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TOXIC LEGACY:

LONG-TERM EFFECTS OF OFFSHORE OIL ON WILDLIFE & PUBLIC HEALTH

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oceana.org/climate

Acknowledgements

The authors of this report would like to thank the following individuals for their help in creating and reviewing this report: Michael Hirshfield, PhD, Kim Warner, PhD, Simon Mahan, Matt Niemerski, Michael LeVine, Eric Bilsky and Nancy O'Connor. We would also like to thank The Scherman Foundation and the Rockefeller Brothers Fund for their support of Oceana's work to reduce the impacts of climate change on the world's oceans.

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EXECUTIVE SUMMARY

Renewed interest in oil drilling in the ocean, spurred by a period of high gasoline prices, threatens marine life and ocean ecosystems. The chances of oiling and poisoning wildlife, the risks of contamination and economic loss to local communities, and the contribution to climate change will all be greater if we expand offshore drilling. The risks are especially grave in the Arctic, a unique and fragile ecosystem, where oil development is already underway and where even a small spill could be impossible to clean up.

Yet there was no mention of the harm caused by oil exploration, production, transportation and use in the political rhetoric that accompanied the 2008 Elections. Economic analyses that clearly showed additional oil drilling from the U.S. outer continental shelf would have almost no impact on gasoline prices,[1] and even less on the country's dependence on foreign oil, were seemingly ignored.

In the process, two layers of protection for our coasts and oceans were removed. First, an Executive moratorium originally enacted by President George H.W. Bush, and expanded to Bristol Bay, Alaska by President Clinton, was lifted. Next, a long-standing moratorium created by Congress was allowed to expire, leaving most of our oceans and coasts vulnerable to oil development.

Together, these restrictions had prevented oil production and coastal industrialization on much of the outer continental shelf and protected coastal areas for more than 25 years until the rush to drill took hold during the 2008 elections. At the same time, large swaths of the Chukchi and Beaufort Seas, which were not covered by the moratoria or other protections, have been made available to oil companies for leasing and exploration.

But the hard economic facts remain. The Energy Information Agency reports that the outer continental shelf area previously covered by moratoria could produce no more than one percent of the United States' daily needs, even on days when it is at peak production,[2] an amount projected to have an insignificant impact on the price of oil.[3]

The consumption of oil is a major contributor to climate change and ocean acidification, two serious threats to the ocean. In fact, in 2006, oil consumption accounted for nearly 45% of United States' carbon dioxide emissions.[4] The planet's climate crisis will continue to worsen unless we quickly shift to a clean energy economy. For the oceans, climate change means melting sea ice, which many species and humans depend on for survival.[5] It also means the ocean will become more acidic, which like climate change, is a direct result of increased carbon dioxide emissions. If we do not act to curb our carbon dioxide emissions immediately ocean acidification could cause a mass extinction of corals by the middle to end of this century, causing a ripple effect throughout the ecosystems that depend on them.[6] We need to quickly stabilize the amount of carbon dioxide in the atmosphere at a level that scientists believe will give us the best chance of avoiding the catastrophic effects of climate change and ocean acidification. This will, according to the Intergovernmental Panel on Climate Change (IPCC), require industrialized nations, like the United States, to reduce their carbon dioxide emissions by 20-35% below 1990 levels by 2020, and 80-95% below 1990 levels by 2050.[7] To achieve the reductions that are necessary to save our oceans, we will need to stop burning oil, coal and natural gas almost entirely.

In addition to climate change, the other impacts of oil on marine life will continue as long as we use our oceans as a source and a means of transport for our oil addiction. This report takes a close look at the impacts of oil on ocean wildlife, as well as the impacts on our own species. The human costs are high, as are those for wildlife.

Photo: MarieTravers, IBRRC

Photo: EVOSTC

Photo: Russian Doors/Marine Photobank

Photo: NOAA/ORR

Consider these findings:

- When oil coats an animal it can limit its ability to swim or fly, and to maintain its body temperature, feed properly, and even reproduce.
- Young animals are usually the most vulnerable to the effects of oil.
- Oil can harm habitats, making them unsuitable for feeding, nesting, and other services they provide to marine life. These include intertidal areas where innumerable species including sea turtles reproduce, as well as wetlands, coral reefs and mangroves, which are nursery areas for commercially important fish.
- Many animals are killed directly after an oil spill. After the *Exxon Valdez* spill, 300 harbor seals, 900 bald eagles, 2,800 sea otters and 250,000 sea birds were killed soon after the incident.[8]
- Sub-lethal impacts of oil can also be devastating. Oil can harm the eyes, mouth, and nasal tissue, as well as the immune system, red blood cells, and organs like the liver, lungs and stomach. It can also disrupt behaviors like navigation, breeding and feeding.
- Oil can persist in the environment long after a spill. More than ten years after the *Exxon Valdez*, enough oil remained in the environment to continue to harm wildlife such as fish, sea otters and sea ducks.[9]
- Oil is composed of many different toxic compounds including trace metals and polycyclic aromatic hydrocarbons (PAHs) many of which are carcinogenic.
- Oil spills can take a major toll on the commercial fishing industry. In the year following the *Prestige* oil spill off the coast of Spain, the coastal fishing and aquaculture industry lost €65 million ($72 million) in revenue.[10]
- Losses to recreational fishing in just the two years following the *Exxon Valdez* spill totaled approximately $31 million.[11]
- Tourism-based economies also suffer after oil spills. Reduced tourism spending in Alaska in the summer of 1989 alone amounted to $5.5 million,[12] while Spain lost about €134 million (around $159 million) in income following the *Prestige* spill.[13]
- Oil contamination can affect subsistence communities that depend on fish and shellfish for food. Besides the toxic effects of oil itself, many subsistence hunters and fishers stop hunting and fishing after a spill because of concerns about food safety.[14] After the Valdez spill, for example, subsistence harvests declined as much as 77 percent.[15]
- The average cleanup costs of offshore spills are about $7,350 per metric ton of oil, while shoreline clean up can average 20 times that at $147 thousand to $294 thousand per metric ton of oil.[16] A spill like the *Exxon Valdez* that oiled over 1,300 miles of coast cost more than $93 thousand per metric ton, which resulted in some $2.5 billion in clean up costs.[17]
- Alternatives to oil exist. For example, shifting to a fleet of plug-in and electric vehicles will greatly reduce the need for oil and will also allow our cars to be powered by clean energy, such as wind power. The National Renewable Energy Laboratory estimates that offshore wind in U.S. waters could generate more than the current total installed electric capacity.[18]

Based on the direct impacts of oil to ocean wildlife, human health and local communities, and its contributions to climate change, Oceana recommends the following:

- Reinstate the pre-existing moratoria for offshore oil production including the protections for Bristol Bay, Alaska. Increasing renewable energy sources and improving energy efficiency can reduce our dependence on fossil fuels.
- Begin the development of a comprehensive conservation and energy plan for the Arctic that provides a transition from oil to renewable energy and conservation. The plan should include a comprehensive scientific assessment of the health, biodiversity and functioning of Arctic ecosystems, as well as the benefits and consequences of specific industrial activities. Ongoing activities must be stopped and a precautionary, science-based approach applied to all oil and gas leasing, exploration, and development activities in Arctic waters to determine if those activities should be conducted and if so, when, where and how.
- Promote energy efficiency and low carbon fuels. Energy should be conserved at every opportunity, including through improved fuel efficiency standards for cars, trucks, airplanes and ships. Provision of cleaner fuels and investment in efficient mass transit should also be priorities. Incentives should be provided to individuals, institutions and corporations to reduce their oil and other fossil fuel consumption.
- Prioritize the development of offshore wind energy in place of offshore oil drilling using financial mechanisms such as loan guarantees and refundable tax credits. Such funds should be extended to manufacturers of necessary technology, as well as to construction firms, where needed to prevent bottlenecks that could limit the development of renewable energy.

Photo: JonHrusa, IFAW

INTRODUCTION

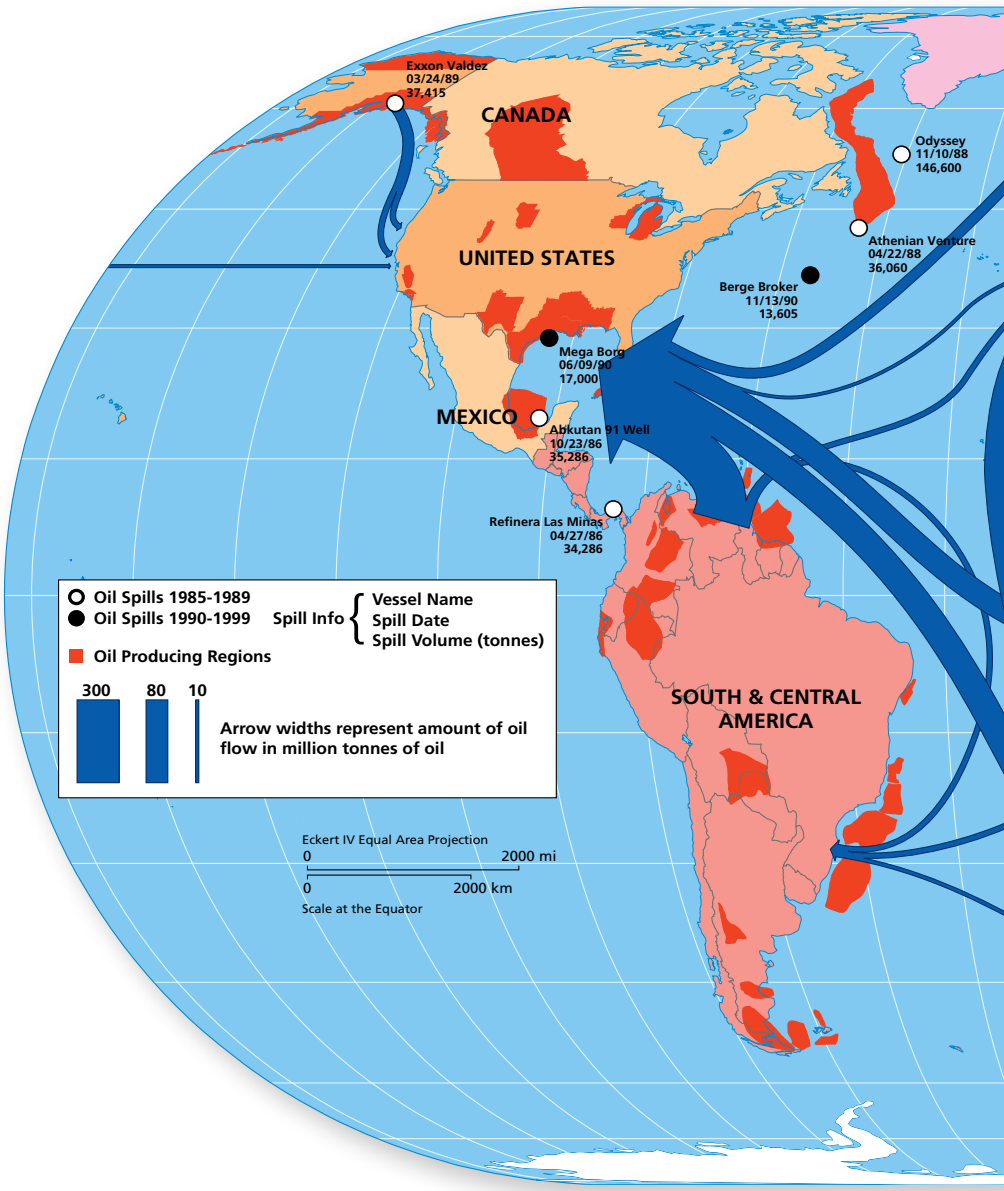
Much of the oil in the ocean enters insidiously through chronic leaks, runoff and spills. Leaks from offshore rigs, vessels and pipes, oily ballast discharges from vessels at sea, along with the runoff from roads are a continuing source of poison into our oceans. While most oil enters the oceans unseen, massive oil spills highlight the catastrophic effects that oil can have on marine wildlife and human communities.

