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Review Global Management utilization of sea cucumbers

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Abstract: *In recent decades, invertebrate fisheries have expanded in catch and value worldwide, thus the sea cucumbers (class Holothuroidea), which are highly valued in Asia and sold as trepang or bêche-de-mer [4]. The utilization of sea cucumbers, including for human consumption, has been steadily growing over the years. [6] Fisher participation data indicated about 3 million sea cucumber fishers worldwide [7]. Worldwide, most sea cucumber fisheries are ineffectively managed, leading to declining stocks and potentially eroding the resilience of fisheries [5]. Sea cucumber exports are derived from countries where either this fishery is banned such as Panama and Most of the sea cucumber exports from the Latin America and the Caribbean regions are from Peru (26.1%) followed by Ecuador (25.9%), Chile (14.1%) and Cuba (10.1%). About 14.0% Costa Rica or have no proper record (Colombia) [8]. According to the FAO (FAO, 2007) report, sea cucumbers catches data is available for Ecuador, Mexico, Chile and Nicaragua with a total contribution of 6035 t (wet weight) for the period from 1988 to 2005 (Table 1) [9,8]. Sea cucumber fisheries in Turkey have been managed by legal regulations since 2007. Sea cucumber fishing is allowed only in a small area of the northern Mediterranean where a fallow period goes into effect after four years of fishing [17]. Sea cucumber fishing is a problem worldwide, another option could be sea cucumber farming. Tropical sea cucumber mariculture has potential to become a profitable industry and contribute towards natural population replenishment. They have superb potential to diversify mariculture industries in the tropics and potentially ameliorate the detrimental effects of mariculture on coastal ecosystems [27]. The conclusion; this review suggests we focus on farming of sea cucumber to decrease the sea cucumber exploitation.*

Key-words: *Holothuroidea, Fisheries and Aquaculture, sea cucumber farming, Management utilization, overfishing, mariculture, exploitation.*

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I. Introduction

Sea cucumbers have their name thanks to their appearance. They reassemble to the fruit, cucumber. But they are, ofcourse, not a fruit. Sea cucumbers are a marine animal who can be find worldwide. They are echinoderms from the class Holothuroidea. Many of these animals are indeed shaped like soft-bodied cucumbers [1]**.** For the pictures of this review article, we dived in Saudi-Arabia in the red sea, near Rabigh. You can recognize the Sea cucumbers by the characteristic leathery skin and an elongated body containing a single, branched gonad. Holothurians measure generally between 10 and 30 centimeters long, with extremes of some millimeters for Rhabdomolgus ruber and up to more than 3 meters for Synapta maculata [1].

Picture 1. Sea cucumber from the red sea nearby Rabigh – Saudi-Arabia, 1.5 – 2 meter depth.

Picture 2. Sea cucumber from the red sea nearby Rabigh – Saudi-Arabia, 1.5 – 2 meter depth.

All sea cucumbers are ocean dwellers, though some inhabit the shallows and others live in the deep ocean. They live on or near the ocean floor, sometimes partially buried beneath it. They can also be found in great numbers on the deep seafloor, where they often make up the majority of the animal biomass [2]. At depths deeper than 8.9 km (5.5 mi), sea cucumbers comprise 90% of the total mass of the macrofauna [3].

Picture 3. Sea cucumber from the red sea nearby Rabigh – Saudi-Arabia,7 meter depth.

Picture 4. Sea cucumber from the red sea nearby Rabigh – Saudi-Arabia, 7 meter depth.

In recent decades, invertebrate fisheries have expanded in catch and value worldwide, the sea cucumbers (class Holothuroidea), which are highly valued in Asia and sold as trepang or bêche-de-mer [4]. Worldwide, most sea cucumber fisheries are ineffectively managed, leading to declining stocks and potentially eroding the resilience of fisheries [5].

