The small-spotted catshark, *Scyliorhinus canicula*, transfer from catch to the public aquarium for the exhibition

Aydın C.*

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Abstract

A public aquarium (or city aquarium) is the aquatic counterpart of a zoo, which houses living aquatic animal and plant specimens for public viewing. The supply of the species to be exhibited is one of the most important issues. The small-spotted catshark (*Scyliorhinus canicula*), is very famous for public aquariums to the exhibition. Along the Turkish coast, bottom trawls primarily take catshark. In this study, it was aimed that live *S. canicula* supply and their transfer to public aquariums. Catsharks were obtained by commercial trawl at the three operations. Operations were carried out in September 2019 in Sığacık Bay, Turkey. Totally 26 *S. canicula* was caught and they had put into 50, 100 and 200-liter tanks for the transportation. In the transfer process, the average, ammoniac, temperature, oxygen pH value and salinity values were taken and their values are70 mg/L, 18.8 C^o, 7.16 mg/L, 8.03 and 39.8 ppt, respectively. At the end of the 3-hour transfer period, all of the fish were successfully transferred to the quarantine process. After 1 week quarantine period, the fish were put into the aquarium to be the exhibition. Mainly ammonia the other transfer water criteria such as temperature, oxygen pH value and salinity are important for transportation. Because *S. canicula* start to release ammonia when get stressed. Therefore, water criteria should be checked every 30 minutes and if necessary Amquel for ammonia bicarbonate for pH added in transfer tanks. After 1.50 h later, all individuals were successufully transported as live (100% survival rate) to the quarantine process.

Keywords: Small-spotted catshark, Scyliorhinus canicula, transfer, catch, public aquarium

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1-Fisheries Faculty, Ege University, Bornova, İzmir Turkey
*-Corresponding autor's Email: caydina@gmail.com

Introduction

A public aquarium (or city aquarium) is the aquatic counterpart of a zoo, which houses living aquatic animal and plant specimens for public viewing (https://en.wikipedia.org/wiki/Public_aquarium). Although the history of public (city) aquariums go way back, the first large public aquarium in the world, known as the Fish House, was built in 1853 at the London Zoo with the name The London Zoo (Brunner (2003). Following the London aquariums, first American aquarium as part of Barnum's American Museum was established in 1856. Then the Aquarial Gardens were founded in Boston in 1859. Several aquariums then opened in Europe, such as the Jardin d'Acclimatation in Paris and the Viennese Aquarium Salon (both founded 1860), the Marine Aquarium Temple as part of the Zoological Garden in Hamburg (1864), as well as aquariums in Berlin (1869) and Brighton (1872) (Brunner, 2011). The first large public aquarium was established in İstanbul, Turkey in 2009. Then the number of public aquariums increased one by one in the following years reached 13 in 2019 (Table 1).

Table 1: Public aquariums in Turkey (Çelik and Ülger, 2020).

Name	Establishment Year	Location	Water Capacity (m3)	Number / Species of Animals
SEA LIFE İstanbul Aquarium (Turkuazoo)	2009	İstanbul	5000	15478 nektons of 500 species
Keçiören Outdoor Aquarium	2010	Ankara	300	2230 invertebrates 671 marine fish in 13 species
Deniz Dünyası	2010	Ankara	1000	4000 marine and 150 freshwater species
İstanbul Akvaryum	2011	İstanbul	6800	17000 land and sea creatures
Kaplıkaya Cazibe Merkezi	2011	Bursa	3000	5000 fish in tunnel and 150 fish in other aquariums
Aqua Vega Aquarium	2012	Ankara	4500	There are 12000 marine species
Antalya Aquarium	2012	Antalya	7500	It hosts roughly 10 thousand species
ETI Underwater World	2014	Eskişehir	1400	2150 creatures in 84 species
Viasea Aquarium	2015	İstanbul	5200	12000 marine creatures
Aqua Diyarbakır	2015	Diyarbakır	1700	2500 different marine creatures of 150 species
Jungle İstanbul	2015	İstanbul		
Emaar Aquarium & Underwater Zoo	2017	İstanbul	48	20000 nektons and amphibians of 200 species
Funtastic Aquarium İzmir	2018	İzmir	2000	70+

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Since the first public aquariums were built, they have become popular and their interest has increased. Over 20 million marine fishes are caught for the aquarium trade, destined for sale (Pinnegar and Murray, 2019). A global market worth more than the US $330 million in the United States and Europe (Tissot *et al*., 2010).

