REPORT OF THE WORKING GROUP ON METHODS TO ASSESS THE AMOUNT AND TYPES OF MARINE DEBRIS

(Christine A. Ribic, Chair)

INFORMATION NEEDS AND METHODOLOGIES

For the determination of the amount and types of marine debris, the working group distinguished between two types of studies: baseline, studies with low sampling frequency made over large geographic areas; and assessment, studies of a more limited area and having more intensive sampling effort over time. Baseline studies describe existing marine debris and seek to identify the magnitude of a problem. Assessments study the level of pollution.

The group considered various methodologies now in place for determining the amount of debris in the ocean (nearshore, open ocean, and bottom) and on beaches. They agreed that the beach survey is appropriate for assessment studies on a large scale. For limited-scale studies, dedicated surveys using visual observations and neuston tows in nearshore areas (e.g., bays, harbors, and estuaries) or limited ocean areas such as offshore dumping areas can be used for assessment.

Table 1 summarizes the current utility of survey techniques. Use of aircraft, while experimental, is feasible for baseline studies. Techniques to study bottom debris are needed; currently bottom debris studies are categorized as baseline.

Figure 1 is a proposed outline of the stages of a marine debris pollution assessment plan.

GEOGRAPHIC AREAS

The vastness of the oceans makes it necessary to select areas of interest for more intensive studies. On an international level, the working group suggested MARPOL special areas as appropriate geographical areas for more intensive study. On a national or a regional level, special areas of local interest must be developed. Examples of national level areas were the Pribilof Islands, because of the impact of debris on northern fur seals (United States), and national marine sanctuaries (United States). A regional area of interest cited was the Caribbean. Freshwater systems, including estuaries, were not discussed by the working group for lack of time.

In R. S. Shomura and M. L. Godfrey (editors), Proceedings of the Second International Conference on Marine Debris, 2-7 April 1989, Honolulu, Hawaii. U.S. Dep. Commer., NOAA Tech. Memo. NMFS, NOAA-TM-NMFS-SWFSC-154. 1990.

Table 1.--Summary of survey techniques.

Survey techniques	Type of study	
	Baseline	Assessment
Nearshore/open ocean		
Surface debris:		
Visual observation (strip/line transect)	Platforms of opportunity	Dedicated surveys in well-defined areas of importance
Neuston nets	Oceanographic surveys	Dedicated surveys in well-defined areas of importance
Photography	Aircraft/helicopter (limited to large debris items)	
Bottom debris:	Limited to certain types of communities	
Survey of fishermen	Questionnaire (limited to certain types of debris)	
Bottom trawl	Limited to certain types of communities	
Remote operating vehicles	Expensive to use	
Beach surveys	Volunteer efforts (educational/ public relations)	Planned surveys Estimates of amounts on beaches--random sampling
		Changes over time--same beach or transect
	Low-flying aircraft	

