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The Health Effects of Oil Contamination: A Compilation of Research

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Abstract

Oil exploitation can lead to contamination of environments, which can have effects on human health. Health symptoms associated with living or working in an area affected by oil contamination are often unclear and debated. In this project, we created a website housing scientific research on the health effects of oil contamination. Five spill sites were examined in detail: Deepwater Horizon, Ecuador, Exxon-Valdez, Kuwait, and Nigeria.

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Authorship Page

The signatures below verify that this project was a collaborative effort for which all required work was divided evenly amongst the four authors. Jon Gay, Olivia Shepherd, Mike Thyden, and Matt Whitman each contributed equally to researching, writing, and editing the final report and website.

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Executive Summary

Oil's importance as both a fuel source and a commodity is constantly increasing. As countries around the globe industrialize, oil companies have to expand to new locations in order to meet the growing demand. The economies of many countries, like Nigeria, 79.5% of whose gross domestic product comes from oil, and Kuwait, where oil accounts for 95% of the government's income, rely almost entirely on its export. Oil extraction is a complicated process that has the potential for unfortunate consequences. In both Northeast Ecuador and the Niger Delta, oil spills have extensively contaminated the landscape, damaging both the environment and the health of the people living in the area. In Kuwait, the inhalation of smoke from the burning oil wells during the Gulf War has been associated with a host of health problems. In both the Exxon-Valdez and Deepwater Horizon spills, various psychological health problems have arisen in those living in the surrounding areas. The types of health effects that derive from a given spill depend largely on the area's level of economic development. The relative speed in which the oil contamination is cleaned up, along with the geographic location of the spill, also impact the consequent health effects.

The goal of this project was to create a repository of information on the health effects resulting from oil exposure in the form of an online database, which can be found here: https://sites.google.com/site/oilcontaminationhealtheffects. This database website allowed us to identify shortcomings in the current body of research, which enabled us to recommend certain areas of focus for future research. This archive is a resource for individuals and organizations involved in research of petrochemical exposure effects on human health. It provides researchers an efficient mechanism for understanding the current state of research, and highlights areas needing further study. The aim of our database is to facilitate collaboration

between researchers at different sites of oil contamination to encourage information sharing between investigators. Information in our database website is categorized in several ways. The archive can be browsed by the location of the oil contamination and by the type of health effect in which an investigator might be interested. To facilitate browsing of all the data we collected, we subdivided the information into different media types, including text, audio, and visual files. By gathering a variety of media types, the database hosts a wider spectrum of data, which helps paint a more inclusive picture of the oil contamination and its effect on human health.

The information contained in our database website was gathered by three different methods. Archival research was gathered through the use of scholarly search engines online. Telephone interviews were conducted of different individuals who dealt with oil contamination through cleanup efforts and scientific studies. We also had correspondence with researchers via email. Through these processes we collected various forms of data relating to health effects present in people exposed to oil contamination.

We found studies examining the relationship between oil contamination and health effects such as cancer incidence, pulmonary ailments, and psychological, reproductive, and dermatologic health problems. We classified the studies collected into these five categories along with one for general health for studies including more than one research topic and an "other" category for studies that did not necessarily focus on health but provided pertinent background information. We also classified the studies by method of research, distinguishing between survey/interview studies, literature reviews, meta-analysis, and advisory studies. We differentiated among those of differing affiliations, separating government studies, independent studies, academic studies, and unpublished studies.

We discussed the oil contamination by site, where we examined the focus of the studies conducted in the area followed by the main reasons we were able to acquire the information.

We then analyzed the oil contamination by geographic location, discussing the commonalities between health problems seen in oil contamination at sea, on land, and in the atmosphere. We then discussed the number and major outcomes of the studies collected on each major category of health effect. Through our research, we found that majority of available studies are largely inconclusive and some were difficult to obtain. We developed recommendations to further the study on the health effects of oil exposure. Any continuation of research done on any topic will help the body of research as a whole and provide more concrete evidence of the health effects of petrochemical exposure.

Chapter 1 – Introduction

Oil contamination from drilling processes creates problems that disrupt the lives of people living in close proximity to oil camps, wells, pumping stations, and pipelines. In addition, oil contamination creates hazards to the local environment. People living on oil-rich sites around the world are subjected to contamination of drinking water, top soil, and livestock due to toxic pollution that can result from the oil extraction process. In some contaminated sites, serious illnesses resulting from exposure have been documented. Before the introduction of petrochemical industries, environments around the world that sat upon large oil reserves supported healthy human life and vibrant ecosystems. Oil contamination from drilling processes, however, has adversely affected the people living in these areas by polluting the environment around them. The water, soil and air have been severely tainted by petroleum pollutants. As a result, wildlife, livestock, and humans have been sickened.

Oil contamination has adversely affected the lives of many people living in areas near oil exploration sites. With crude oil and production chemicals polluting water supplies, air, and surrounding plant and animal life, human health has suffered. Because a high percentage of those affected by oil contamination live off the land, local economies have also been impacted by the destruction of the surrounding environment. In addition to physical effects, economic stress affects the psychological health of the individuals living in polluted areas. A number of investigations have focused on specific ailments noted in particular contaminated sites (e.g., Jernelöv, San Sebastián et al., UNDP).

Many problems have arisen because of oil exploration and extraction and their associated pollution. Our project focused on health issues affecting people living in areas contaminated by oil. Our preliminary investigation indicates that there is a significant lack of available information regarding health issues from exposure to oil contamination. Published

studies conducted by researchers are scarce and tend to be location-specific. Thus, at the initiation of our project, we know that the short and long-term effects resulting from oil contamination have not been thoroughly explored, and there is not sufficient understanding of the psychological and physical implications that oil exploration and its extraction present for human communities globally.

Our project aims to create a clearinghouse for available research on oil contamination and its health effects on humans, and thereby to describe in more detail the specific gaps in this body of research. Our first step in identifying the real problematic gaps in this area of research was contacting people who have studied health issues arising from petrochemical exposure. Next, we gathered all available data, including several unpublished works, and some firsthand accounts to understand the current body of knowledge. We established a website that stores documents, audio files, and video files related to health related effects of oil contamination exposure from several spill sites around the world. By providing easy and immediate access to a significant body of research on health effects of oil spills, this tool makes it easy for scientists to access each other's work and learn from it. Ideally, it will encourage information sharing and collaboration between among researchers at different sites, like Ecuador and the Niger Delta, for instance. We expect this to help in protection of human health in contaminated areas.

Chapter 2 – Background

Section 2.1 Importance of Oil in the World

In regions around the world, oil is commonly categorized as one of the highest valued resources an organization can extract from the ground (IHRDC, 2010). In the United States alone an approximate 20 million barrels of oil are consumed each day (Darmstadter and Parry, 2003). This translates to 7.2 billion barrels of oil annually. Behind the U.S. in daily oil consumption is China with 8 million barrels daily, Japan with 5 million barrels, and India coming in at 3 million barrels of oil consumed per day (Europe's Energy Portal, 2010). Clearly, the world has a heavy dependence on oil. In addition, the economies of many countries, such as Kuwait and Nigeria, are dependent on revenues from crude oil exports (Ahmad and Mottu, 2002). The people of the world have many different views on the global dependence on oil, yet there is one commonality. In the world's search for new oil wells there are sometimes incidents that result in the contamination of the region that is being explored. Because of these contaminations, the environment and the native residents of the land are affected.

Section 2.2 Oil Contamination

This section explores specific sites around the world where human beings were, or are, exposed to crude oil or its chemical byproducts. In these areas, toxins can be found in the air, water, and soil that people interact with routinely. When absorbed into the body during respiration, drinking, eating, and bathing, oil appears to have adverse effects on the human body.

Section 2.2.1 Northeast Ecuador

Beginning in 1972 oil was extracted in the Northeast region of Ecuador, also referred to as the Oriente. Since then, close to 2 billion barrels of crude oil have been extracted from the region. This region of Ecuador is home to a vast rainforest, which contains complex ecosystems and a multitude of residents including 8 groups of indigenous people. Peasants, who migrated to this region in the 1970's and 1980's after encouragement by land policies of the national government, also reside in this area (Hurtig and San Sebastián, 2004b; Center for Economic and Social Rights, 1994). The exploration prior to 1972, along with the extraction, processing, and transportation of oil in subsequent years, has significantly altered the Oriente's geography and ecosystems. These alterations included opening up almost "one million hectares" of Amazon rainforest to colonists through a constructed network of roads (Kimerling, 1990, p 849).

This colonization was not the only infringement that affected the environment of the region. Severe leakage of the trans-Andes pipeline, highlighted in purple in figure 1, which carries the oil across the country to the coast, contributed to the altered environment. Of the 2 billion barrels of crude oil that were collected from the Oriente, approximately 16.8 million gallons of crude leaked out of the trans-Andes pipeline (Sawyer, 2001). In addition to the leakage from the pipeline, many unlined pits were used as storage units for oil waste that succumbed to toxic seepage and overflow. The pollution of this area has persisted for five decades with almost no measures being taken to clean up the situation.

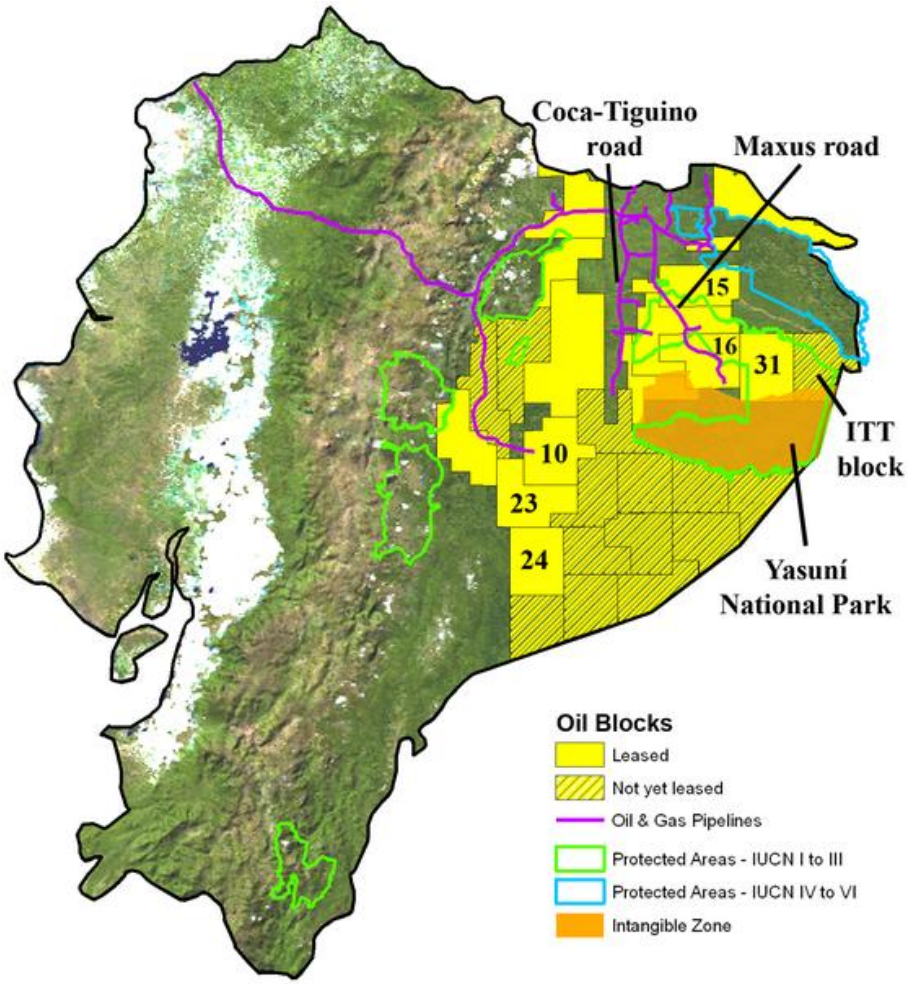

Figure 1: Map of Ecuador's Oil Production (Jenkins, 2009)

With contamination came severe effects in the people living in the surrounding areas. Streams and rivers that are used as water supplies for drinking, cooking, bathing, and washing clothes are polluted with chemicals. Multiple studies have been done that compare cancer rates of people living in close proximity to oil contamination to those who live in unaffected regions (Hurtig and Sebastián, 2004b). Most of these studies conclude that there is a correlation between the proximity of the subject to the contamination and increased cancer rates. Along with studies done on cancer rates, there have been reports from locals of skin rashes and pregnancy complications (Armstrong et al, 2002). In addition to these problems, a 1993 study by

a community health workers association found increased morbidity, spontaneous abortion, dermatitis, skin mycosis, malnutrition, and mortality rates in human residents of the area (Hurtig and San Sebastián, 2004a). Almost all of these studies suggest that there is a relation between contact with oil contaminants and these different ailments.

During the time that private and state-owned oil companies were exploring and extracting oil from the Oriente, the Ecuadorian government had no environmental regulations on the oil industry (Liddle, 2005). It was not until 1992, due to national and international pressure, that the government implemented a set of regulations on the oil industry in Ecuador. Even once the regulations were in place, a majority of them conflicted with laws encouraging development and settlement of the Amazon. Due to lack of regulation, pollution continued, resulting in severe health and environmental damage in areas near oil wells, camps, or pumping stations. However, there has been little focus placed on the cleanup of the pollution.

In 1995, after an agreement between the two parties involved in the oil extraction of the Oriente, Texaco and PetroEcuador, there was some remediation by Texaco (Doyle, 2009). The agreement stated that Texaco was responsible for remediating 37.5% of the 161 oil pits that were left behind from drilling. Between 1995 and 1998, Texaco claims to have spent $40 million on remediation of the area (Kimberling, 2005). To date, there remain nearly 200 open oil separation ponds full of untreated waste (Hurtig and San Sebastián, 2004b). Regardless of the agreement and the claims made by Texaco, there is much disagreement over the quality of the remediation. The disagreement is so strong that there is a $27 billion lawsuit currently taking place between the affected people in Ecuador and Chevron, which acquired Texaco. Since the controversial cleanup efforts of Texaco, there have not been enough advocates for the cleanup. This is potentially due to a lack of awareness of the issue and the complexity of the problem.

Section 2.2.2 Exxon-Valdez Oil Spill

The 2010 oil spill in the Gulf of Mexico is not the only major spill that has directly affected the United States. In March of 1989, approximately 25 miles off the coast of Valdez, Alaska, the tanker Exxon-Valdez crashed into the Bligh Reef, causing 11 million gallons, or 260,000 barrels of crude oil to leak into the Prince William Sound (Downs et al, 1993). As shown in figure 2, located below, the spill occurred to the southwest of Valdez, and to the northwest of Cordova. Carried by ocean currents in the Gulf of Alaska, the oil contamination from the spill spread extensively to the southwestern areas.

