PREASSESSMENT EVALUATION OF INJURY TO MARINE MAMMALS

Summary of Known Impacts from Oil Spills

One of the most important adaptations of marine mammals in relation to oil spill response is t mechanisms used to control body temperature. The ability to maintain normal body temperat immersed in relatively cool water is the greatest single factor affecting the survival of individual Whales and dolphins are believed to be relatively insensitive to spilled oil, because they rely entirely and skin for thermoinsulation, and the insulative properties of blubber and skin are not affected by e oil. However, the furred mammals such as otters, fur seals, and polar bears are much more vulne because they depend on clean fur for thermal insulation.

To review the known impacts of oil spill on marine mammals, the information must be separated int marine mammal groups. Although there are some general similarities relative to oiling, the im between mammal groups. These groups are:

- Cetaceans (whales, dolphins, and porpoises)
- Pinnipeds (seals, sea lions, and walruses)
- Sea otters
- Polar bears

There are three anticipated interactions that may occur for marine mammals when exposed to include:

1. direct surface fouling;
2. ingestion; and
3. inhalation of the toxic vapors.

Cetaceans. In general, whales, dolphins, and porpoises are considered to have the ability to detect oil and other petroleum hydrocarbons. The extent and effects of ingestion of oil by dolphins are unkn is evidence of oil accumulation by toothed and baleen whales, but there are no data on any lethal c effects of either ingestion or accumulation in tissues. There are also few data on the effects of direct oil on sensitive tissues. Direct long-term exposure of gasoline on dolphin skin produces mild, transier effects on eye or nasal membranes are unknown. During the early stages of large spills, there could anesthetic effects of volatile hydrocarbons on breathing in marine mammals (Geraci, 1990). After *Valdez* oil spill in Prince William Sound, thirteen members of a very stable pod of killer whales disa has been postulated that the whales could have been killed by exposure to the volatile hydrocarbons early days of the 10.8 million gallon spill (Dahlheim and Matkin, 1993).

Observations during spills have documented few direct impacts of oil spills on dolphins. It is th dolphins tend to avoid large slicks; captive dolphins are known to actively avoid floating oil. Durin 1990 *Mega Borg* oil spill, surveys of the distribution and behavior of dolphins during the spill were co NOAA scientists (Mullin *et al*., 1992; Sumltea and Würsig, 1992). They found that dolphins did not detect oil slicks, though they were able to detect and avoid areas covered with emulsified oil. Ther observed marine mammal mortalities. For more information on the impacts of oil spills on marine refer to Geraci and St. Aubin (1990) and RPI (1987a).

Pinnipeds. The ability of walrus, seal, and sea lion species to detect and avoid oil and other hydrocarbons is unknown. However, in the wild, there have been many incidents where seals, sea lio

seals have entered into oiled areas, not seeming to notice the oil slicks. Numerous deaths have been related to direct and indirect exposure of seals and sea lions to petroleum hydrocarbons (St. Aubin, 1990).

Most pinniped species rely on thick layers of blubber to protect them from the cold water they live in and to retain their core temperatures. Surface oiling, as with cetaceans, does not present a thermoregulatory problem. Direct surface contact for most pinnipeds is suspected to result in local irritation of a temporary nature. However, several furred pinniped species, such as the northern fur seals, are susceptible to surface oiling. With the reduced insulative properties of their fur, hypothermia often results (St. Aubin, 1990).

Little information is available regarding the effects or impacts from pinnipeds inhaling the volatile, toxic fractions of petroleum hydrocarbons. As with cetaceans, there could be general anesthetic effects of volatile hydrocarbons on breathing in pinnipeds during the early stages of large spills. The consumption of petroleum hydrocarbons has been implicated in numerous seal and sea lion deaths. Experimental results have revealed a wide variety of effects that may result from oil ingestion by different species. Symptoms related to oil ingestion range from organ diseases to permanent damage or death (St. Aubin, 1990).

Sea Otters. Sea otters are the smallest marine mammals and also the most susceptible to the impacts from an oil spill. Numerous deaths have been related to direct and indirect exposure of sea otters to petroleum hydrocarbons. Sea otters have no subcutaneous blubber layers and depend entirely on their fur pelage for insulation. If their coats become even partially oiled, they usually succumb to hypothermia (Geraci and Williams, 1990).

