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Seasonal changes in the marine litter in the Eastern Black Sea Region of Turkey

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ABSTRACT. The present study was performed on Eastern Black Sea Region coasts and trawling areas. Its aime was to investigate the amount and composition of marine litter and its seasonal changes. The beach surveys were conducted on nine selected stations during four seasons. Also trawl surveys were conducted on December 2012 on trawling areas. All litter items greater than 2 cm diameter were collected and categorised according to their material and usage categories. A total of 36,880 m^2 beach area was surveyed and 5,690 pieces of litter with 108.28 kg weight were collected during the study. Taking into acount the seasonal average values, with 0.21 items/m^2 autumn was the most abundant season while spring was the merest with 0.13 items/m^2. Plastic (71.85%) was the most abundant material followed by nylon (16.90%) and paper (3.76%) according to sum of seasons. Composite materials (1.48%) which consist of at least two different materials was the less abundant. The most common usage category was foams (26.43%) followed by beverage (24.38%) and undefined (23.93%) while clothing (2.21%) was the less abundant. According to trawl surveys nylon (65.67%) was the most abundant material while the glass (1.49%) and metal (1.49%) was least. The most abundant usage category was undefined (40.32%) while clothing (3.52%) was least.

Key words: marine litter, pollution, beach surveys, Black Sea, Turkey

INTRODUCTION

Any persistent, manufactured or processed solid material disposed of or abandoned in the marine and coastal environment can be defined as marine litter [*9*] and marine litter problem is a vast and growing problem to marine environment in all over the world. It can be found both on coastal and benthic zones and not only most populated regions [*4*] but also most remote regions such as poles [*1*].

Marine litter is an environmental, economic, health and aesthetic problem. Entanglement, ingestion, destruction of smothering sea bed, transportation of invasive species and accumulation of toxic subsequences are some of the known examples of the impacts to marine ecosystem. It also has economic effects such as damage to fishing vessels, fouling the fishing gears [*6*].

The importance of the subjectcomprehended by the scientists in all over the world butdue to the lack of systematic and comprehensive surveys on the quantities of marine litter onregional scalesthere is insufficient data about Black Sea. Güneroğlu (2010) [*5*], Topçu and Öztürk (2010) [*7*] made a start on marine litter studies in the region but there is a data gap for Eastern Black Seacosts and trawling areas of Turkey.

MATERIALS AND METHODS

A total number of five surveys were conducted during the study to estimate the beach litter. The aim of the first survey conducted on August 2012 was to determine the stations and to reset the litter accumulated for a long time. The rest four surveys were conducted on November 2012, February 2013, May 2013 and August 2013.

Study area

Beach surveys were conducted on Eastern Black Sea coast of Turkey. Nine stations were selected randomly for the beach surveys (**Fig 1**).

The most populated city on the central Black Sea was selected for the benthic marine litter surveys (**Fig. 2**). With 1.2 million population and shown as a hot spot by UNEP (2005) [*9*], the study area is between two big streams, named Kızılırmak and Yeşilırmak, and there is also an intensive fishing activity except the ban period (between 15 May and 1 September).

Sampling Method

Transects were selected randomly from each area between 30-70 m long. All the litter items >2.5 cm diameter collected betweenshore line andshore edge line.

For the surveys of the benthic marine litter cruises were taken with a commercial fishing vessel at speeds of 2.8 - 3.2 knots/h in December 2012 by using bottom trawl net with 25 m mouth opening and 22 mm mesh size. Five trawl shots (**Fig. 2**) taken between 45 - 50 m depth and lasted between 1 - 1.5 hours.

For both beach and benthic marine litter, collected litter items were counted, weighed and sorted into sevenmaterial (plastic, nylon, cloth, paper, metal, glass, composite) and ten usage categories(beverage, foams, clothing, food packaging, general packaging, medical, fishing equipment, household goods and undefined) according to their usage categories. Because of very low rates of medical litter items, fishing equipment and household goods, they were grouped in "other" category. Although nylon is derived from plastic we preferred to separate them because of high abundance especially in bottom surveys. After the samplingthe litter items were taken to the nearest disposal site. Density of litter items were calculated as the number of items per unit and as the weight per unit area.