This unseen scourge, which harms and kills countless numbers of marine animals, is a result of our addiction to oil. In 2007, the United States consumed about 7.5 billion barrels of oil, an increase of almost 30 percent over the last 20 years alone.[19] Unfortunately, this number is expected to continue to grow as our oil demand increases. OPEC has projected that by 2030 global demand for oil will increase by nearly 34 percent above 2006 levels.[20] Much of this increase can only be met by foreign and offshore oil. As a result more refinery capacity and coastal oil handling facilities will be needed, and increased amounts of oil will be transported by pipes and vessels. The result will inevitably be more leaks and spills into the ocean.[21]

As more and more oil enters the oceans, whether in the form of crude oil or a refined product (such as kerosene or gasoline) increasing numbers of marine animals will come in contact with it. Oil can coat feathers and fur, reducing buoyancy and insulation and compromising the ability to fly and swim. Many components of oil are also toxic and can result in diverse effects ranging from eye, skin and throat irritation to damage to reproductive organs and death.

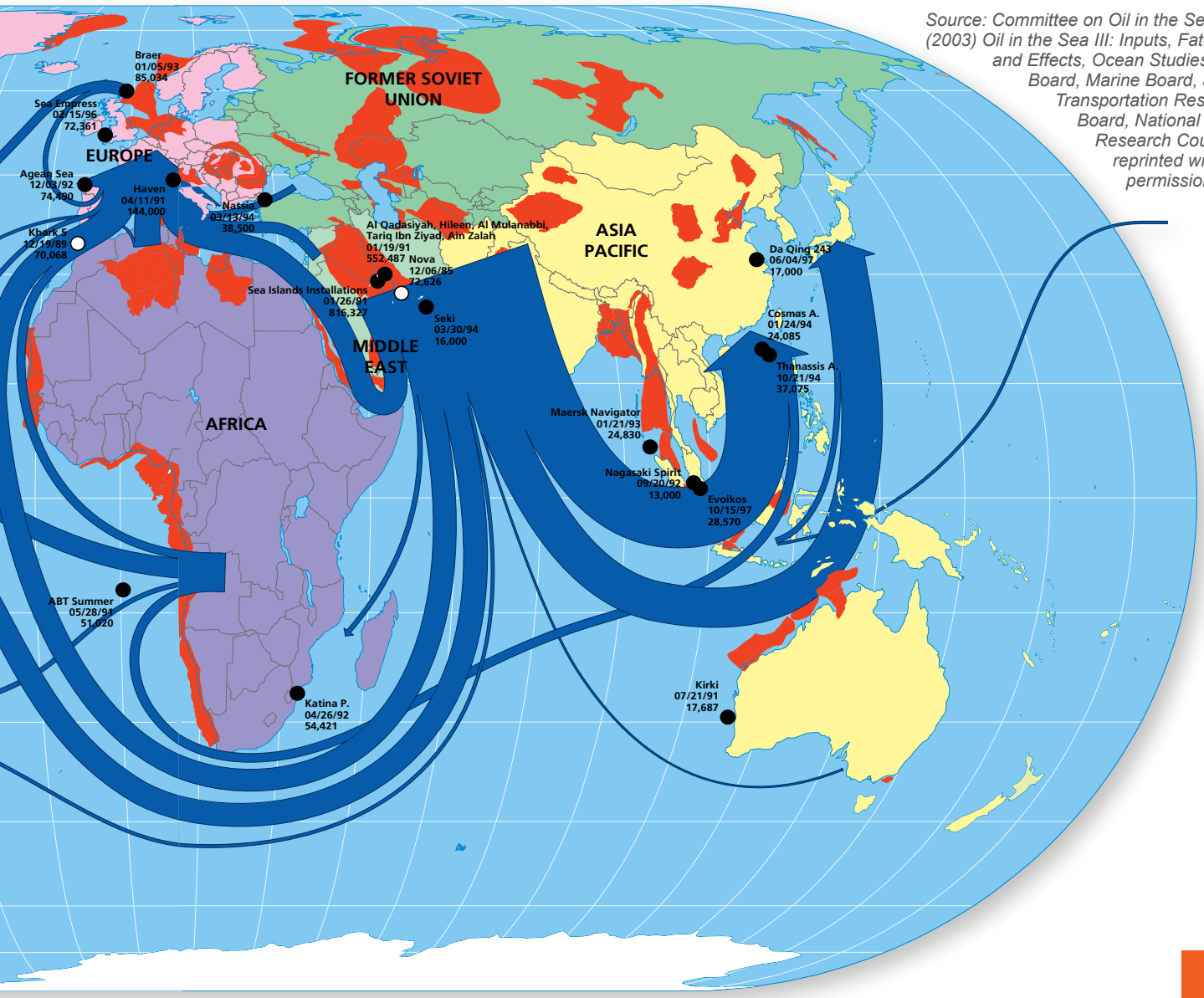
Oil in the ocean can also severely impact local communities that rely on marine resources for their health and economic well-being. People may be unable to consume or sell fish and other seafood because of oil contamination. Communities may also lose vital tourism income as surrounding beaches and coastal areas are compromised by oil pollution. Local communities may continue to be affected for many years after a spill as oil can remain in the environment for decades, even after “cleanup” attempts.

Oil use is also a major contributor to climate change. In 2006, oil consumption in the United States contributed 2.6 billion metric tons of carbon dioxide, accounting for almost 45 percent of all U.S. carbon dioxide emissions to the



atmosphere.[22] That same year, over 31 billion barrels of oil were consumed globally, producing 11 billion metric tons of carbon dioxide.[23] This is more than one third of all the carbon dioxide emitted by humans and about the same amount of carbon dioxide that is absorbed by the oceans each year.[24] Global carbon dioxide emissions from oil consumption are expected to grow 35 percent by 2030.[25] Human-produced carbon dioxide emissions are causing a significant shift in the Earth's climate system, resulting in more severe droughts, changing food production, shifting rainfall patterns, rising sea levels and intensified storms.[26] Increased carbon dioxide emissions are also making the oceans more acidic, which is expected to cause a mass extinction of corals by the middle to end of this century.[27]

Oil is not a necessary evil. Alternatives already exist and more are being developed that can replace our thirst for oil. Kicking the oil habit is the only way to end our dependence on foreign energy production. Instead of continuing our oil addiction, we need to improve energy efficiency and conservation and increase our reliance on domestically produced alternatives, such as wind and solar power.



Source: Committee on Oil in the Sea (2003) Oil in the Sea III: Inputs, Fates, and Effects, Ocean Studies Board, Marine Board, and Transportation Research Board, National Research Council, reprinted with permission.

Figure 1: *Global flow of oil in 2000.*


OIL
KILLS
Oil spilling from the Alvenus, Louisiana, 1984

SOURCES OF CONTAMINATION

Although oil enters the ocean from a myriad of sources, these inputs can be generally broken into four categories: extraction; transportation (including pipeline, accidental spills and normal ship operations); consumption (including runoff from land sources, deposition from air pollution and fuel jettisoned from aircraft); and natural seeps. These four categories contribute about 380 million gallons of oil to the oceans each year. [28]

Extraction

During extraction there can be large oil spills and chronic leaks. These releases can include the crude oil being extracted as well as refined products that are used as part of the extraction process.[29]

Transportation

Oil based products, including crude oil and refined distillates like gasoline, can be released during the transit process, either as a large spill or as a series of smaller releases,[30] such as intentional discharges of oily ballast waters. Every step of the transportation equation – from loading, shipping, unloading, piping and storage – presents a chance for oil to escape.