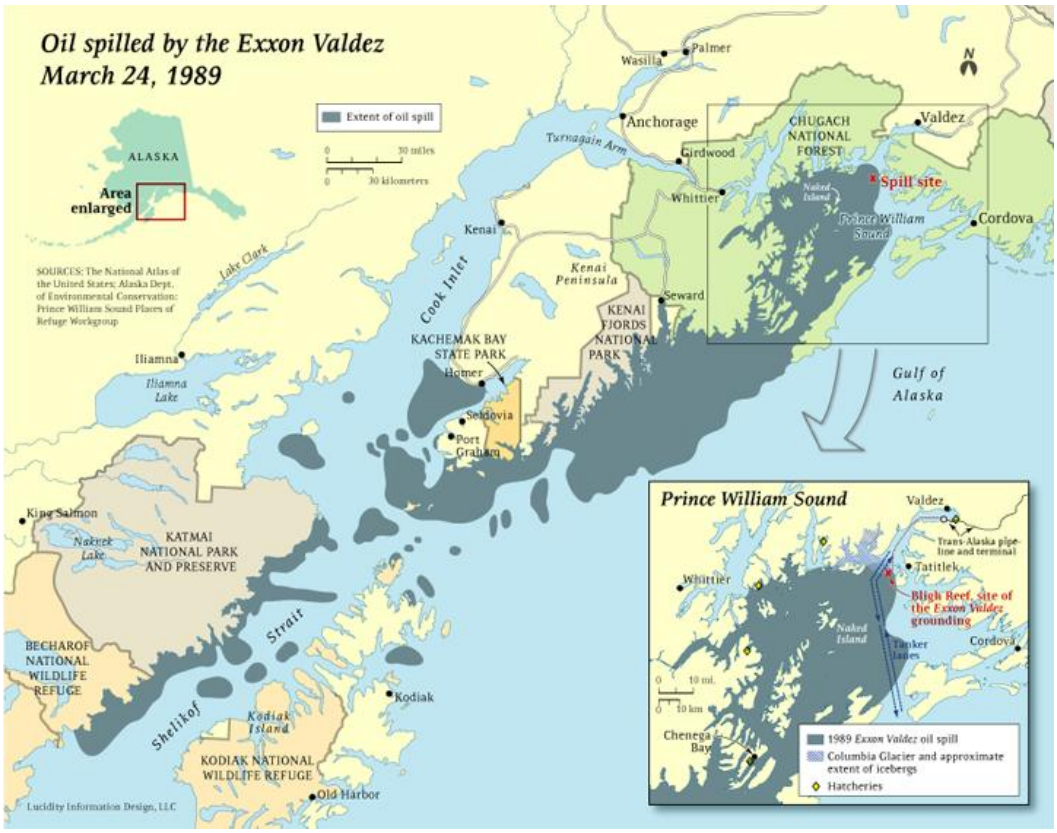

Figure 2: The Exxon-Valdez Oil Spill and Affected Areas (Lucidity Information Design, 2009)

Prior to the spill, the Prince William Sound was pristine. The environment was full of life, existing as an untouched ecosystem. The oil that leaked into the ocean from the Exxon-Valdez

had a drastic effect on the life and ecosystems of the area. Mammals and seabirds were affected significantly due to their frequent need to be at the surface of the ocean. It is estimated that between 1000-2800 sea otters and 250,000 sea birds died during the days after the spill as a result of oil on the surface of the ocean (Ballachey et al, 2003). Sea birds frequented the surface of the ocean in search of fish but were often immobilized by the layer of oil. Mammals such as sea otters, which surface to breathe, inhaled the toxic oil. The oil spill also had fatal effects on the herring and salmon fishery populations of the area (Picou, 2009). This directly hurt the economy of the region, as many commercial fishermen who fished in the Prince William Sound weren't able to produce the amount fish that they were accustomed to from this once highly productive fishing area. This also hurt the native people of the area whose livelihood was largely based on fishing. Other native social traditions were inhibited by the contamination of the sound as well. Because of economic struggles in places such as Cordova, Alaska, psychological depression resulted in numerous people. Whether or not there are any long-term health effects in the human population is not documented.

Many techniques that were used in the cleanup of the oil spill in the Gulf of Mexico in 2010 were used in the cleanup in 1989 of the Exxon-Valdez spill. Booms were used extensively to trap the oil so it would not continue to spread out into the ocean, but only a limited amount of oil could be contained at a time. Eventually the majority of the oil was cleaned up, but the Alaskan natives and towns still feel the effects of the oil spill today. The herring and salmon fisheries were negatively impacted by the spill, and those impacts continue to depress the fisheries today. The Exxon-Valdez oil spill was one of the largest environmental disasters in United States history, but it resulted in a number of regulatory changes such as stricter guidelines for oil tankers to prevent oil spills like this from happening again.

Section 2.2.3 BP Oil Spill

On April 20, 2010, aboard an offshore oil rig called the Deepwater Horizon, there was an explosion resulting in the leaking of crude oil into the Gulf of Mexico (Hutson et al, 2010). The explosion caused an oil well named Macondo to blow out, which resulted in a large oil leak located at the bottom of the ocean (Jernelöv, 2010). Originally, aerial and satellite images were used in attempts to determine the magnitude of the oil spill. Below is an example of what the oil leak looked like from satellite imagery. The discoloration in the ocean is the location of the oil spill. Cleanup teams were employed to trap and remove the oil.

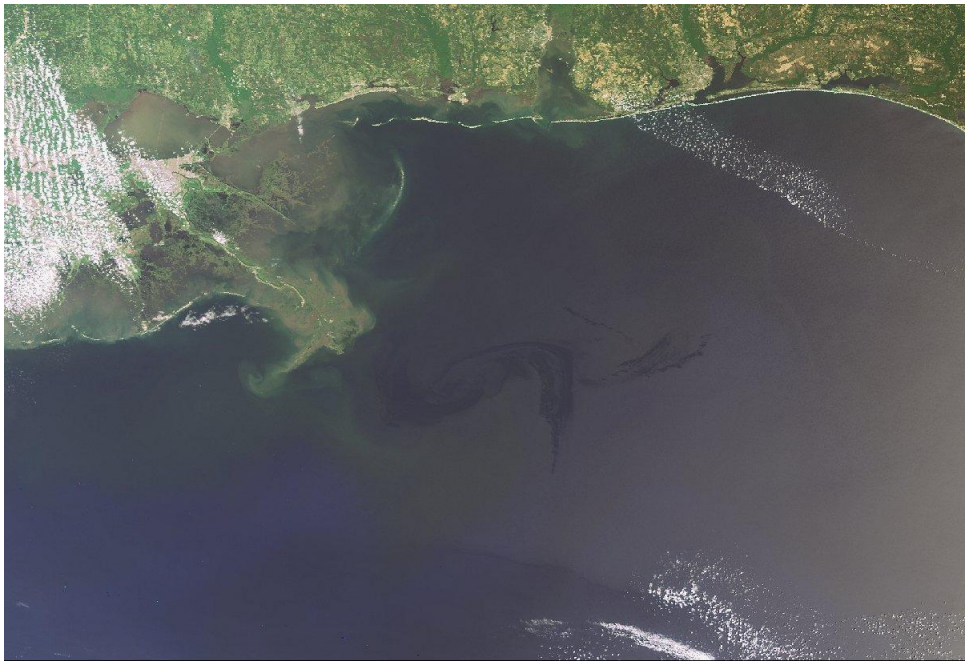

Figure 3: Satellite Images of the gulf oil spill (Mengel, 2010)

Through these images, experts calculated that oil was leaking at approximately 800 tons per day but, because the source of the oil leak was located at the bottom of the ocean, it was concluded that the extent of the oil spill was likely to be seriously underestimated (Jernelöv, 2010). Due to this, the National Incident Commander, Admiral Thad Allen, appointed the Flow

Rate Technical Group to conduct a more accurate assessment of the size of the oil leak. The Flow Rate Technical Group was able to determine that approximately 1600-2600 tons of oil was leaking into the Gulf of Mexico per day initially, but increased this number range to be as high as 5600 – 9500 tons per day. By the end of June, approximately 250,000 – 400,000 tons of oil had spilled into the Gulf and the leak had not been stopped.

Figure 4 below shows the location of the BP oil spill at the Deepwater Horizon Rig. The rig was located off the coast of southern Louisiana and Mississippi (Jernelöv, 2010). The oil leak spread in the ocean and affected the shore on the Gulf Coast of the United States. Ixtoc 1, as depicted in figure 4, was another oil platform that had an oil spill in 1979. The Ixtoc 1 oil spill was extremely similar to the Deepwater Horizon oil spill. Ixtoc 1 was an oil platform owned by Pemex, or Petróleos Mexicanos, which is a government-owned oil company of Mexico. There was a blowout in the well, causing half a million tons of oil to gush into the ocean from the bottom of the sea over a period of 9 months. Many of the cleanup techniques developed for remediation of the Ixtoc 1 spill were also used to clean the Deepwater Horizon oil spill. Therefore, lessons learned from the Ixtoc 1 spill were relevant in the cleanup of the Deepwater Horizon spill and will continue to be in the aftermath of this more recent disaster.

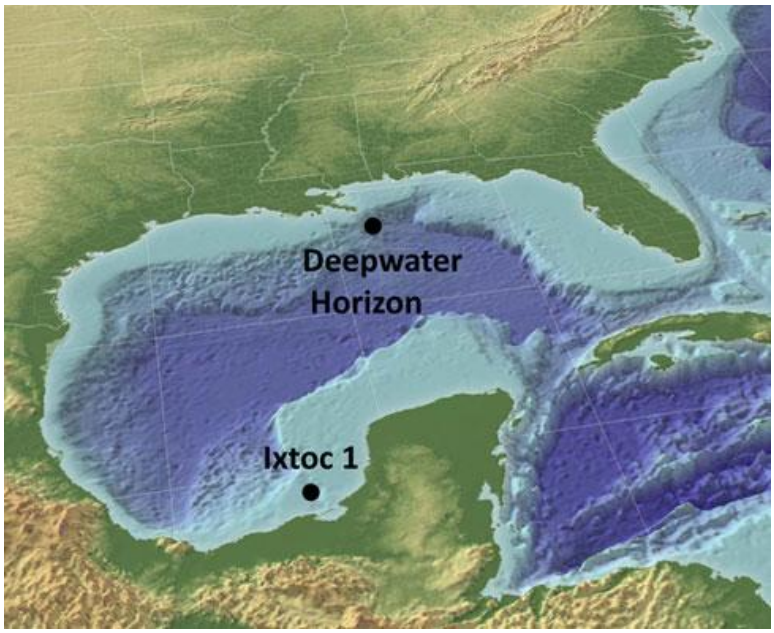

Figure 4: Location of Deepwater Horizon and Ixtoc-1 Oil Spills (Jernelov, 2010)

The Deepwater Horizon oil spill has greatly affected the marine life of the Gulf of Mexico, but the extent of effects from chemicals such as methane on specific ecosystems in that of the deep ocean is still unknown. This problem was recognized by the National Oceanic and Atmospheric Administration (Bowman, 2010). However, oceanic oil contamination can kill fish, mammals, and other aquatic invertebrates, and the oil released in the Deepwater Horizon oil spill has already done so. Sea turtles are an example of a mammal in the gulf coast that is suffering from an oil-contaminated ecosystem. When sea turtles need to surface for air, they have to swim through a layer of oil. This oil can be detrimental to the health of the sea turtle population, and four out of the five sea turtle species that live in the Gulf are now endangered. Unfortunately, because the BP oil spill happened recently, the long-term effects on the ecosystems and the people of the gulf can only be speculated.

An article by Cain Burdeau (2010) article notes extensive death of coral within 7 miles of the Deepwater Horizon well site. Dr. Charles Fisher of calls this the “smoking gun,” (Burdeau, 2010) but says that data correlating coral death with oil is only circumstantial. While more

scientific study needs to be done on the remains of the coral, these findings may be the first to indicate oil's impact of aquatic life in the Gulf of Mexico.

Cleaning up the Gulf oil spill is a continuing process that will involve many steps. The initial phase of the process was locating the oil. One cost effective method that is used extensively in the Gulf is visual observation aided by still and video photography from the air (Graham, 2010). After locating the oil, the next step is to trap and remove it using a floating fence called a boom as well as a skimmer to collect surface oil. Boom technology has increased over the years allowing more oil to be absorbed at a time, but it is impossible to completely gather all oil molecules in a certain spot. Collecting oil in booms is also a slow process, and due to the size of the Gulf of Mexico, this is an ongoing job.

Dispersants are widely used in the oil cleanup process in bodies of water and are being used to clean up the Gulf. Graham (2010) defined dispersants as "chemical formulations composed of solvents, surfactants and other additives that disrupt the solid surface of an oil slick by reducing the surface tension between oil and water." Dispersants greatly thin out oil levels on the surface of the water and cause the oil to sink into the water column where it can disperse into a much larger volume of water than the surface. The surface area of the oil droplets is increased, and they are biodegraded by microorganisms. Regardless if dispersants are used, natural dispersion of an oil spill will occur, thus causing great harm to the underwater ecosystems. This process takes longer without the use of dispersants, however, so the oil will spread and potentially harm a larger area of the underwater ecosystem as it disperses naturally. Dispersants are controversial, because they can be toxic to marine life and are potentially toxic to humans. The use of dispersants is typically determined by the severity of the projected environmental impact of the oil spill. In the Deepwater Horizon oil spill, they were used extensively to accelerate the process of dispersion that occurs naturally. This allowed the oil to

mix with the water column, which thinned the oil on the surface so it would not affect the coastal ecosystems in the southern United States as much. The Deepwater Horizon oil spill was capped on September 19, 2010, but the cleanup and research on the impact of the spill will continue (Associated Press, 2010).

Section 2.2.4 Niger Delta

Since the discovery of crude oil at Oloibiri, Nigeria, the oil industry in Nigeria has completely restructured the country's economy. Prior to 1958, Nigeria's economy relied on the production and export of cocoa, palm oil and kernels, timber, rubber, cotton, and groundnuts (Freund, 1978). Furthermore, according to the United Nations Development Programme, in Nigeria (2006), prior to World War II, "a delicate balance existed between the human populations of the Niger Delta and its fragile ecosystem. The exploitation of natural resources did not go beyond the search for medicinal herbs, fuel, game, fish, and construction materials."

Figure 5: The Niger Delta Region (Abidde, 2009)

Today, the oil and gas sector contributes 79.5% of the government's revenues and is responsible for 97% of Nigeria's foreign exchange revenues (Amnesty International, 2009). The Shell Petroleum Development Company (SPDC), a subsidiary of Royal Dutch Shell is the largest operator in the region. The SPDC is a joint venture between the Nigerian National Petroleum Corporation (NNPC) at 55% ownership, Shell at 30%, Elf Petroleum Nigeria Ltd. at 10%, and Agip at 5% ownership.

The Niger Delta covers approximately 70,000km^2 and is home to over 40 ethnic groups. The SPDC alone prospects on over 40% of this land and operates pipelines, wells, and flow stations that often exist near homes, farms, and communities. Hundreds of thousands of these people are affected by the resulting oil contamination near their homes. Especially affected are some 60 percent of the region's inhabitants who have little money and rely on fishing and agriculture to survive (UNDP, 2006).

In the Niger delta, oil spills are a common occurrence. Reasons for spills include corrosion of pipelines, poor maintenance of infrastructure, spills or leaks during processing at refineries, human error, and as a consequence of intentional vandalism or theft of oil (Amnesty International, 2009). The UNDP (2006) estimates that between 1976 and 2001 there were approximately 6,800 spills totaling 3,000,000 barrels of oil. This value represents only the data that oil companies chose to report to the Department of Petroleum Resources (DPR), thus the data provided by the companies and reported by the DPR do not accurately represent the magnitude of the oil spillage. Because of this potentially inaccurate data, an independent group of experts on oil and the environment endeavored to establish their own estimation of total oil spilled before 2007 (Jernelöv, 2010). By considering all sources of oil discharge into the environment, the group estimated a total discharge between 9 and 13 million barrels over 50

years. This roughly translates to 1.5 million tons or one Exxon-Valdez spill annually for half a century.

The severity of these frequent and collectively massive spills is only amplified by other environmental problems in the region. In particular, the region is plagued with seasonal floods and has a shortage of land for development (UNDP, 2006). This means that contaminated water and sediment is spread all over "communities, roads, and farmlands [which] are partially or totally submerged" (UNDP, 2006, p74). In the case of a serious spill, people may not even be able to relocate due to the shortage of land for development.

Section 2.2.5 Kuwait Oil Contamination

Kuwait is an expanse of 17,819 km^2 of flat desert plain, and is located south of Iraq and northeast of Saudi Arabia at the northern end of the Persian Gulf. Industry in Kuwait is largely centered on petroleum extraction and refining, with a hand in the manufacture of fertilizer, chemicals, construction materials, and in desalination. Despite its small size, it has become a very wealthy country due to its vast oil reserves, which are estimated at 105 billion barrels and comprising 9% of world reserves. Ninety five percent of both the Kuwaiti government's income and export revenues comes from petroleum, as it comprises nearly half of the GDP (Travel Document Systems, 2009). According to official Organization of Petroleum Exporting Countries (OPEC) figures, Kuwait has the fifth-largest oil reserve in the world after Saudi Arabia, Canada, Iran, and Iraq (U.S. Dept of State, 2010).