RESULTS AND DISCUSSIONS

There was no litter free surveys during both beach and bottom survey period (**Fig. 3** and **Fig. 4**).

Beach Surveys

Total area of the beach transects surveyed was 36,880 m^2 and a total number of 5,690 pieces and 108.28 kg litter items were collected in two seasons (**Table 2** shows the weight of litter items per unit area in the nine study-areas). The litter distribution is varied between 0.05 - 0.55 items/m^2 and 0.001 - 0.015 kg/m^2. The average amount of litter items per unit area ranged between 0.13 (+/- 0.10) in Spring and 0.21 (+/- 018) in Autumn (**Table 1**).

The most abundant litter items were plastics (71.58%) followed by nylon (16.29%), paper (3.76%) and metal (3.44%) in total.

The most common usage category was foams (26.43%) followed by, beverage (24.38%) and undefined pieces (23.92%) in total.

Table 1

Amount of litter items per unit area

Station	Autumn	Winter	Spring	Summer	Mean
Rize-Ardeşen	0.21	0.23	0.24	0.18	0.22±0.03
Trabzon-Of	0.55	0.40	0.34	0.37	0.41±0.09
Trabzon-Çarşıbaşı	0.46	0.46	0.13	0.24	0.32±0.17
Giresun-Tirebolu	0.10	0.05	0.05	0.09	0.07±0.03
Ordu-Bulancak	0.14	0.13	0.09	0.11	0.12±0.02
Samsun-Terme	0.23	0.17	0.14	0.18	0.18±0.04
Samsun-Atakum	0.06	0.03	0.03	0.04	0.04±0.01
Sinop-Gerze	0.11	0.06	0.09	0.06	0.08±0.03
Sinop-Merkez	0.05	0.05	0.06	0.06	0.05±0.01
Mean	0.21±0.18	0.17±0.16	0.13±0.10	0.15±0.11	

Table 2

Weight of litter items per unit area

Station	Autumn	Winter	Spring	Summer	Mean
Rize-Ardeşen	0.004	0.003	0.005	0.004	0.004±0.001
Trabzon-Of	0.010	0.005	0.003	0.005	0.006±0.003
Trabzon-Çarşıbaşı	0.015	0.009	0.002	0.003	0.007±0.006
Giresun-Tirebolu	0.004	0.002	0.001	0.001	0.002±0.001
Ordu-Bulancak	0.008	0.004	0.003	0.001	0.004±0.003
Samsun-Terme	0.004	0.006	0.003	0.002	0.003±0.002
Samsun-Atakum	0.001	0.001	0.001	0.001	0.001±<0.001
Sinop-Gerze	0.004	0.002	0.001	0.001	0.002±0.001
Sinop-Merkez	0.002	0.001	0.001	0.001	0.001±0.001
Mean	0.006	0.003	0.002	0.002	

Trawl Surveys

The swept area for benthic marine litter surveyswas 0.34 km^2.

Nylon is the most abundant litter item (65.67%) followed by plastic (19.40%), metal (4.48%) and paper (4.48.%) (**Fig. 5**).

Usage categories of 40.32% litter collected could not be defined. The most common usage category was general packaging (25.80%) followed by beverage (12.90%), fishing gear (6.95%) and food packaging (3.72%) (**Fig. 6**). Amount of litter items per unit area (km^2) ranged between 121 and 366 (**Table 4**).

Table 4

Amount of litter items per unit area (bottom surveys)

Haul Number	Item per unit area (item/km^2)	Weight per unit area (kg/km^2)
1	366	17.41
2	296	24.58
3	121	2.3
4	186	116.89
5	142	10.45
Mean	222.6±105.11	34.32±41.93

CONCLUSIONS

Results show that plastic is the most abundant litter item as addressed on the other studies over the world ([2]; [3]; [8]).Common usage and low degradation rate of plastics makes them most abundant litter items in marine environment of the area.

Foam boxes are especially used in fishing season (1 September-15 April) by the fisherman to transport the catch. It can be presumed the high abundance of the foams is because of inconvenient disposal of those boxes. Since they are light they can be transported by currents and wind to one region to another easily. The beverage bottles and food packages amount increases on summer when local people use the costs for recreational activities such as swimming. Apparently changing human activities affects the litter amount and composition.

