WEC285

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Effects of Oil Spills on Marine and Coastal Wildlife[1]

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Off-shore oil spills can do great harm to many components of natural ecosystems. Some of the most conspicuous effects of oil spills are apparent among larger species of wildlife, such as marine mammals and seabirds.

Marine and coastal wildlife exposed to oil suffer both immediate health problems and long-term changes to their physiology and behavior. In small doses, oil can cause temporary physical harm to animals. Types of trauma can include skin irritation, altering of the immune system, reproductive or developmental damage, and liver disease. When large quantities of oil enter a body of water, chronic effects such as cancer become more likely, and direct mortality of wildlife can be widespread.

Direct effects of oil spills on wildlife

Oil spills can impact wildlife directly through three primary pathways:

- ingestion – when animals swallow oil particles directly or consume prey items that have been exposed to oil
- absorption – when animals come into direct contact with oil
- inhalation – when animals breathe volatile organics released from oil or from "dispersants" applied by response teams in an effort to increase the rate of degradation of the oil in seawater

Ingestion of oil or dispersants can cause gastrointestinal irritation, ulcers, bleeding, diarrhea, and digestive complications. These complications may impair the ability of animals to digest and absorb foods, which ultimately leads to reduced health and fitness. Ingestion can occur at multiple levels of the food chain. Herbivorous (plant-eating) wildlife, such as sea turtles, may consume vegetation that has been coated with oil particles. Carnivorous (animal-eating) wildlife, such as shorebirds that feed on clams, mussels, or worms buried in the intertidal area, may consume prey organisms that have been exposed to oil sediments washed onto the shoreline. Baleen whales (those with hair-like teeth used to trap small particles from the ocean water) can become incapacitated when oil clogs their filtering device; in extreme cases this fouling of the baleen can lead to starvation and death. Top predators may become vulnerable to large quantities of pollutants through bioaccumulation (the increased concentration of toxins found at higher levels of the food chain).

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Absorption of oil or dispersants through the skin can damage the liver and kidneys, cause anemia, suppress the immune system, induce reproductive failure, and in extreme cases kill an animal. Exposure to oil may irritate, burn, or cause infections to the skin of some species. Fish and sea turtle embryos may grow more slowly than normal, leading to lower hatching rates and developmental impairments.

Inhalation of volatile chemicals (vaporized materials released by oil floating on the surface) commonly occurs among those species of wildlife that need to breathe air. Inhalation of these harmful materials can cause respiratory inflammation, irritation, emphysema, or pneumonia. Manatees, dolphins, whales, and sea turtles all come to the surface to breathe periodically, and all are susceptible to this risk.

Indirect effects of oil spills on wildlife

Oil spills can also have indirect effects on wildlife by causing changes in behavior:

- relocation of home ranges as animals search for new sources of food
- increases in the amount of time animals must spend foraging
- disruptions to natural life cycles

Changes in foraging locations may result from oil spills. If a spill causes direct mortality to the food resources of a particular species, many individuals of this species will need to relocate their foraging activities to regions unaffected by the spill. This leads to increased competition for remaining food sources in more localized areas. This congregating can be especially problematic for rare species which may become more susceptible to predation or to future catastrophic events while a large proportion of the population forages in a few concentrated patches.

Increases in foraging time may be required to meet energetic requirements. Animals may need to make longer trips to find food in unfamiliar areas, and they may need to forage on less preferred food that takes more time to acquire or that is digested less efficiently. Decreases in diet diversity due to lower food availability may lead to reduced overall health. At the same time, the energetic requirements of these animals may be heightened, due to the physiological challenges brought on by exposure to the oil (difficulty maintaining temperature balance with oiled fur or feathers, for instance, or trouble fighting off disease challenges with newly compromised immune systems).

Disruptions to life cycles may become apparent if particular life forms are more susceptible to the effects of oil than others. Eggs, larvae, and juveniles of many species are more vulnerable to harmful effects from pollutants than adults. Changes in the relative numbers of individuals from different life stages within a species may lead to shifts in habitat use patterns which cause ripple effects up and down the food chain. Furthermore, if a particular life stage of a species is decimated, the ability of the species to rebound after the spill is greatly reduced.

Factors influencing the degree of impact of oil spills on wildlife

The magnitude of harm caused to wildlife by oil spills varies according to a number of factors:

- the amount of exposure of each animal to oil
- the pathway through which each animal is exposed to oil
- the age, reproductive state, and health of each animal
- the type of synthetic chemicals used by response teams to clean the spill

The magnitude of exposure an animal has to oil influences the degree of harm caused (such as the amount of time the skin is in direct contact with oil, or the amount of toxic material ingested or inhaled). The more extensive the area an oil spill covers, the more difficult it becomes for animals to avoid the oil particles, and the greater the magnitude of exposure. Also, the longer the time period over which oil is present at the surface, the greater the likelihood of exposure to species that forage at or near the surface. Wave action and prevailing winds can accelerate the rate of mixing of oil from the surface into the water

column, reducing exposure to species that spend time at or near the surface, while increasing exposure of benthic organisms (animals that live at the bottom of the ocean, like crabs, sponges, oysters, clams, and starfish) to smaller particles. Harm to these benthic organisms is not only any issue to these organisms themselves, but also to the many surface-dwelling organisms higher up in the food chain who suffer when their food becomes contaminated or scarce.

