A note on plastic materials in trawl catches in the north-eastern Mediterranean

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Ms. received 7. 7. 1986
Ms. accepted 19. 2. 1987

Abstract

During four cruises between autumn 1983 and autumn 1984 along the north-eastern Mediterranean coast of Turkey, plastic materials retained in the trawl net were determined in weight units. The distribution of these synthetic materials in the continental shelf region down to a depth of 100 m was described and total masses calculated applying the "swept area" method.

Kurzfassung

Eine Notiz über die Plastik-Materialien in den Schleppnetzfängen im nordöstlichen Mittelmeer

Während vier Reisen zwischen Herbst 1983 und Herbst 1984 entlang der nordöstlichen Mittelmeerküste der Türkei wurden die von dem Schleppnetz zurückgehaltenen Plastik-Materialien in Gewichtseinheiten bestimmt. Die Verteilung dieser synthetischen Materialien im Gebiet des Kontinentalsockels bis zu einer Tiefe von 100 m wurden beschrieben und die Gesamtmassen bei Anwendung der "swept-area"-Methode berechnet.

Résumé

Une Note sur les matières plastiques dans les chaluts en Méditerranée Nord-Est

Au cour de quatre expéditions entre l'automne 1983 et l'automne 1984 sur le long de la côte nord-est de la Méditerranée de Turquie, le poids des matières plastiques, retenues dans le chalut, a été déterminé. La distribution de ces matières synthétiques, jusqu' à une profondeur de 100 m a été décrite dans la région du plateau continental et la masse totale a été calculée en utilisant la méthode "swept-area".

Introduction

Usually, light packing materials (plastic bags etc.) are introduced into the sea either by rivers, shipping activities, dumping or by bathers. Because of their high resistance, these materials sink to the sea bottom after a certain period of flotation at the surface. During this floating period and after settling on the sea bottom they are carried by currents probably over long distances. Holstrom (1975 after Gerlach 1976) reported that fishermen in the Skagerrak almost every time found plastics in their nets trawled at depths of 180–400 m.

Meeresforsch. 31 (1987), 227–233

ISSN 0341-6836

This study will report on the distribution and abundance of plastic materials along the north-eastern Mediterranean coast of Turkey.

Material and methods

During studies for the assessment of trawlable fish biomass off the north-eastern Mediterranean coast of Turkey, the plastic materials caught by the trawl net were recorded in weight units. These cruises carried out in autumn 1983, spring 1984 and autumn 1984 and covered the coastal strip extending from Iskenderun in the east to Anamur in the west (Fig. 1).

Depending on the bottom topography and capacity of the vessel a depth range of 0–100 m was covered. At places suitable for longer trawling 30 minute and at other places 15 minute hauls were made. The number of hauls done in different depth ranges and regions during the cruises are given in Table 1.

Table 1. Number of hauls done in different depth ranges and sub-areas. (A) denotes autumn 1983, (B) spring 1984 and (C) autumn 1984

Depth Range (m)	Iskenderun Bay			Mersin Bay			West of Goksu river delta		
	(A)	(B)	(C)	(A)	(B)	(C)	(A)	(B)	(C)
0– 50	9	12	13	17	18	14	6	8	7
50–100	5	8	7	11	9	9	5	8	9
Σ	14	20	20	28	27	23	11	16	16

A bottom trawl with small mesh size (14 mm in the codend) suitable for soft grounds was used. The net opening between the wing tips was 6 m. Speed of the vessel was recorded while trawling.

The well known "swept area" method has been applied for the calculation of the amount of synthetic materials on the sea bed. Where (y) denotes the mean catch, (a) the area swept by the net and (q) the catchability coefficient, the density per unit area is y/aq. If (A) is the total area then the estimated abundance $B = \Sigma Bi$ and thus is equal to

$$\Sigma (Ai/aiqi)yi$$

(Saville 1977; FAO 1980).

It is evident that the trawl net does not catch all plastic material encountered. Nevertheless, the catchability coefficent is taken as $q = 1$ (100 %) assuming that all plastics were retained in the trawl net and so a minimum biomass was assessed.

Distribution of plastic materials

The geographical distribution of the plastic materials found during the cruises is shown in Fig. 2.

In autumn 1983, plastic materials were concentrated in the Iskenderun Bay region, west of Mersin Bay, around the Goksu river mouth region and east of Tasucu. Relatively higher concentrations were seen to the north-east of the Bay of Iskenderun, around Karatas Cape and in the small Bay of Ovacik, west of Tasucu. Minimum (120 g/h) and maximum (6200 g/h) plastic material was found in the west of Goksu river delta region.