More than 7000 species like fish, invertebrates, amphibians, aquatic reptiles, and aquatic plants have been exhibited in the aquarium. Therefore, obtaining the species to be displayed is one of the most important issues. The transportation of fish is a science in itself (Brunner, 2011). A fish transfer is the healthy transport of a living creature from its current environment to another controlled environment.

Elasmobranchs are a popular exhibit specimen among public aquaria worldwide. Despite the contrary, elasmobranchs are delicate animals. This delicate nature is nowhere more evident than during the difficult process of capturing and transporting these animals from their natural habitat to a place of study or display (Smith *et al*., 2004). If not sufficient, care should be used, elasmobranchs perish during transport (Boldwin and Wells, 1990; Murru, 1990; Smith, 1992).

The small-spotted catshark (*Scyliorhinus canicula*) (also known as the sandy dogfish, lesser-spotted dogfish, Rough-hound or Morgay) is an Elasmobranch species of *Scyliorhinidae*. It is found primarily over sandy, gravelly, or muddy bottoms from depths of a few metres down to 400 m(Rodriguez-Cabello *et al*., 2007). Catshark is of only moderate commercial fisheries importance. It is utilized fresh and dried salted for human consumption, fishmeal and oil. Besides, exhibited in a public aquarium. Bottom trawls primarily take this catshark as a bycatch species in Turkey, it is also caught with trammel nets longline and hand line.

In this study, it was aimed that live *S. canicula* supply from trawl and their transfer to public aquariums. This paper presents the first results of the transportation of *S. canicula* from Turkey.

Material and methods

S. canicula's were obtained by bottom trawl. Trawl operations were conducted on Sığacik bay of the Turkish coast of the Aegean Sea on 8 October 2019 on the commercial fishing ground (Fig. 1). A commercial stern trawler "BATUHAN EYLÜL" which have 20.0 m LAO and 750HP engine power was utilized (Fig. 2). A modified 900 meshes fishing circle demersal trawl net was used in the sampling (Figs. 3 and 4).

Polipropilen (PP) tanks which have 100 (width:40 cm, height: 49 cm, lengths: 66 cm) and 200 (width:65 cm, height: 59 cm, lengths: 75 cm) litre capacity were used to keep fish in the ship. Water quality, important for transfer, was monitored throughout the transport. They were measured every 30 minutes with multifunction measurements devices for dissolved oxygen concentrations and pH, and

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refractometer for salinity, ammonia kit for ammonia concentrations and nitrate-nitrite kit for nitrate –nitrate concentrations.

Additional tools were utilized taken the species and their transportation processes such as air pump and stone, oxygen tube, external filter, scoop, submersible pump and hose pipe for successful transportation.

