A Selected Bibliography on the Biological Effects of Ocean Dumping

by F. R. Bernard
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A SELECTED BIBLIOGRAPHY ON THE BIOLOGICAL EFFECTS OF OCEAN DUMPING

by F. R. Bernard

This is the 255th Technical Report from the Research and Development Directorate Pacific Biological Station Nanaimo, British Columbia
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ABSTRACT


A selected bibliography of important contributions, many with extensive literature citations useful to engineers and biologists engaged in management and interpretation of the Canada Ocean Dumping Act, is presented.

RÉSUMÉ


L'auteur présente une bibliographie choisie d'ouvrages importants, beaucoup étant longuement cités, qui seront utiles aux ingénieurs et aux biologistes chargés de l'exécution et de l'interprétation de la Loi sur l'immersion des déchets en mer.
INTRODUCTION

Ocean dumping is the deliberate disposal at sea of unwanted and waste materials. Though submarine disposal sites have long been used, particularly for aged and faulty ammunition and for the disposal of dredge spoils, public concern was aroused in 1969 by accounts in the United States press of disposal of nerve-gas and other warfare agents at sea. Use of United States territorial waters for this purpose was then the responsibility of the Army Corps of Engineers, and to a lesser extent, the Atomic Energy Commission and the United States Coast Guard. The Presidential Council on Environmental Quality recommended the establishment of legislation controlling ocean dumping, responsibility to be vested in an environmental quality agency. No regulations cover dumping and pollution of the high seas so the international community in demonstrating increased awareness of the importance of the quality of the global oceans moved to develop a treaty to regulate ocean dumping. In late 1972 Canada and the United States were among 80 signatories to a Convention on Prevention of Marine Pollution by Dumping Wastes and Other Matter. In order to come into force the convention required ratification by a minimum of 15 nations. In 1973 the United States Senate ratified the convention, supportive legislation being provided by the United States Marine Protection, Research and Sanctuaries Act (1972), which regulated ocean dumping through the issuance of permits by the Environmental Protection Agency for all materials other than dredge spoils, which are administered by the Army Corps of Engineers. In late 1974 Bill C-37 was introduced to the House of Commons of Canada providing for the regulation of ocean dumping, and received Royal Assent in 1975. This action will ensure Canada's participation in the international consultations aimed at developing the convention.

Provisions of the Act make it illegal to dump any substance at sea without a permit, except in emergency situations. The Act gives jurisdiction to Canada over foreign vessels plying territorial waters and over Canadian vessels on the high seas or in foreign waters. The Act covers disposal of materials from vessels, aircraft, platforms, or other man-made structures and also includes disposal on ice and incineration at sea. The act does not cover discharges incidental to normal operations of crafts, and also excludes discharges resulting from the exploration and exploitation of submarine mineral resources.

The Ocean Dumping Control Act includes a clause that states "no permit may be granted if the dumping or disposal described in the application is prohibited under any other Act of Parliament," so no permits can be issued that may conflict with the Fisheries Act provision against introduction of "deleterious substances of any type in waters frequented by fish." The major difficulty stems from the fact that not all deleterious substances are identified and that acceptable levels have not been set for most substances.

North of 60° latitude the Arctic Waters Pollution Prevention Act is the controlling statute and there certainly will be some questions which Act is to take precedence and whether there is to be uniform interpretation of the Ocean Dumping Act irrespective of geographical location. The practice by Arctic communities of placing sewage and garbage on ice during winter
contravenes Bill C-37; however, the wording of the Ocean Dumping Control Act makes it subordinate to previous statutes.

South of 60°N several statutes have a bearing upon the Ocean Dumping Act. These include the Navigable Waters Protection Act and the Canada Shipping Act where oil pollution prevention regulations could be applicable to the control of vessels and platforms used for recovery of offshore mineral resources. The Oil and Gas Production and Conservation Act provides for measures to prevent pollution of air, water and land, while enabling legislation is in place no regulations have been drawn. Other statutes with a bearing upon the Ocean Dumping Act include the Canada Oil and Gas Land Regulations (1961) and the Canada Oil and Gas Drilling and Production Regulations (1961).

The Act is administered jointly by the Environmental Protection Service and the Fisheries and Marine Service of the Department of the Environment. The Environmental Protection Service is the Department's contact with industry and Provincial authorities and is responsible for the management of the permit system, the coordination of analyses of wastes proposed for dumping, and the selection of dump sites. Fisheries and Marine Service undertakes the biological examination of each dumping application, and monitors ecological conditions at dump sites. The issuance or refusal of permits for dumping are decided by a regional committee chaired by the Environmental Protection Service. Unresolved matters are referred to a Standing Committee in Ottawa chaired by Fisheries and Marine Service.