Inhalation of hydrocarbon vapors results in a wide variety of effects ranging from mild irritation of mucous membranes to permanent damage or even death. Ingestion of petroleum hydrocarbons also results in organ diseases to permanent damage and death. There are many behaviors and habits which predispose sea otters to exposure (Geraci and Williams, 1990).

Polar Bears. Polar bears occur in low densities as solitary animals or family groups associated with pack ice. They must maintain a clean pelt for thermoregulation, thus they would likely ingest oil during grooming (Stirling, 1990). However, little is known about actual effects of oil ingestion.

Field Methods for Population/Behavioral Changes

Field methods for assessing injuries to marine mammals as a result of an oil spill will be a function of the size and type of spill, the spill trajectory, and the seasonal distribution of the animals. Expert marine mammalogists will certainly be involved and use existing studies as a basis for conducting impact assessments. The following list of key parameters to measure oil effects on marine mammals are provided in Table 9 and discussed below.

TABLE 9. Parameters for evaluation of oil spill effects on marine mammals.

Acute effects including mortality

Determination of cause of death

Reduced reproduction

Habitat degradation

Acute Effects Including Mortality. When marine mammals are at risk, aerial, boat, and foot surveys should be designed to identify and count dead organisms. These surveys should also looked for live, oiled animals (noting the degree of oiling), moribund animals, and any behavioral abnormalities. These surveys should be conducted frequently, as early reporting of carcasses is very important because the tissues break down rapidly. Because of their large size, most stranded marine mammals (except sea otters) are readily sighted, so the greatest loss of dead animals is likely to be due to sinking. Only certain persons are allowed to collect marine mammals, thus all carcasses should be reported to the Marine Mammal Stranding Network[5]. Trained mammalogists will respond to collect the necessary data, photography, and samples for necropsy to confirm cause of death and chemical samples for fingerprinting.

A second approach is to compare post-spill counts with data from pre-spill data, using the same or similar survey methods to strengthen the validity of the comparisons. High interannual variations and incomplete pre-spill coverage for the impacted area/populations can be serious limitations. This approach is best used for stable, well-studied populations.

A third approach is to develop computer models to simulate oil movement, the distribution and abundance of animals, and the likelihood of intersection between the two. An intersection model was developed to estimate sea otter mortality following the *Exxon Valdez* spill (Bodkin and Udevitz, 1993).

Determination of Cause of Death of Dead Animals. If there are other likely causes of mortality for the species of concern, it may be necessary to determine the cause of death in a representative number of animals. Other possible causes could include a large winter kill or areas with high incidence of disease. Dead animals from the oiled area may be collected for necropsy and histopathological analysis, for comparison with animals collected from outside the oiled areas.

Reduced Reproduction. Reproductive impacts are determined by monitoring for the number and survival of young. Most marine mammals nurture their young for at least one month (but up to two years), thus it is possible to observe and count parents and young over time to determine survival rates. Photo-identification techniques have been used to identify and track individual whales in stable pods according to their unique markings (Bigg *et al*., 1986). However, there is often a lack of baseline data on life history (birth rates, survival rates for juveniles and adults, etc.) for many species and sub-populations.

Using aerial survey methods, data can be obtained on marine mammal populations and distribution patterns during and following the spill for comparison with pre-spill survey data to quantify the potential extent of injury. The displacement of local populations from known habitats needs to be monitored

Habitat Degradation. When habitats known to be highly utilized by marine mammals are exposed to oil, great care should be taken to avoid assessment activities that may result in disturbance or displacement of the animals. All assessment efforts should be coordinated with the scientists and

managers responsible for the management of those species. When marine mammal habitat degredation is an issue, those concerns should be made known to the scientists conducting intertidal and subtidal habitat surveys and studies. In addition to collecting information that may be helpful in evaluating impairment to marine mammal habitats, this coordination should help minimize disturbance of the animals.

Application of Injury Quantification

The results of the assessment studies should be able to support generation of estimates of:

1. the total number of animals killed as a result of exposure to the oil spill;
2. changes in mammal abundance and other population parameters in the oiled-affected areas;
3. losses in services provided to mammal populations by the habitat injured by the spill;
4. the baseline conditions of mammal population resources; and/or
5. the time needed for recovery of mammal population resources.