Consumption

By their very nature, oil releases as part of the consumption process are generally small, but they are continuous. Oil is burned as fuel for cars, boats, airplanes, power plants, and heating units. Burning oil creates air pollution, which can precipitate out into the ocean. Oil is also dumped down storm drains or leaked from vehicles. These releases are washed down drains or sewers and are deposited into waterways and ultimately the oceans. Due to the many pathways to the ocean, these releases often end up in coastal zones, which are extremely sensitive to oil.[31]

Natural Seeps

Crude oil can naturally seep from beneath the seafloor, releasing oil into the overlying water column. While these seeps can release large amounts of oil, the rate is usually very slow, which allows the surrounding ecosystems to adapt. Some species, however, may be unable to adapt and may die in the vicinity of these areas.[32] While some ecosystems may be able to cope with natural seeps, human caused spills - even small ones - can cause considerable harm to areas that have not previously been exposed to oil in a way that allows the type of adaptation seen in natural seep areas. Even animals with some level of natural exposure may be unable to cope with the stress associated with a spill of a different oil product or a larger than usual exposure.[33]

Although one study has suggested a link between oil drilling and decreases in natural seeps,[34] this relationship has not been widely demonstrated for natural seeps in general.[35] Reductions in natural seepage may only occur in the early stages of drilling, when oil is easily extracted. Beyond this point, as the oil field ages, oil recovery becomes more difficult and more advanced techniques are required – techniques that may in fact increase the likelihood of seepage, instead of decreasing it.[36]

SOURCE	NORTH AMERICA	GLOBAL
	Gallons	Gallons
Extraction	880,000	11,000,000
Oil Transportation	2,700,000	44,000,000
Consumption	25,000,000	140,000,000
Natural Seeps	47,000,000	180,000,000
Total	75,580,000	375,000,000

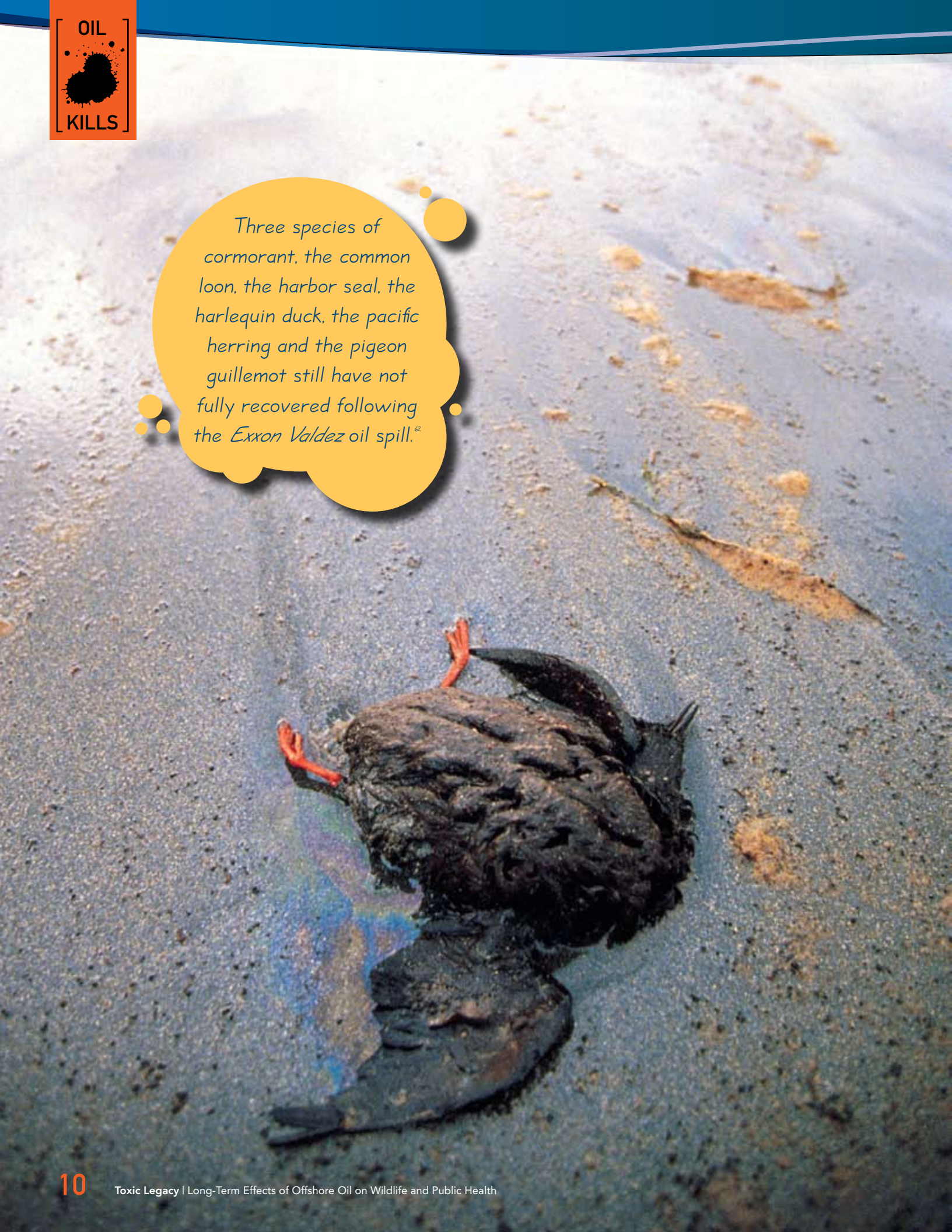
Table 1: *Amounts of oil entering the global ocean and the waters of North America on a yearly basis.*[37]

Properties of Oil

Crude oil is a naturally occurring substance that can be refined to produce a variety of different oil products, such as gasoline and kerosene. Oil is composed of many different hydrocarbon compounds, a small proportion of which are bound to nitrogen, sulfur and oxygen. Crude oil can also contain some salts and trace metals. Since there are many possible combinations of components in crude oils, their products have differing effects when they enter the marine environment.[38] For example, polycyclic aromatic hydrocarbons (PAHs) a component of oil, are extremely toxic and can cause cancer in mammals, including humans.[39]

The different components of oil also determine its viscosity, or ability to flow. More viscous oils tend to be very 'sticky' and coat animals' fur and feathers. Such oil is also more likely to travel long distances in the form of tarballs and can remain in the ocean or on beaches for decades.[40] Less viscous, or more fluid oils, are less likely to result in wildlife coatings. However, these oils tend to be more toxic to wildlife.[41]

The composition of oil also determines its density and therefore its tendency to sink or float. Less dense oils will float and tend to evaporate more easily than more dense oils which are more likely to sink and remain in the environment longer.[42] Wind, waves and oceanographic processes will also determine how long and in what form oil will remain in the marine environment.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Three species of cormorant, the common loon, the harbor seal, the harlequin duck, the pacific herring and the pigeon guillemot still have not fully recovered following the *Exxon Valdez* oil spill.[62]

EFFECTS OF OIL ON MARINE LIFE

Once oil makes its way into the environment it poses a range of threats to marine life. Animals coated by even small amounts of oil may be unable to swim or fly properly, maintain their body temperature, feed or even reproduce. Oil can also cover beaches and other vital habitat making it difficult for animals to find uncontaminated food, and nesting and resting places.

Some animals are more vulnerable to oil than others. For example, young may be less able to deal with either coatings or exposure to toxic substances than adults due to their size, underdeveloped immune systems and behaviors.[43] Marine mammals, seabirds (especially penguins), and turtles are all particularly vulnerable to oil on surface waters as they spend considerable amounts of time on the surface feeding, breathing and resting.[44] Turtles and marine mammals are vulnerable to floating oil at all life stages as they do not appear to avoid oil slicks and they must inhale large amounts of air prior to diving. Turtles also feed in convergence zones, areas where air flows and currents meet, which tend to collect floating oil.[45] Fish embryos are also particularly vulnerable to oil exposure, even at extremely low concentrations of less that one part per billion.[46] In fact, one study found that when pink salmon embryos are exposed to PAH levels in oil at concentrations of less than 20 parts per billion half of the population can die before reproducing.[47] This level is near many of the water quality standards for PAHs around the world, for example in Alaska the standard is 10-15 parts per billion.[48] Consequently, even traces of oil pollution at levels often considered safe for wildlife can cause severe damage to fish.

Animals that become coated in or ingest oil often die quickly. Large numbers of animals were killed immediately after the *Exxon Valdez* spill, including as many as 300 harbor seals, 900 bald eagles, 2,800 sea otters and 250,000 seabirds.[49] However, exposure to oil can also result in non-lethal impacts, including liver and eye damage, and skin irritations. While these effects may not cause immediate death, they can reduce survival rates by compromising an animal's ability to find food and shelter, reproduce and avoid predators.

Exxon Valdez Oil Spill Facts

On March 23, 1989, at 9:12 pm the *Exxon Valdez* oil tanker left the Alyeska Pipeline to cross Prince William Sound carrying approximately 53 million gallons of crude oil. The tanker was headed for Long Beach, California. Three hours later, just after midnight on March 24th, the *Exxon Valdez* ran into Bligh Reef spilling 10.8 million gallons of oil into the sound.[50]

- The amount of oil spilled could fill 125 Olympic-sized swimming pools.[51]
- As many as 2,800 sea otters, 300 harbor seals, and 250,000 seabirds died in the days following the disaster.[52]
- 1,300 miles of coastline were hit by the oil spill.[53]
- 1,000 harlequin ducks were killed by the oil spill, in addition to many chronic injuries that occurred as a result of the long term effects of the spill.[54]
- The cleanup required about 10,000 workers, 1,000 boats and roughly 100 airplanes and helicopters.
- Four deaths occurred that were directly associated with cleanup efforts.[55]
- The spill caused over $300 million of economic harm to more than 32 thousand people whose livelihoods depended on commercial fishing.[55a]
- Tourism spending decreased by eight percent in South-Central Alaska and by 35 percent in Southwest Alaska in the year after the spill.
- There was a loss of 9,400 visitors and $5.5 million in state spending.[56]
- Many fish populations were harmed during the spill. For example, sand lance populations went down in 1989 and 1990, herring returns were significantly fewer in 1992 and 1994, and adult fish had high rates of viral infections.[57]
- Pink salmon embryos continued to be harmed and killed by oil that remained on stones and gravel of stream banks through at least 1993.[58] As a result, the southwestern part of Prince William Sound lost 1.9 million or 28 percent of its potential stock of wild pink salmon. By 1992 this part of the sound still had 6 percent less of the wild pink salmon stock, than was estimated to have existed if the spill had not occurred.[59]
- Two years following the *Exxon Valdez* spill the economic losses to recreational fishing were estimated to be $31 million.[60]
- Twelve years after the spill, oil could still be found on half of the 91 randomly selected beaches surveyed.[61]
- Three species of cormorant, the common loon, the harbor seal, the harlequin duck, the pacific herring and the pigeon guillemot still have not fully recovered.[62]

Acute Impacts of Oil - 'Sticky' and Toxic Oil

Oil in the marine environment poses an acute threat to wildlife, either because of its toxic components or because animals become coated in 'sticky' oil. Although the acute impacts may be short-lived they can result in long-term effects on populations or even ecological communities as a whole.