Because of lots of litter items were consist of < 10cm diameter pieces, it was not possible to define their usage categories. The large part of undefined litter items were the pieces of plastics and nylon.

It can be concluded that the study carried out has shown that the Eastern and Middle of the Black Sea coast is more clean than any other Turkish cost as well as in the Mediterranean area where the tourism is very abundant leisure activity. This is because of that the local municipalities like Atakum in Samsun is much concerned about the pollution and its sources and take action soon it becomes necessary.

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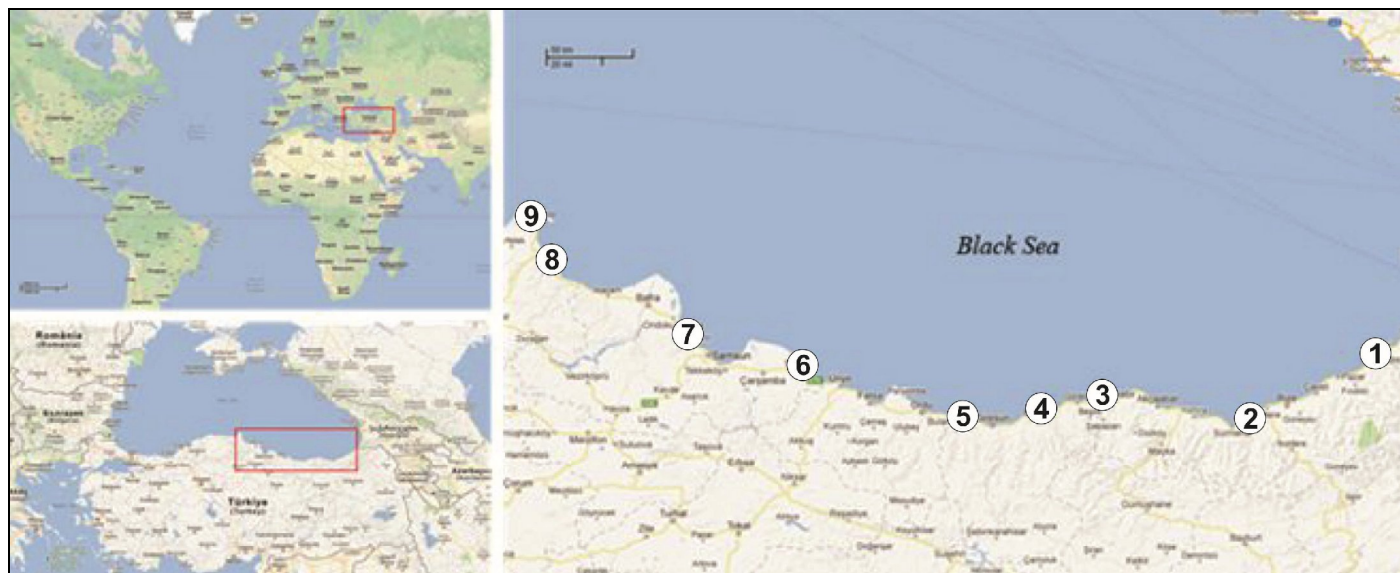
Fig. 1. Beach sampling areas in the eastern Black Sea.
Note. 1. Rize-Ardeşen, 2. Trabzon-Of, 3. Trabzon-Çarşıbaşı, 4. Giresun-Tirebolu, 5. Ordu-Bulancak, 6. Samsun-Terme, 7. Samsun-Atakum, 8. Sinop-Gerze, 9. Sinop-Merkez.
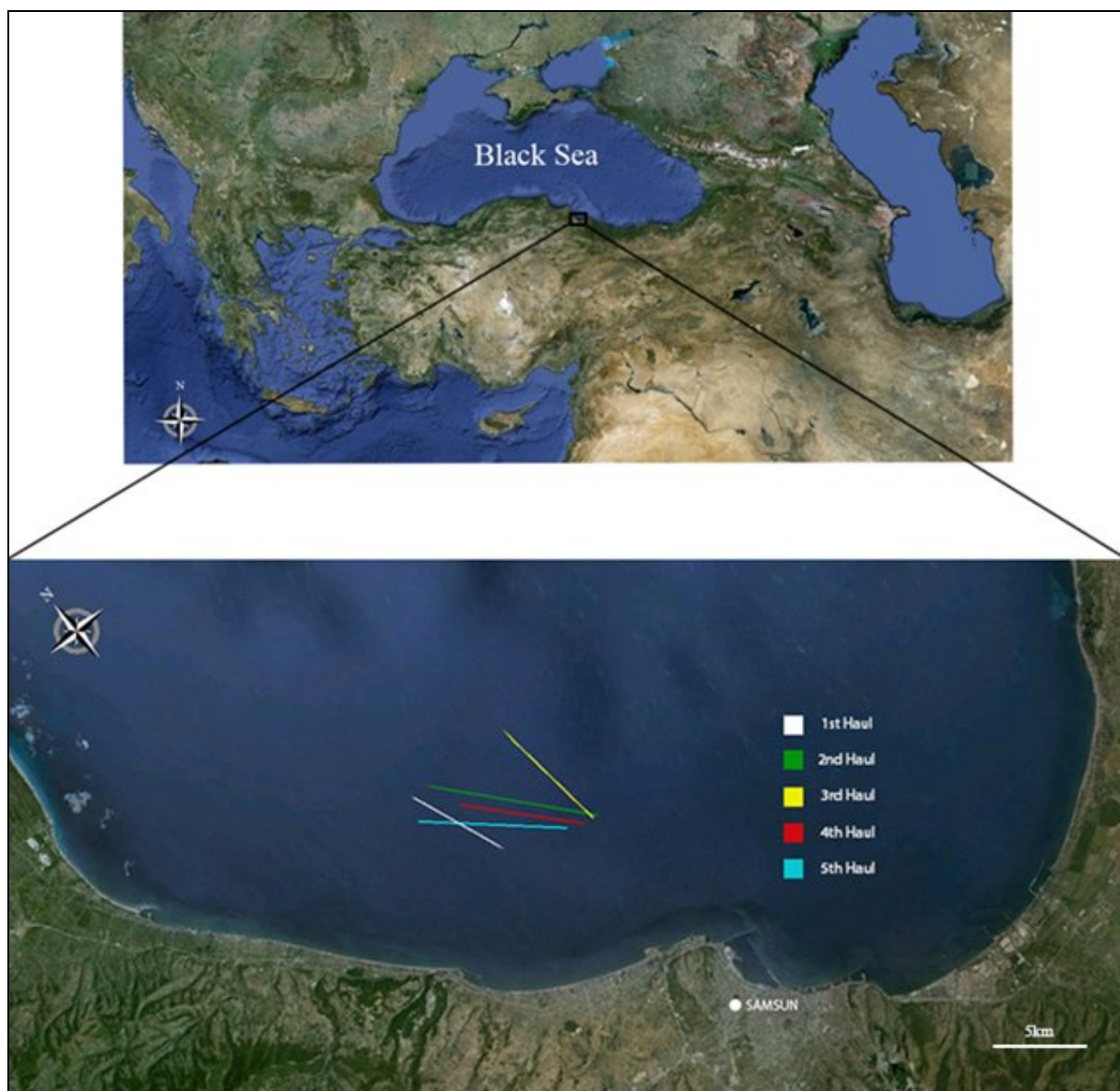
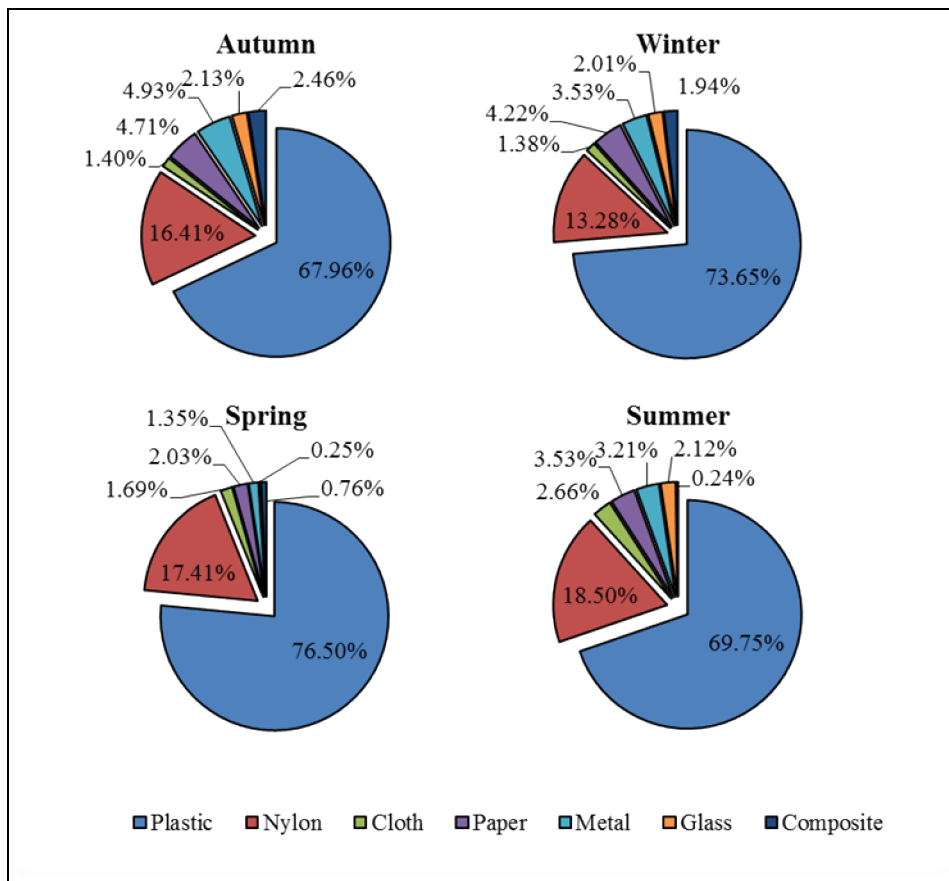**Fig. 2.** Trawl sampling area in the eastern Black Sea.