As a result of aggression during the Gulf War of 1991, six million barrels (1 to 1.5 million metric tons) of crude oil were dumped into the Persian Gulf. Of these six million barrels, only 2 million were recovered. The remainder created a nine mile long oil slick regarded as the "largest oil spill on record" (Husain, 1998). The Persian Gulf is relatively shallow which magnified the

oil's effects on the coastline. The majority solidified to an asphalt-like substance and sank beneath the water's surface once the light toxins had evaporated. Continued attack upon Kuwait's oil facilities at hundreds of locations proceeded as Iraqi troops retreated (Seacor, 1994). In this deliberate destruction of the Persian Gulf environment, ten percent of the world's daily oil ration was being consumed by fires (Figure 6).

Figure 6: An Oil Well in Flames in Kuwait during the Gulf War of 1991 (Baxter, 2009)

By the end of the Gulf War, over 800 wells had been detonated. More than 650 of these wells burned for several months as the remainder spilled oil over the desert terrain forming lakes and pools (Husain, 1998). The gushing oil wells, releasing over 60 million barrels of crude, created over 200 lakes, some of which were 11 kilometers long and some over a meter deep (Afzal et al, 1998; Al-Sulaimi et al, 1993). The smoke from the ignited wells plumed into the atmosphere an estimated 7 kilometers and 1,300 kilometers long darkening the region's skies.

The Kuwaiti oil fires released approximately 22,000 metric tons of sulfur dioxide, 18,000 metric tons of soot, and thousands of tons of carbon monoxide and oxides of nitrogen daily (Husain 1998).

Section 2.3 Health Effects of Petrochemical Exposure

In this section, we describe the health effects resulting from petrochemical exposure. Because of the relative scarcity of health information pertaining to other spills, we focus on spills in Kuwait and Ecuador. Information has become available on health effects in Kuwait through reports from a vast amount of war veterans affected. The health effects in Ecuador have been studied in more depth as a result of the ongoing lawsuit.

Section 2.3.1 Health Effects in Ecuador

The discarded petrochemicals in NE Ecuador have had direct impacts on the lives of many people in the area. For over five decades these people have struggled to survive as a result of the effects that the contamination has had on their living conditions. Everyday life of the indigenous people has been strongly influenced by the oil waste left behind by petroleum operations. One of the largest problems caused by the oil waste is pollution seeping into the water supply of the communities in the area. More than 30 billion gallons of oil waste, known as formation water, was released into the environment. Formation water contains unusable petroleum byproducts mixed with water from beneath the bedrock. These contaminants leached into the Amazon Basin's headwaters, which serve as the water supply for many communities (Hurtig and San Sebastián, 2002). Streams and rivers in the contaminated areas of NE Ecuador have collected much of the crude oil, especially in times of rain, when petroleum products are carried from the waste pits by the running water. The contamination is also

brought to the surfaces of streams and rivers as the turbulence of the water stirs the settled heavy oil waste. People have reported a decrease in aquatic life and an increase in death of livestock that drink this water. Unfortunately, these are the very water sources used by the locals for drinking, cooking and bathing. According to Armstrong et al (2001), peasants have reported skin rashes after bathing in these waters. Many people, the majority being children, have gotten horrible rashes and sores on their skin from bathing in water that is severely contaminated by oil (McGovern, 2008).

Many adults, usually between the ages of 40 and 60, who live near oil pits, have been struck with cancer of the stomach and/or skin (Hurtig and San Sebastián, 2004b). Hurtig and San Sebastián (2002) conducted a study to contrast the cancer rates of people living near oil pits to people who live far from them. Their research shows that people who lived in close proximity to the contamination had elevated rates of cancer of the stomach, rectum, skin, soft tissue, kidney, cervix, and lymph nodes. They also found a great increase in hematopoietic cancers among children who were less than 10 years of age.

In the Northeast region of Ecuador, Hurtig and San Sebastián (2004a) noted a correlation between childhood leukemia and living in close proximity to oil fields. In the provinces of Sucumbios, Orellana, Napo, and Pastaza, which are all located in Northeast Ecuador, there were 91 cancer incidences and 42 leukemia incidences in children aged 0-14 between the years 1985-2000. Of these, 28 cases of leukemia and 27 other forms of cancer were reported in counties that were exposed to crude oil. The relative risk calculated in this study for both genders to experience leukemia in all age groups was determined to be significantly higher in areas affected by the oil contamination.

Another study by San Sebastián (2002) was conducted in Ecuador on the pregnancy outcomes of women aged 17 to 45. Women living in contaminated areas for at least 3 years

were studied and interviewed along with a control group that lived in areas of the Amazon Basin in Ecuador that were untouched by oil. Local streams and rivers used for drinking, bathing and fishing were tested from both contaminated and non-contaminated areas and the former revealed concentrations of polynuclear aromatic hydrocarbons (PAHs) that were 10 to 10,000 times greater than levels considered acceptable by U.S. Environmental Protection Agency guidelines. Miscarriage rates were found to be much more prominent in oil-contaminated areas as the study revealed a risk for spontaneous abortion 2.34 times higher among communities situated near oil contamination.

Section 2.3.2 Health Effects in Kuwait

The health effects believed to be associated with petrochemicals in Kuwait varied greatly due to the wide range in possible exposure (Abramson et al, 2004). The oil contamination, occurring in the water, on land, and in air, affected different aspects of people's health. As the crude oil wells burned, they released a host of toxic chemicals into the atmosphere. High levels of particulate matter were found in air samples. Husain, (1994), reveals that chronic and probably irreversible respiratory disorders result from long-term exposure to these contaminants. Kuwait's oil is characterized as sour crude, containing high levels of sulfur. As a result, when ignited, the oil is much more toxic than its low sulfur containing counterpart known as sweet crude. Human health and the vegetation of the area were potentially affected as reported by Husain, (1998), who says that the burning wells produced large amounts of toxic gases including sulfur dioxide (SO2), carbon monoxide (CO), hydrogen sulfide (H2S), carbon dioxide (CO2), along with the oxides of nitrogen (NO(x)) as well as particulates containing partially burned hydrocarbons and metals.

The many oil wells burned for months, producing dramatic visual effects in the air (Husain, 1994). The effects were seen around the world as a global concern erupted over significant potential changes in meteorological patterns and ecosystems, along with adverse health effects among those exposed to the smoke and pollution. As many of those affected by the smoke plume were veterans, there was a strong concern over the potential long-term effects, which have yet to be characterized. As reported by Gastañaga et al (2002), the vast range of health problems of American and Australian veterans related to their exposure of crude oil in the Gulf War, include infections and parasitic diseases, neoplasms, endocrine, nutritional, and metabolic diseases, mental disorders, diseases of the blood, nervous system, circulatory system, respiratory system, digestive system and genitourinary system, complications of pregnancy, skin diseases, musculoskeletal system diseases, poisoning, asthma, acute bronchitis, chronic bronchitis, malignant neoplasms of the respiratory and intrathoracic organs, malignant neoplasms of the oropharynx, nasopharynx, and hypopharynx, emphysema, ischemic heart disease, respiratory conditions due to chemical fumes and vapors along with other diseases of the respiratory system.

The impacts of the oil released into the Persian Gulf on human health and the environment have been more significant due to the shallow depths, limited circulation, and high salinity and temperature that distinguish the northeastern part of the Gulf (Al-Bahloul et al, 1995). Apprehension was evident in both the scientific community and the public. A significant area of concern was the extent of contamination of seafood with petroleum hydrocarbons. In reaction to the anxiety, studies assessing the impact of oil pollution on the marine ecosystem of the Persian Gulf were performed. Despite this array of research, focus was not directed toward the effects on the consumer. The study by Al-Bahloul et al (1995) aimed to identify whether seafood being sold in Kuwaiti markets was safe to eat. A wide variety of toxins at high

concentrations were found in fish and shrimp samples taken from Kuwaiti fishing waters. Elevated levels of one chemical, naphthalene, omnipresent in seafood samples, were indicative of the pollution of Kuwait's territorial waters with crude oils.

Section 2.4 Importance of Gathering Research

Since 1967, there have been 37 major oil spills in various places around the world (Information Please Database, 2010). Because of this large number of spills, there is a multitude of scientists who have researched oil's effects on humans. In order for scientists and other interested parties to identify areas needing further research, it is necessary to know who has done what research previously. Our investigation revealed that many individual researchers and non-governmental organizations have conducted studies on the health effects of oil contamination. Unfortunately, many of them have studied different spills or live in different countries and there is little collaboration between them. When researchers are trying to gather information from experts on particular topics and they live on opposite sides of the globe, it can make collaboration very difficult. If a repository was created with all information on particular topics such as oil spills and their effects on human health available, future researchers will benefit. This type of a compilation of works and contacts would provide anybody interested in the subject with the resources to identify what research has been done and by whom, along with research that has yet to be done. Links between researchers can be made in this way, allowing them the ability to team up and take on new projects.

In addition to promoting collaboration between interested parties within developed countries, such as the United States, collaboration between developed and underdeveloped countries is also very important (DuPont, 1991). Countries with more resources have a lot to offer and can help to promote research in regions with less money or technology for specific

studies. Effective cooperation between scientists can help define problems that they can collectively work toward fixing. In addition, collaboration between developed and less developed countries could lead to self-sufficiency in less developed countries to help them solve their own problems. With a widely accessible portal of information, researchers with fewer resources can be encouraged to either contact other researchers in different countries or start

Databases

An extremely useful way to organize information on a particular topic such as the health effects of oil contamination is by using a database. Databases are storage units that allow for organization, management, and easy access of information (Chapple, 2010). These storage units can be as simple as a Microsoft Excel spreadsheet or as advanced as a server database. Microsoft Excel databases can organize information into rows and columns for easy access to information. Server databases allow many people to contribute at once and can handle almost all data management problems, but can be much more expensive to keep up and running. Some examples of server database programs are Microsoft SQL Server, Oracle and IBM DB2.

A desktop database is another alternative. This is a less expensive, easier to establish example when compared to servers. They are aimed at less complex data storage but can still be published on the web to be accessed by others. Information can be organized in a way where it can be easily accessed and run on a desktop computer. Some examples of programs that can be used to create a desktop database are Microsoft Excel, Microsoft Access, FoxPro, FileMaker Pro, Paradox and Lotus Approach.

A website is probably the most accessible form of a database. Websites have no limitations on who can access them as there is no software required to view them, and it is easy to provide permissions for editing them. Additionally, because there is no software required to

view or edit them, they are inexpensive to create and maintain. Examples of websites include wiki pages, Facebook pages, or GoogleSites. A Face book page could be used in unison with a wiki or Google Site to increase publicity and make it easier to connect people to the site.

Section 2.5 Conclusion

In many countries, oil is essential to preserving the prosperity local and national economies. For several countries, oil is their primary export and can be responsible for as much as 50% of the GDP. However, drilling for that oil can lead to substantial amounts of pollution that is left for years. Unfortunately, for many such spills, little to no remediation to the contaminated sites is carried out. This long-term pollution has several harmful effects on the surrounding environment. It affects the ecosystems, pollutes the soil and water with toxins, and even causes severe health effects to the inhabitants of the area. There have been studies done on these effects, yet there are scarce amounts of information on the health effects on the people living in close proximity to the contamination. The goal of this project was to collect, compile, and catalogue data on the health effects on the inhabitants near oil contaminations, and to identify gaps in research on those health effects. We hope the database we have created will inspire researchers to address those gaps with continued research, and to promote collaboration among researchers.

Chapter 3 – Methodology

Oil contamination can have significant effects on people living in close proximity to pollution. There is basic information available on the negative health effects of crude oil, but detailed scientific research on the short and long-term effects is scarce. Furthermore, locating scientific research that has already been conducted is a difficult and time-consuming process, which can inhibit collaborative research. Efforts in aiding people, which are facilitated by the analysis of research, are limited because scientific data are difficult to obtain. Our goal is to create a repository of scientific research done on the health effects of exposure to crude oil and oil production waste. Because of this consolidation, gaps in research may become evident and areas needing further research can be identified. Most importantly, researchers will be encouraged to collaborate and build on each other's work.

In order to attain this goal, we identified and contacted researchers who have studied the health effects of oil exposure on humans. From these researchers and from our own reading of published work, we gathered data from scientific studies that are otherwise not centralized or difficult to find. With these data, we created a database containing all information we gathered on oil's effects on human health. We used the database both to identify areas where research has been conducted and to identify areas needing further study. Additionally, this tool helps make evident to other researchers what studies have not been conducted in depth.

Section 3.1 Choosing Spill Sites

Once we determined that a database was the best way to satisfy our objectives, we needed to determine which spill sites from which we would collect research. Far too many oil spills have occurred to all be added to our database in seven weeks. To account for this, the

team chose a diverse group of oil spills that we hoped would best represent all instances. We evaluated several characteristics of the spills to categorize them.

First, we divided oil pollution into three categories: terrestrial, aquatic, and atmospheric. Because these different categories of contamination may result in different health impacts, the sample group had to contain at least one site for each spill category. Sites that had more than one kind of contamination were placed in multiple categories.

It appeared that one of the most important factors in expeditious cleanup of oil spills was the socioeconomic environment of the region in which the spill. We divided spills sites into two socioeconomic categories: those that occurred in developed countries and those that occurred in developing countries. To distribute work evenly, we determined that each category needed to be represented by a minimum of two spill sites.

In addition to accounting for the ways different national governments handled spill cleanup, we felt it would be beneficial to sample spills from wells operated by different oil companies. This would allow us to examine the ways different companies reacted to spills and the social and governmental pressure applied to them to expedite cleanup. No standard was established for which companies should be included, but the team aimed to avoid repetition in this category.

Section 3.2 Gathering Scientific Documents

For the purposes of this project, a scientific document is defined as any document that contributes to the scientific community. This contribution may constitute data that was collected and analyzed by the author in an effort to increase understanding of an issue or it may be meta-analysis of works already completed. Acceptable documents include reports and testimonies to government committees and courts, works published in peer-reviewed journals,

ongoing or unpublished research conducted by researchers or MS/ PhD students, expert panel reviews, case reports, and site evaluations. To be included in our database, scientific documents must directly discuss a relationship between oil and human health (or lack thereof) or they must provide examinations of environmental conditions related to oil contamination that could be used in future studies on human health.

Our database categorizes each document based on the health field to which it relates. The categories were determined by a brief evaluation of the bulk of research available. Fields like oncology, which contained a substantial body of research, were chosen. Additionally, we chose fields like dermatology, from which symptoms were mentioned as part of the background information for other studies but were rarely directly studied. The categories that we pursued include oncology, pulmonology, psychology, and dermatology. Sections 3.2.1 and 3.2.2 discuss our methods for finding and collecting scientific documents.

Section 3.2.1 Archival Research

For each site, documents were found primarily through use of scholarly search engines like Google Scholar and the Quick Find and Gale PowerSearch tools provided by the George C. Gordon Library at WPI. Additional searches were performed in databases like JStor, Beyond (Worldcat), LexisNexis, and IEEE. General search terms included the name of the spill site in various iterations (e.g. BP oil spill, Deepwater Horizon, Gulf oil spill) combined with words like 'health', 'health effects', 'oil contamination', 'health concerns' and 'health problems.'

Section 3.2.2 Identifying and Contacting Researchers

To acquire documents that could not be acquired through basic archival research, the team compiled a list of researchers who might possess documents not freely available. This list

includes authors of published works, people from various non-government organizations (NGOs), and other individuals interested in the health effects of oil contamination. From each person we spoke to, we tried to gather referrals, and these soon grew into a web of researchers for us to contact.

We identified people from NGOs by conducting interviews of people to whom we were referred by WPI faculty and staff. The interviewees were more experienced and knowledgeable on topics related to oil spills and were able to refer us to people interested in oil contamination who we otherwise would not have found. These contacts also referred us to people at NGOs who may be able to help us. Once these links were established, we were able to get more referrals to even more people. Below we provide more detail about the interviews we conducted.

Interviews

Previous projects done on oil pollution, specifically in Ecuador, used the office of Congressman Jim McGovern as a resource. As co-chair of the Tom Lantos Human Rights Committee, Congressman McGovern has expressed a great deal of interest in helping the people of Ecuador. In 2008, the Congressman traveled to Ecuador along with his Legislative Director, Cindy Buhl. His office continues to work on and advocate aiding those affected by oil spills in Ecuador. For these reasons, the team interviewed Cindy Buhl in an effort to acquire any documents Jim McGovern's office might have relating to oil exposure and related health problems. We also asked her for any contacts she could provide us that might have documents that could be useful to us, or information about where we can find this data.