Sticky Oil

Heavier oils contain fewer volatile components and therefore tend not to evaporate quickly. These oils can remain as slicks on the water surface. Tarballs that form from heavy oil can persist in the environment for a long time and present a significant threat to wildlife living in, or passing through an affected area. Heavier oils can adhere to animals' coats, skin and feathers with severe consequences. Many animals will not actively avoid a slick and can therefore come in contact with floating oil. Animals that must surface in order to breathe, such as marine mammals, penguins and sea turtles are particularly vulnerable to becoming coated in oil. Seabirds can become coated when diving for food beneath a slick, or being engulfed by it while resting on the surface.[63]

Toxic Oil

Oil contains many toxic components that can poison wildlife and disrupt their development. These contaminants can also disrupt many important behaviors and physiological processes that are necessary for survival. These effects may cause a quick death or they may cause sub-lethal effects that may or may not be fatal. For example, chemicals in oil can cause genetic damage or disruption of energy production needed for growth and reproduction.[64] While these effects may not kill animals outright they can result in changes that impact the long-term survival of individuals as well as entire populations.

Photo: Sascha Regmann Project Blue Sea Marine Photobank

Effects of 'Sticky' Oil on Marine Life

- **Hypothermia –** Oil can reduce or destroy the insulation and waterproofing properties of fur and feathers.[65]
- **Difficulty Flying and Swimming –** Oil can make animals more susceptible to predation.
- **Drowning –** Oil can increase the risk of drowning for birds. Feathers soaked in oil are unable to capture air, making birds less buoyant.
- **Difficulty Feeding –** Oil can compromise feeding ability. For example, baleen whales may be unable to feed if their baleen becomes coated in oil.
- **Weight Loss –** Oil can cause unhealthy weight loss if more than the usual amount of energy is used to regulate temperature.
- **Blockage of Airways –** Oil can block the airways of air-breathing animals, such as marine mammals, penguins and turtles.
- **Food Availability –** Oil can limit the availability of food in oil-slicked areas.
- **Ingestion –** Oil can prevent chewing and swallowing and fill stomachs, block intestines and disrupt the absorption of vital nutrients.
- **Olfactory Effects –** Oil can disguise the scent of an animal which can prevent young animals, such as seal pups from finding their mothers, possibly leading to rejection, abandonment and starvation. Scent disruption can also impact animals, such as turtles, that use scent in navigation and orientation.

Toxic Effects of Chemicals in Oil[66]

- **Reproductive Decline –** Chemicals in oil can damage the reproductive system and disrupt breeding behaviors.
- **Damage to Tissues and Organs –** Oil contaminants can damage eyes, mouth, skin, and nasal tissue, as well as the immune system, red blood cells, and organs, such as liver, lungs and stomach.
- **Harm to Young Fish –** Chemicals in oil can damage fish eggs, larvae and young. Fish embryos are particularly vulnerable to PAHs found in oil. Even at extremely low concentrations contamination can lead to deformities, genetic mutations, reduced growth, impaired development and behavior, premature hatching, difficulty swimming, and death, with long-term consequences for the individual and population.
- **Increased Risk of Death in Young Turtles –** Developmental defects and death of turtle eggs are more likely after exposure to oil contaminants.
- **Regulatory and Immune System Impairment –** Oil chemicals can cause damage to the salt glands and immune systems of turtles.
- **Transfer of Oil from Seabirds to Their Eggs –** Toxic compounds transferred from adults to eggs may cause developmental failures in the embryos. As little as 0.004 ml of oil can kill a bird embryo.
- **Inability to Maintain Blood Pressure –** Adrenal tissue of birds, which regulates blood pressure, can be damaged by the chemicals in oil.
- **Immune System Suppression –** Ingestion of oil and its components or the consumption of contaminated food can lead to suppression of the immune system and increased susceptibility to disease.
- **Compromised Oxygen Transport by Blood –** Exposure to toxic elements of oil can trigger a form of anemia in birds where oxygen is not effectively transported to essential organs. This may persist even after the bird seems to have recovered from other effects of oil exposure.
- **Inhalation –** Animals can inhale toxic fumes, which can lead to stress, disorientation and brain lesions.
- **Ingestion –** Animals can ingest oil directly, exposing them to toxic chemicals such as PAHs,which include known carcinogens. Animals may also become exposed to these toxic chemicals in oil through preening and other efforts to remove oil covering their coats and feathers.

Photo: EVOSTC

Photo: Kim JaeHwan, AFP, Getty Images

Photo: Ticiana Fettermann

Long-Term Effects of Acute Exposure to Oil

Acute exposure may result in long-term effects on either individuals or populations. In cases where oil does not directly kill an animal, it may compromise its long-term survival. For example animals may be unable to effectively avoid predators due to eye damage, or may die prematurely due to organ damage. These injuries can also limit successful reproduction, which can impact a population's survival. Reproductive success may also be affected by direct damage to reproductive organs or changes in behavior caused by oil exposure.[67]

Sub-lethal exposure may result in effects on the population if important behaviors are interrupted. For example, sea turtles use scents to navigate and orient themselves. If they are unable to make use of these cues and are unable to complete important breeding or feeding behaviors, the overall population will likely suffer.

Animals may also be indirectly affected by loss of prey if one or more prey species become unavailable due to oil exposure. For example, reductions in fish populations following the *Exxon Valdez* spill resulted in a decline in the population of Marbled Murrelets, a small seabird.[68] Species at the top of the food web may also be harmed if they are feeding on contaminated food because many of the compounds ingested with oil are toxic and carcinogenic.[69] Exposure to oil, either directly or via food sources, can have lasting impacts on individuals and populations. Even twenty years after the *Exxon Valdez* spill some species have not yet fully recovered.[70]

Ecosystem impacts from oil pollution may also include trophic cascades in which species whose numbers are usually controlled by a predator may be released from this pressure due to a reduction in the predator species. For example, the intertidal community of snails, limpets and barnacles changed dramatically following the mass mortality of rockweed. The subsequent reductions in the invertebrate populations meant less food was available for their predators.[71] Prior to the *Exxon Valdez* spill these types of wide-ranging ecosystem effects were largely unappreciated, and it was only upon studying the spill that it became evident that oil pollution can alter the functioning of an ecosystem.

Effects of Chronic Exposure to Oil

Chronic exposure to oil can result from the small but steady releases of oil that are washed off our roads, released from routine operations of ocean going vessels, aircraft and drilling operations. Chronic exposure can also result from oil that has remained in the marine environment after a spill or other release. Some toxic components are also able to remain in the environment for long periods of time in instances when the oil is protected from normal weathering - including evaporation, dispersion, and dissolution – by being caught up in sediments or hidden under rocks. While oil may be unavailable for some time, large storms can release these chemicals making them available again many years after the initial release.[72] We now know from the *Exxon Valdez* spill that the effects can persist as long as twenty years.

Three years after the *Exxon Valdez* spill, two percent of the original spill, about 200,000 gallons of oil, was estimated to still remain on beaches.[73] Twelve years after the spill, there was still oil present on some beaches. At that time, enough oil persisted in the environment to continue harming individual animals and some population declines were still occurring. Chronic exposure was still evident in fish, sea otters and sea ducks which all suffered from increased mortality for several years after the spill.[74] Nearly two decades later, in 2006, the *Exxon Valdez* Oil Spill Trustee Council listed 31 species and resources as still injured by the spill.[75]

Oil residues, oily bilge water and oily sludge are all released routinely from ships. These discharges can cause chronic, but significant harm to marine wildlife. Penguins serve as a good example since they are known to be especially vulnerable to oil in water because they are air-breathing, swim low in the water and cannot fly. 1994 estimates suggest that over 40,000 Magellenic penguins were killed yearly by chronic oil pollution released from ships along the Chubut Province coast in Argentina.[76]

Tarballs - dense, sticky globs of oil, that form when heavy oils undergo the weathering process - serve as another source of chronic effects from oil.[77] Tarballs can form from oils discharged from ships, chronic leaks or major spills and pose considerable problems for sea turtles as they often collect in areas where turtles aggregate. Since turtles are particularly vulnerable to tarballs, they serve as a good example for what may also occur in other vulnerable species. One 1993 study, not prompted by any recent spills in the area, found tar in the esophagi and stomachs of 34 percent, and in the mouths of over 50 percent of the post-hatchling loggerheads captured and examined off the Florida coast.[78] In a turtle's stomach, tar can cause a series of problems, including starvation, absorption of contaminants, unstable buoyancy, intestinal blockage, and interference with fat metabolism.[79]

Chronic exposure to oil can shorten life spans, interrupt important breeding physiology and behaviors, and result in population level effects. Chronic exposure can also reduce the fitness and resilience to other threats. This may be particularly important for species, such as sea turtles, that are already threatened or endangered.

Photo: WhatImSeeing/Marine Photobank


Photo: IFAW/ J. Hrusa

Photo: NOAA/ORR

Contaminated Habitats

Contaminated habitats can affect individuals and populations, even those that may have otherwise avoided harm from oil present in the ocean. Wildlife may become exposed to the oil in their habitats. For example, fish embryos have been found to be sensitive to toxic effects from oils on beach and stream sediments.[80] Wildlife may also be affected by oil pollution in their habitats as they may be unable to find appropriate food resources, resting or breeding areas. For example following a spill off the coast of Panama in 1986 there was a large die off of seagrass, a significant component of the diet of the green sea turtles in the area.[81]

Habitats that are built by living organisms, such as coral reefs, mangroves, and mussel and sea grass beds, are particularly vulnerable to oil exposure. In these habitats both the persistence of oil and the long-term nature of habitat recovery pose major problems for wildlife that depend on them.[82]

Coral reefs that are already suffering the effects of acidification are extremely vulnerable habitats. Oil can disrupt coral reproduction, colonization and feeding. It can also cause corals to expel their symbiotic algae, all of which can result in tissue damage, bleaching and coral reef decline.[83] Since reefs are important habitats for so many other species, their decline can have ripple effects throughout the marine community.