In spring 1984, plastic materials were found at almost all trawling grounds except south of the city of Mersin. Again, there were higher concentrations of plastic materials in the

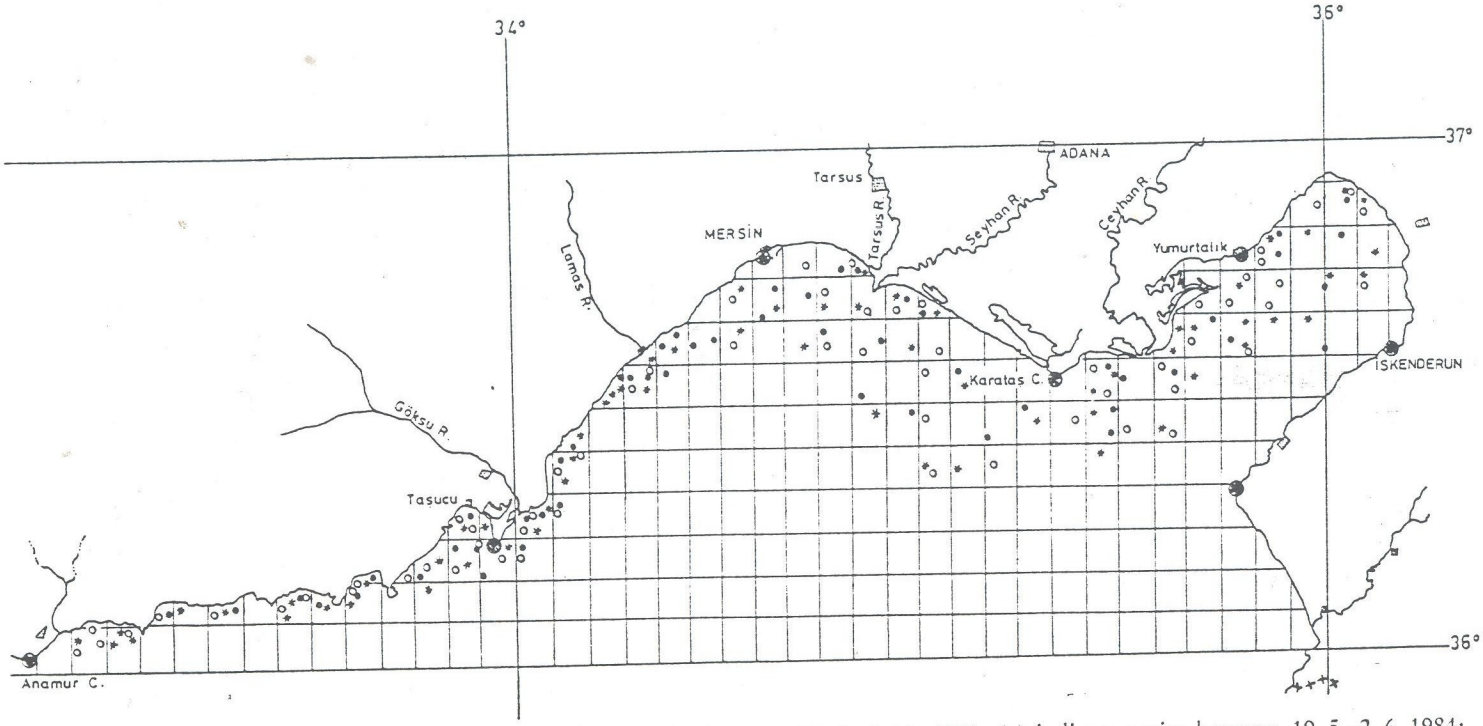

Fig. 1. Trawling stations in the study period. (●) indicate cruise between 29. 9.–4. 11. 1983; (*) indicate cruise between 19. 5.–2. 6. 1984; (○) indicate cruise between 11. 10.–31. 10. 1984

