

## 1. Physical Effects of Oil on Pacific Walrus and Polar Bear

Walrus could contact oil in water and on potential haulouts (ice or islands), while polar bears could contact spilled oil in the water, on ice, or on land. In 1980, Canadian scientists performed experiments that studied the effects to polar bears of exposure to oil. More information is available regarding the effects of oil on polar bears than walrus.

Effects on experimentally oiled polar bears (where bears were forced to remain in oil for prolonged periods of time) included acute inflammation of the nasal passages, marked epidermal responses, anemia, anorexia, and biochemical changes indicative of stress, renal impairment, and death. In experimental oiling, many effects did not become evident until several weeks after exposure to oil.

**A. External Oiling—**Oiling of the pelt causes significant thermoregulatory problems by reducing the insulation value of the pelt in polar bears. Excessive oiling could cause mortality as well. Polar bears rely on their fur as well as their layer of blubber for thermal insulation. Experiments on live polar bears and pelts showed that the thermal value of the fur decreased significantly after oiling, and oiled bears showed increased metabolic rates and elevated skin temperatures. Irritation or damage to the skin by oil may further contribute to impaired thermoregulation. Furthermore, an oiled bear would ingest oil because it would groom in order to restore the insulation value of the oiled fur. In one field observation, biologists documented a bear in Cape Churchill, Manitoba, with lubricating oil matted into its fur on parts of its head, neck, and shoulders. The bear was re-sighted two months later, at which time he had suffered substantial hair loss in the contaminated areas. Four years later, the bear was recaptured and no skin or hair damage was detectable, which suggests that while oiling can damage the fur and skin, in some instances this damage is only temporary.

Walrus do not rely on fur for thermal insulation, using a layer of blubber for warmth. Hence, they would be less susceptible to similar insulative and pelt impacts of external oiling than bears.

Petroleum hydrocarbons can also be irritating or destructive to eyes and mucous membranes, and repeated exposure could have detrimental consequences to polar bears and walrus. In one experimental study, ringed seals quickly showed signs of eye irritation after being immersed in water covered by crude oil. This progressed to severe

inflammation and corneal erosions during the 24-hour experiment. When the animals were returned to uncontaminated water, the eye condition resolved within 3–4 days. This reaction could be expected in other marine mammals, such as polar bears and walrus.

**B. Ingestion and Inhalation of Oil—**Oil ingestion by polar bears through consumption of contaminated prey, and by grooming or nursing, could have pathological effects, depending on the amount of oil ingested and the individual's physiological state. Death could occur if a large amount of oil were ingested or if volatile components of oil were aspirated into the lungs. Indeed, two of three bears died in the Canadian experiment and it was suspected that the ingestion of oil was a contributing factor to the deaths. Experimentally oiled bears ingested much oil through grooming. Much of it was eliminated by vomiting and in the feces, but some was absorbed and later found in body fluids and tissues.

Ingestion of sublethal amounts of oil can have various physiological effects on a polar bear, depending on whether the animal is able to excrete and/or detoxify the hydrocarbons. Petroleum hydrocarbons irritate or destroy epithelial cells lining the stomach and intestine, and thereby affect motility, digestion, and absorption. Polar bears may exhibit these types of symptoms, such as affected motility, digestion, and absorption if they ingest oil.

Polar bears and walrus swimming in, or bears walking adjacent to, an oil spill could inhale petroleum vapors. Vapor inhalation by polar bears and walrus could result in damage to various systems, such as the respiratory and the central nervous systems, depending on the amount of exposure.

**C. Indirect Effects of Oil—**Oil may affect food sources of walrus and polar bears. A local reduction in ringed seal numbers as a result of direct or indirect effects of oil could, therefore, temporarily affect the local distribution of polar bears. A reduction in density of seals as a direct result of mortality from contact with spilled oil could result in polar bears not using a particular area for hunting. Possible impacts from a loss of a food source could reduce recruitment or survival. Also, seals that die as a result of an oil spill could be scavenged by polar bears. This would increase bears' exposure to hydrocarbons and could result in lethal impact or reduced survival to individual bears. Additionally, potentially lethal impacts caused by an oil spill to an area's benthic community could divert

walrus from using the area as a food source.

## 2. Potential Oil Spill and Waste Products Impacts on Pacific Walrus and Polar Bears

**A. Pacific Walrus.** Onshore oil spills would not impact walrus unless oil moved into the offshore environment. During the open-water season, if a small spill occurs at offshore facilities or by vessel traffic, few walrus would likely encounter the oil. In the event of a larger spill during the open-water season, oil in the water column could drift offshore and possibly encounter a limited number of walrus. During the ice-covered season, spilled oil would be incorporated into the thickening sea ice. During spring melt, the oil would then travel to the surface of the ice, via brine channels, where most could be collected by spill response activities.

Few walrus are found in the Beaufort Sea east of Barrow and low to moderate numbers are found along the pack-ice edge 241 km (150 mi) or more northwest of Prudhoe Bay. Thus, the probability of individual walrus occurring in the vicinity of industry and encountering oil, as a result of an oil spill from Industry activities, is low.

**B. Polar Bear.** Polar bears could encounter oil spills during the open-water and ice-covered seasons in offshore or onshore habitat. Although the majority of the Southern Beaufort Sea polar bear population spends a large amount of its time offshore on the pack ice, individual bears could encounter oil from a spill regardless of ocean conditions.

Small spills (1–50 barrels) of oil or waste products throughout the year by Industry activities could impact small numbers of bears. As stated previously, the effects of fouling fur or ingesting oil or wastes, depending on the amount of oil or wastes involved, could be short term or result in death. In April 1988, a dead polar bear was found on Leavitt Island, approximately 9.3 km (5 nmi) northeast of Oliktok Point. The cause of death was determined to be poisoning by a mixture that included ethylene glycol and Rhodamine B dye; however, the source of the mixture was unknown.

During the ice-covered season, mobile, non-denning bears would have a higher probability of encountering oil or other production wastes than denning females. Current management practices put in place by Industry minimize the potential for such incidents by requiring the proper use, storage, and disposal of hazardous materials. In the event of an oil spill, it is also likely that polar bears would be deliberately hazed to move them away