

## Present status of the sea cucumber fishery in Turkey

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### Introduction

More than 66 sea cucumber species are commercially fished worldwide (Purcell et al. 2012). The Mediterranean Sea is thought to have 37 species from the Holothuriidae family (Fischer et al. 1987). So far, eight holothurians (*Holothuria forskali*, *H. mammata*, *H. polii*, *H. sanctori*, *H. tubulosa*, *Stereoderma kirschbergii*, *Stichopus regalis* and *Synaptula reciprocans*) have been recorded in Turkish waters (Aydın and Erkan 2015; Aydın 2015).

The sea cucumber fishery in Turkey 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 (Aydın 2008; González-Wangüemert et al. 2014), 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 (Çaklı et al. 2004; Özer et al. 2004; Aydın 2008; Aydın et al. 2011). This article presents information about the present status

of the sea cucumber fishery in Turkey. Data were obtained from the General Directorate of Fisheries and Aquaculture, SUBİS (Fisheries Information System) records and private companies.

### Fishing areas and management

The sea cucumber fishery is only allowed in the northern Mediterranean region by Turkish regulations (Fig. 1). This region is divided into two sub-regions, one of which is left as a recovery zone (alternating every four years) to let stocks recover. The use of rotational zoning systems has been reported as a successful method in the management of sea cucumber stocks (Purcell et al. 2016). Prior to opening a fishing zone in Turkey, the status of the stocks (e.g. individual weights, lengths, biomass, distribution) is checked by the Turkish Ministry of Food, Agriculture and Livestock, and if it is appropriate, then fishing is allowed.

Moreover, fisheries in an open region are not allowed during the reproduction period (1 June–1 November). Vessels intending to catch sea cucumber must be authorised by the Ministry of Food, Agriculture and Livestock at the beginning of the fishing season.

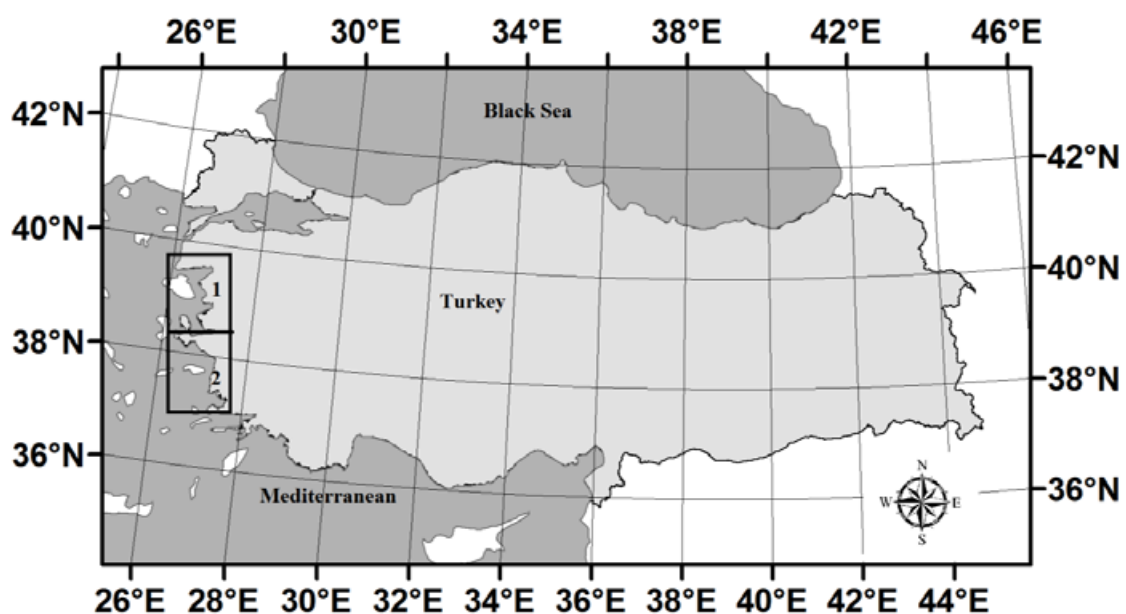


Figure 1. Sea cucumber fishing areas in Turkey shown by rectangles. Source: Fisheries Information System 2016

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**Fishing method**

Wooden boats, 4–12 m long and with 28–170 hp engines are typical in the sea cucumber fisheries of the region (Fig. 2). On average, two divers work on each vessel, diving to depths of 3–30 m using a hookah system (surface supplied air). In 2008, a single diver’s catch was anywhere from 2,000 to 3,000 individuals per day (Aydın 2008), a figure that is comparable to today’s catch amounts.