Oil washed ashore can also damage important beach habitats. Many species use beaches as resting, nesting and breeding areas and they may become exposed to oil if the beaches are contaminated. For example, turtles may become coated in oil when leaving their nests or returning to beaches to mate and lay eggs.[84] Eggs may come in contact with oil leading to abnormal development or death. Even if eggs are not contaminated by oil, oil covering the sand beneath which they are buried can interfere with natural processes such as sex determination in the hatchlings. Since the sex of turtles and other reptiles is determined by temperature during incubation, if the temperature of the nest is raised even a few degrees due to darker, more heat absorbent oil covering the sand above, the sex ratio of the hatchlings can be skewed.[85]

Oiled habitats can remain contaminated and poisonous to wildlife for many years. For at least five years following the *Exxon Valdez* spill pink salmon embryos were harmed and killed due to oil that remained on stones and stream gravel.[86] Laboratory studies found that even very low concentrations of oil remaining in the marine environment can expose fish embryos to toxic PAHs, which explains the continued mortality of fish embryos after the spill.[87] The toxic effects of these beaches persisted even longer for sea otters and sea ducks that forage in the intertidal areas, impairing their recovery for more than ten years.[87a]

Photo: NOAA

EFFECTS ON LOCAL COMMUNITIES AND ECONOMIES

Oil pollution also threatens local communities that rely on the ocean for their livelihoods. In communities that rely on fish and other marine resources for their subsistence, critical food sources may become contaminated after an oil spill or as a result of chronic leaks. Human health can also be affected by both accidental and operational spills. Coastal economies are hurt and jobs are lost when oil pollution affects commercial and recreational fishing and tourism.

Fishing

While small spills, slow leaks, and other consequences of daily oil operations are a threat to commercial fishing industries, larger oil spills from oil transportation and from operational accidents are an even bigger threat. The *Exxon Valdez* spill off the coast of Alaska in 1989 and the Prestige oil spill off the Spanish coast in 2002 are disturbing examples of the lasting impacts large spills have on the fishing industry.

As of 2001, twelve years after the *Exxon Valdez* spill, the fishing industry in and around Prince William Sound still had not recovered. By 2002, the *Exxon Valdez* Oil Spill Trustee Council labeled pink and sockeye salmon as recovered, but the Pacific herring had still not recovered. For 11 of the last 19 years since the spill, the Prince William Sound herring fishery, one of the most important fisheries in the area, has been closed.[88] In the years following the spill over $300 million of economic harm came to more than 32 thousand people whose livelihoods depended on commercial fishing.[88a]

The Prestige spill took place off the coast of northwest Spain and affected large areas of the country's coast as well as parts of southwestern France. A study of aquaculture and coastal fishing yields one year after the spill showed a reduction of 34,000 metric tons of product and more than $72 million (€65 million) in revenue. Most of this loss was in the fishing sector, which suffered a decline of 31,000 metric tons in lost catch and more than $62 million (€56 million) in lost revenue.[89]

Oil spills can also be extremely harmful to the recreational fishing sector. In the two years following the *Exxon Valdez* spill, the estimated economic losses in recreational fishing came to $31 million.[90] More recently, the *Athos I* oil spill caused over $1 million in losses to those using the Delaware River for recreational fishing and hunting.[91]

Tourism

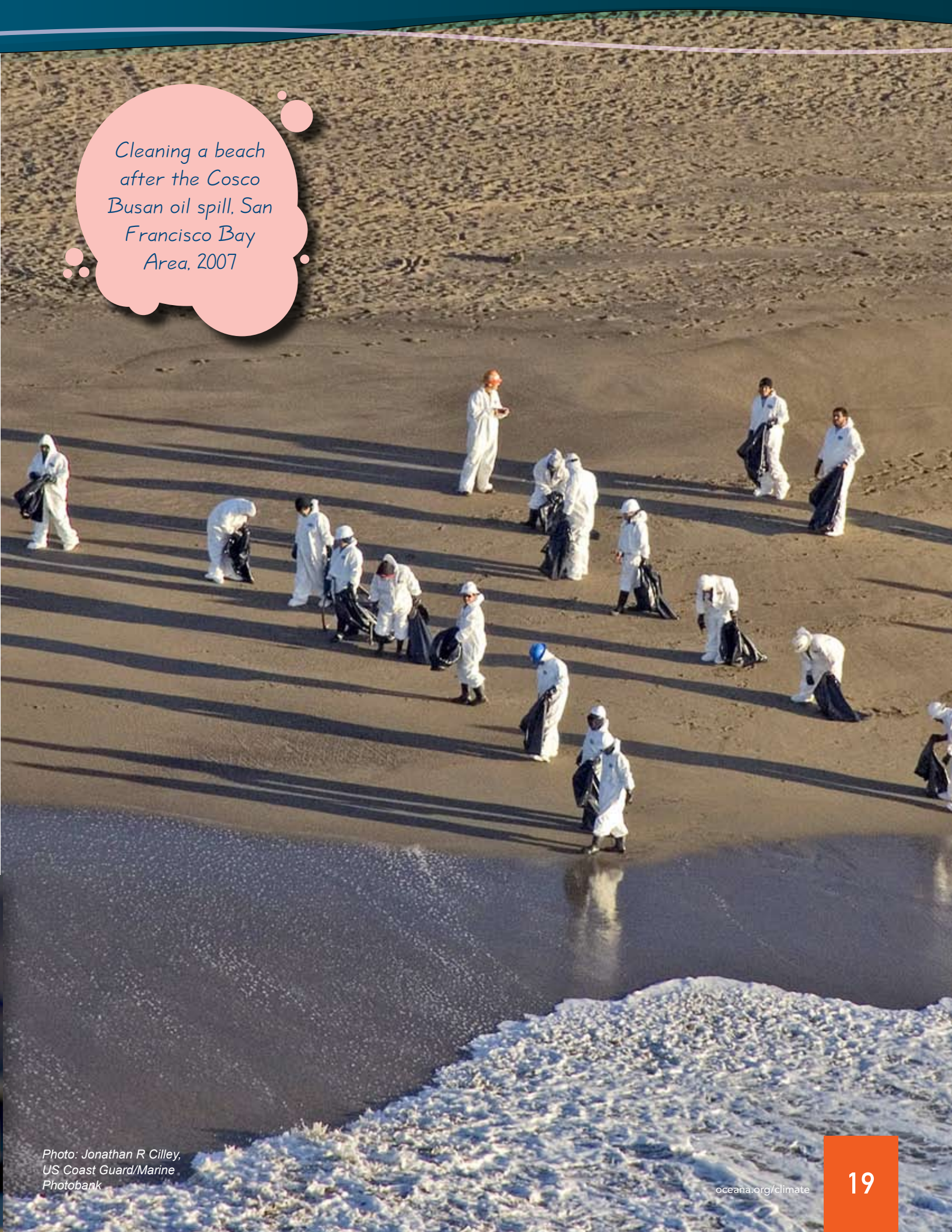
Oil spills are a major threat to coastal tourism. Coastal areas provide a variety of recreational activities that can be compromised by oil pollution, such as boating, scuba diving, fishing, and swimming. Ecotourism also has become a major industry in many U.S. coastal areas. Oil pollution on the coast can limit the appeal of these activities, resulting in losses to the local economy and community well-being. Studies show that as oil pollutes the ocean, property values decrease, business activity declines and investment in coastal areas becomes more risky.[92]

The *Exxon Valdez* spill again provides a useful case in point. Research conducted by the Alaska Visitors Statistics Program showed that a year after the 1989 *Exxon Valdez* oil spill, visitor spending decreased by eight percent in South-Central Alaska and by 35 percent in Southwest Alaska.[93] Visits dropped by nearly 10,000 people resulting in a loss of $5.5 million in in-state spending the summer of 1989.[94] In the year following the Prestige spill off the northwest coast of Spain, the number of overnight tourists went down by 5 million causing a loss of €134 million (approximately $159 million) in income for the region.[95] This number would be expected to increase if effects linger beyond the one-year time frame of the study. The *Bouchard 120* oil spill in 2003 resulted in polluted beaches along the Massachusetts coast, while the *Cosco Busan* oil spill in San Francisco Bay in 2007 resulted in the closure of many beaches in the area. The economic impact of these closures remains to be quantified.[95a]

Human Health

Oil causes a variety of public health problems either through direct exposure to oil during a spill or through indirect exposure. Slow leaks of oil and other contaminants from oil drilling and shipping can lead to contamination of fish caught recreationally or commercially. Consumers eating contaminated fish are exposed to these chemicals as well.

Photo: Bob Talbot



Cleaning a beach after the Cosco Busan oil spill, San Francisco Bay Area, 2007

Photo: Jonathan R Cilley, US Coast Guard/Marine Photobank

Public health and safety problems are common in the event of an oil spill. Acute health effects from the evaporation of volatile oil components can include headaches, nausea, vomiting, eye irritation, worsened asthma symptoms, upper respiratory tract irritation, vertigo, leg and back pains and psychological ailments.[96] Spills can also have psychosocial effects in the communities where they occur. For example, those exposed to the *Exxon Valdez* oil spill and the cleanup efforts which followed were 3.6 times more likely to have generalized anxiety disorder and 2.1 times more likely have developed post traumatic stress disorder than those who were not exposed.[97] Besides the direct impacts, food (fish and shellfish) and water supplies can become contaminated as the result of a spill.[98]

Subsistence Communities

Oil contamination, especially from spills, can have a large and lasting impact on subsistence communities that depend on fish and shellfish for food. For example, there are 2,200 natives living in 15 different communities who were affected by the *Exxon Valdez* spill.[99] These communities and approximately 13,000 other Alaskan subsistence permit holders were affected by the *Exxon Valdez* spill. Besides the physical and toxic damage that oil spills create, families in subsistence communities often stop hunting and fishing because of concerns about the safety of the food. The Exxon spill caused a decline in subsistence harvests in ten nearby communities that ranged from nine to nearly 80 percent. These declines were driven by concerns that contaminated resources were not suitable to eat.[100] While harvest levels are now comparable to other communities in Alaska, in the case of the *Exxon Valdez*, there are still some resources that have not fully recovered from the spill. The *Exxon Valdez* Oil Spill Trustee Council still lists subsistence communities as an "injured service" that is still in the recovering stage.[101]

