Plastic Materials Accumulating in Narragansett Bay

A survey of the plastic materials accumulating on a private beach on Conanicut Island, Narragansett Bay, Rhode Island, indicated that the plastic pollutants were mainly a by-product of recreational activities within the bay and not household, industrial or agricultural refuse. Plastic objects manufactured from polyethylene made up the bulk of the flotsam on the beach.

A visit to the seashore will acquaint even the casual observer with the prevalence of discarded plastic materials in the coastal environment. Reports are appearing in the literature which suggest both coastal and oceanic waters are polluted by plastics. Oceanographers have found plastics accumulating on plankton tows (Carpenter *et al.*, 1972; Carpenter & Smith, 1972) and have sighted plastic objects from research vessels in mid-ocean, far from major shipping lanes (Heyerdahl, 1973; Venrick *et al.*, 1973). In a recent survey of isolated stretches of shoreline in Scotland, Scott (1972) demonstrated that pollution due to plastic packaging was the result of seaborne wastes of foreign origin. The burden of blame for plastics littering beaches and foreshores is usually placed on visitors. Scott emphasized that the low density polyethylene plastic products, such as agricultural sacks, wrapping film, and detergent bottles found in his survey, persist because of their resistance to environmental breakdown.

The Dumpling private beach on the East Passage shoreline of Conanicut Island, Narragansett Bay, was selected for survey because of its location at the entrance of the Bay and northerly aspect (41°29′N, 71°21′W). The initial collection was made between the low tide and spring high tide marks on 18 July, 1973. A further collection was made one calendar month later to determine the monthly accumulation of plastic materials on the beach. Care was taken to ensure all plastic objects were collected. It was assumed that plastic materials deposited above the survey site would be carried southward by tidal oscillations and non-tidal currents (Hicks, 1959). In practice, however, it is impossible to clearly differentiate between flotsam and refuse left by visitors.

On return to the laboratory, the plastic materials were washed, dried and sorted into categories, based on function and material of construction. To the layman, the identification of different plastic polymers is difficult. The salient criteria used in the qualitative analysis of polymer type are appearance, density, burning characteristics, melting point, solubility in organic solvents, resistance to concentrated sulphuric acid, sodium fusion followed by tests for individual elements, and specific colour reactions (Wake, 1969). Also, many plastic articles and their polymeric material can be identified from descriptions in trade magazines.

Table 1 shows the plastic objects from the beach in the initial collection. The majority of the plastic pollutants were derived from the consumption of food (drinking tumblers, milk shake tops, beverage containers, drinking straws, candy wrappers, bread wrappers, etc.), boating activities (floats, buoys, rope, etc.) and fishing (fish-hook packages, monofilament and lobster floats). The absence of household items (detergent containers, bleach and sanitary fluid containers, garbage bags and food containers), agricultural materials (fertilizer bags, mulching film, etc.) and industrial wastes (resin, expanded chips, packing materials, etc.) was noticeable.

The second collection, detailed in Table 2, confirmed the pattern of origin. However, a small number of plastic objects were derived from industrial (a cable jacket and packing case strap) and household use (two bleach containers).

From the data the monthly accumulation of plastic objects during the summer can be calculated. The dimensions of the beach were 87 by 10 m. The rate of

TABLE 1

Description of the plastic objects found on the beach (first collection).

Objects	Material of Construction	Total Weight
Drinking tumblers, foam (4 plus fragments)	Expanded polystyrene	32·0 g
Drinking tumblers, transparent (2)	High flowgrade polystyrene	29·0 g
Tumbler, red	Nylon	20·0 g
Tumblers, grey (2)	High density polyethylene	10·7 g
Milk shake tops (5)	Low density polyethylene	11·5 g
Vacuum flask caps (2)	Acrylonitrile butadiene styrene	28·5 g
Food container	Polypropylene	22·6 g
Beer can carriers (5)	Low density polyethylene	23·0 g
Plastic jug (gallon)	High density polyethylene	106·4 g
Plastic jug (half-gallon)	High density polyethylene	40·8 g
Plastic jugs (gallon; used as buoy) (3)	High density polyethylene	209·0 g
Floats (2)	Expanded polystyrene	150·2 g
Bread and candy wrappings	Cellophane	11·2 g
Rope (4 lengths)	Nylon	294·5 g
Plastic drinking straws (3)	Polypropylene	2·7 g
Sheeting and bags	Low density polyethylene	207·5 g
Fish-hook bags (5)	Nylon	29·0 g
Sheeting, plasticized	Polyvinylchloride	1·5 g
Packing blusters (2)	Polymethylarylate	9·0 g
	Total	1,237·5 g

