revista Mexicana de Biodiversidad* 87(2):519–522. <https://doi.org/10.1016/j.rmb.2016.05.004>.
- SEMARNAP. 1994. Norma Oficial Mexicana NOM-059-ECOL-1994, que determina las especies y subespecies de flora y fauna silvestres terrestres y acuáticas en peligro de extinción, amenazadas, raras y las sujetas a protección especial, y que establece especificaciones para su aprovechamiento. Mexico: Diario Oficial de la Federación.
- SEMARNAT. 2010. Norma Oficial Mexicana NOM-059-ECOL-2010, que determina las especies y sub-especies de flora y fauna silvestres terrestres y acuáticas en peligro de extinción, amenazadas, raras y las sujetas a protección especial, y que establece especificaciones para su aprovechamiento. México: Diario Oficial de la Federación.
- Singh-Cabanillas J. and Vélez-Barajas J.A. 1996. La Pesquería de Pepino de Mar *Isostichopus fuscus* en la Costa Oriental de Baja California Sur y Propuesta de Regulación. *Cienc Pesq* 12:13–18.