Costs of Cleanup

The financial costs of cleaning up an oil spill are hard to measure due to the types of losses experienced which vary considerably. These depend on the details of the spill including the type and amount of oil, the type of environment and habitat affected, the time of year, whether it is coastal or offshore, and a variety of other factors.[102] Some cleanup costs, such as repair of physical facilities, payment for cleaning-up the oil and remediation expenses are easier to calculate than others. On the other hand, it may be impossible to put a price on the years of effort required to heal a community after a spill and the cost that is involved in treating animal and human health problems is very difficult to quantify.[103]

When an oil spill reaches coastal areas the cost and scope of the cleanup efforts increase significantly. When a spill hits a coast, as much as 99 percent of the costs can go to just cleaning-up the shoreline. Some estimate the cost of cleaning oil from offshore waters to be approximately $7,350 per metric ton of oil spilled, while shoreline cleanup can average twenty times that at $147 thousand to $294 thousand per metric ton. Smaller spills may be more costly to clean up for a given amount of oil spilled because of the relatively high price tag on evaluating the spill, bringing in equipment and getting it set up.[104]

Besides the costs of cleanup the impacts on coastal ecosystem structure and function, as well as the valuable services provided by the ecosystem, such as water filtration by wetlands and mangroves, that will likely be lost or disrupted should also be taken into account when evaluating the cost of an oil spill.[105]

All told, these large scale cleanups are rarely complete and the effects of oil on the coastline can linger for many decades after a spill. In the case of the *Exxon Valdez* spill in 1989, $2.5 billion was spent over the three years following the spill. In 1998, nine years after the spill, studies showed that the cleanup efforts had little effect on the oil deposits left under rocks.[106] In 2001, twelve years after the spill, studies of the area showed that more than half of the beaches analyzed still had considerable amounts of oil remaining from the *Exxon Valdez* spill.[107]

Photo: NOAA/ORR

Bags of oily waste collected after the Exxon Valdez oil spill

OIL IN THE ARCTIC

The Arctic is home to almost four million people,[108] including vibrant communities of indigenous peoples who have lived in harmony with their surroundings for thousands of years. It also provides important habitat for 23 species of marine mammals, such as polar bears, whales, seals, and walrus; 100 species of fish including Arctic cod, capelin, and herring; and more than 50 species of seabirds including spectacled Eiders, Arctic terns, and Ivory Gulls. These areas have not been protected by moratoria and currently are at risk from oil and gas activities.[109] These activities must be stopped and a comprehensive plan, based on an assessment of the health and biodiversity of the ecosystem, implemented.

Photo: NOAA

The Arctic Seas

The Chukchi and Beaufort seas, together nearly 200,000 square miles, have been largely protected from industrial activity by the remoteness and unforgiving climate of the Arctic.[110] The incredible reduction in Arctic sea ice over the last few years, however, opens the Arctic Ocean to the possibility of unprecedented industrialization. The Arctic is particularly vulnerable to the substantial risks from oil spills, noise, and other industrialization in places that serve as vital habitat for animals, such as migratory birds, polar bears, whales, walrus, seals, and fish. Moreover, while the people of the Arctic live onshore, their culture and the subsistence way of life are inextricably tied to the oceans and, in particular, to the bowhead whale, ice seals, walrus, and fish.

These areas, which have not been protected by any moratoria, are now open for oil and gas activities.[111] The federal government's current 5-year plan (2007-2012) makes available for oil and gas development more than 70 million acres of land underlying the Beaufort and Chukchi seas.[112] Leasing has occurred, and there is ongoing seismic exploration.[113] Many of the decisions to make these areas available were made in the absence of the scientific information needed to assess impacts, and the federal government has acknowledged a substantial risk of a major oil spill. Rather than this push to drill, ongoing activities must be stopped and science-based, precautionary management implemented for these Arctic seas.

Similarly, the area slated to be leased in Bristol Bay coincides with critical habitat for endangered right whales.[114] It is also adjacent to the Togiak National Wildlife Refuge which is a crucial migratory-bird nesting habitat along the northwestern side of the Alaska Peninsula. It also makes up part of the nearshore nursery area for the largest salmon runs in the world, as well as for commercially important shellfish such as king crabs.[115] Placing these resources at risk for a modest and temporary economic gain from oil extraction in Bristol Bay makes no economic sense, especially when considering that the returns from the fishery resources alone can continue in perpetuity.

Oil spills threaten Alaska Native communities as well, because they depend heavily on the sea for subsistence, as discussed previously. Even the perception of a tainted environment can sever the link between Native peoples and subsistence foods. Besides threatening their physical health, such changes can also sever the link between generations and threaten the long-term survival of the culture, since Alaska Native culture is primarily transmitted in association with subsistence food gathering, distribution and consumption.[116]

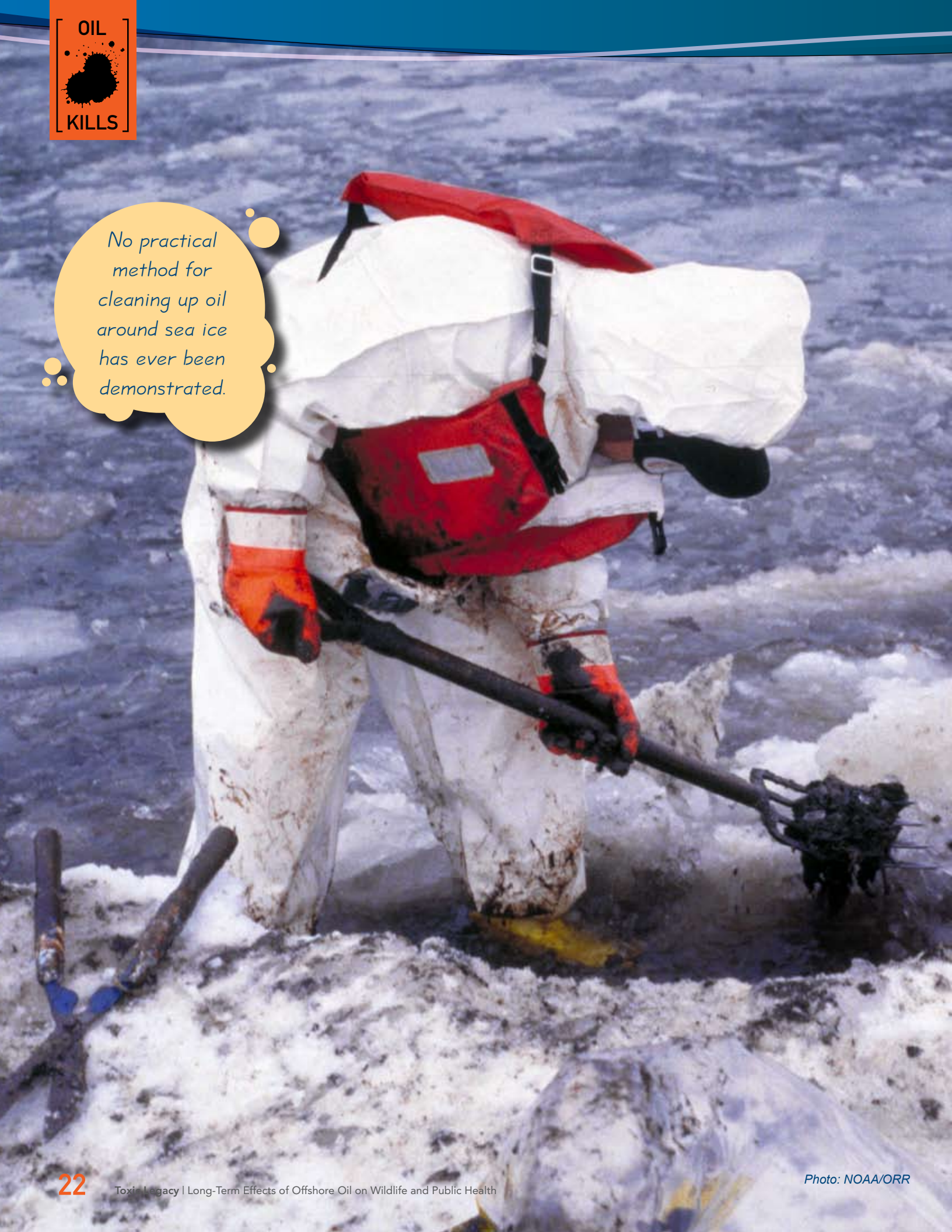


Photo: NOAA/ORR

Cleanup Extremely Difficult

While oil spills are difficult to clean up even under ideal circumstances, circumstances in the Arctic essentially present a worst case scenario. Sea ice, for example, creates multiple challenges. First, it displaces oil slicks into open water areas that are essential places for marine mammals to surface and breathe. Oil in these areas, combined with the animals' need to surface, makes marine mammals especially vulnerable to the inhalation and contact hazards of oil. Also, marine plant growth is very susceptible to poisoning from oil spills, and nearly half of the marine plant growth in arctic waters may be associated with sea ice near the Arctic sea ice front.[117] As a result, oil accumulation in this area poses major risks to the marine plants that form the base of the food web.

Spill response is another major concern. When spills occur, there are few resources in the Arctic to deal with them. For example, there are currently no deepwater ports anywhere along the U.S. Arctic coast, making it unlikely that response materials can be deployed in time to be effective. Worse yet, it is possible that major spills could go undetected for extended time periods if long marine pipelines connecting production wells with shore-side storage facilities are damaged.

For these reasons and others, oil spills in the Arctic present a unique set of challenges and threats. In fact, no practical method for cleaning-up oil around sea ice has ever been demonstrated. In the case of the *Exxon Valdez*, despite heroic efforts and comparatively favorable conditions, only about 8 percent of the oil spilled was recovered.[118]

Exploration, Production, and Transportation Risks

Impacts from oil in the Arctic and elsewhere begin with the exploration process. Sonic shockwaves used to locate likely oil-bearing formations produce the loudest man-made noises on earth. These can interfere with communication among marine mammals as well as their ability to detect prey. In extreme cases these sonic shockwaves can damage their hearing and possibly even cause death.[118a] Noise pollution continues through production and transportation phases as drilling rigs and large vessels also contribute to noise pollution.