Global Management Utilization Of Sea Cucumbers

The utilization of sea cucumbers, including for human consumption, has been steadily growing over the years. Up-to-date information on the present status of world sea cucumber resources and utilization is presented with special focus on countries such as China, Ecuador, Indonesia, Japan, Malaysia and the Philippines that have been heavily engaged in the industry for decades. Information from other countries such as Cuba, Egypt, Madagascar and the United Republic of Tanzania, relative newcomers to the sector, is also provided, indicating to some extent the growing interest with regard to the exploitation of holothurians for the demanding Asian markets [6].

Fisher participation data indicated about 3 million sea cucumber fishers worldwide [7]. Sea cucumber exports are derived from countries where either this fishery is banned such as Panama and Most of the sea cucumber exports from the Latin America and the Caribbean regions are from Peru (26.1%) followed by Ecuador (25.9%), Chile (14.1%) and Cuba (10.1%). About 14.0% Costa Rica or have no proper record (Colombia) [8]. According to the FAO (FAO, 2007) report, sea cucumbers catches data is available for Ecuador, Mexico, Chile and Nicaragua with a total contribution of 6035 t (wet weight) for the period from 1988 to 2005 (Table 1) [9,8]. Of the 52 commercially exploited species, most are tropical and sub-tropical species belonging to the families of Holothuridae and Stichopodidae, including the genus *Actinopyga*, *Bohadschia*, *Stichopus* and *Holothuria* [10].

Year	Nicaragua	Ecuador	Mexico	Chile	Total in the Region	World harvest total	Percentage from region
1988	-	3	-	-	3	19,905	0.02
1989	-	10	-	-	10	17,467	0.05
1990	-	12	-	-	12	19,976	0.06
1991	-	29	-	-	29	21,790	0.15
1992	-	152	-	237	389	20,892	1.95
1993	-	12	-	13	25	19,348	0.13
1994	-	12	-	4	16	24,505	0.08
1995	-	12	-	106	118	24,050	0.59
1996	-	12	-	115	127	26,795	0.64
1997	-	15	-	1	16	24,672	0.08
1998	-	15	271	30	316	22,004	1.59
1999	-	15	234	108	357	20,462	1.79
2000	-	15	426	1510	1951	24,509	9.80
2001	-	15	481	107	603	20,431	3.03
2002	-	15	290	106	411	23,445	2.06
2003	-	15	285	307	607	28,085	3.05
2004	-	15	265	234	514	27,540	2.58
2005	51	15	312	153	531	26,002	2.67
Total	51	389	2564	3031	6035	411,878	1.46

Table 1: FAO Fisheries and Aquaculture Information and Statistics Service 2007 [9,8].

Futher more a socio-economic assessment was conducted at Vanga, Shimoni, Majoreni and Gazi villages in the Kenyan south coast with focus on the sea cucumber fishing patterns, the social and economic characteristics of the fisher communities, the contribution of sea cucumbers to the local livelihoods, and analysis of the management systems. According this research, the economic value of the product was substantial; the average monthly revenue for dry sea cucumbers in the area was estimated to US$ 8000. The relative highest profits are derived from juvenile species, thus there is an economic incentive hindering local stocks to reach sexual maturity, which in turn may create a situation in which recruitment success is highly dependent on faraway populations. Their conclusion is that the present management system falls into general fisheries regulations and was found weak. No specific management plan for sea cucumbers was found [11].

Sea cucumber fishing Turkey

For a better understanding, this review explores the sea cucumber fishery in Turkey, it started in 1996 with the export of S. regalis, which was a bycatch species of shrimp trawls during the years 1996 and 1997. After 1997, three species (H. tubulosa, H. mammata and H. polii) became the main targets of the sea cucumber fishery [12,13], but between 2002 and 2009, H. tubulosa and H. mammata became the two major commercial sea cucumber products of the Turkish seas. The sea cucumbers are not domestically consumed and are, therefore, used as an export product, mainly to Asian countries [14,15,16].

