ABSTRACT: The Government of Mauritius, the International Maritime Organization, and the United Nations Environment Programme sponsored a joint project in 1987 and 1988 to establish an oil spill contingency plan for the island of Mauritius. Two main objectives were achieved: the formulation of a National Oil Spill Contingency Plan (NOSCP) for consideration by the government and the creation of a Coastal Sensitivity Atlas detailing the sensitive resources of Mauritius and the strategies to protect them. The project was in support of the Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region and its protocol on emergency cooperation.

The organizational structure of the proposed NOSCP evolved during workshops with Mauritius authorities and was expressly developed to utilize the capabilities of existing emergency response units such as the National Coast Guard, the port authority, and the fire services. The NOSCP document also recommends supporting legislation and ratification of relevant regional and international conventions, and proposes techniques for oil spill response and the disposal of oily wastes.

The Coastal Sensitivity Atlas is a separate document containing 19 maps on a scale of 1:30,000, which cover the coastline of Mauritius and neighboring islets. The atlas is color-coded to indicate the priority areas for containment and cleanup. Living and socioeconomic resources are indicated by symbols and suitable response actions are specified.

The island of Mauritius is situated at 20°S latitude and 57.5°E longitude, 1,000 km east of Madagascar (Figure 1). Mauritius lies in the southeast trade winds belt and is exposed to frequent cyclones. Volcanic in origin and ringed by coral reefs, except in some areas to the south and west, the island has beaches composed of coral fragments and carbonate derived from coraline algae, carbonate and volcanic mixtures, and basaltic rocks.

With a population of about one million inhabitants, Mauritius has recently undergone a rapid increase in industrial activity. On attractive beaches hotel construction has sharply increased to accommodate tourism. Concurrently, awareness of the need for environmental protection has resulted in several recent studies (for example, World Bank, 1988).^5^ There is, at present, no refinery or oil drilling activity in or near Mauritius. Major tanker traffic from the Middle East to the West does not pose a great oil spill hazard. Previous incidents have been reported, however, of the occurrence of tar balls on the beach from unknown origins. Probable sources of oil spills include accidents in the major port (Port Louis) and in severe weather, discharge of oily wastes from tank washing at sea, and inland accidents involving tanker trucks, pipeline ruptures, and tank farms. The economic and ecological impacts of a major oil spill are potentially disastrous.

In a cooperative venture, the Government of Mauritius, supported by the International Maritime Organization and the United Nations Environment Programme, sponsored a study to develop a National Oil Spill Contingency Plan (NOSCP) for the island, which would include a delineation of sensitive coastal habitats. The results of the investigations are contained in two reports: Gundlach and Murday,^3^ and Murday and Gundlach. This article discusses the methods used to develop the two reports and the reports' contents.

Methods of study

The project was conducted primarily during a site visit to Mauritius in September 1987. Two major exercises were carried out with the assistance of the Mauritius government.

First, a series of individual and group meetings was held with concerned individuals and organizations. Participants included research scientists with knowledge of the coastal environment and government agencies dealing with emergency response, port operations, oil import, tourism, fisheries, natural resources, and legislation. Participation of the oil marketing and sugar industries and nongovernmental organizations was also secured. During the course of many meetings, an organizational plan for oil spill response was developed to cover existing resources and infrastructures.

The second exercise consisted of data collection and field work necessary for the construction of a Coastal Sensitivity Atlas for oil spill response. The format and methods used are discussed in Gundlach and Hayes (1978),^1^ as updated to include biological, socioeconomic, and spill response information (Gundlach and Hayes, 1982).^2^ Observations of shoreline type, exposure to wave attack, and biota were made at low tide at a total of 66 sites. A preliminary classification of shoreline types was based on this survey. A low-level overflight of the coastline was then undertaken, during which shoreline types were determined and marked directly on 1:25,000-scale topographic maps. Aerial observations in certain areas were confirmed during an additional, brief, ground survey. A survey of the literature and information provided by the government were used to supplement field observations on the living and socioeconomic resources found along the coast.

Contents of reports

The following sections provide an overview of the material included in the documents developed as part of the project.
Legislation. A review of legislation relating to environmental protection within Mauritius revealed few legal constraints on pollution, dealing primarily with the control of oily discharges in the Port Louis area and of maritime pollution in general. To provide authority for NOSCP and to derive the benefits provided by international conventions, the following recommendations were made:

- Provide NOSCP with specific legal authority. Given the multiplicity of environmental and coastal problems in Mauritius, provision for NOSCP could be effectively made within a more comprehensive Environmental Protection Act.
- Clarify present regulations to increase existing maximum penalties for maritime pollution within the harbor and extend them to the Exclusive Economic Zone.
- Ratify the 1969 Civil Liability Convention and the 1971 Fund Convention, to qualify for compensation in the event of major oil spills.
- Clarify present regulations to increase existing maximum penalties for maritime pollution within the harbor and extend them to the Exclusive Economic Zone.

Organizational response structure. The organizational structure developed for NOSCP is shown in Figure 2. It utilizes the resources of existing national plans for response to such emergencies as hurricanes, fires, and other disasters within the port, and for search and rescue at sea. The lead agencies for these three plans are, respectively, the Special Mobile Force (Police Department), the Port Louis Harbor (Mauritius Marine Authority), and the newly formed Mauritius Coast Guard.