During the production period, the dense, briny and oil-laden produced water from the wells sinks to the seafloor and can spread over large areas of the shallow, flat continental shelf of the U.S. Arctic, poisoning the rich benthic community on the seafloor that supports walrus, seals and whales. Chronic spills from drilling rigs, marine pipelines and marine vessels will exacerbate these impacts as production continues.

Another unique threat from oil production in the Arctic stems from production of black carbon. Black carbon is released during the flaring process where natural gas is burned off. It is also released by ocean-going ships. Production of black carbon in close proximity to Arctic sea ice could exacerbate warming effects in the Arctic. These particles accelerate sea ice loss when they settle because they absorb sunlight more efficiently than the ice. As a result, they can speed the melting of the ice.

Besides the obvious concerns with sea ice loss, this melting also leads to a positive feedback loop. The additional ice loss results in more open water areas during the summer. Open water, in turn, absorbs sunlight much more efficiently than does ice, promoting more melting, including the thawing of permafrost in the boreal landmass. Besides exposing more dark surfaces, this also results in the release of methane, a greenhouse gas even more potent than carbon dioxide. Hence more warming still. If not reversed, continued loss of seasonal Arctic sea ice could trigger a runaway release of methane and carbon dioxide from permafrost, with catastrophic consequences for both ocean life and humanity.

Photo: NOAA/ORR

Photo: NOAA

IMPACTS OF OFFSHORE DRILLING

Offshore drilling operations create various forms of pollution that have considerable impacts on marine and other wildlife. These include drilling muds, brine wastes, deck runoff water, and flowline and pipeline leaks.[119] Catastrophic spills and blowouts are also a threat from offshore drilling operations. These operations also pose a threat to human health, especially to oil platform workers themselves.

Drilling muds and produced water are disposed of daily by offshore rigs. Offshore rigs can dump tons of drilling fluid, metal cuttings, including toxic metals, such as lead chromium and mercury, as well as carcinogens, such as benzene, into the ocean.[120]

Ixtoc I blowout, Bay of Campeche, Mexico, 1980

Photo: NOAA/ORR

Drilling Muds

Drilling muds are used for the lubrication and cooling of the drill bit and pipe. The muds also remove the cuttings that come from the bottom of the oil well and help prevent blowouts by acting as a sealant. There are different types of drilling muds used in oil drilling operations, but all release toxic chemicals that can affect marine life. One drilling platform normally drills between seventy and one-hundred wells and discharges more than 90,000 metric tons of drilling fluids and metal cuttings into the ocean.[121] One well can potentially affect an area of a one kilometer (approximately two-thirds of a mile) radius through the discharge of these materials.[122] Experimental studies suggest that chemicals dumped in the ocean from oil operations can stunt the growth of fish and affect their breeding patterns.[123] For example, cod exposed to this waste water had smaller eggs and delayed spawning time.[124]

Produced Water

Produced water is fluid trapped underground and brought up with oil and gas.[125] It makes up about 20 percent of the waste associated with offshore drilling. Produced waters usually have an oil content of 30 to 40 parts per million.[126] As a result, the nearly 2 billion gallons of produced water released into the Cook Inlet in Alaska each year, contain about 70,000 gallons of oil.[127]

Exploration

Factors other than pollutants can affect marine wildlife as well. Exploration for offshore oil involves firing air guns which send a strong shock across the seabed that can decrease fish catch, damage the hearing capacity of various marine species and lead to marine mammal strandings.[128] More drilling muds and fluids are discharged into the ocean during exploratory drilling than in developmental drilling because exploratory wells are generally deeper, drilled more slowly, and are larger in diameter. The drilling waste, including metal cuttings, from exploratory drilling are generally dumped in the ocean, rather than being brought back up to the platform as is often done in developmental drilling.[129]

Effects of Rigs

Offshore oil rigs may also attract seabirds at night due to their lighting and flaring and because fish aggregate near them. Bird mortality has been associated with physical collisions with the rigs, as well as incineration by the flare and oiling from leaks.[130] This process of flaring involves the burning off of fossil fuels which produces black carbon. Black carbon contributes to climate change as it is a potent warmer both in the atmosphere and when deposited on snow and ice.[131]

Drilling activity around oil rigs is suspected of contributing to elevated levels of mercury in Gulf of Mexico fish.[133] Drilling muds and produced water discharged from oil rigs in the Gulf of Mexico released mercury and other heavy metals into the ocean.[134] The United States Minerals and Management Service reports that oil and gas drilling contributes 0.8 metric tons of mercury per year to the Gulf.[135] Areas near oil rigs can have higher levels of sediment toxicity and lower levels of species abundance, diversity and reproductive success compared to areas farther from rigs.[136] As a result, mercury levels in shrimp and fish can be significantly higher near rigs. The effects of mercury from drilling muds on other fish species remains to be seen.

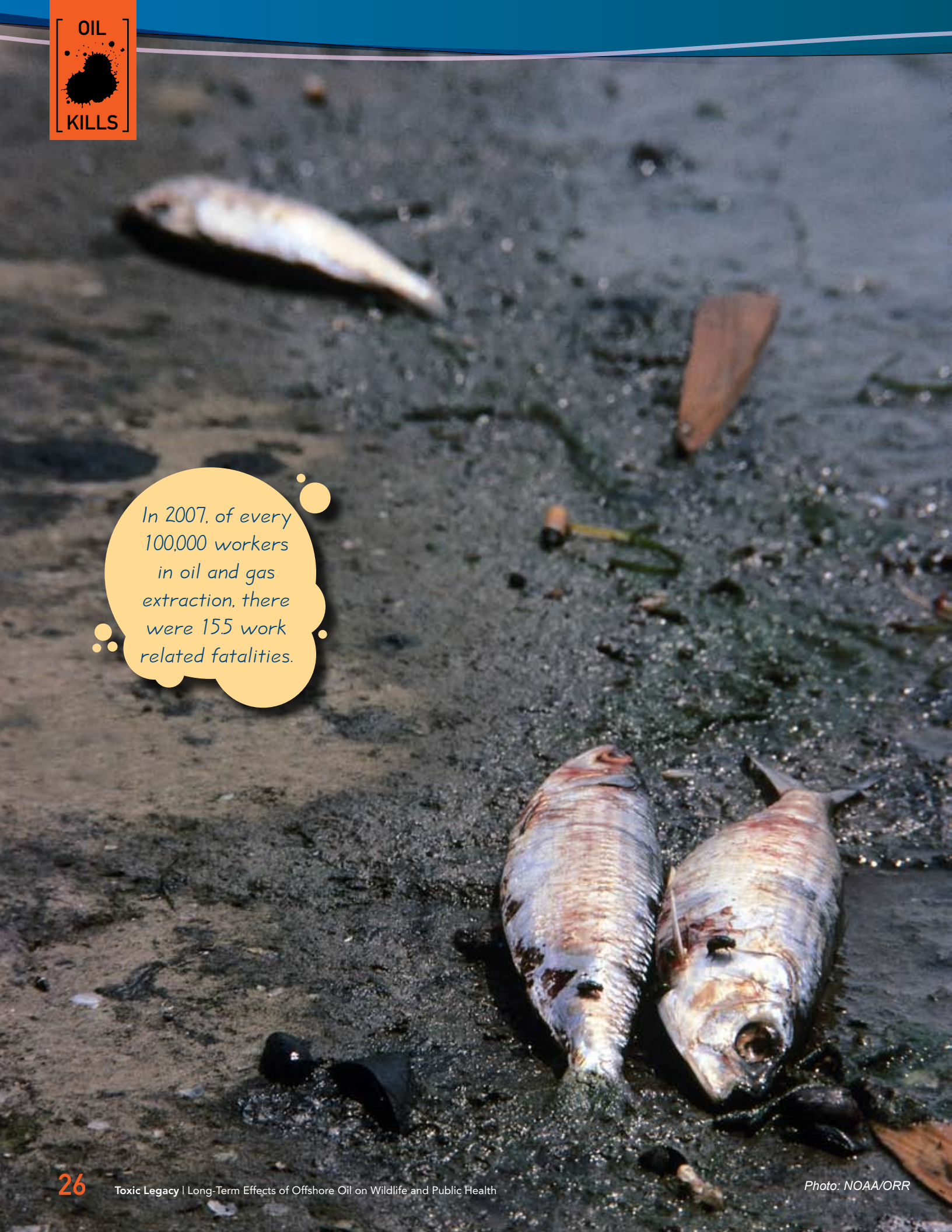


Photo: NOAA/ORR

Impacts of Oil Production on Humans

Oil exploration and drilling are the most dangerous parts of working in the oil industry, especially offshore exploration and drilling. Explosions and fires are common in offshore drilling because of the increased risk of blowouts. Health and safety problems are even more prevalent and widespread in the event of an oil spill.[137] The process of oil exploration, drilling and extraction can lead to various health problems in people close to the operation, most commonly oil workers. The Bureau of Labor Statistics reports that in 2007, of every 100,000 workers in oil and gas extraction, there were 15.5 work related fatalities.[138]

During drilling, radioactive materials are brought to the ocean's surface.[139] The accumulation of products such as oil and mercury can also be released in the drilling process. These products end up in the fish and other marine resources that humans consume. Some oil platform workers experience skin problems, such as contact dermatitis and acne, and respiratory problems like asthma and pneumonia.[140] Dangerous accidents are also a threat to oil workers' health.

Air pollution from oil rigs also poses a health threat to people who live near oil platforms. Various types of toxic air pollutants are emitted in the process of separating oil and managing malfunctions, which is done by flaring – burning off excess gas at the well.[141] This process releases more than 250 different chemicals into the atmosphere that are known to cause lung and heart disorders, cancers, asthma, and reproductive problems.[142] This process also emits high concentrations of sulfur dioxide, a gas that is known to cause decreased lung function, wheezing, shortness of breath and asthma in children. Those who already suffer from lung and cardiovascular disease are at greater risk and these pollutants can affect people and animals living within 300 kilometers from the drilling platform.[143]

Impacts of Oil Production on Fisheries

Offshore drilling operations threaten productivity of the commercial fishing industry through seismic testing, loss of fishing grounds, chronic small spills, loss of port infrastructure and through the contamination of fish. The large sound blasts from seismic testing in the exploratory stages of offshore oil operations kill and scare away small fish. Debris from oil rigs can damage fishing gear and safety zones around oil rigs prohibit fishing. Small spills can affect fishing gear and taint the fish. Offshore oil operations also displace facilities such as marinas and fish processing plants that commercial fisheries require.