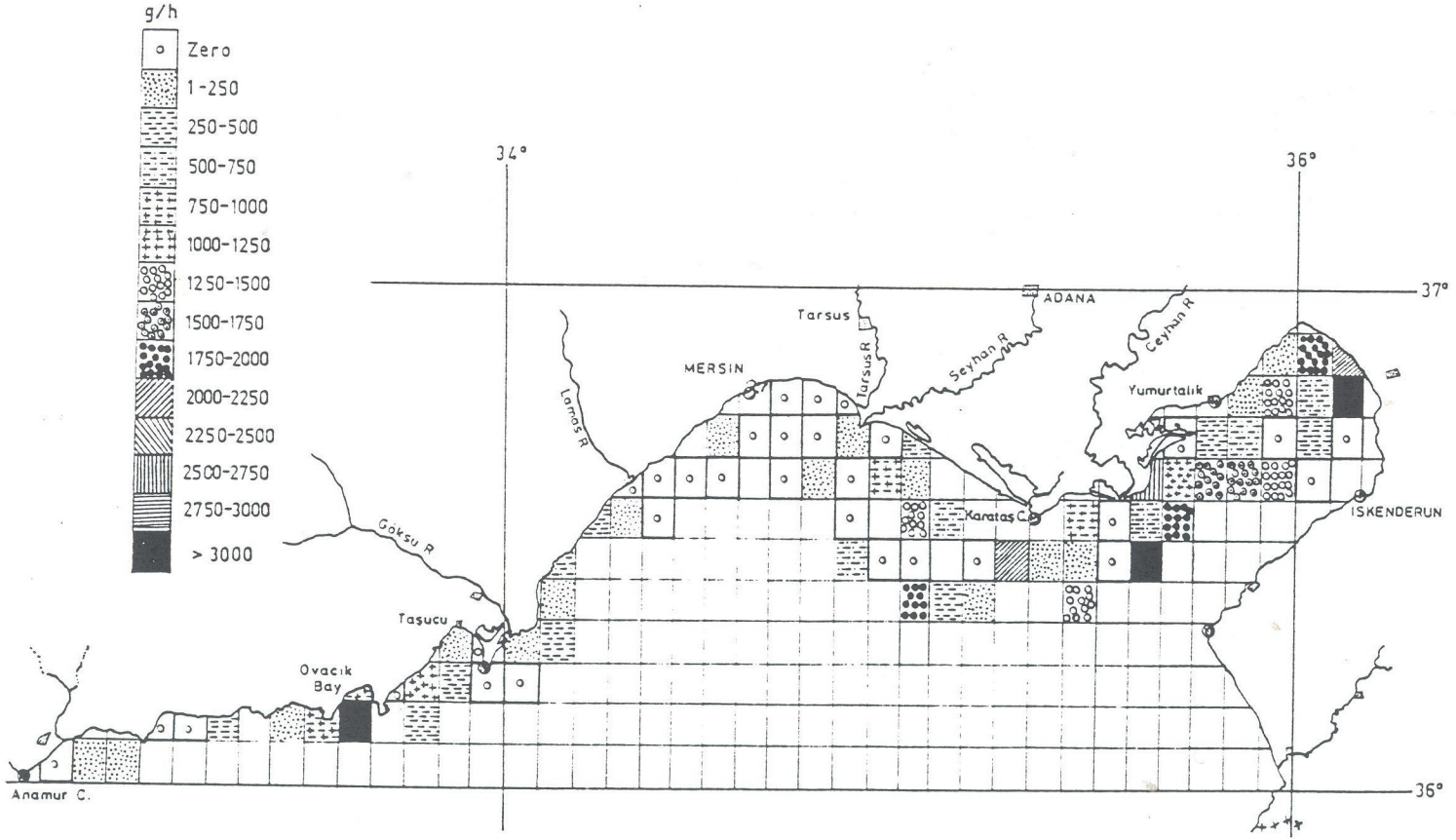

Fig. 2. Distribution of plastic materials in the northern Levantine waters (autumn 1983, spring and autumn 1984)

north-eastern part of Iskenderun Bay. A secondary maximum was observed in the opening of this Bay to the open sea. Along the rest of the coastal region, the materials were dispersed almost evenly except south of Mersin. During this cruise, the minimum catch (100 g/h) was obtained in the region west of Goksu river delta and the maximum catch (4500 g/h) was obtained in the Iskenderun Bay.

In autumn 1984, the distribution was more or less uniform although there were certain areas with higher concentrations, such as the inner parts and the entrance of Iskenderun Bay, and the smaller bays in the western parts. In this period, the minimum (10 g/h) and maximum (1900 g/h) concentrations were obtained in the Bay of Iskenderun.

In summary, three important accumulation areas were detected. The first and most important area is the Bay of Iskenderun. Next, the easterly and westerly extents of the shelf area adjacent to Mersin also contain relatively high concentrations. Tasucu Bay and other bays west of Tasucu are further areas where accumulation of plastic materials on the sea bottom occurs.

Oceanographic conditions influencing the distribution of plastic materials

The plastic materials accumulation on the bottom appears to be strongly correlated with the basic oceanographic conditions in the region:

a. The highest accumulations in Iskenderun Bay occur as distinct maxima at the entrance, center and in the innermost areas. According to circulation patterns inferred from earlier studies (COLLINS and BANNER 1979), two or more closed gyres are often found in Iskenderun Bay. The variation of concentrations in the longitudinal direction within Iskenderun Bay seems to agree with such a pattern.

b. The mean currents in this area of the northeastern Mediterranean are to sweep by the coast in an anticlockwise direction, i.e. the northerly currents following the coasts of Lebanon and Syria then follow the Turkish coast in a westerly direction (ENGEL 1967; COLLINS and BANNER 1979; UNLUATA et al. 1983). Parts of this current bifurcate into the Iskenderun Bay, while the main flow bypasses the Bay.