Professor David DiBiasio at WPI recommended that we speak to Dr. Tom Webler of the Social and Environmental Research Institute. Dr. Webler researched impacts of the 1989 Exxon-

Valdez oil spill in Cordova, and had knowledge of who in the research community might be able to help us. Our interview with Dr. Webler aimed at gaining his insight on the concept of the project and whether he thought it would be helpful to the scientific community. We also requested any research documents he had, contact information for other researchers, or recommendations for our project. An interview outline as well as interview summaries can be found in appendix D.

Email Correspondence

The team emailed numerous scientists, government officials from several national governments, volunteers to gather collect contacts, feedback on our ideas, and documents. A complete list of these researchers can be found in appendix A, and a template for a standard email is shown in Appendix C.

Section 3.3 Gathering Pictures and Videos

In addition to the documents section of the database, we felt that a supplementary section for pictures and videos would help to indicate the severity of situations at each site. While visuals rarely have the same scientific value as a several-hundred page study, they provide an individual with a general understanding of a situation almost instantaneously. Most pictures and videos were gathered through Google searching, however some were collected through email correspondence.

Section 3.4 Creation of a Database

In order to house our collected information, we needed to identify a host so that the

information could be accessed by interested researchers and other individuals. We researched different database programs including iWeb, Microsoft Excel, Microsoft Access, Google Sites, Wix, FoxPro, FileMaker Pro, Paradox and Lotus Approach. We tested each program and determined the pros and cons of each host.

We evaluated the prospective database programs using several criteria. These criteria included: price, ease of use, accessibility, aesthetics, and how the final product could be published. Because our project had no budget, several programs had to be eliminated right away. The next limiting criterion was accessibility and publishing. Programs that required a user to install 3rd party software to a computer before using the database would increase the effort required to access information and thus limit the number of people who would use the resource. Finally, we wanted a program that would look both attractive and professional to end users.

When building the foundations of our web page database we first debated the organization of the website. This discussion included debate over ways to search within specific categories such as the type of health effect, the location of the contamination, and the person who conducted the research. Once the team decided on how the site should be organized, we moved on to what types of files should be included under the categories. We discussed whether it was important to include audio and visual files as well as text files under each category. After we decided which files to include we debated how to organize each individual page of information. We discussed if we wanted to include all files on one page or have different pages for each type of file. Ultimately, we decided upon a layout for each page and discussed the legal issues that we might come across while adding published documents into our database.

Section 3.5 Analysis of the Database

In order to interpret the body of research that we collected, we categorized the various documents in several ways and read them for content. This categorization enabled us to find inadequacies in the research from both individual sites and our entire collection of studies.

Section 3.5.1 Categorization

First, we broke the documents into types of paper. We used six main categories: unpublished studies, judicial documents, university studies, books/book chapters, government studies, and journal papers. Any ongoing study as well as those waiting for acceptance into a journal can be considered unpublished. We classified judicial studies as those mandated by a court for the purposes of a trial, and called any study conducted by a university student a university study. We labeled studies that were sponsored or conducted by a government agency as government studies, and those studies that were conducted by non-governmental researchers that were published in peer-reviewed journals were classified as journal papers.

Next, we classified the documents based on their primary method of research, using advisory, literature review, meta-analysis, data collection/analysis, and surveys/interviews/ focus groups as our main categories. We classified an advisory document as any document which did not present data from a new study and whose sole purpose was to advise others on various scientific techniques and methods. Literature reviews used conceptual information from other studies to draw their own conclusions, whereas meta-analysis statistically analyzed data from a group of studies. Studies that were based around the collection and analysis of new data were classified as data collection/analysis, and those that relied on surveys, interviews, focus groups, or other direct interaction with primary sources were put in the surveys/interviews/

focus groups category. When tallying documents in each category, those that fit into more than one section of a category but no more than three, were counted as fractions in each category.

Finally, we graphed the distribution of documents in four different categories: year published, the primary health effect that the study examined, the type of paper, and the primary method of research. When tallying documents for primary health effect and type of paper, we counted documents that fit into more than one sub-category using fractions. For example, a document that discusses cancer and respiratory effects was considered 50% cancer and 50% respiratory. Documents that discussed more than three health effects or only examined health as a whole were labeled as general health documents. Finally, documents that did not directly discuss health but were still relevant to a discussion about human health were placed in the 'other' category.

Section 3.5.2 Identifying Gaps

Once the collection of documents was broken down by publishing date, primary health focus, method of research, and type of document, we analyzed the data to determine if there were inadequacies in either the collective research or the research from specific contamination sites. To do this, we used the graphs of studies over time and the distribution of health effects over the total number of papers. Additionally, we studied the distribution of papers on specific health effects at each spill site and graphed the distribution of types of research and types of documents over the total number of studies we collected. This allowed us to understand the emphasis placed on each type of research and each health effect by the research community. It also showed us who was most interested in the data.

Chapter 4 – Results and Analysis

Through archival research, email correspondence, and interviews, we gathered a variety of scientific documents that address different health effects of oil contamination from five places around the world. In this chapter, we examine the body of research as a whole, and describe the layout of our completed database.

Section 4.1 Choosing Spill Sites

In an effort to diversify our sample of spill sites, the team chose five spill sites globally from which we endeavored to collect scientific research documents pertaining to oil contamination and its effects on human health. The oil contamination sites examined in our paper include the Oriente region of Northeast Ecuador, the Ogoni Peninsula of the Niger Delta, the 1991 Gulf War oil spills in Kuwait, the Exxon-Valdez oil spill in Southeast Alaska, and the 2010 Deepwater Horizon spill in the Gulf of Mexico. Fourteen other studies on the health effects of oil exposure were gathered from other places around the world to strengthen the repository of scientific data. Table 1 shows each of the sites along with the type of contamination present and the major health and social effects that can be associated with that oil contamination site.

	Sites				
Effects	**Exxon-Valdez**	**Deepwater Horizon**	**Niger Delta**	**Kuwait**	**Ecuador**
Cancer				X	X
Crops, Fishing, & Livestock	X	X	X	X	X
Dermatological				X	X
Economic	X				
Environmental	X	X			
General Health	X	X	X	X	X
Neurological				X	
Other	X	X	X	X	X
Pregnancy & Early Childhood Development		X		X	X
Psychological	X	X	X	X	X
Respiratory		X		X	
Type of Contamination	Aquatic	Aquatic	Terrestrial & Atmospheric	Terrestrial & Atmospheric	Terrestrial & Atmospheric

Table 1: Probable Effects of Large-scale Oil Contamination

In order to diversify data sampling further, we selected spills in a variety of socioeconomic environments. Of the five spills, two occurred in the industrialized world and received extensive media attention and two occurred in the developing world and received little attention relative to their size. The fifth spill occurred in a developed but war torn Kuwait.

Additionally, each spill site represented in our database had a different primary operating company. The sites were operated by Shell LLC., Exxon, Texaco/PetroEcuador, and Deepwater Horizon. The Kuwaiti spill was the result of the destruction of thousands of wells so no corporation was directly responsible for the cleanup.

Selecting spills that varied in terms of geographic location, primary operator, social and economic status of the country in which the spill happened, and as a result, the level of global awareness about the spill allowed us to better model the climate of research on health effects of oil spills as a whole.

Section 4.2 Gathering Scientific Documents

Each document in our collection is categorized in figure 7 by type of health effect. Each symptom graphed is broken down to show the amount of research that was collected from each oil contamination site. The majority of the documents that we found fell under the categories of general health or other. There are also certain health effects in which the majority of the information came from one site. Psychological health effects are more prevalent in the research gathered on the Exxon-Valdez oil spill, and respiratory symptoms were identified in the body of research on oil contamination in Kuwait. We also found that studies on cancer incidence have been conducted on oil contamination in Ecuador and Kuwait, but did not find studies elsewhere that focused on this topic. A list of documents summarized for each oil contamination site categorized by health effect is provided in Appendix B.

Figure 7 also notes what health effects have been examined the most at each site. For example, in Nigeria, many studies were placed into the other category, but we found very few documents focusing on individual health problems associated with oil contamination. Kuwait has the most balanced body of research, with studies completed on all different health symptoms associated with oil contamination.

Citations for the documents that we have gathered, along with summaries for each, can be found in Appendix B. In this appendix, the documents that we gathered are displayed for each country, categorized by health effect that each study examines. The health effect categories that we used only contain documents that solely focus on that health effect.

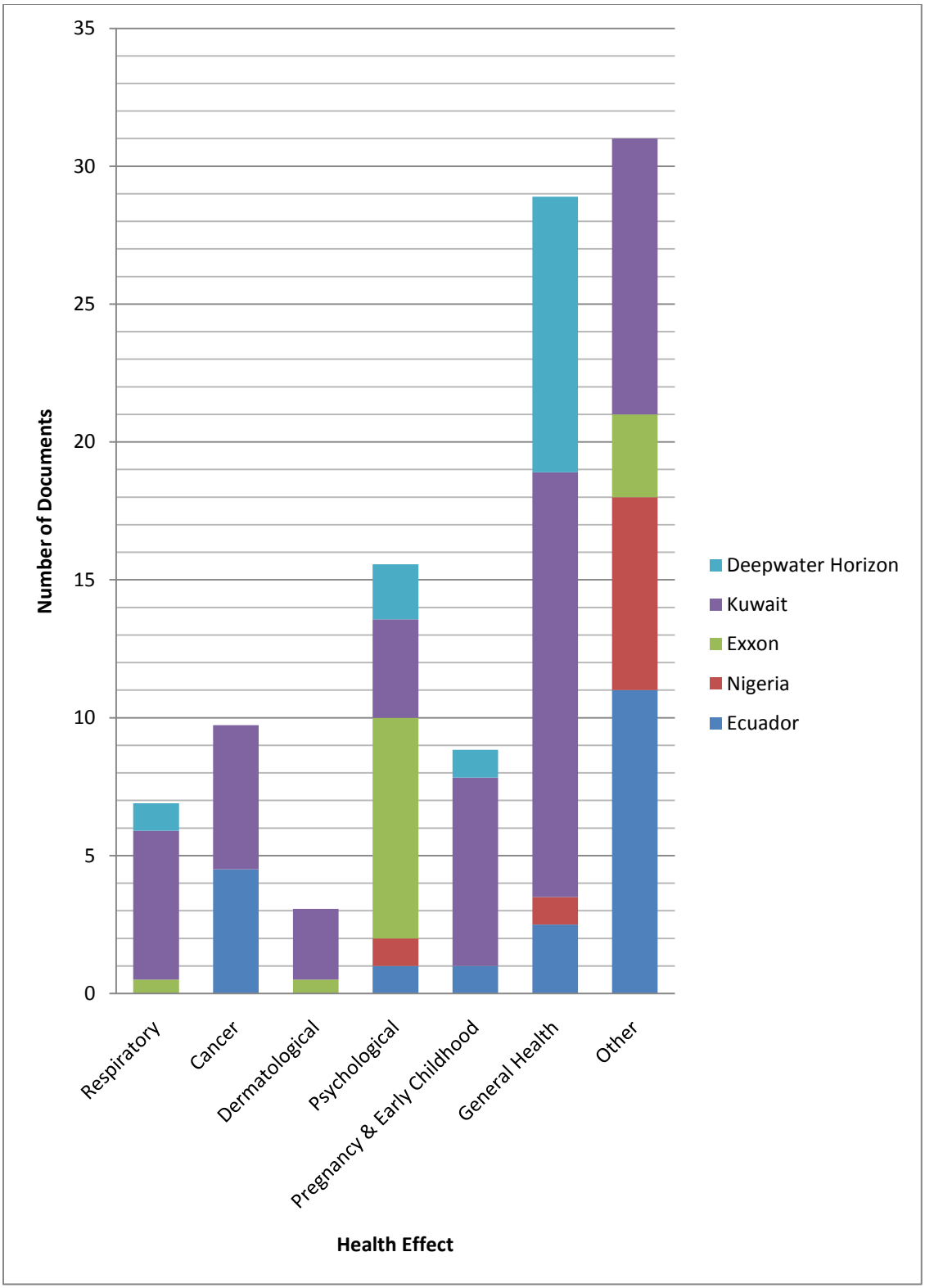

Figure 7: Total Number of Documents by Health Effect, Broken Down into Spill Sites

Type and Focus of Documents Collected

In total, we located, analyzed, and summarized 101 documents about the health effects of oil contamination from the five sites investigated. In order to satisfy our objectives, we had to consider the type of studies we found, as well as the focus that the documents have. Figure 8 categorizes the documents that we found as either a journal article, a government study, a book or book chapter, a university study, a judicial document, or an unpublished work. In addition, Figure 8 shows the collection of document separated by type of document and subdivided primary method of study. Each type of document is identified as an advisory document, a literature review, a meta-analysis, a data collection and analysis paper, or a document focused around surveys, interviews and focus groups. In some cases, a document had more than one focus. For example, a document could be considered both advisory and a literature review, or a document could focus on interviews and surveys as well as data collection and analysis. In these cases, half of the document would be considered one focus, and half of the document would be considered another. By doing this, we still have a correct representation of the number of documents investigated, and we have a more accurate representation of the focus of documents.

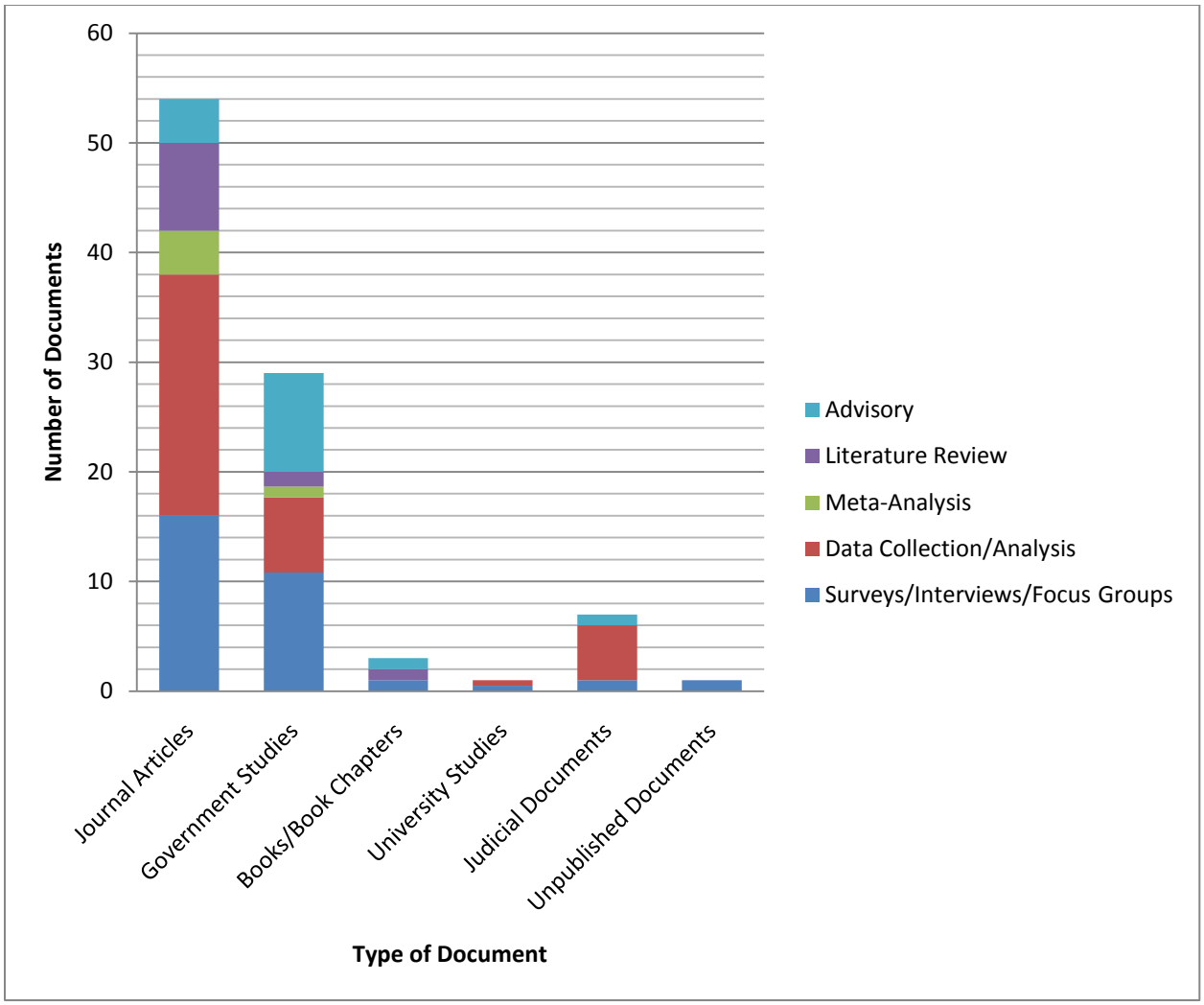

Figure 8: Type and Focus of Documents for Entire Body of Research Collected

Studies over Time

One topic we investigated is the number of studies that have been done on all health effects of oil contamination over time. Figure 9, located below, is a line graph indicating how many studies have been done per year since 1990. The trend of the graph shows a slight increase since 1990 for studies that have been done on the health effects of oil exposure. There is also a large increase for 2010, which is most likely, attributable to the occurrence of the Deepwater Horizon Spill.