The route by which an animal is exposed to oil (ingestion, absorption, or inhalation) can also influence the rate and toxicity of the effects. Animals with varied diets may have fairly limited contact with oil through the ingestion route, whereas low-mobility animals that need to breathe at the surface will have high rates of exposure through inhalation due to their limited ability to escape the extent of the spill.

The age and overall health of an animal may influence the degree of harm caused by exposure to an oil spill to that animal. Individuals of lower fitness are likely to be impacted to the greatest extent by the additional stresses imposed by an oil spill. In general, eggs, larvae, and early juvenile life stages are more susceptible to oil and to chemical dispersants than are adult animals of most species. Depending upon their reproductive states at the time of a spill, the exposure of a population of animals to oil will influence the degree of harm for the population as a whole. If many larvae or juveniles die the year a spill occurs, for instance, the capacity of the species to rebound the following year will be lowered because many fewer reproducing individuals will be present.

Finally, the types of synthetic materials used by response teams to clean up or disperse oil can influence the magnitude of harmful effects to wildlife. Often "dispersants," detergent-like surfactants, are applied to an oil spill site to increase the rate of degradation of oil. The use of these dispersants can reduce exposure to harmful effects caused by the inhalation of toxic materials by animals visiting the surface to breathe, and can reduce impacts to shoreline habitats. However, these materials may increase the harmful effects of oil on the insulation abilities of bird feathers. Dispersants also cause oil particles to disperse deeper into the water column where the oil may harm populations of benthic animals in deeper waters.

Susceptibility of various types of wildlife to oil spills

The vulnerability of various species of wildlife to an off-shore oil spill changes as time since the spill increases. Species that spend time at the surface of the water will be impacted most during the early stages of the spill. Once the oil begins to wash ashore, species that forage and nest along the shoreline are affected. Finally, influence on benthic species begins once the oil particles leave the surface and become mixed throughout the water column.

Mammals are susceptible to harm from oil spills through a variety of means. Mammals with fur become vulnerable when oil coats their fur and prevents it from providing insulation from cold temperatures. Fortunately, mammals in the Gulf of Mexico, such as whales, manatees, and dolphins, are hairless and therefore less likely to suffer the dire consequences faced by sea otters and fur seals exposed to oil spills at more northern latitudes. However, animals without fur can experience irritation and increased likelihood of infection when exposed to oil. Also, the whales, manatees, and dolphins found in the Gulf of Mexico must come to the surface to breathe, which increases their risk of exposure to inhalation of volatile compounds. Baleen whales, such as Bryde's whales, may face difficulties filtering food through their baleen if they forage in areas with oil.

Birds are primarily affected through damages oil causes to their plumage and through ingestion. Oil reduces the ability of bird feathers to provide insulation, which increases their risk of hypothermia in cold climates. Rate of heat loss is much higher in the water than in air, so oiled plumage is particularly problematic for birds that must find food in the water, such as seabirds, cormorants, and grebes. In extreme circumstances, oil-soaked birds are unable to fly or remain afloat because the oil has reduced both the insulation and the waterproofing of the feathers. Birds with oiled feathers are likely to have reduced survival rates because of difficulties obtaining food and escaping from predators. Oil can also be ingested directly by birds that feed on contaminated prey or while preening. As the coverage of oil on a

bird increases, so does the amount of preening and the amount of oil ingested.

Sea turtle adults are probably most susceptible to oil spills through inhalation when they surface to breathe, or through ingestion of oil-fouled food and floating tar balls they mistake for food. Sea turtles have a habit of ingesting floating objects, regardless of their nutritional value. Eggs and hatchlings are susceptible through absorption. Three of the five species of sea turtles occurring in the Gulf of Mexico are endangered (Kemp's Ridley, Leatherback, and Green), whereas the other two are threatened (Loggerhead, Hawksbill). Nesting season for these species begins in the spring, which means that eggs and hatchlings are likely to experience high risk of exposure to oil spills that occur this time of year.

History of oil spills in the Gulf of Mexico

The Gulf of Mexico is home to a rich abundance of wildlife, including many threatened and endangered species. Six large oil spills have occurred in the Gulf of Mexico during recent times, providing important insight on how best to manage such catastrophes to minimize harmful effects to wildlife. Many federal, state, and local agencies, as well as volunteers, are working together to minimize the damage to wildlife from oil that began leaking when the deepwater drilling platform collapsed off the coast of Louisiana on 22 April 2010.

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