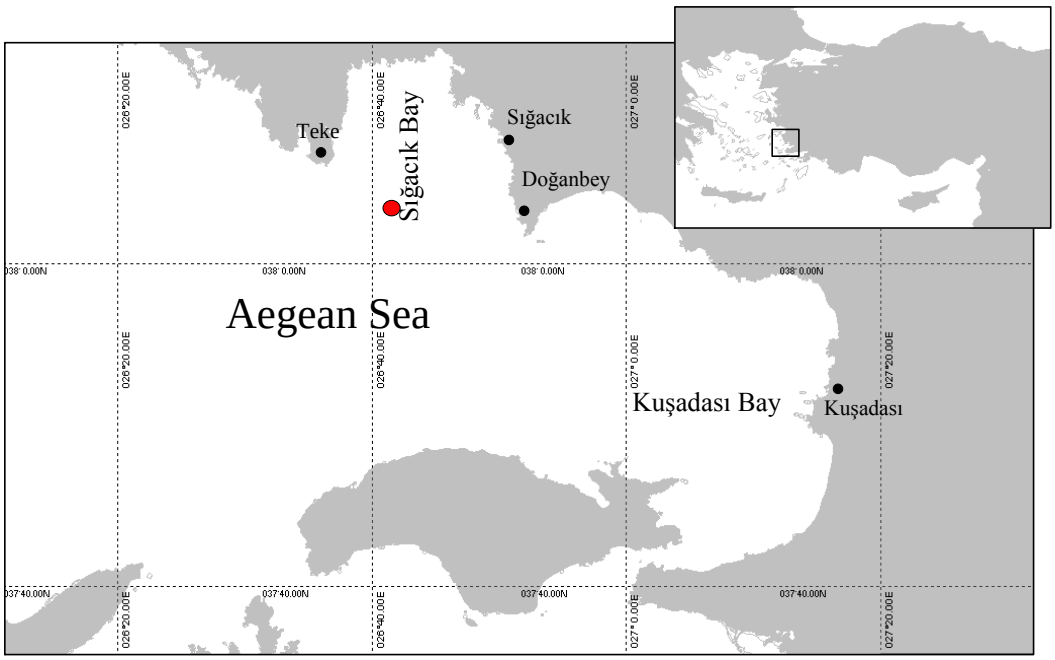

Figure 1: Trawl operations.

Figure 2: Trawler used in the operations.

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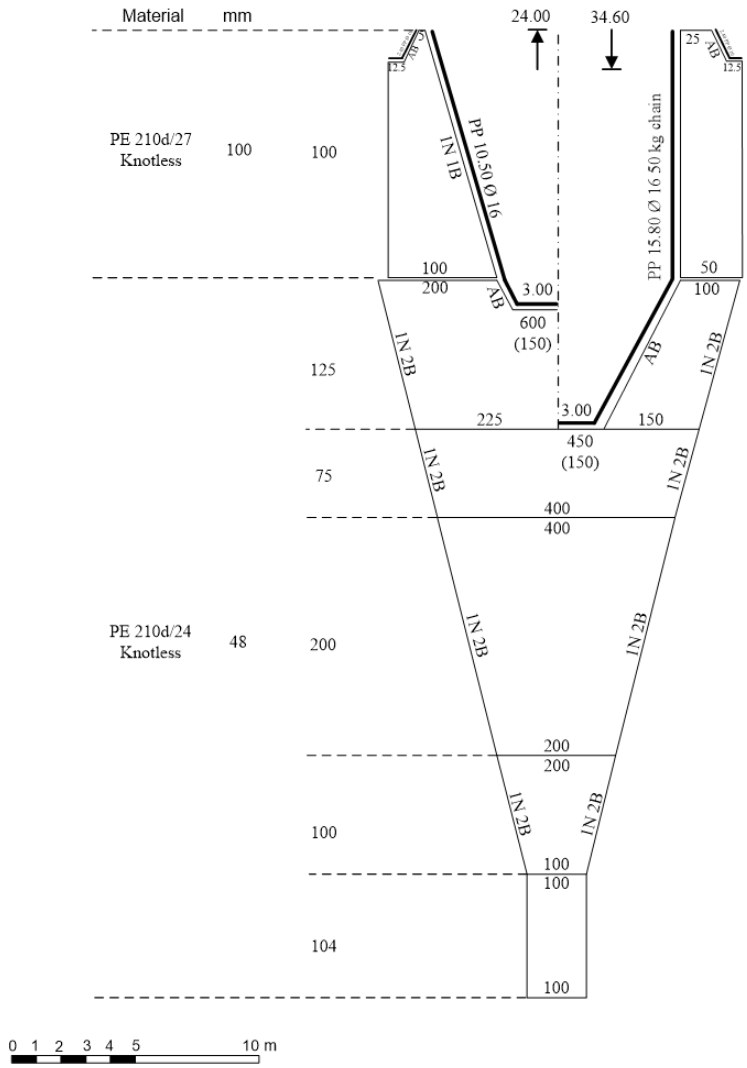

Figure 3: Trawl used in study.

Figure 4: PVC tank.

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Results

Three trawl operations were done. Mean depths is 77.3 m ranging from 75 to 80 m. The average haul duration and trawling speeds were 201.3minutes (from 144 to 241 minutes) and 2.5 knots (from 2.4 to 2.5), respectively (Table 1). After trawl hauls up, *Scyliorhinus canicula* were separated and put in the tank. A total of 26 *S. canicula* were caught in three operations. The commercial species sorted out by crews on the deck and taken on the case. Some of these species are deep-water rose shrimp (*Parapenaeus longirostris*), European hake (*Merluccius merluccius*), horse mackerel (*Trachurus trachurus*), large-scaled gurned (*Lepidotrigla cavillone*), John Dory (*Zeus faber*), angler fish (*Lophius piscatorius*) and European squid (Loligo vulgaris), The others which have no commercial values were throw out the sea as a discard (Table 2). Fresh seawater was continuously added to the tanks where the fish were kept during the time passed on the ship until the transfer time. A track, which has air-container oxygen tube used to transfer. 50, 100 and 500 liter capacity (width:65 cm, height: 62 cm, lengths: 152 cm) PP tank was used during transport.