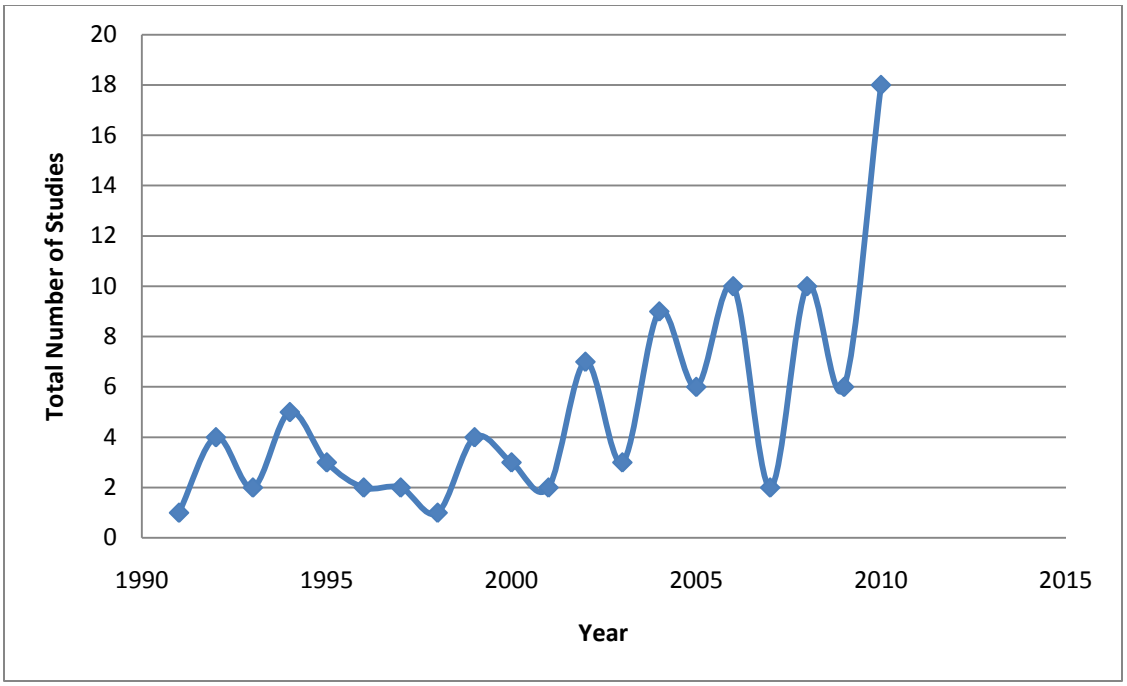

Figure 9: Number of Studies on the Health Effects of Oil Contamination over Time, by year published

Focus of Documents by Country

During the collection of documents, we noted the focus that each study had. Figure 10, located below, depicts the focuses that were most prevalent in each oil contamination site. We found that data collection and analysis was done the most for contamination in Ecuador and Kuwait and was not as common in other spill sites. We also found that for the Exxon-Valdez oil spill, surveys, interviews, and focus groups were used the most. Most of the studies done on the Deepwater Horizon oil spill were advisory. We did not locate many meta-analysis documents in our findings nor did we find many documents that were mainly literature reviews.

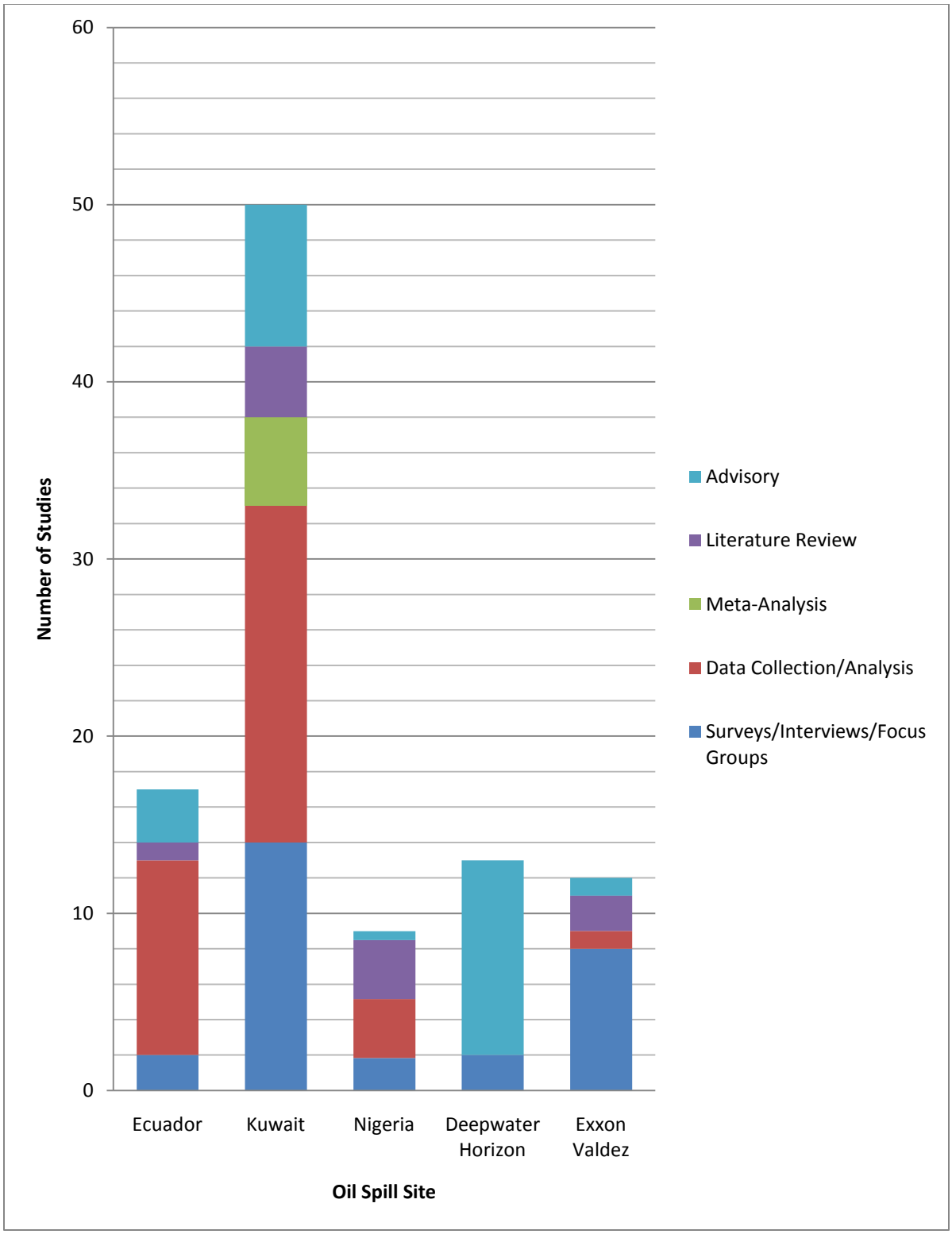

Figure 10: Focus of Documents Collected, Broken up by Spill Site

Type of Study by Spill Site

Figure 11 is a graph showing how many studies have been completed at each oil spill site. Additionally, the type of study conducted is expressed for each spill site. The vertical bars represent the number of studies from each site and are sectioned per the type of the study. Each focus category is represented by a different color. The graph shows that the majority of documents we collected came from published journals. Besides journal articles, there is also a large number of documents from government studies. Few documents that we gathered were books, university studies, and unpublished documents.

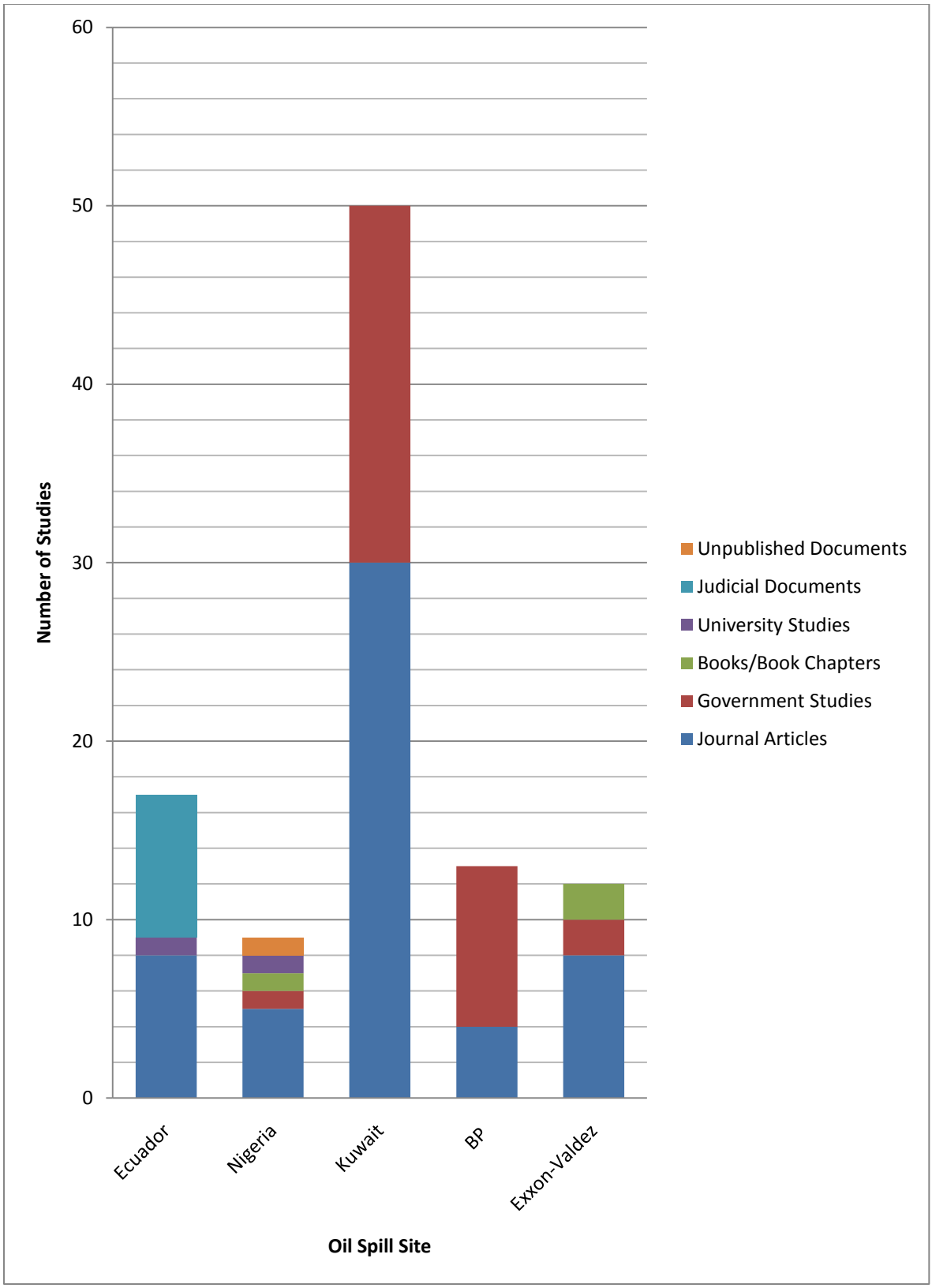

Figure 11: Distribution of Studies over the Five Main Spill Sites. Bars are subdivided by type of document.

Section 4.2.1 Cancer Incidence

One health problem that is commonly associated with long-term exposure to petroleum products is cancer. Several studies have been conducted to examine possible correlations between increased cancer incidence and long-term oil exposure; however, this is a topic that has not been thoroughly researched. We identified 9.5 studies that referenced cancer incidence related to oil exposure, with other documents touching on the subject. A full list of the documents we found with references is contained in Appendix B. Dr. Miguel San Sebastián and Dr. Anna-Karin Hurtig led the research on cancer incidence in the Region of Northeast Ecuador. Dr. San Sebastián took part in three separate studies, while Dr. Hurtig co-authored two of them. In Kuwait and the Niger Delta, research has been done on the general health effects of exposure to oil in which the authors briefly touch on the subject of cancer, but we did not find any studies that focus on cancer. We found no studies on cancer incidence as a result of the Exxon-Valdez oil spill in Southern Alaska, and because the Deepwater Horizon oil spill occurred so recently, it is unlikely that much if any detailed analysis has been completed on this subject.

Section 4.2.2 Pulmonary Health

Many people who are exposed to air pollution created by drilling operations and waste gas flaring suffer from pulmonary health issues. Most of these pulmonary problems are caused by inhalation of oil fumes from burning oil fires, gas flaring, and pure crude oil. Of the documents on pulmonary health that we collected, the majority were done in Kuwait after the Persian Gulf War. We found 11 studies done that referenced pulmonary health in Kuwait. Summaries and citations for these can be found in Appendix B. In Northeast Ecuador and Nigeria, documents discussed the subject of pulmonary problems caused by inhalation of oil fumes, but no studies were done solely for that purpose. We were not able to identify any

studies done on pulmonary issues as a result of oil exposure from the Exxon-Valdez spill or the Deepwater Horizon spill in the Gulf of Mexico.

Section 4.2.3 Pregnancy and Early Childhood Development

Exposure to crude oil in everyday life can lead to birth defects, miscarriages, and problems in early childhood to children. In the scientific data we gathered on health effects in Northeast Ecuador, there was one study devoted to pregnancy. There was one other document from Ecuador regarding early childhood leukemia, but no other documents specifically were devoted to pregnancy. From Kuwait, we found a total of seven studies that referenced pregnancy or early childhood development, especially in terms of birth defects, which are summarized and cited in Appendix B. For other spills, we found no studies that were devoted entirely to pregnancy. We did not find any documents regarding this topic in our search for scientific studies on the Exxon-Valdez oil spill and found only one advisory document on the Deepwater Horizon spill in the Gulf.

Section 4.2.4 Dermatological Heath

Dermatological health problems from oil contamination seem to present themselves after direct exposure with chemical compounds. People in Ecuador, Nigeria, and Kuwait experienced dermatological health issues due to direct exposure to oil in their everyday lives. Workers in the cleanup of the Exxon-Valdez and Deepwater Horizon oil spills suffered from dermatological symptoms. Many of the documents that we gathered that focused on general health discussed dermatological health, however we only identified seven documents that had it as a primary focus. Oil spills that we examined at sea such as the Exxon-Valdez and the

Deepwater Horizon spill did not have any studies completed on dermatological health problems associated with them.