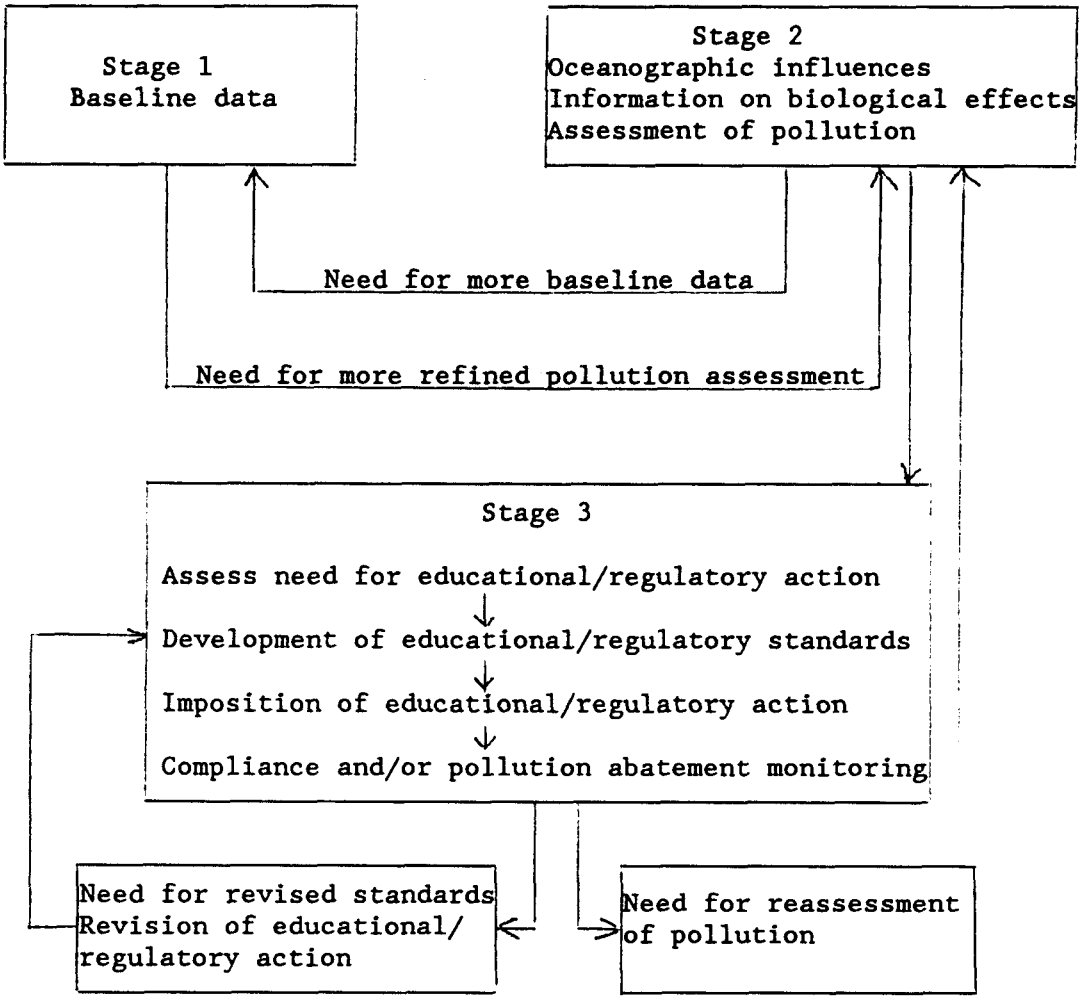

Figure 1.--Components of a marine debris assessment plan (after G. Kullenberg et al. (1986) Mar. Pollut. Bull. 17:341).

Floating Debris at Sea

At sea, counts of floating debris are made using platforms of opportunity and dedicated surveys.

Visual observation from a viewing platform such as the flying bridge of a vessel is used when counting large debris. Most studies employ a strip transect method and count all debris sighted within a certain distance of the ship, using the glare-free side of the ship for observation. The width of the strip depends on the height of the viewing platform as well as on survey conditions (e.g., Beaufort sea state), and may change during the survey. All debris in the strip is assumed to be sighted. No one has done work on the probability of sighting different debris objects, and there are potential size and color biases that need to be evaluated. The length of a single transect varies as does final total transect length. The variable considered is usually a density estimate, number per square

kilometer or number per square nautical mile. The group recommended that two or three observers be employed in the survey. A single observer should use a strip width of 25 m or less. Calibration runs were recommended to estimate strip width, and experiments were recommended to investigate color and size biases and the probabilities of sighting different debris types.

There has been limited line transect work, but no formal analysis has been published. Problems persist with inaccuracies in the data, notably in the accurate determination of the distance of debris perpendicular to the ship. When accurate distance measurements can be made, the working group recommended the use of the line transect.

Neuston tows (necessarily strip transects) appear to be the most extensively used method for the study of particulate plastic and tar balls. The group agreed on the usefulness of such tows when made from dedicated survey vessels, but questioned whether neuston tows could be made successfully using platforms of opportunity. They require certain speeds--some devices can be used at speeds of only 3 kn or less; others at up to 7 kn--and the group questioned a captain's willingness to slow the ship down sufficiently to accommodate the towing device. Important to the success of a neuston tow is the estimate of time actually towing, or sweep efficiency.

The working group noted the possibility of using low-flying aircraft to survey nearshore areas for debris.