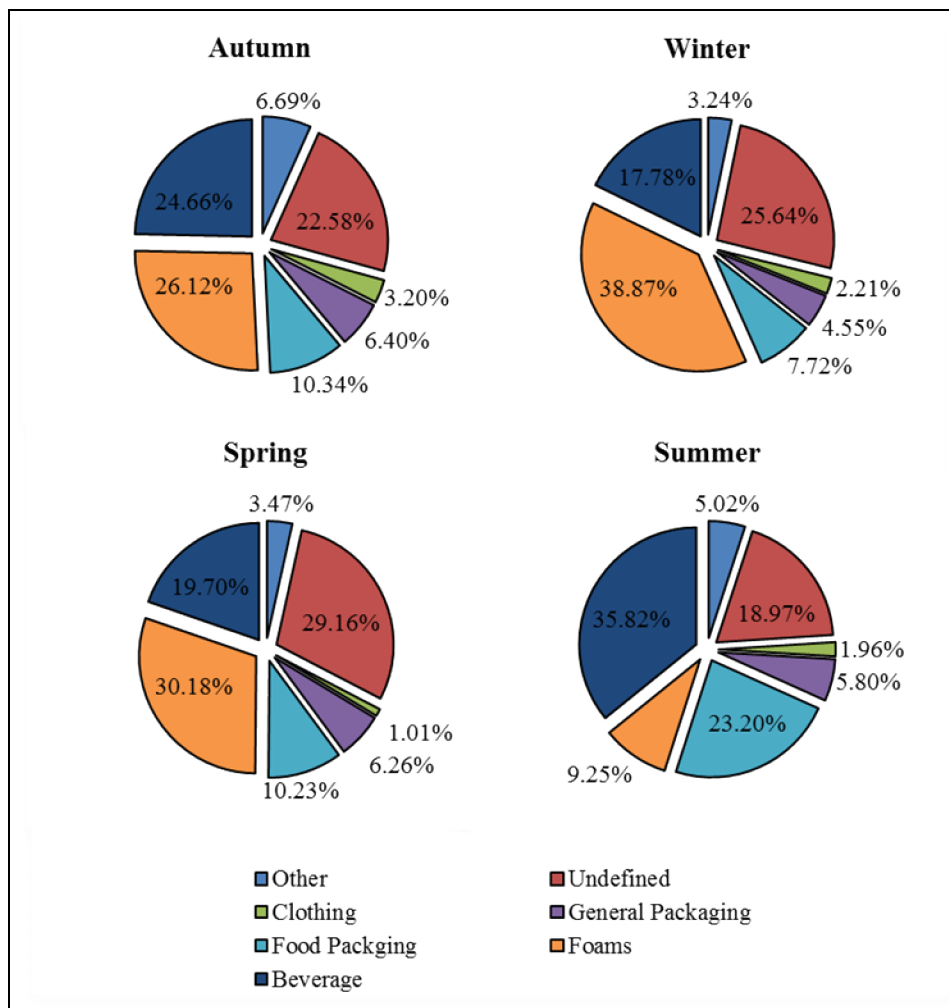**Fig. 3.** Distribution of the materials in different seasons.