Table 2: Trawl operations details.

Operations	Time	Coordinates	Depths (m)	Speed (Knots)	Number of *S.canicula*
1. Haul	06:32-10:11	38° 08' 567" N, 26° 40' 860" E-38° 04' 186" N, 26° 48' 684" E	77.7	2.5	8
2. Haul	10:39-14:07	38° 05' 102" N, 26° 48' 442" E-38° 08' 199" N, 26° 39' 271" E	75.8	2.4	12
3. Haul	14:38-18:39	38° 08' 245" N, 26° 40' 267" E-38° 02' 854" N, 26° 49' 056" E	78.5	2.5	6

Oxygen level in seawater is on average 7 mg/L. Oxygen value measured during transfer is minimum of 6.95 mg/L, maximum 7.40 mg /L and the average oxygen value is 7.16 mg/L. The valve of the oxygen cylinder was turndown or turn up according to the change of oxygen in the water in mg/L. The seawater salinity is 41 ppt. The measured salinity during the transfer is minimum 39 ppt, maximum 41 ppt, and the average salinity value is 39.8 ppt. Another important water criteria are pH. If the pH was found to be lower than 8.0, a 50.0 g dose of sodium bicarbonate was also added to the water. The pH values measured during the transfer are minimum 7.95 and maximum 8.12, and the average pH value is 8.03.

Ammonia and urea are found in the blood of cartilaginous fish. In the transfer step into stress sharks, begin to excreted mucus and ammonia. Ammonia reduces the quality of the water and causes more stress for the fish. If the concentration of ammonia found to be higher than 0.5 mg/L a 420.0 ml dose of an ammonia detoxifier was added to the water. This amount of

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AmQuel had been to neutralize 1.0 mg/L of ammonia in 3.20 m^3 of water (i.e., the volume of the transport containers). Water temperature was not monitored during the transport, although the ambient temperature was regulated using the air-conditioning systems and maintained at approximately 15.0°C

The transport duration 1 hr 50 min. All individuals were transported as live (100% survival rate) to the quarantine process. After one week quarantine process *S. canicula* were still alive in İzmir.

Discussion

From the capture to the exhibition, the live fish transfer is long, intenseprocess need to be extremely careful. We supplied 26 *S. canicula* from the trawl and achieved a 100% survival rates success. Studies have shown that post-discard survival rates of Catharks are extremely high, around 98% (Ellis *et al*., 2017).On the other hand, catch composition of bottom trawl fisheries of the Aegean Sea is composed of more than sixty fish species (Stergiou *et al*., 2003). Various in the body shapes and behaviour of species can be caught (Stergiou *et al*., 1997). Therefore, conventional demersal fisheries have rather a poor selectivity. Besides, long towing duration and depths can affect the supplying live fish from the trawl. If other fish species want to be caught as alive, it can be extremely careful especially when the haul up the trawl otherwise negative effects such as exhausted and swimming bladder swell up can cause damages. For example Survival rate of red mullet from traditional bottom trawl towed for just 15 min were varied between 77.4% and 94.7% (Metin *et al*., 2004) and black goby fish were 69% and 77.2% (Düzbastılar *et al*., 2010).

Elasmobranch transport regime takes into account a number of considerations related to species biology and transport logistics well described in 16 steps (Smith *et al*., 2004). Each step is important for transportation. Among these, water criteria are an important factor during transfer. They should be able to provide optimal conditions throughout the process. The criteria applied for this study appeared to be effective until 2 hours. For longer transports, further water treatment mechanisms should be considered (e.g., additional water exchanges, replacement of activated carbon, staging at an intermediate facility, etc.).

In conclusion, Aquariums are established in many parts of the world. The transfer of live fish to marine aquariums has become an important sector and catching the species from nature with the least damage has become an important issue. The interaction of several parameters should be taken into consideration when a transport regime the species. They cover captured methods (trawl, longline, etc.) fish (swimming, morphology, etc.), the water quality of the transport process. The techniques adopted in this study appear to have extended the possible duration for the

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transport of *Scyliorhinus canicula* by up to 2 hr.

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