Both Mersin and Iskenderun ports receive considerable foreign traffic. Qualitative observations of labels on the plastic materials (e.g., bags, boxes etc.) were made but could not be quantified because of the age, erosion etc., of the material. A higher percentage of material with Arabic scriptures or adresses was observed in Iskenderun Bay as compared to the outer continental shelf area and the western parts of the surveyed region. It is, therefore, possible that most of the materials found in the Bay of Iskenderun may originate from the countries located along the eastern coast of the Mediterranean (e.g., Syria, Lebanon, Israel) and find their way into the Bay.

c. In the region extending from Iskenderun Bay to the Goksu river delta, the amounts of plastic debris decrease considerably, possibly because of the increased net currents along the shelf.

d. Immediately to the west of the Goksu river delta, the concentration of plastics increases again. The Goksu delta has a wide cone spreading across the shelf bottom and the topographic control imposed by this structure deflects the currents offshore. To the west of this coastal feature, the shelf currents are effectively blocked by the offshore steering (UNLUATA et al. 1983). Increased settling of the debris may, therefore, occur to the west of the delta, for example as indicated by the data for the waters near Ovacik Bay.

Because of the afore mentioned features, this part of the Turkish coast is divided into three sub-areas (Iskenderun and Mersin Bays and the area west of Goksu river delta) for abundance estimations of the materials concerned.

5 Abundance estimation of the plastics

The determination of the catchability coefficient of the net for plastic material is nearly impossible. Therefore, as it is already mentioned above, this coefficient (q) was choosen as 100 % so that, the estimated amounts reflect minimum mass of the plastics.

The estimated weight of material retained in the trawl net and calculated abundances of plastics in three sub-areas are summarized in Table 2.

The total area covered, extending to a depth of 100 m, is 5654 km². The calculated weigth of plastic materials in this area is 496 tons. This approximately amounts to 88 kg/km². The distribution of the material according to depth ranges (0–50 and 50–100 m) and quantity of material in kg/km² are given in Table 3.

Table 2. Amount of calculated plastic masses found in different depth ranges and regions between Iskenderun and Anamur Cape (autumn 1983, spring and autumn 1984). The numbers have been rounded

Depth Range (m)	REGIONS Iskenderun Bay Autumn 1983 (tons)	Spring 1984 (tons)	Autumn 1984 (tons)	Mersin Bay Autumn 1983 (tons)	Spring 1984 (tons)	Autumn 1984 (tons)	West of Goksu river delta Autumn 1983 (tons)	Spring 1984 (tons)	Autumn 1984 (tons)
0– 50	22	50	22.6	13	15	10	12.6	11	2.8
50–100	25	97	48	45	45	6	51	11	11
Total amount of plastics (tons)	47	147	71	58	60	16	64	22	14
Mean Catch (g)	793	2000	1100	758	319	206	22000	602	392
95 % Conf. Lim.	59 %	27 %	35 %	∞	46 %	126 %	114 %	25 %	96 %

Table 3. The distribution and amount of plastic matter in depth ranges of 0–50 m and 50–100 m in three regions (autumn 1983, spring and autumn 1984)

Depth Range (m)	Iskenderun Bay kg/km²	Tons	Mersin Bay kg/km²	Tons	West of Goksu river delta kg/km²	Tons
0– 50	102.4	94.6	30.7	38.0	54.0	20.1
50–100	263.4	170.0	72.0	96.0	113.3	73.0
Σ		264.6		134.0		93.1

As can be seen from Table 3, the plastic material is not equally distributed with respect to regional divisions and depth. The maximum amounts are found in Iskenderun Bay. This is followed by Mersin Bay. Most material is concentrated in the deeper part of the shelf area.

Although the absolute amounts of the plastic materials decrease from east towards west, the values per km² differ from this trend. The concentrations are higher in Iskenderun Bay and to the west of Goksu as compared to the wide shelf area adjacent to Mersin, because the mean currents in these two areas have slower speeds as compared to the mainstream shelf circulation. The ratio of debris in the 50–100 m range to the 0–50 m range is higher in the western and central subareas as compared to Iskenderun Bay and in general more accumulation occurs in deeper parts.

Because of the extreme resistance of this material to decay, there is reason to expect that

the amount of plastics in the coastal marine environment will increase in time. There are indications that probably larger parts of these synthetics are transported to deeper waters. Further investigations covering the whole continental shelf could provide a better understanding. It is not known whether the plastic material on the sea bed would positively influence the faunal colonization of the soft bottoms, or have destructive effects because of eventual pollution. Therefore a long-term monitoring, including field and laboratory studies, on the positive and negative aspects should be appropriate.

Acknowledgement

Reviewing of the draft of this note by Dr. E. Ozsoy and the efforts of the crew of R/V Lamas are sincerely appreciated.

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