Fig. 4. Distribution of the materials (by usage categories) in different seasons.
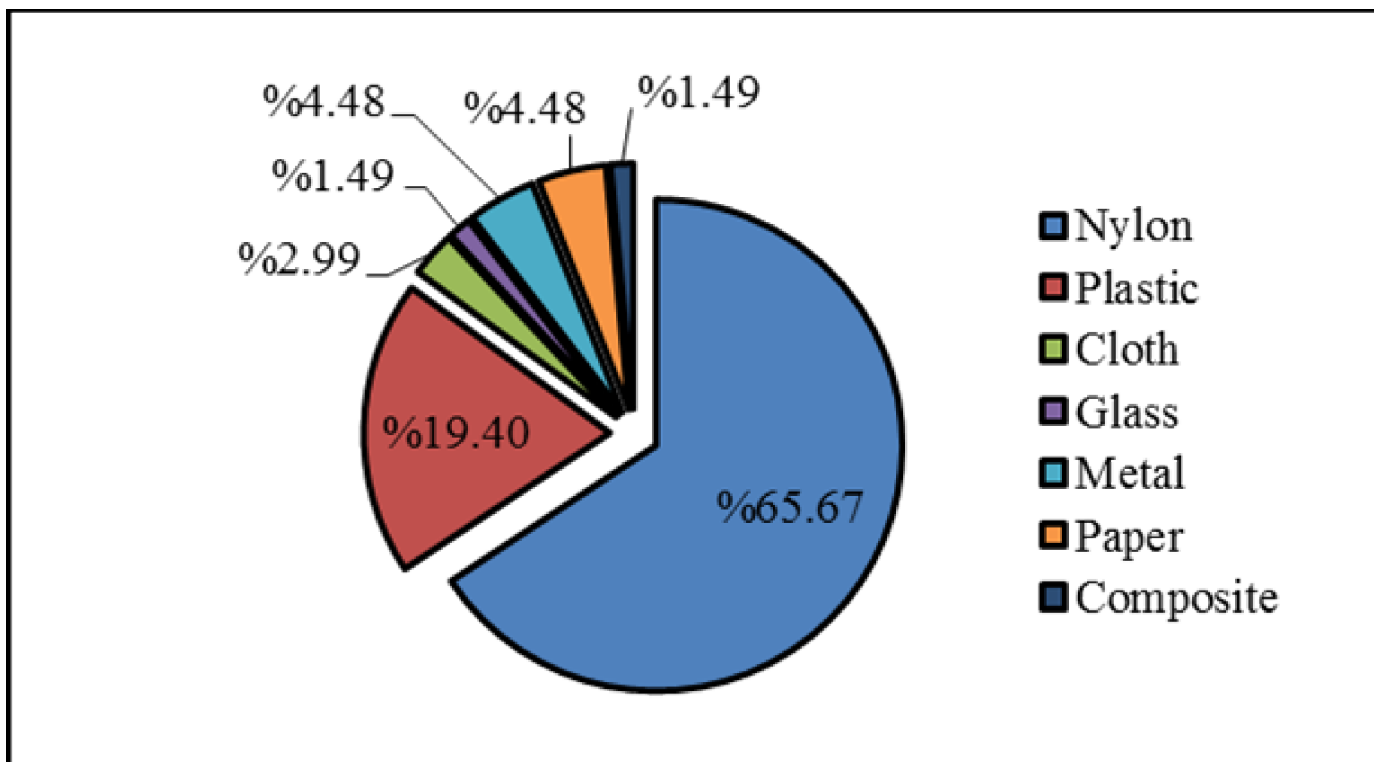