The contamination of fish from offshore oil drilling is one of the bigger threats to commercial fishing companies. Fish around oil exploration and drilling sites can have an accumulation of mercury that comes from the drilling muds and oil discharged into the ocean.[144]

U.S. Offshore Moratoria

From 1982 to 2008, Congress protected much of the outer continental shelf waters in the "Lower-48" with a moratorium on oil and gas activities. Congress also has enacted a moratorium to protect the sensitive areas of Bristol Bay, Alaska. In addition, Executive moratoria have been issued by two Presidents. In 1990, responding to the 11 million gallon *Exxon Valdez* oil spill, President George H. W. Bush used his executive authority to place a moratorium on any leasing or pre-leasing activity in Lower-48 offshore areas, including a small portion of the eastern Gulf of Mexico. President Clinton limited new drilling in the rich Bristol Bay fishing grounds in Alaska until 2012. In addition, Congress has protected those same offshore waters with a moratorium emplaced as part of its appropriations process. Unfortunately, the Congressional moratorium expired in 2008, and the Executive moratorium was lifted by President George Bush that same year. As a result, only one part of our oceans is currently covered by a moratorium. This is a section of the Gulf of Mexico that was protected until 2022 as part of the Gulf of Mexico Energy Security Act of 2006.

The opening of these areas to offshore oil and gas development raises some serious questions with regard to the increased risks of harm to marine life as described in this report, as well as the increased contribution to climate change that will result in the production and use of oil and natural gas contained under our oceans. At the same time, developing these reserves is projected to have a minimal impact, if any, on gasoline prices and energy dependence. Since the benefits are questionable and the risks are clear, it would be prudent for the Obama Administration and Congress to reinstate the moratoria.

ALTERNATIVES TO OIL

In the United States, nearly 40 percent of all energy comes from oil and 96 percent of fuel used in the transportation sector is petroleum based.[144a] This high consumption of oil makes us dependent on foreign oil regardless of whether new offshore drilling operations are begun. According to the Council on Foreign Relations' Independent Task Force, the United States is vulnerable to national security threats and is limited in its foreign policy due to its profound reliance on foreign oil.[145] To curb our dependence on oil, reduce the risk of oil spills and reduce our carbon dioxide emissions, we need to conserve energy, improve efficiency and switch to carbon-free alternatives. Alternatives already exist to reduce or even eliminate oil use, including electric and hybrid vehicles, and renewable energy, such as wind and solar power.

The United States consumes about 21 million barrels (or 882 million gallons) of oil each day. Two-thirds of that is used in the transportation sector, which accounts for 96 percent of the fuel used for transport in the U.S.[146]

Switching the fleet to electric vehicles would eliminate the largest segment of demand for oil in the United States. Electric vehicles use electricity as their power source, rather than oil. Electricity is cheaper than gasoline and as the country switches to clean energy sources, such as wind and solar power, these cars will run without producing greenhouse gas emissions.[147]

Offshore wind development is one way to power an electric fleet, thereby eliminating the need for oil. Offshore wind power has no fuel cost since the wind is free, produces no pollution, is domestically produced, and is located near high-demand urban centers.[148] The United States Department of Energy and the National Renewable Energy Laboratory (NREL) estimates that 900,000 megawatts (or 900 gigawatts) of electricity, about as much as we currently use, could be produced from wind generation.[149] In a 2006 study, NREL also predicts that with research and development efforts, the United States has the potential to produce 50 gigawatts (or 5% of the country's current capacity) of offshore wind energy in the next twenty years and 100 gigawatts in the following ten years.[150]

Improving energy efficiency and conservation will also be critical to weaning ourselves off of oil. Being more efficient is one of the cheapest and most effective ways we can reduce our dependence on oil and start addressing our climate issues. For example, McKinsey & Company estimates that efficiency measures, including more fuel efficient vehicles, better insulation, and more efficient industrial equipment can cut the growth of our global demand for electricity in half over the next 25 years.[151] We can reduce our dependence on oil and other fossil fuels through national and state level conservation and efficiency programs that promote conservation and provide incentives to industries to make their products more energy efficient. Combined with individual actions, such efforts could reduce our dependence on oil, protect the marine environment from the catastrophic effects of oil, and reduce our carbon emissions.

CONCLUSION

This report clearly shows the broad array of impacts that result from oil in the marine environment. These risks to marine life, human health and coastal economies are more likely to occur if there is expanded oil drilling on the outer continental shelf. The toxic effects of oil on marine life will be problematic even without a major spill. However, any spill will intensify those effects and take a toll on coastal communities and coastal economies. Most importantly, continuing our reliance on oil will worsen the already severe problems associated with climate change and ocean acidification, including their direct effects on marine life.

Renewable energy, energy efficiency and electric transportation alternatives can eliminate the need for oil. In fact, alternative energy sources, such as offshore wind can supply our electricity needs in full. Meanwhile, oil production on the outer continental shelf will not come close to meeting the United States' oil demand nor will it reduce foreign oil dependency. As a result, Oceana recommends the following:

- Reinstate the pre-existing moratoria for offshore oil production including the protections for Bristol Bay, Alaska. Increasing renewable energy sources and improving energy efficiency can reduce our dependence on fossil fuels.
- Begin the development of a comprehensive conservation and energy plan for the Arctic that provides a transition from oil to renewable energy and conservation. The plan should include a comprehensive scientific assessment of the health, biodiversity and functioning of Arctic ecosystems, as well as the benefits and consequences of specific industrial activities. Ongoing activities must be stopped and a precautionary, science-based approach applied to all oil and gas leasing, exploration, and development activities in Arctic waters to determine if those activities should be conducted and if so, when, where and how.
- Promote energy efficiency and low carbon fuels. Energy should be conserved at every opportunity, including through improved fuel efficiency standards for cars, trucks, airplanes and ships. Provision of cleaner fuels and investment in efficient mass transit should also be priorities. Incentives should be provided to individuals, institutions and corporations to reduce their oil and other fossil fuel consumption.
- Prioritize the development of offshore wind energy in place of offshore oil drilling using financial mechanisms such as loan guarantees and refundable tax credits. Such funds should be extended to manufacturers of necessary technology, as well as to construction firms, where needed to prevent bottlenecks that could limit the development of renewable energy.

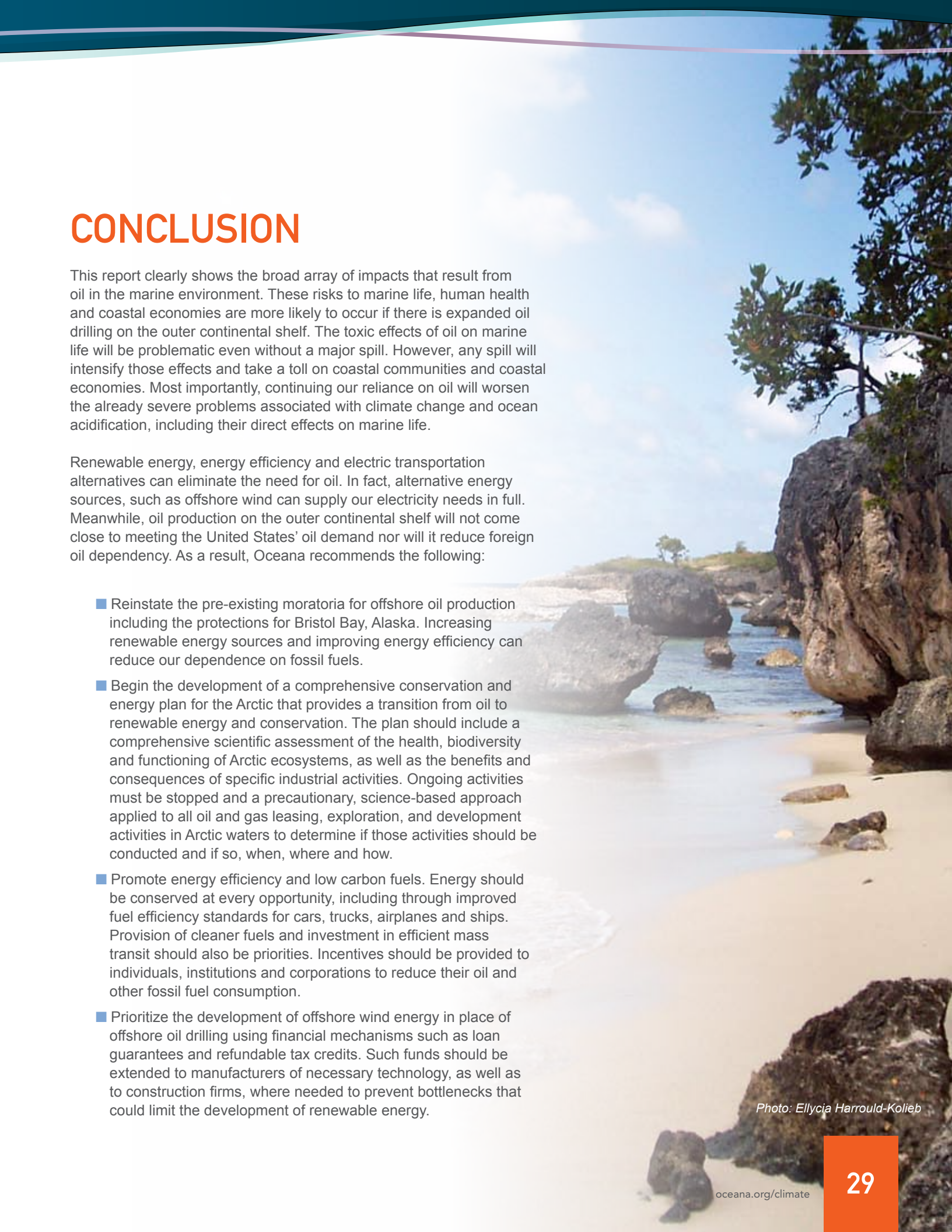


Photo: Ellycia Harrould-Kolieb

OIL KILLS

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