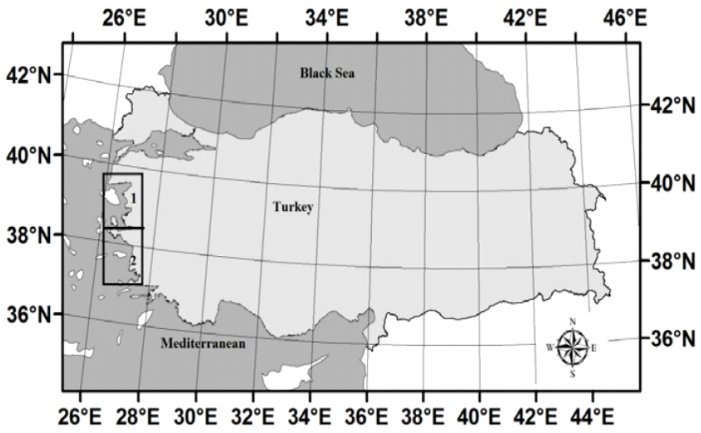

Figure 1. Sea cucumber fishing areas in Turkey shown by rectangles. Source: Fisheries Information System 2016

Sea cucumber fisheries in Turkey have been managed by legal regulations since 2007. Sea cucumber fishing is allowed only in a small area of the northern Mediterranean where a fallow period goes into effect after four years of fishing (See figure 1). Resumption of fisheries after the fallow periods is allowed only after a stock assessment has been made by the Ministry of Food, Agriculture and Livestock in Turkey. Boats engaged in sea cucumber fishing must obtain legal authorisation before every fishing season [17].

Table 2. Total production of sea cucumbers in Turkey by year and product.

Year	Total production (kg)	Product	
1996	19,868	Frozen	
1997	37,665	Frozen	
2002	172	Pulverised (for the use in pharmaceutical industry)	
2003	10,843	Dried and pulverised	
2004	5,421	Dried	
2005	53,293	Dried and frozen	
2006	24,200	Frozen and dried	
2007	77,238	Frozen, dried and salted	
		Dried (kg)	Frozen (kg)
2008	33,669	789	32,880
2009	37,976	7,036	30,940
2010	97,183	16,203	80,980
2011	479,985	13,930	466,055
2012	447,644	27,479	420,165
2013	254,226	21,465	232,761
2014	247,585	23,585	224,000
2015	270,270	51,300	218,970
2016 (first six months)	150,250	100	150,150

Data comes from private companies and the General Directorate of Fisheries and Aquaculture.

However, sea cucumber fishing is a problem. Pandemic overfishing to critical levels currently threatens the persistence of sea cucumber fisheries and the important role they play in the livelihoods of coastal fishers. Resource managers must embrace an ecosystem approach to fisheries, in which biodiversity conservation, ecosystem services and the concerns of stakeholders are taken into account together with the economic gains from fishing [18] This is why it is important to find out if it is beneficial to manage an agriculture and grow sea cucumbers in artificial ecosystems to stop the overfishing.

Compiled global landings, economic data, and country-specific assessment and management reports

Researchers [19] compiled global landings, economic data, and country-specific assessment and management reports to synthesize global trends in sea cucumber fisheries, they evaluate potential drivers, and test for local and global serial exploitation patterns. Their results suggest that development patterns of sea cucumber fisheries are largely predictable, often unsustainable and frequently too rapid for effective management responses. Thus they discuss potential ecosystem and human community consequences and urge for better monitoring and reporting of catch and abundance, proper scientific stock assessment and consideration of international trade regulations to ensure long-term and sustainable harvesting of sea cucumbers worldwide [19]. Worldwide, most sea cucumber fisheries are ineffectively managed, leading to declining stocks and potentially eroding the resilience of fisheries [20]. In contrast, the tropical sea cucumber fishery in Australia's World Heritage listed Great Barrier Reef Marine Park (GBRMP) is operating in a developed high-income country with relatively few licensed fishers to manage [21].