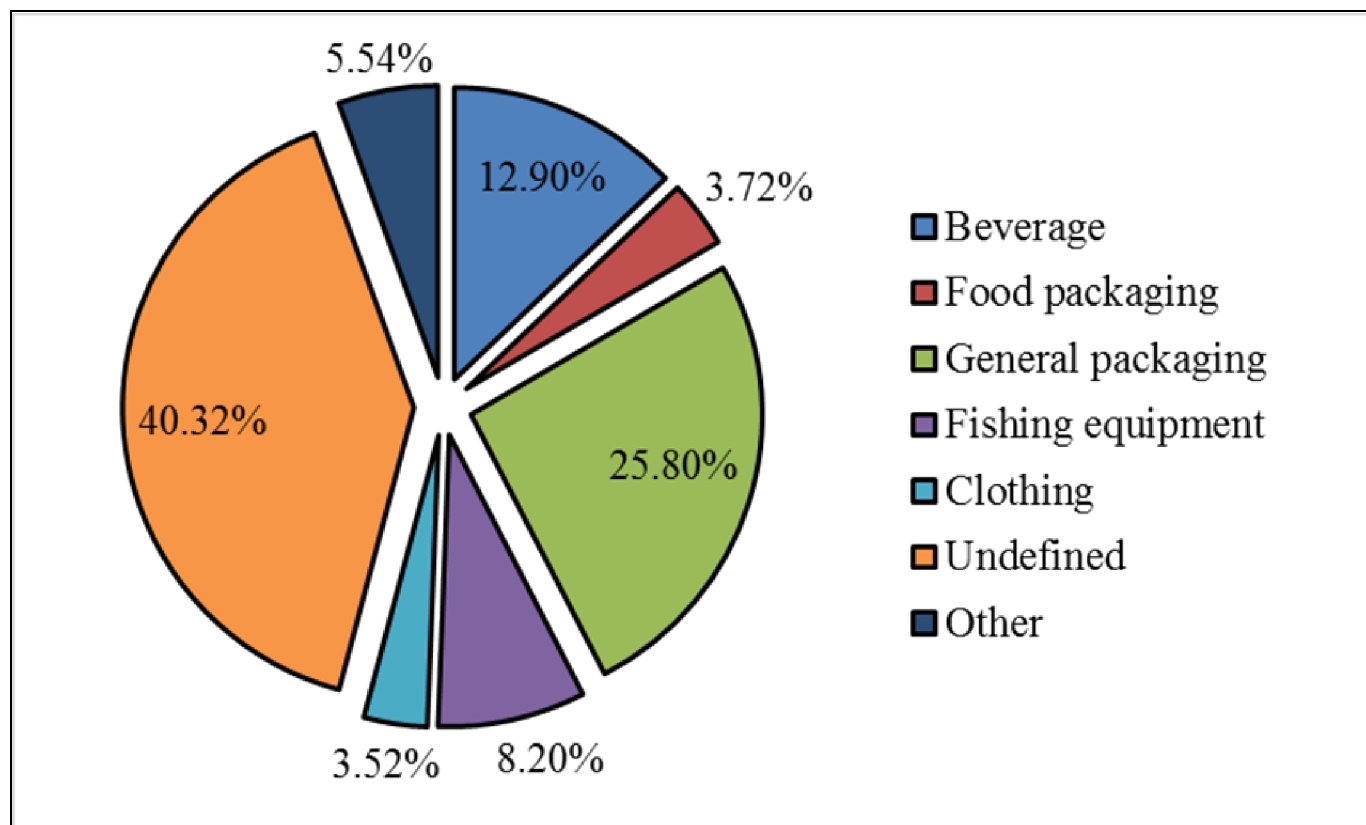**Fig. 5.** Distribution of the materials in trawl surveys.

Fig. 6. Distribution of the usage categories in trawl surveys.