**Figure 2.** A sea cucumber fishing boat from İzmir.

**Table 1.** Number of boats authorised to fish for sea cucumbers in Turkey.

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Number of boats	46	69	45	87	89	29	46	50	109

Note: It is estimated that an additional 30% of illegal boats are also fishing for sea cucumbers in recent years.

An ordinary vessel using hookah is equipped with a compressor, air tank, air hose and regulator as well as bags and barrels used to catch and store sea cucumbers. Vessels with a hookah system use one or two divers simultaneously to collect sea cucumbers. In the latter case, air is divided by a hose with a “Y” shape piece leading to two separate air regulators.

When the vessels reach the fishing sites, they either anchor or drift. When anchored, the divers can operate in an area that is limited by the length their hoses. When they finish harvesting in a zone, the vessel moves to another place for another dive.

When the weather permits, the vessel is left drifting and the divers are able to collect sea cucumbers from a wider area. The collected sea cucumbers are kept in bags by the divers. The bags are tied to upturned barrels, which are filled with air using the regulator to keep them neutrally buoyant in the water column as the harvest weight increases. This helps divers moving the barrels around under water. When a bag is filled with cucumbers, the barrel is fully filled with air so that it rises to the surface. Fishing with the hookah system is conducted in the daytime, and generally, a diver stays underwater for three to four hours, depending on the depth.

**Processing**

Sea cucumbers collected by the divers are transferred to the processing plants in plastic barrels (Figs. 3 and 4).

**Figure 3.** A sea cucumber catch brought aboard and bagged.



**Figure 4.** Plastic barrels used to transfer the harvested sea cucumbers to the processing plant.





Sea cucumbers are transferred live from the sea water to the processing plant, where they are first eviscerated by squeezing the body from the ends towards a 2 cm ventral incision (Fig. 5).

After evisceration, the sea cucumbers are washed with cold water and then boiled under pressure at 100°C for 20 minutes (Fig. 6).

After boiling, the material is washed again with cold water (Fig. 7).

The Asian demand for sea cucumbers is constantly increasing (Purcell 2010; Perez and Brown 2012; Roggatz et al. 2015). Depending on the buyer's request, sea cucumbers are usually marketed as frozen, cooked-dried, cooked-salted, cooked-salted-dried and cooked-calcium removed

products (Figs. 8–12). In recent years, sea cucumbers harvested and processed in Turkey are mostly exported to Taiwan, Hong Kong and the United States in frozen or dried form.

### Sea cucumber production in Turkey

Turkey's yearly sea cucumber production since 1996 is given in Table 2.

Total production during 1996–1997 was based on an estimate of commercial catches of *Stichopus regalis* as bycatch of the shrimp beam trawls. However, this species was no longer commercially harvested after 1997.

There was a gradual linear increase in sea cucumber production up to 2010, and in 2011 production



**Figure 5.** Evisceration of sea cucumber at the processing plant.



**Figure 6.** Pressurized boiling of sea cucumbers.



**Figure 7.** Boiled and cold-washed sea cucumbers.



**Figure 8.** Sun-drying sea cucumbers.

**Figure 9.** Sea cucumbers in a drying room.

**Figure 10.** Frozen sea cucumbers.

**Figure 11.** Salted sea cucumbers.

**Figure 12.** Calcium removal, a chemical method that is a company secret.

**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.

soared. The reason was that *H. polii* had not been commercially exploited up to 2011 due to its low economic value. However, the processing of this species began that year, which increased total sea cucumber production. Moreover, fishing effort approximately doubled in 2011 and 2012, which is reflected in production amounts. The trend since then has been relatively stable.

## Conclusions

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. 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. Boats engaged in sea cucumber fishing must obtain legal authorisation before every fishing season. These regulations seem to have allowed a sustainable sea cucumber fishery in the region.

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