A wide array of materials are candidates for ocean dumping. In the United States in 1974 over 14 million tons were disposed by dumping, a large part consisting of sewage sludge and industrial wastes. The total does not include dredging spoils which are probably substantial, over 1.6 million cubic yards were disposed at sea in the Canadian Atlantic region in 1974.

Wastes fall into three categories, nonsoluble, water soluble, and fat soluble, which will profoundly influence their behaviour in the marine environment and influence mode of disposal, though the major criterion is whether wastes are subject to decomposition. Nondegradable wastes are those that will not break down under biological and physical attack, or so slowly as to be classed permanent. Included in this group are long-lived radio-isotopes, trace metals, inorganic nutrients, and plastic wastes. This class of pollutants is a major source of environmental degradation and is either prohibited or restricted in schedules appended to the Ocean Dumping Control Act. Other nondegradable wastes include dredge spoils, wood and mineral fibers, ash, building demolition materials and other solid wastes which may destroy the benthos by burying the existing substrate, altering bottom currents and topography, or interfere with bottom fisheries.

Degradable wastes are mostly organic substances readily decomposed either by bacterial activity, direct ingestion by filter and detritus feeders, or by chemical changes. In most situations decomposition leads to harmless substances such as carbon dioxide and water, but overwhelming oxygen demand may destroy the existing biota. Other substances may form harmful intermediate products, while overfertilization may cause severe problems due to enhanced production of phytoplankters and benthic macroalgae. Little information is
available on the effect of addition of large quantities of nutrients to the
euphotic region.

The carrying capacity of rivers and inland water bodies has acted
as a buffer protecting the seas which are the ultimate repositories of all
water-borne wastes. The nearshore location of sewer outfalls, the demands
for recreational use of shorelines and the preservation of shellfish resources,
have all functioned to limit gross pollution of many areas. Unfortunately, no
such direct constraints exist to limit offshore pollution and ocean dumping.

The highest levels of pollution are in coastal areas, but a wide
array of pollutants, including polychlorinated biphenyls, pesticides,
petroleum hydrocarbons, and plastic fragments, together with their products,
are ubiquitous in the global oceans. The addition of man-created wastes to
the oceans presently rivals quantitatively the seaward movement of materials
due to natural weathering processes, while the increasing international drive
for pollutant abatement of inland waters and the nearshore, as well as
atmospheric pollution, and the difficulty of finding acceptable sanitary
land-fill localities, will place increasing reliance upon the ocean dumping
alternative.

There has been little research into the assimilative capacity of
the open ocean and the stability of the deepwater benthos. Unlike the
neritic, the oceanic zone has been of interest to oceanographers and
biologists attempting to understand fundamental processes, and there has been
little input by pollution engineers and ecologists concerned with immediate
and long-term damage to the ocean environment.

To date the national pollution control approach has been one almost
exclusively of reaction to obvious environmental damage. This has resulted
in the accumulation of an inventory of parameters governing many important
criteria, so that a pool of past experience is available to set criteria
that will avoid wholesale environmental damage. This information is not
directly applicable to the deepwater and oceanic arena, which are character-
ized by poorly understood and highly dynamic community and physical inter-
actions. For instance, there is a high degree of doubt in the application
of predictive models for water circulation over the continental shelves and
into the deep ocean.

Biological information is required for the development of criteria
for the management of permit applications, the selection of dumping sites,
and the monitoring of environmental impact of dumping. The development of
adequate scientific information is a preliminary requisite to the establish-
ment of base lines against which trends in ocean pollution may be determined.
Biological information is required in the following six components of ocean
dumping management:

1. Development of an understanding of the behaviour and characteristics of
waste substances in the marine environment, with special attention to
toxicity, uptake and concentration in food-chains, and possible
synergistic effects.

2. Development of techniques to monitor effects of wastes in marine
ecosystems, both planktonic and benthic and establishment of specific
criteria for commonly released wastes.
3. Development of information to govern the selection and designation of dumping sites, their absorptive capacity, and effect of dumping with a view to permit cancellation or limitation should ongoing monitoring suggest adverse ecological impact.

4. Development of a protocol for ongoing monitoring of dumping sites to check for possible permit contravention by user.

5. Exploration of alternatives to ocean dumping.

6. Establishment of a centralized biological data bank for reporting and recording ocean dumping activities and make biological interpretation available to management.

It is anticipated that demand for ocean dumping will increase, due in large measure, to implementation of more stringent criteria for the protection on inland waters and the atmosphere, as well as improve municipal and industrial waste-water treatment facilities. With the Canadian Ocean Dumping Act a potent protective and regulatory tool is available, but the ability to achieve the objectives of the Act rests on the establishment of effective inter-service cooperation in research and management.


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