The organizational structure for oil spill response provides the following chain of command:

1. The Director of NOSCP (the Commissioner of Police) assumes final authority for all categories of oil spills.
2. The Port Master responds to oil spills in the port and reports to the Director of NOSCP.
3. Oil company managers (Caltex, Esso, Total, and Shell currently market oil in Mauritius) respond to oil spills in their operational areas. Their response actions are carried out after consultation with the Port Master for spills in the port area, or with the Director of NOSCP for all other spills.

On-Scene Coordinators (OSCs) are responsible for cleanup operations in the port (OSC PORT, appointed by the Port Master), inland (OSC LAND, the Chief of the Special Mobile Force), and offshore, in coastal waters, and on the beaches (OSC SEA, the Commandant of the National Coast Guard). Cleanup for oil companies is carried out under a Field Supervisor (SUP OIL) appointed by the oil industry cooperative.

Three advisory teams assist the responding OSC: the Scientific Advisory Team (SAT), the Socioeconomic Team (SOCAT), and the Strike Force Advisory Team (SFAT). Their activities are monitored by a Spill Advisory Coordinator (SAC), who maintains liaison with the OSCs. Because the plan is not expected to have an elaborate infrastructure, but will draw mainly upon existing capabilities and resources, the members of the advisory teams are provided by the university, research institutes, government ministries, and industry. In particular, SFAT is composed of individuals with knowledge of the availability of personnel, equipment, and supplies in government and industry.

Alert procedure. Figure 3 describes the notification and alert procedure to be followed in Mauritius when an oil spill is discovered. The Emergency Communications Center (phone number 999) receives spill reports, immediately notifies the Director of NOSCP, and obtains verification from regional fisheries posts, coast guard posts, or fire stations. The Director of NOSCP then notifies the Port Master if the spill is within the port. Otherwise, the Port Master assigns responsibility to the oil company concerned, the OSC LAND, or the OSC SEA, as the situation warrants. Spills reported by employees of an oil company or the Mauritius Marine Authority (MMA) are reported directly to the oil company manager or the Port Master, according to the provisions of their own spill response plans.
Coastal sensitivity. The sensitivity of Mauritius coastal resources is indicated on a set of 19 maps representing the coastline of Mauritius and neighboring islets (Figure 4). Explanatory texts and photographs within the document describe the environmental settings, living and socioeconomic resources, predicted oil impact, and recommended response activities.

The shoreline types defined for Mauritius are given below, in order of increasing sensitivity to spilled oil. Each is color-coded in the atlas. Marshes and mangroves are considered the most sensitive of the Mauritius coastal environments.

1. Exposed cliffs
2. Low-lying basalt, beach rock, and seawalls
3. Exposed boulder/cobble beaches
4. Sand beaches
5. Mixed sand and gravel beaches
6. Exposed sand flats
7. Sheltered rocky shores
8. Coral reefs
9. Sheltered tidal flats
10. Marshes and mangroves

Using symbols, the maps also locate the following:
- Principal biological resources: seabirds, shorebirds, wading birds, fish, and shrimp
- Important socioeconomic resources: fishponds, fishing reserves, nature reserves, public beaches, and coastal hotels
- Facilities that can be utilized during a spill: police stations, fire stations, fisheries posts, and sugar factories.

Spill response strategies. Both documents prepared under this project, the proposed National Oil Spill Contingency Plan and the Coastal Sensitivity Atlas, contain recommended response strategies for spills occurring inland, on the beaches, and at sea. Decision-making procedures (e.g., for the use of dispersants) are also provided for the OSCs and the advisory teams.

Recommendations in the documents include the following:
1. Conduct aerial surveillance of spills at sea to determine probable landfall.
2. If shoreline impact is expected, aerial dispersant spraying of spills in deep water outside the coral reefs is preferred.
3. If dispersant spraying is undertaken, existing aircraft in Mauritius can be appropriately modified.
4. Once a spill has come ashore on the beaches, manual methods of removal are generally preferred.
5. Using locally available material for sorbents is preferred (possibly bagasse, a by-product of the cane sugar industry, or coconut husks).
6. Storage of oily waste in existing and other temporary tanks is adequate for small spills.
7. Disposal of oily waste poses a particular problem. Burning is considered appropriate with due consideration to atmospheric conditions; however, the identification of suitable sanitary landfill sites for disposal of both oily and domestic wastes is preferred.

An inventory of available spill response equipment and a list of additional needed equipment are also provided in the proposed NOSCP document. It was concluded that the oil marketing companies are to provide part of this equipment in support of their own local contingency plans.

Conclusions

The Mauritius oil spill contingency plan project is a good example of how a relatively small country with little background in oil-related activities can prepare to defend its important coastal resources from potential spills. The National Oil Spill Contingency Plan report, due for printing by the United Nations Environment Programme, can be used to support the passage of appropriate environmental legislation. The plan has a format suitable for periodic updating as Mauritius increases its level of preparation. The Coastal Sensitivity Atlas, being printed in Mauritius, is a working document that can be used conveniently by managers and scientists in the event of a spill. Plans for a drill in the use of the NOSCP and the Coastal Sensitivity Atlas are to be implemented in the near future. The Mauritius model provides
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