Debris on the Sea Floor

Little is known about bottom debris. Bottom trawls may be used from either dedicated survey vessels or platforms of opportunity to sample sea floor debris. The working group discussed bottom trawls for sampling debris, noting that this area has seen little work. They agreed that composition of debris is measurable using bottom trawl gear, but estimates of density are thought to be questionable.

Remote Operating Vehicles (ROV) were mentioned as a possible sampling tool, but it was agreed that this approach is too expensive for widespread use. Bottom drifter studies were also mentioned.

A potential source of information are fishermen whose gear has become entangled in sea floor debris. The working group recommended the development of a survey form to collect bottom debris from fishermen. This could be a starting point for collecting baseline information on bottom debris.

Debris on Beaches

Beach debris surveys can be carried out in designed or in volunteer programs. Standardization of beach surveys has been attempted for Alaskan beaches and English beaches, with the major difference being the sampling unit. In Alaska the sampling unit is the entire beach (at least 1 km in length). The sampling unit for the English beach is one transect per beach. Based on the working group discussion, it appears that the difference in sampling strategy stems from the types of debris found on the beaches. Entire Alaska beaches have to be surveyed in order to count the trawl web

that dominates the debris. In England, where most of the debris is plastic, transects are used because there is too much debris to count.

To avoid as much as possible counting debris that has originated on land, both approaches emphasize surveying beaches that are away from urban areas and have little recreational use. Beaches of sand and small gravel substrates with moderate slope were selected because they tend to collect debris. In England back beach areas were included; in Alaska they were not. Alaskan beaches facing the open ocean were used. Beaches with complicated topographic features such as partly sheltering reefs should be avoided, as should beaches known to be cleaned periodically. Other variables to consider are prevailing winds and accessibility.

If the intent of the study is to estimate the amount of debris on beaches in a given area, then random beach selection is important. In England a two-stage stratified random sampling scheme was used successfully. To detect changes over time, the majority of the group felt that selected beaches should be sampled repeatedly over time. The kind of change expected should be predicted, an appropriate variable defined to measure that change, and data collected to support or refute the prediction.

For baseline and some assessment studies, total amount, weight, and composition of the debris should be measured. Volume measurements were considered, but the working group felt that they would not be possible in all situations. For studies of changes in debris type over time, there was general agreement that the type of debris would determine whether changes in total amount or changes in composition were of more importance. In Alaska it was considered important to detect a change in the amount of trawl web. In England, composition and age structure of plastic containers were of prime interest. The important point in addressing the question of change over time is to define a variable of interest that can be measured.

For assessment studies, more work is needed to understand beach debris dynamics--for example, local currents and sinks for the debris as well as debris sources.

A suggestion was made to utilize low-flying aircraft, as some current surveys in Alaska are doing.

Debris Emanating From Land

The working group disagreed about the ease of distinguishing debris of land origin from debris originating on board ship. The accuracy of identification may vary from area to area. After some time in the water, debris items lose any paper labels and may acquire encrusting biota. Some items obviously originating on land may include plant seeds.

CATEGORIZATION OF DEBRIS

One suggestion was to categorize debris sizes as follows:

Mega - >2-3 cm
Macro - 5 mm to 2-3 cm

Meso - <5 mm (granule size)
Micro - powdered (generally unseen).

The working group also made a list of some more common or important types to track. Suggested were:

Nets (by type)
Other fishing gear
Strapping bands (open/closed) (cut/uncut)
Granulated plastic (recycled plastic)
Particulate plastic
Fragmented plastic
Plastic bags
Plastic containers (country of origin, age)
Styrofoam
Medical waste
Rope
Entanglement remains (e.g., bones)

Due to the time limitation, the group was unable to decide on broad categories for use in comparing data on an international scale, but recommended a review of existing categories in order to develop a common list that could be tailored to fit individual areas of interest.

MONITORING PROGRAM

Also because of a time limitation, the working group did not address the topics of sampling frequency and sample size requirements. A seasonable variation in the amount of floating debris was noted.

PROCEDURES MANUAL

The working group generally agreed that a procedures manual detailing survey techniques should be written. This manual would provide ideas for those interested in initiating marine debris studies.

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