TABLE 2
Description of the plastic objects found on the beach (1 month accumulation).

Objects	Material of Construction	Total Weight
Drinking tumblers, foam (16 fragments)	Expanded polystyrene	14·0 g
Beer can carriers (2)	Low density polyethylene	11·0 g
Plastic jugs (gallon; household bleach) (2)	High density polyethylene	226·0 g
Plastic jugs (gallon; beverage) (2)	High density polyethylene	179·0 g
Plastic jug (fragment used as buoy)	High density polyethylene	30·0 g
Candy wrappings	Cellophane	12·25 g
Twine (6 lengths)	Nylon	54·5 g
Plastic drinking straws (2)	Polypropylene	1·0 g
Sheeting and bags	Low density polyethylene	167·5 g
Fishing line reel	Acrylonitrile butadiene styrene (ABS)	24·0 g
Doll's arm	Polyvinylchloride	13·5 g
Fragment of a tray	ABS	21·5 g
Vinyl glove	Polyvinylchloride	34·0 g
Monofilament	Nylon	6·5 g
Packing case strap	Polyvinylchloride	10·0 g
Shotgun pellet holders (3)	Polyethylene	8·0 g
Fragment of plastic basket	ABS	3·0 g
Cable coating	Polyvinylchloride	12·0 g
Plastic fork	ABS	2·0 g
Cocktail sticks	Polyethylene	0·5 g
	Total	830·25 g

deposition of plastic material was 0·96 g/m^2 of beach per month or 9·6 g/m of beach front per month.

It is tempting to extrapolate from these estimates to calculate the quantity of plastics entering Rhode Island Sound. Since the entrance to East Passage adjacent to the Dumplings private beach is approximately 1,520 m wide, an estimated 14·6 kg of plastic material per month may pass down Narragansett Bay via the East Passage during the height of summer period.

The nature of the plastic pollutants reflected the major use of Narragansett Bay for recreational activities. The Rhode Island state regulations which encourage the disposal of household refuse in sanitary landfill areas distant from wetlands may have contributed to the absence of garbage within Narragansett Bay. Also, the Port of Providence, being mainly associated with the importation of petroleum products, reduces waterborne plastic wastes. A clear need for the positioning of more trash bins along recreational shorelines and at marinas is obvious from the origin of the plastic objects found in this survey. Perhaps the use of plastic materials could be discouraged and more cellulose-based materials, which are more readily subject to environmental breakdown, could be substituted (whenever possible) for plastic packaging materials. The controlled photodegradation of plastic polymers appears a promising solution to the persistence of plastics in the marine environment (Scott, 1973), especially since the failure of public service campaigns to educate the public against the indiscriminate disposal of litter, means that the accumulation of plastic materials in coastal areas will pose a growing problem.

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Chlorinated Hydrocarbons in Sediments from Southern Greece

Polychlorinated biphenyls (PCBs) can be used as tracers of long-term integrated flow of contaminants in the sea. They have been used to map the distribution of effluents from sewage outfalls on the southern Greek coast.

Although evidence for a widespread contamination of the western Mediterranean by chlorinated hydrocarbons has been presented by various investigators (DeLappe *et al.*, 1972; Franco Soler, 1972), their distribution and biological consequences in the oligotrophic waters of the eastern Mediterranean remain unknown. Toxification of certain areas by these compounds, especially locations