Section 4.2.5 Psychological Health

The majority of oil spills fall under the category of a technological disaster, because they are caused by careless, irresponsible, or reckless human behavior (Picou, 2009). Technological disasters such as the Exxon-Valdez oil spill can lead to social problems and psychological health issues. Economic collapse, social problems, change in subsistence lifestyle of natives, loss of life, contaminated water supplies and crops, and stress of the environmental cleanup can all also lead to psychological health problems. These are all topics that are addressed in the compilation of research on psychological health issues resulting from oil exposure that we have collected. In our findings, eight documents on the Exxon-Valdez oil spill referenced social or psychological health problems because of the spill. Citations and summaries for these documents are located in Appendix B. These studies examined topics such as post-traumatic stress disorder, depression, anxiety, and other psychological problems. There was one document regarding the oil contamination in Northeast Ecuador that had a primary focus on psychological issues faced by the public, but there were also other documents that discussed the subject. We collected one document from Nigeria on psychological health and 3.5 from Kuwait. We also collected two documents on the Deepwater Horizon oil spill that examined anger and anxiety in the areas surrounding the Gulf of Mexico.

Section 4.2.6 General Health

In our repository of scientific or academic studies, the majority of the documents that we identified fell into the category of general health. With the exception of the studies that we

collected about the Exxon-Valdez oil spill, each site had studies that addressed several specific health issues associated with oil contamination at once. The documents that we collected regarding the Exxon-Valdez oil spill focused primarily on psychological health since the spill happened at sea and had less physical contact with people. All general health documents are cited and summarized in Appendix B.

We categorized many documents from Northeast Ecuador, the Niger Delta, and Kuwait as general health documents. In the case of Northeast Ecuador, some of these studies were performed for the Ecuadorian Government as part of the ongoing court case of *Maria Aguinda y Ostros v. Chevron Corp.* These needed to be thorough investigations on every aspect of health that was affected by the oil contamination.

Some studies completed in the Niger Delta were done by a workshop of individuals who worked to examine the health effects of the oil-covered landscape. Many of the documents from Kuwait analyze the health problems experienced by Gulf War veterans who are now hospitalized with a variety of problems that were caused by oil exposure in Kuwait. Because the Deepwater Horizon oil spill occurred so recently, very few studies have been completed and those that have been done examine only general health. These focus on psychological health, as well as speculation of what health effects, if any, people will experience as time goes on.

Section 4.2.7 Archival Research

Archival research was our primary method for collecting scholarly documents, and was nearly our only method for collection of videos and photographs. Initial research was done using resources at the George C. Gordon Library at WPI; however, many of the results from these searchers were published in journals that required subscription. This presented a problem since we were unable to host these documents in the database. In an effort to circumvent this

problem, we used Google Scholar extensively and collected any documents that were free to access. For those that could not be accessed freely, a link to the journal page is provided so that a user may access the document if they possess a subscription.

Section 4.2.8 Identifying and Contacting Researchers

While we worked towards the creation of a database that housed information available on the health effects of oil contamination throughout the world, there was a long process of gathering research. We began this process with archival research, using Google Scholar as our primary tool. Once this method was exhausted, we pursued researchers and other interested parties to collect research that was not available through web searches. Often, our initial contacts referred us to somebody who could better help us. In a few cases, researchers that we emailed both provided us with a document and referred us to other interested people or parties. We found that many people who we contacted expressed strong support for our efforts. A list of contacted researchers and what they provided us with can be found in Appendix A.

Other than our email contacts, the interviews that we conducted with Cindy Buhl and Dr. Tom Webler provided us with contact information of researchers and helped guide our project in the right direction. In addition to the advice and contacts we received from Cindy Buhl, we also received an extensive collection of documents relating to the oil contamination in Amazon Basin of Ecuador. Our interview with Dr. Tom Webler sparked the idea for our project, and he gave us the names of several researchers who were involved in disaster response and oil clean-up research in the United States. Interview notes and summaries from these two interviews can be found in Appendix D.

Section 4.3 Gathering Pictures and Videos

In our database, we incorporated pictures and videos to provide a visual representation of what each oil spill was like. The majority of the pictures were gathered through Google searches. Some pictures for oil contamination in Ecuador were given to us through email correspondence, but basic searches were used to find the majority of them. Videos were located through use of Google as well as Youtube. The videos we gathered were generally news reports, sections of documentaries, or interviews with information on the oil contamination sites we explored.

Section 4.4 Creation of a Database

Once we determined how to evaluate our choices for database construction, we used those methods to determine the best option. The choices were initially narrowed down to four database programs. Programs with database capabilities that were eliminated at the start were those that cost money, those that needed to be uploaded to a host site and required upkeep by a third party, those that required too much technical knowledge, and those that were not user friendly.

In order make our database useful to any interested party, we had to make it easy to find and easily accessible. If an individual could not find the database, they certainly could not use it. Furthermore, if significant effort was require to access the data –for example signing up for a service or installing software – it is unlikely that people would want to put the effort in. If few people can find or access the database, then it is not an effective tool.

Because the media collected for our resource existed in many different formats and focused on very different topics and regions of the globe, we had to organize it in a way that would make information easy to find. This allows users to find what they need with only a

minimal time investment. Next, we structured the database to allow upload and download of documents thus promoting information sharing. We wanted to create a central location could house everything on the topic and would have the flexibility to allow additions to the database.

Of the four programs we researched in depth (Microsoft Access, Microsoft Excel, Wikipages and Google Sites), we developed a list of pros and cons for each. We determined that the Microsoft Excel program was simple, straightforward and searchable. However, we found that the accessibility of this program would be problematic for many people. It was also sacrificed aesthetics for simplicity to an unsatisfactory degree.

Microsoft Access was a very good candidate for the creation of our database. The program allows for the upload and download of different files and it can be very well organized. However, this program was eliminated because it was too difficult to publish the final product. In order to publish the finished database, we needed a website that was set up to host an Access database, and because no team member had previous knowledge of web design, this would have been too difficult to complete in seven weeks.

Wikipages proved to be a great candidate for our database. It provided most of the functions that we required, such as the ability to upload and download files, publish on the internet, and be searched. However, Wikipages was not conducive to the organizational structure we envisioned and did not look as professional as we wanted. Additionally, Wikipages can be edited by anyone who signs up for the free service, and we felt this might undermine the scientific integrity of the resource.

An expert on computers, Matthew Runkle (personal correspondence), suggested using Google Sites. This is an online web-based program that allows for the organization of collected documents into multiple categories and is searchable. This program has the option of selecting who can edit and add to the site, providing a filter to the content posted. It is also easily

accessible to a variety of interested parties because it is a website and is available freely online. We chose Google Sites as the program that we would use for our database because it possessed enough qualities that we needed for our purposes.

Layout

As our database is hosted on a website, we were able to include different pages in addition to the section that houses studies on the health effects of oil contamination. We incorporated a description of our project and reasons that it was necessary. We also included an authorship page with our contact information as well as contributors to the website. The home page also describes recent developments.

The organizational layout of the database was difficult devise. We did not want the volume of files to interfere with the database's ease of use or navigation. Figure 12 is a screen shot of the home page of the website. The home page includes a link to the database section where the documents and files are separated into two different browsing categories. They are sorted by type of health effect and location of contamination.

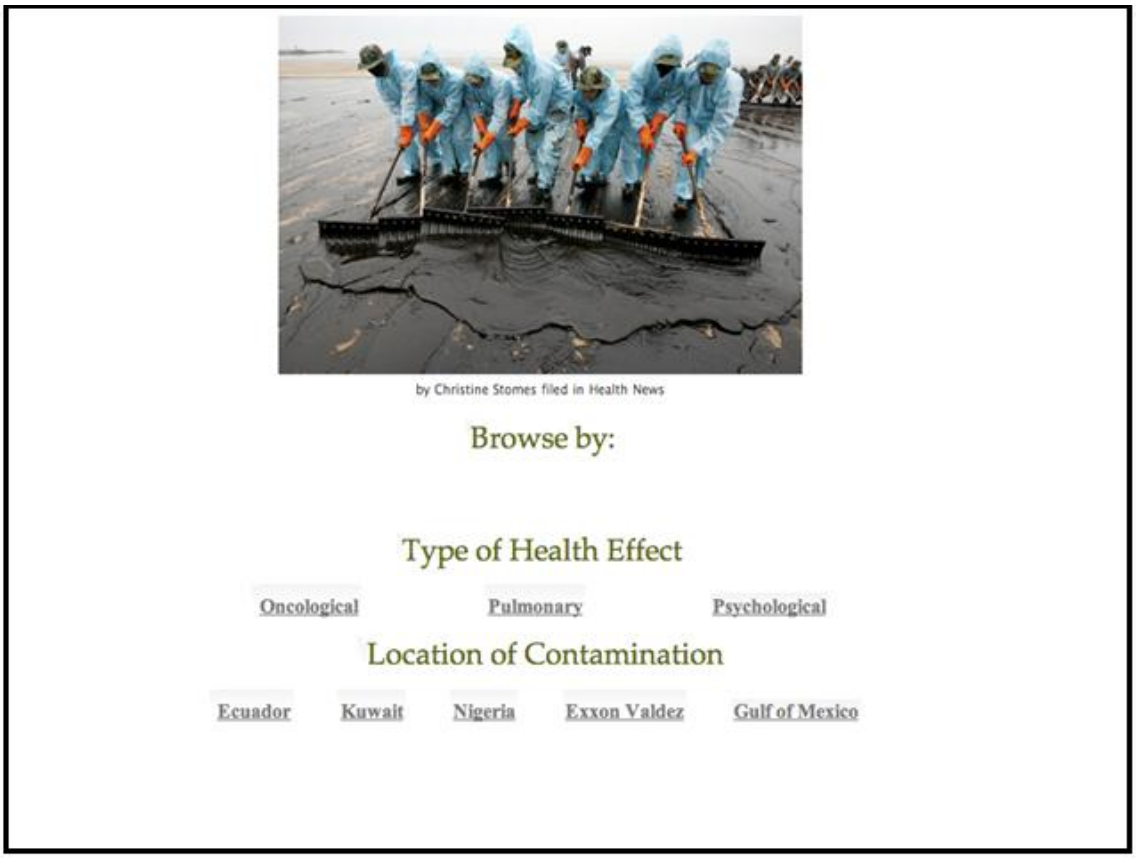

Figure 12: Database Page of the Website

The categories allow for individuals studying a specific geographic location to quickly determine the research that has been done on health effects of oil contamination in that area. This arrangement also allows for users to browse by specific health effects rather than by geographic location. The organization of the pages within the database was divided into two categories. When viewing a particular health effect or location, there are links to either documents or audio and visual files. This allows for easier navigation by reducing the amount of information per page. Figure 13 shows a screenshot of a sample page.

Figure 13: Ecuador Home Page to Access Specific Browsing Categories

The audio and visual pages for each location and health effect were divided into sections. The pages show pictures, video files and audio files as well as links to those not available for posting.

To make the site user-friendly, the pages containing documents were categorized into type of heath effect or geographic location. This allowed for less tedious navigation through the many documents housed in our database. Figure 14 shows an example of how each page is broken up into sections. The first section on this sample page includes sources related to oncology. Scrolling down this page takes viewers to documents categorized by other health effects. The top of figure 14 shows a navigation bar which brings the user directly to the category of documents selected. This method of browsing also reveals areas that are lacking research as one category may have many documents while others have very little. Screenshots of the entire website can be found in Appendix E.

Figure 14: Organization of Ecuador Documents Page

Chapter 5 – Discussion

The spark for the creation of this project was the apparent lack of reliable, unbiased information on the health effects of oil exposure, and the need for a central repository for the information that is available. As we collected information through archival research, email correspondence, and interviews, it became apparent to us that there are numerous studies available investigating various aspects of health effected by contact to oil. When attempting to research one specific symptom resulting from oil exposure, it is likely that the topic has been explored, however the researcher may have to look to different spill sites around the world to find the information that they are looking for. When looking at information on a health symptom of oil exposure at a specific site, it is much less likely that there will be a large amount of information available compared to the body of research including all other oil contamination sites. We have found that some contamination sites have been investigated more than others have. Specifically, we noticed that there is a difference in the body of research between oil contamination sites on land and at sea. In this section, we examine the research collected as a whole and note trends in the focus, type, and distribution of studies as well as studies done per year over time. We discuss the information we collected on the oil spill sites investigated as well as the implications of oil contamination at sea and on land. We also examine our findings on oil contamination in the air, specific health effects of oil exposure, and the distribution of the media for each oil spill site.

Section 5.1 Examining the Body of Research

In this section, we discuss the trends in the body of research that we have collected. Groups of documents that we examined in our project are referenced in this section. All of these documents are cited and summarized in Appendix B.

Section 5.1.1 General Type and Focus of Documents

By re-visiting figure 8: Type and Focus of Documents for Entire Body of Research Collected, it is apparent that our investigation found some types of studies more than others. Journal articles and government studies were by far the most prevalent, and university studies and unpublished documents were not common at all. Judicial documents were found to be available only on the oil contamination in Ecuador, probably because of the lawsuit between Chevron and the people of Ecuador. One possible explanation for the prevalence of journal articles is that the easiest way to identify and locate documents is through use of the internet. Almost all journal articles we identified could be found on the web, which is a reason why journal articles were the most common in our findings. Some government studies were also found online, however a few of these were obtained through contact with people who had access to these documents. University studies and unpublished documents are especially difficult to locate online because they are not published in peer-reviewed journals which are indexed by search engines. The university studies and unpublished documents acquired were provided to us by other researchers. A list of researchers contacted and what they gave us can be found in Appendix A.

Section 5.1.2 Distribution of Studies by Spill Site

From the results shown in figure 11 it is possible to formulate several different general observations about the collected studies. There is likely a correlation between media and public attention to the problems and the substantial number of studies conducted. In Ecuador, the court case of *Maria Aguinda y Ostros v. Chevron Corp.* has undoubtedly attracted the attention of many researchers. The Exxon-Valdez spill was widely publicized and thus was apparent to researchers who wanted to protect the environment. In the case of Kuwait, Australian and American Gulf War Veterans who served in regions where they encountered plumes from burning oil have returned home with severe and widespread health problems. This has not only spurred research from independent researchers but also various government agencies. The Deepwater Horizon oil spill had a dire effect on the Gulf of Mexico, and because it happened so recently there has been much media attention on it, which most likely facilitated research on the health effects of the spill. The Nigeria oil contamination issue has not been publicized in the media much, which could explain the lack of data on the health effects of the oil contamination there.

The majority of studies that we encountered were published journal articles or government studies. The only other document types with any major representation in the database are judicial documents. Judicial documents are represented only in the collection of documents from Ecuador and are responsible for eight out of the 17 documents collected on Ecuador. There is an obvious correlation between the number of judicial documents that we were able to find, and the ongoing court case for which judicial studies were mandated by the court –especially those conducted by the court's expert Richard Cabrera. Unpublished studies can be difficult to locate because they are not always available on the internet which could explain the lack of them in our findings. It is also unlikely that many books have been published

on the health effects of oil contamination because typically studies on the health effects of oil contamination are published in journals which could account for the lack of excerpts from books in our database.

Very few conclusive studies were collected from the Nigeria and Deepwater Horizon sections. In the case of BP, most of the documents that we were able to find are government documents that advise people on how to handle and avoid oil. There has not been enough time for any large number of studies to be conducted on the Deepwater Horizon spill, but based on the documents we gathered on the Exxon-Valdez oil spill and considering the amount of attention the Deepwater Horizon spill has garnered, it is likely that studies on the Deepwater Horizon spill will greatly exceed the numbers from Exxon-Valdez in the years to come. Also, because Nigeria has social problems demanding more immediate attention than do health problems resulting from oil contamination, it is logical that few studies were found from this site. Those studies that have been conducted on health in Nigeria often mention health problems as having a negative impact on the social conditions, but no studies that we found directly address health concerns.

Section 5.1.3 Research Focus by Country

When examining the focus of documents broken up by country, as seen in figure 10, conclusions can be drawn as to why there were trends in the data collected on the spill sites. We found that more surveys, interviews, and focus groups were used when investigating the health effects of the Exxon-Valdez oil spill. This is likely because the majority of the documents found on the Exxon-Valdez oil spill had to do with psychological health. Psychological health is best examined through interviews, surveys, and focus groups as was apparent in the research collected on the Exxon-Valdez oil spill. For the Deepwater Horizon oil spill, surveys, interviews,

and focus groups were used as well. This is most likely because the Deepwater Horizon oil spill happened at sea, and health effects similar to those from the Exxon-Valdez oil spill may develop. There were also many advisory documents for the Deepwater Horizon oil spill because it is such a current oil spill and there has not been enough time for more in depth studies to be completed. Kuwait, Nigeria and Ecuador had similar distribution patterns in terms of the focus of documentation. This is probably because these are oil contamination sites on land, where all aspects of health are affected; therefore studies with different focuses were needed.

