Mapping out the chronic effects of silent oil spills

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By Anna Kulow

We are all familiar with the images from massive oil spills. A sea otter blackened by a thick coating of oil on its fur. Masses of dead fish floating in iridescent seawater. Pelicans being lifted from the water, hydrocarbons dripping from their saturated feathers. However, the majority of oil pollution in our oceans does not come from large oil spills, nor does the damage to the organisms living there.


Photo by Igor GOLUBENKOV (NGO: Saving Taman). November 12, 2006, on Tuzla Spit.

Each year, ten billion gallons of petroleum is released into the environment. Motor oil and other industrial lubricants are lost in use, illegally dumped, or burned as fuel. In contrast, the total amount of crude oil released into the oceans from accidental oil spills from 1901 to 2013 was 2.7 billion gallons worldwide. Chronic pollution from motor oil and other lubricants into our oceans is causing chronic health issues in marine wildlife. Unfortunately, these impacts are less likely to make front-page news because it is difficult to understand the role these silent oil spills play in disease and declining populations.

A classic case illustrating the problems facing scientists centers on a group of toxic chemicals called polycyclic aromatic hydrocarbons, or PAHs, which are a major component of used motor oil and other industrial pollutants. These molecules accumulate in fatty tissue and have been linked to high levels of cancers in exposed organisms. Besides being present in motor oil, PAHs enter the environment from other natural and man-made sources, such as natural hydrocarbon seeps in the ocean floor and the combustion of wood and fossil fuels, including forest fires. As a result, pinpointing the source of PAHs found in marine organisms is tricky.

Nevertheless, PAHs are being found in animal tissues and researchers are linking it to declining health in a variety of marine mammals. A 2014 study by researchers at the Cook Inlet Regional Citizens Advisory Council (RCAC) compared levels of PAHs in the fatty tissue of beluga whales living in Alaska's Cook Inlet with those found in sediment samples from area. Although the PAH levels in the sediment samples were not especially high, levels in the blubber and liver samples collected from the whales were higher than those found in other populations. The research indicates the primary source of PAHs in the whales comes from their diet, which consists of 40 to 60 pounds (18-27 kilograms) of fish and shellfish each day. These prey accumulate low levels of PAHs and other toxins in their tissue as they filter contaminated sediment in search of smaller organisms to feed on. Even present in low levels, PAHs quickly accumulate when ingested in these quantities.

Still, tracing the source of contamination is difficult. Sue Saupe, science and research director of the Cook Inlet RCAC says identifying where PAHs in Cook Inlet come from presents challenges because PAHs may come from natural or man-made sources. New methods of fingerprinting PAHs are helping to parse out different sources of PAHs in the Inlet and the surrounding watershed.

"From all of the information, we know that there is a background signal in parts of Cook Inlet that mirrors the fingerprint of PAHs from the Gulf of Alaska and appears to be a recalcitrant, non-biologically available natural source," said Saupe.

Analyses have also detected PAHs identified as coming from pyrogenic sources – either incomplete combustion from anthropogenic sources or from forest fires or volcanoes. However, there is no doubt that human activities are a significant source of PAHs in the Inlet.

"[The] Cook Inlet watershed drain areas that encompass over half of the entire state's population," Saupe said "The potential for non-point source pollution entering the Inlet is likely greater due to potential introductions of PAHs from [urban] run-off."

 Oil spill 03-25-07 008. Taken by John Buchanan.

Tim Tinker, a wildlife biologist with the Western Ecological Center of the U.S. Geological Survey and adjunct professor at the University of California Santa Cruz, echoed this sentiment. Tinker leads the USGS's otter research program, which has been investigating the causes of population decline off of California's coast.

In a 2010 article in *TIME* magazine, Tinker said, "All the research we have done to date suggests that there's no one mortality factor…but that the deaths are caused by a suite of interacting stressors."

One of these stressors is likely PAHs. From 1992 to 2002, researchers at the State University of New York, Albany analyzed the liver tissue of 81 California sea otters from three geographical areas along the coast. The types of PAHs found in each group varied significantly and matched PAHs from sediment and shellfish samples. The results of the analysis concluded that the PAHs in otters living near Monterey Bay primarily came from combustion-related emissions. Otters living at the southern end of the range near Santa Barbara were primarily exposed to PAHs from natural oil seeps.

Future research is needed to determine the exposure of top predators, such as otters, sea lions, and whales, to PAHs from urban and industrial runoff. Until the research catches up, we can strive to reduce the amount of PAH-containing used motor oil entering the ocean via urban runoff.

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