Effect overexploitation and managing overfishing sea cucumber

Sea cucumbers are thought to play an important role in the recycling and remineralization of organic matter in reef sands through feeding and bioturbation. However, growing demand and high prices from Asian markets are driving the overexploitation of sea cucumbers globally [21]. Sediments in tropical coastal habitats are capable of trapping a substantial amount of organic matter [22]. Water flows are able to transport OM into and within the sediment, and small organisms living within sediments are able to efficiently degrade OM [23]. Because the seafloor and the overlying water are closely linked through such transport processes, changing the function of sediments can have direct negative consequences on the quality of the overlying water [22]. Porous sediments are thus considered as a kind of biocatalytical filter system [23]. Thus, the removal of sea cucumbers reduces the efficiency of reef sediment to function as a filter system to buffer organic matter pulses, and negatively affects the function and productivity of inshore reef ecosystems [21].

For example, the sea cucumber fishery in Fiji has been operating intermittently for 200 years and has incurred intense fishing pressure in the past two decades. A recent change to fishery regulations now prohibits the issuance of exemptions for the use of Underwater Breathing Apparatus (UBA) for collecting sea cucumbers [24]. Acording to [21] Given the current low abundances of sea cucumbers in Fiji, the proposed national sea cucumber management plan should consider a moratorium on collection and sales until stocks are able to sufficiently recover and ecosystem function is restored. Studies [24] provide evidence for the introduction of better minimum legal size limits, shortlists of permissible species, and limited entry requirements to reduce the number of fishers permitted to collect sea cucumbers. At the same time, management actions are needed to strengthen enforcement of the regulations, support better postharvest processing and value chains, and develop nation-wide standards for pricing of raw and dried sea cucumbers. Prompt action on these management needs will give hope to reversing the perilous status of the fishery. Inaction will likely result in loss of biodiversity and some local species extinctions, erosion of ecosystem benefits of sea cucumbers, diminished long-term performance of the fishery, and a long-term loss of a valuable livelihood resource for current and future generations of Fijians [24].

Pond farming, culture-based production and resource management systems

Sea cucumber fishing is a problem worldwide, another option could be sea cucumber farming. A research [25], investigate the potential environmental effects of pond farming for Apostichopus japonicas in Yellow River estuary, they examined discrepancies of distance-based typical pollution indicators (TOC, TN, $NO3^-$, $NH4^+$, $NO2^-$ and $PO43^-$) and biochemical tracers ($\delta 13C$ and $\delta 15N$) in water column and sediment, as well as dietary characteristics of dominant macrobenthos between farming and non-farming areas. The overall results showed that pond farming for Apostichopus japonicus in the Yellow River estuary altered the local environment to a certain extent. For methodological consideration, sediment biogeochemical characteristics as a historical recorder much more effectively reflected aquaculture waste accumulation, and stable isotope approaches are efficient in tracing the origin and extent of various allogenous sources [25].

Culture-based production and resource management systems are being developed to restore depleted populations and increase the supply of premium-grade sized Holothuria scabra [26]. An adaptive and integrated socio-ecological framework to optimize production potentials and enhance sustainability through production clusters is proposed. Community trials validated that ocean-based systems can be readily adopted by small-scale fishers. Understanding of the biophysical and economic considerations for different production systems, and the relative capacity of stakeholders to manage threats, reduces their vulnerability to economic loses. Multi-sectoral involvement and multiplication of sandfish production clusters confer resilience for production systems and enable economies of scale while facilitating responsible management of genetic stocks [26].

II. Conclusion

Sea cucumbers are thought to play an important role in the recycling and remineralization of organic matter in reef sands through feeding and bioturbation. However, growing demand and high prices from Asian markets are driving the overexploitation of sea cucumbers globally [21]. Worldwide, most sea cucumber fisheries are ineffectively managed, leading to declining stocks and potentially eroding the resilience of fisheries [20]. Multi-sectoral involvement and multiplication of sandfish production clusters confer resilience for production systems and enable economies of scale while facilitating responsible management of genetic stocks [26]. However Tropical sea cucumber mariculture has potential to become a profitable industry and contribute towards natural population replenishment. They have superb potential to diversify mariculture industries in the tropics and potentially ameliorate the detrimental effects of mariculture on coastal ecosystems [27]. This research suggests that we focus on farming of sea cucumber to decrease the sea cucumber overfishing, exploitation.

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