Section 5.1.4 Temporal Changes in Research Focus

Using figure 9, we examined the number of studies on the health effects of oil contamination over time. It shows that there has been an overall increase in the number of studies completed over time; however, this is all we can conclude from this graph. This increase may be caused by increased interest in conducting research, an increase in the number of oil spills over time, or an increase in the publishing of studies on the internet. It is unclear whether interest in this topic grew significantly prior to the Deepwater Horizon oil spill in 2010. The Deepwater Horizon oil spill undoubtedly had an effect on the data in this figure because all studies completed on this spill had been done in 2010. It is likely that the Deepwater Horizon oil spill sparked interest in the health effects of oil contamination due to its recent occurrence. It can also be inferred from figure 8 that between 1990 and 1995 there was an increase in the number of studies because of the Exxon-Valdez oil spill that happened in 1989.

However, because the data gathered from the collection in our database is not statistically relevant, there is no way to infer that the trend of the graph represents increased interest in research on health effects and not an increase in the number of oil spills or an

increase in internet publication over time. There does appear to be an increase in the number of studies since the Deepwater Horizon spill, and there is probably some correlation.

Section 5.2 Oil Contamination By Site

In this section, we discuss the research collected for each of the five spill sites that we focused on. We also examine the significance of our findings and locate any gaps in the body of research for each site. We also discuss possible explanations as to why there is the amount of research that is available for each site. Summaries and citations for referenced documents can be found in Appendix B.

Section 5.2.1 Ecuador

We have determined through investigation of studies done on health effects of oil contamination in the Oriente region of Northeast Ecuador that a wide spectrum of symptoms has been explored for this site. We have found documents on cancer incidence, psychological health, pregnancy and early childhood, general health, as well as other documents that take into consideration various health issues associated with oil exposure. Studies done on cancer incidence and general health were the most prevalent in our findings, while documents focusing solely on psychological and pulmonary health were not as common. There were also a large number of documents that could not be categorized into a specific health category because they had other purposes besides looking at the health effects of oil exposure.

One of the primary reasons for the volume of research on the health effects of oil contamination in Ecuador is the ongoing lawsuit of *Maria Aguinda y Ostros v. Chevron Corp.* being contested in Ecuador. Dispute regarding the health effects of oil contamination has led to

the need for many studies to be completed investigating specific symptoms. For the court to find definitively that oil does or does not affect human health the evidence has to be thorough. Therefore, the studies done in this region examine many different symptoms resulting from oil exposure. Additionally, because the case between Ecuador and Chevron has been extremely long, many studies have been done in its duration adding to the total body of research available on the health effects of oil exposure in Northeast Ecuador.

Section 5.2.2 Kuwait

The most common illness associated with Gulf War service is not one particular ailment, but rather a multi-symptom illness termed the Gulf War Illness (GWI) (Ismail and Lewis, 2006). Many of the studies could not find conclusive evidence as to what the root cause of this illness is, and so it has been deemed “medically unexplained”. Symptoms generally include changes in mood and cognitive functions, but no single symptom is omnipresent. The research gathered included six documents that focused solely on reproductive health, three on cancer, one on psychological, two on respiratory, 28 that fell under more than one category which were catalogued under general health, and ten classified as other. These documents have been summarized, and these summaries and citations for each article can be found in Appendix B.

The vast body of research done regarding the health effects incurred from exposure to crude oil during the Persian Gulf War in 1990-1991 were mainly focused on veterans. Many of the men and women in service in the Persian Gulf at the time have experienced many health effects in the years since. Both private researchers and the governments of the countries that sent military personnel to the Persian Gulf have launched many studies to uncover the roots of the veterans’ illnesses. Only a few studies have aimed towards examining the health of people

native to that region who were exposed to the contamination. These findings will help for future deployments in the prevention of diseases of this type.

Section 5.2.3 Nigeria

The Niger Delta region of Nigeria has suffered from severe social conflict for many years (Ukeje, 2001). Tensions between the oil companies, federal government, and the indigenous people of the region have resulted in numerous violent conflicts that resulted in loss of life on both sides. Various ethnic groups -including the Ogoni, who first employed violent resistance against the oil companies - feel that they were forced to stand helpless as oil companies and the Nigerian government profited at expense of the environment of the Niger Delta and the health of its inhabitants. Members of some ethnic groups even captured pumping stations and wells in protest of these conditions, halting production.

We had difficulty locating information regarding the health effects of oil contamination in the Niger Delta. This is likely because the people of the Niger Delta face much greater problems. It is unlikely that researching cancer or dermatitis is a top priority amidst a class revolt. This is especially likely because cancer, which is the most severe of the health problems commonly associated with exposure to oil spills, often takes many years to develop into a serious problem, and social conflict presents a more imminent danger.

Most research that was completed in this region of Nigeria focused specifically on the causative relationship between the oil pollution and poverty of the Niger Delta and the extreme social tension between the people and the oil companies. Health problems were cited by these studies as support for arguments that living conditions are the reason for violent conflict, but were never studied themselves. There is very little data quantifying the oil's impact on the

health of people whose property, crops and livestock, drinking water, and air are polluted by oil, waste products from exploration and extraction, and extensive waste gas flaring.

Section 5.2.4 Exxon-Valdez

In collecting documents on the Exxon-Valdez oil spill, we noticed that the majority of them focused around a similar topic. Almost all of the studies that we found studied psychological or social implications of the oil spill on the people of Southern Alaska. One large reason for this was the economic losses that many people in this region suffered when the salmon and herring fisheries died out from the toxicity of the oil spill (Curry et al, 1992). A large portion of this region was dependent on commercial fishing, and many natives in the area lived subsistence lifestyles in which they were very dependent on the sea for food and other cultural traditions. The economic losses and necessary change in lifestyle for natives were largely responsible for psychological and social issues in the area. While natives in this region did not suffer from direct contact to oil due to the spill happening at sea, the workers who cleaned up the spill in the Prince William Sound did have direct contact to the oil. We were only able to encounter one study focusing on the health implications of workers who cleaned up the Sound after the spill, and this is something that has not been examined in depth.

As we found, there was a serious lack of information on the health effects of direct exposure to oil in the cleanup process. One possible reason for this is that only very recently have people begun to examine the health implications of workers cleaning oil at sea. The 2010 Deepwater Horizon oil spill in the Gulf of Mexico has required large numbers of workers to clean it up, and the health implications of being exposed to crude oil for that long during the cleanup process is a topic that has caused concern in many people. Because of this, many researchers are looking to the Exxon-Valdez oil spill to see what health issues were associated with cleaning

the spill back then. Since this issue was not really investigated by researchers in the aftermath of the Exxon-Valdez oil spill, this is a topic that is relatively new. This Exxon-Valdez spill had a devastating effect on the environment and fisheries of the Prince William Sound, and since it did not have direct effect on the habitat of the people of Southern Alaska, the human health implications of the oil spill were not explored as much. However, many psychological and social symptoms were present as a result of poisoned fisheries that the people of Southern Alaska depended on in their economy and subsistence lifestyles of natives. This is a large reason why many studies took place on the psychological and social state of the people in Southern Alaska after the Exxon-Valdez oil spill.

Section 5.2.5 Deepwater Horizon

Our research on the Deepwater Horizon oil spill has resulted in a greater knowledge of the health concerns in the Gulf of Mexico. The majority of the studies and documents we found focused on what measures should be taken to accommodate the potential health effects of the oil spill. Along with these documents, there were a significant number of articles on precautionary measures for people working on the cleanup to limit their exposure to the oil. While most of the articles we collected regarded the health of the workers cleaning the oil spill, some also addressed residents of the affected areas. Although there were a large number of articles expressing concerns on these topics there was a lack of actual documentation of current health effects in the region. There were few studies referring to the psychological health of the locals, however, we were not able to locate further documents.

The blatant lack of studies on health effects of the Deepwater Horizon oil spill is potentially linked to the recent nature of the oil spill. A situation of this magnitude has never occurred in the United States. As a result, there is no protocol or knowledge of what measures

should be taken to deal with the health effects of a circumstance like this. Another reason for the lack of documentation on health effects could possibly be linked to the fact that this is a relatively new scientific topic. Before the Deepwater Horizon oil spill there was little public pressure to address the issue. Most of the situations in which people are exposed to crude oil were either in a controlled working environment, or in a less developed area of the world where bigger problems outweighed the need for research on health effects of oil exposure. With the combination of these two circumstances the number of studies done on health effects of oil contamination in the Gulf is very limited to speculations and precautionary measures.

Section 5.3 Oil Contamination By Geographic Location

Early into our investigation we came to the realization that oil spills on land are much different from oil spills at sea. However, the oil spills that we explored on land, especially those in Ecuador and Nigeria, had very similar issues associated with them. Oil spills we examined at sea, Exxon-Valdez and Deepwater Horizon, also were similar in terms of impacts on health. Due to this, we decided to look at oil contamination on land and oil contamination at sea separately to discuss the health implications of both on a more general level. Referenced documents are summarized and cited in Appendix B.

Section 5.3.1 Oil Contamination on Land

The most apparent health effects of various forms of oil pollution are those present in terrestrial contaminations. Spills that occur on land, while relatively stagnant when compared to pollution of air or oceans, often happen in close proximity to homes and agricultural areas (Cabrera, 2008). Because of this proximity, oil and associated waste chemicals can seep into groundwater, streams, or rivers, all of which may be used as water supplies for laundry, cooking,

bathing, and drinking. Additionally, polluted freshwater may be consumed by livestock or used to water crops causing death in both the livestock and crops. Besides polluting water, petrochemicals may contaminate soil in which crops are grown and on which homes may be built.

The oil spills in NE Ecuador, the Niger Delta, and Kuwait all contaminated thousands of square miles with crude oil or its chemical byproducts. Similar symptoms were present in people who were extensively exposed to this pollution in all three sites. People who ingested the oil directly in drinking water or indirectly through consumption of meat from contaminated livestock appear to have increased incidence of cancer and digestive problems (Armstrong et al, 2001). Pregnant women who ingested oil in Ecuador had increased rates of miscarriage, but there is no data that we found from the other four sites that we investigated to corroborate these findings (Armstrong et al, 2002).

In addition to symptoms brought on by ingestion, people in Ecuador who used polluted water for laundry, bathing, and recreation frequently contained dermatological problems (Cabrera, 2008). These problems ranged from mild rashes to severe and lasting eczema and malignant melanomas. Studies from Kuwait also indicate higher probabilities of skin diseases, though these may be the result of atmospheric pollution and not terrestrial.

Section 5.3.2 Oil Contamination at Sea

By examining the Exxon-Valdez and Deepwater Horizon oil spills at sea, we were able to compare the body of research that has been done on the health effects of the two oil spills and come to conclusions. The health issues that can be expected in people involved in the cleanup as well as the inhabitants of the area affected were examined.

Since the Exxon-Valdez oil spill happened 20 years ago, many researchers are looking back at this oil spill for expectations in the aftermath of the Deepwater Horizon oil spill. In our findings, the people of Southern Alaska experienced numerous psychological and social effects because their lives were very dependent on the sea (Curry et al, 1992). It is estimated that some people living on the coast of the Gulf of Mexico who depend on the cleanliness of the sea in their lives will experience similar psychological and social problems. We can also expect that with any large oil spill such as the Exxon-Valdez or Deepwater Horizon, there will be psychological or social impacts to the impacted community.

Oil spills have a very extensive cleanup process taking many months and involving hundreds of workers. People who work long hours remediating oil spills experience extensive amounts of direct contact to the crude oil. It is known that there are some health impacts of direct contact to oil in the cleanup process; however, it is a topic that has not been researched in depth (Bender et al, 1991). Some known health problems associated with long hours of cleaning oil spills include skin rashes and upper respiratory infections. It can be expected that with any oil spill at sea direct contact to the oil in the cleanup process can cause health issues without proper protective equipment.

Section 5.3.3 Oil Contamination in the Air

During the Persian Gulf War in 1990-1991, many of Kuwait's oil wells were set on fire. These burning oil wells produced a giant plume of smoke that engulfed the region. This toxic cloud included many heavy metals and other particulate matter along with the hydrocarbons (Seacor, 1994). Many of the military and civilian personnel who served in the Persian Gulf at the time developed respiratory problems as a result of inhalation of this smoke (Smith et al, 2002).The studies completed on oil pollution of the air in Kuwait mainly centered on defining a

group of veterans exposed to the plume along with a control group. This collective body was usually surveyed and or hospitalization data was gathered to assess the health outcomes of exposure. Different types of models have also been widely used to estimate various aspects and movements of the smoke plume. These models along with records of the troops movements estimated the level of exposure that the veterans experienced. A host of respiratory problems were the main health effects associated with deployment to the Persian Gulf and exposure to the smoke plume. Cancer has also been connected with the metals present in high concentrations in the smoke.

Section 5.4 Discussion of Health Effects Associated with Oil Contamination

In our investigation of research that has been done on health effects of oil contamination, we encountered numerous studies about various health symptoms. In this section, we look at the research done on some health effects that we found the most information on as a whole. We discuss the health effects that have been studied and the prevalence of the information on each symptom to show more evidence and draw parallels between oil contamination and effects on human health. Summaries and citations for referenced documents are located in Appendix B.

Section 5.4.1 Reproductive Health

Adverse effects on reproductive health have been associated with areas of oil contamination. Miscarriages, stillbirths, infertility, sterility, and birth defects have all been studied in places such as Ecuador and Kuwait. There has been conflicting evidence as to the severity or even the suggested link of these health effects to exposure to oil. Four studies found

no sign of increased levels of birth defects among children born to those who served in the Persian Gulf War (Wells, 2006; Doyle et al, 2004; Bégassat et al, 2008; Cowan, 1997). One study did not find any conclusive evidence that those who served in the Persian Gulf were at a higher risk of adverse affects on their reproductive health (Forbes et al, 2007). Two studies found conflicting evidence on sterility and infertility (Carson et al, 2004; Bégassat et al, 2008). Carson et al found that veterans had no increase in infertility or sterility compared to the general population, while Bégassat et al found that they were, and backed their findings with an analysis strictly based on clinical diagnoses. A study done in Ecuador found miscarriage and stillbirth rates to be much higher among those exposed to the oil contamination (Armstrong et al, 2002).

Section 5.4.2 Cancer

Concern over the effect of oil contamination exposure has led to studies conducted on cancer. One study found levels of metals in the atmosphere to be very high during the Gulf War (Hayat, 1996). These metals have been found and studied in the tissues of both benign and malignant cancers and have been associated with increased incidence in rates of cancer in Gulf War veterans. Another study found lung cancer to be more prominent among those who served in the Persian Gulf (Kang et al, 2010). A study tracking testicular cancer found it to be more prevalent in veterans of the Gulf War than non Gulf War veterans peaking 4 to 5 years after the war (Levine, 2005). In Ecuador, childhood leukemia was found to be significantly more frequent in people residing near oil fields as compared to people not directly affected by oil contamination (Hurtig and San Sebastián, 2004a). Another study found increased cancer rates in areas in close proximity of oil fields relative to areas segregated from them (Hurtig and San Sebastián, 2002). Cancers of the stomach, rectum, skin, soft tissue and kidneys were found to be more common among males, while cancers of the cervix and lymph nodes were more noted in

females. The study also found a great increase in hematopoietic cancers among children less than 10 years of age. A study of the San Carlos region of Ecuador found a much higher excess of many different types of cancers in males than was expected (Hurtig and San Sebastián, 2004b). As the people residing near oil fields in Ecuador have experienced so for many years, the constant exposure to petrochemicals may be the cause of the widespread cancers. In other sites where the interplay between people and oil contamination is more variable, cancer incidence appears to be lower, and more concurrent with the general population. Thus, the evidence indicates that chronic exposure to crude oil leads to increased cancer incidence, while intermittent exposure shows cancer rates that are more characteristic of the general population.

Section 5.4.3 Respiratory Issues

When analyzing the documents that were collected, respiratory conditions were apparent in Kuwait and the Deepwater Horizon oil spill. The toxic cloud that resulted from the burning oil wells in Kuwait during the Persian Gulf War of 1990-1991 caused many respiratory health problems in those exposed. The smoke plume included many heavy metals and other particulate matter along with the hydrocarbons, which proved detrimental when inhaled (Husain, 1998). The studies found assessing the health aspect of the plume, associated many respiratory problems with deployment to the Persian Gulf. The health concerns of the Deepwater Horizon oil spill also included respiratory problems. However, these concerns were not because of the contamination itself but because of the cleanup methods being used. Dispersants were used as a method for eliminating some of the oil that was floating around in the ocean, and with their use came health concerns (NIOSH, 2010). Even though these dispersants are regarded as non-hazardous there are still precautious methods that need to be

followed such as wearing masks to prevent inhalation. The continuous exposure to these chemicals was a great concern when looking at potential health effects of the workers. Even though both sites have had studies examine respiratory problems as a result of oil contamination, they are very different because the respiratory issues resulting from the Deepwater Horizon oil spill result from the cleanup efforts, while the symptoms from Kuwait result from gas clouds in the atmosphere after the Gulf War.

Section 5.4.4 Psychological Health

One trend that was apparent as we went through the documents for each oil contamination site was that many people experienced psychological health issues associated with oil contamination. We can conclude that in all cases when oil contamination affects a community either directly or through other means there can be psychological symptoms such as stress, anxiety, and depression (Downs et al, 1993). In Ecuador and Nigeria, psychological health issues have resulted from oil that had contaminated crops and livestock as well as water supplies to the indigenous populations who are dependent on farming and the environment to survive. With water supplies and crops poisoned, and livestock such as chickens dying from ingestion of this water, depression would sink in to the community affected by the oil contamination (Cabrera, 2008). Psychological health issues were also apparent in communities affected by oil spills such as the Exxon-Valdez oil spill. Even though the spill occurred at sea and did not directly affect the habitat of the individuals of Southern Alaska, the fact that fisheries were poisoned that people were largely dependent on in the economy of this region led to some severe psychological health issues in communities (Curry et al, 1992). Many natives who were also dependent on the sea for a subsistence lifestyle experienced psychological symptoms

as well because they could no longer rely on the sea for many cultural traditions (Downs et al, 1992).

Section 5.5 Recommendations

After review of the 115 documents included in our database, we have arrived at several recommendations for the continuation of research on the health effects of oil contamination and exposure. As our collection does not include every document from these categories, these recommendations are meant to be used as guidelines.

1. We recommend that the health of those exposed to petrochemicals be tracked and documented from the initial moments of all oil spills. The health effects resulting from oil spills are not often documented beginning shortly after exposure, but rather are typically examined once health problems set in. Monitoring the health of people impacted by oil spills can be done through interviews, surveys, and semi-annual physical check-ups. There is speculation over the true health impacts that oil exposure has on the human body. By monitoring the health of those exposed from the time of first exposure, more conclusive evidence can be gathered, and all complicating factors can be more thoroughly assessed. This recommendation applies to all subsequent recommendations made.

2. We recommend that researchers of developed nations team up with those in developing nations to help facilitate research. In developing nations, like Nigeria and Ecuador, the personnel, equipment, and financing required to conduct a scientific

study are scarce. This problem can be circumvented through collaboration between those researchers in developed nations with resources, and those researchers in developing nations with fewer or no resources. Resources to spend on this topic in countries like Nigeria or Ecuador may be limited by larger problems, such as the social crisis in Nigeria or the constant pressures presented by poverty in underdeveloped areas.

3. We recommend that researchers of the Deepwater Horizon Spill collaborate further with those who did research on the Exxon-Valdez spill. The similarities between the two oil spills are abundant and similar health effects can be expected between the people of Southern Alaska and the people of the Gulf of Mexico.

4. We recommend that cancer research be conducted in places that have oil contaminated water which is consumed by humans and animals. There have been links to cancer by ingestion of, and contact with, tainted water (Hurtig and Sebastián, 2002; Armstrong et al, 2001), but these claims are not scientifically proven and some still refute the connection. Cancer research has been pursued in Ecuador and Kuwait, both of which are terrestrial oil contamination sites. Since Nigeria is also a terrestrial spill site, and research from Kuwait and Ecuador suggests that oil exposure and cancer are related, we recommend that cancer research be done on inhabitants of Nigeria where conditions are similar.

5. We also recommend that cancer research be conducted in places where air pollution is abundant due to flares and burning oil. There has been evidence in

Kuwait and Nigeria that the burning of hydrocarbons has led to cancer, especially of the lungs (Kang et al, 2010). The relation is not completely understood, however, as the studies present are not conclusive and the claims are not sufficiently supported. We recommend that this research be conducted in Ecuador as well, as companies in Ecuador often flare waste gas according to interviews of locals conducted by Alex Bethel (Bethel, Alex, personal communication, Nov. 18, 2010).

6. We recommend that all facets of reproductive biology and physiology be studied and monitored in populations that live in oil-contaminated environments over time. We recommend that infertility be tracked from the initial stages of oil exposure and be analyzed directly with pregnancy outcomes. There has been evidence that oil contamination from ingestion, inhalation, and overall exposure to petrochemicals has led to adverse effects in these areas (Armstrong et al, 2002). As there is evidence of increased incidence of miscarriages and developmental problems in children in Ecuador, we recommend that pregnancy and early childhood development be studied in Nigeria as well. Tracking the effect that oil exposure has, from infertility and sterility to the birth defects of newborns, has not been done.

7. Five studies done in Kuwait, where atmospheric pollution was so thick that it blocked out the sun, showed a relationship between atmospheric pollution and respiratory problems. We recommend that these results be used to help evaluate conditions in Nigeria where 75% (more than anywhere else in the world) of waste gas is flared (Ibaba, 2008). Research that has already been done on soldiers from the Gulf War may help to save people in Nigeria from severe respiratory problems.

8. For the continuation of our database website, we recommend that a host organization like the Centers for Disease Control and Prevention (CDC), Oil Change International, or Oxfam International assume control of it. With a health-oriented organization like the CDC controlling our database, it will be more likely to contain the most relevant and up to date information on health and oil. As the government oversees the CDC, it will likely have access to the latest technology to keep the website current and compatible with all users' equipment. Oil Change International and Oxfam International are interested in reforming the way the globe exploits oil and protecting human rights, respectively. If associated with a large organization, our website database will likely be more frequently accessed, leading to a larger body of researchers uploading information to it and facilitating its expansion. Hopefully, a duplicate of our project will not be necessary if ours is readily available and updated.

We were not able to collect every study conducted on the health effects of petrochemical exposure and so our estimates as to the division among years, type of document, type of study, and health effect, may not accurately represent the entire body of research. It is clear, however, that more research in all areas needs to be encouraged, since conclusive evidence directly relating particular oil exposures to certain health effects is deficient. Any continuation of research done on any topic will help the body of research as a whole and provide more concrete evidence of the health effects of petrochemical exposure.

Section 5.6 Conclusions

Oil is undoubtedly one of the most important commodities in the world. Without it, most vehicles cannot move, many homes cannot be heated, and national economies - especially in certain developing countries - would crumble. Unfortunately, with oil exploration and extraction practices comes an inherent risk of spills. Spills can range in magnitude from a few gallons that spill when filling a truck or tanker to millions of gallons that spill as the result of deteriorating infrastructure, shipping mistakes, and inadequate handling practices. Dangerous chemical waste, which must be stored or transported to prevent it from affecting the environment in which drilling occurs, is also produced in vast quantities by oil processes and may be spilled.

This research project completed three objectives with the goal of encouraging the scientific community to work toward conclusive evidence that oil and associated chemicals are or are not dangerous. First, we identified researchers who had done scientific research on the health effects of exposure to crude oil or chemical byproducts from oil exploration and extraction. Next, we built a web portal to house data and contact information for researchers from polluted sites around the world to encourage information sharing between all places affected by oil development. Lastly, we identified gaps in the available research on oil contamination and its effects on human health and recommended areas that researchers should investigate further.

Because of logistic constraints on the team, this project only included studies from five major oil spills and a few auxiliary studies. Obviously, this is a far from complete collection of scientific studies related to the health implications of human exposure to crude oil and other chemical byproducts. Inclusion of a third party organization like the Oil Spill Recovery Institute in future efforts would increase the effectiveness of a database like ours as they have resources to

maintain and add to the database. Ideally, this database would be developed into a resource that houses all studies relevant to the health implications of exposure to oil spills instead of those from only a few major spills.

It is our intention that the web database be used as a resource for scientific researchers looking for background information on oil spills. This database will make searching for relevant science from many parts of the globe easy and will help prevent people from different places from unknowingly conducting repetitive research. Furthermore, individuals who access the database can find research that they can build on to increase the strength of scientific arguments.

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Appendix A: Contacts

1. Tom Webler:
    - Founding member of Social and Environmental Research Institute (SERI)
    - Provided information on the psychological effects of oil contamination
    - Commented on our website throughout the duration of its creation
    - Helped to formulate the idea of our project
2. Cindy Buhl
    - Legislative Director at the office of Congressman McGovern
    - Provided us with documents done by Miguel San Sebastián et al.
        1. Geographical differences in cancer incidence in the Amazon basin of Ecuador in relation to residence near oil fields
        2. Incidence of Childhood Leukemia and Oil Exploitation in the Amazon Basin of Ecuador
        3. Exposures and Cancer Incidence near Oil Fields in the Amazon Basin of Ecuador
        4. Outcomes of Pregnancy among Women Living in the Proximity of Oil Fields in the Amazon Basin of Ecuador
        5. Oil development and health in the Amazon basin of Ecuador: the popular epidemiology process
    - Provided us with the English version of the Cabrera Report as well as Cabrera's responses to the plaintiffs
    - Provided us with the Stratus Comments on the Cabrera Report
    - Provided us with a document displaying a list of Texaco's consultants

- Provided us with Appendix L of the Cabrera Report
    1. The Psychological Impact of Texaco's Oil Production Facilities on Amazonian Communities in Ecuador
- Provided us with contact information for Dr. Richard Clapp from Boston University, Steve Kretzmann from Oil Change International, Doug Beltman of Stratus Consulting Inc, and Rachel Ross of Partners in Health

3. Washington Office on Latin America - Krystal Wubben
    - Director of Finance and Operations
    - WOLA was very helpful to last year's projects
    - Referred us to Coletta Youngers and Chris Jochnick
4. Coletta Youngers
    - Works for WOLA
    - Provided us with contact information for Sandra Edwards – A consultant in Ecuador for WOLA
5. Sandra Edwards
    - WOLA Consultant in Ecuador
    - Attempted to set up a meeting with Juan Aulestia, who's contact information she could not find.
6. Chris Jochnick
    - Works for Oxfam America & CDES
    - Referred us to Paulina Garzon from Amazon Watch who did not respond.
7. Rachel Ross
    - Works for Partners in Health
    - Provided us a contact: Steve Donziger

8. Steve Donziger
    - Lawyer involved in the *Maria Aguinda y Ostros v. Chevron Corp.* lawsuit
    - Forwarded our email to Andrew Woods, who works in Steve Donziger's office
9. Andrew Woods
    - Works at Donziger and Associates lawfirm
    - Provided us with a link to chevrontoxico.com where we gathered:
        1. Estimate of the Number and Cost of Excesses Cancer Deaths Associated with Residence in the Oil-Producing Areas of the Sucumbios and Orellana Provinces of Ecuador
10. Richard Clapp
    - Accompanied Congressman McGovern on his trip to Ecuador.
    - Professor of Environmental Health at Boston University
    - Provided us with a contact: Carolyn Stephens, at the London School of Hygiene and Tropical Medicine. She was contacted but did not respond.
    - Provided us with one document:
        1. Oil: A life Cycle Analysis of its Health and Environmental Impacts
11. Solomon Braide
    - Institute of Pollution Studies
    - Referred us to Ms. Joe Igbara who could not be reached.
12. Miguel San Sebastián Chasco
    - Did case studies on cancer rates and pregnancy defects as a result of oil contamination in northeast Ecuador.
    - Contributes information to our database and provide us with contacts.

- Author of Yana Curi Report (2000) – document that studies the influence of pollution resulting from the extraction of oil in the Amazon of Ecuador on the health of the population of the area.
- MD, PhD in Epidemiology and he is a senior lecturer in public health at Umea University. Research areas including environmental epidemiology, indigenous health (Amazon region), and primary health care and health impacts of globalization processes.
- In email correspondence, he gave us permission to house his documents on the health effects of oil contamination in Northeast Ecuador and said that our project was a "good initiative".

13. Kwabena Kyei-Aboagye
    - Professor of environmental law and urban environmental issues at Boston University
    - Worked at the EPA
    - Works as environmental justice coordinator for the US EPA Region One.
        1. Responsible for designing, implementing, and managing the Regional Environmental Justice Program
    - Worked for six years as watershed planner for the Greater Boston Harbor for the Commonwealth of Massachusetts Executive Office of Environmental Affairs
    - Researching the impact of mining on rural communities in Ghana.
    - Provided contacts to us:
14. Dr. E. C. Chukuigwe
    - Name was acquired off of a document: The Niger Delta Resource Damage Assessment and Restoration Project

- Contacted the Nigerian Ministry of the Environment attempting to request a comprehensive report on the Niger Delta. We never acquired this document.

15. Nils Daulaire
    - Currently director of the Office of Global Health Affairs.
    - Was CEO of the Global Health Council
        1. Coordinated with international leaders, governments, UN agencies, to improve public health in the world's poorest communities
    - As deputy assistant administrator for policy and as a senior international health advisor for the US Agency for International Development
        1. Oversaw global strategy ecompassing health, population, hunger, girls' Ed.
16. David A. Savitz
    - Brown University
    - Said that the most complete source of reference is the Institute of Medicine Workshop held in June of this year
17. Alex Bethel
    - Volunteer at RUNA Tea company in Ecuador
    - Provided us with pictures, videos, and a first person account of conditions in Ecuador
18. W. Scott Pegau
    - Oil Spill Recovery Institute
    - Contacted him to request documents on the health effects of oil contamination after the Exxon-Valdez Oil Spill

- He recommended the Prince William Sound Regional Citizens' Advisory Council for information

Appendix B: Document Summaries

List of scientific documents collected and summaries of each.

Ecuador

Oncological

Estimate of the Number and Costs of Excess Cancer Deaths Associated with Residence in the Oil-producing Areas of the Sucumbíos and Orellana Provinces of Ecuador

Rourke, D. (2010). Estimate of the Number and Cost of Excess Cancer Deaths Associated with Residence in the Oil-producing Areas of the Sucumbíos and Orellana Providences of Ecuador.

Summary:

This document presents estimates of the number of excess cancer deaths of residents in the Texaco 1973 Concession Area (C.A.), located in the Sucumbíos and Orellana provinces of Ecuador. The estimated cost based on the most recent entry of newly exposed persons (2009) is US$ 46.9 billion for persons residing in the Concession area and US$ 27.5 billion for persons residing within five km of oil facilities. These estimates are on the 42-year period following initial oil exploration in 1967. The calculations required for these estimates were made using standard actuarial life-table methodology.

Cartographic documents, provided by the Instituto Nacional de Estadistica y Censos (INEC), were used to prepare a map of communities overlaid on a map of the C.A. Using this map and census data on each community, a weighted total population of 121,596 people in 2001 was determined. Additionally, population growth rates for the Sucumbíos and Orellana regions were calculated to be 1.048 and 1.053 respectively. Using a different method, the

populations within the C.A. and within five km of oil facilities in 2009 were estimated at 174,338 and 102,275 persons respectively. Next, a distribution of age was calculated. Age specific mortality rates for all causes of death and for all malignant neoplasms were calculated for 2001 and 1990. Finally, using statistics from an article by Hurtig and San Sebastián (2002), estimates of the excess cancer risk associated with residence in oil-producing areas were made.

Two sources for the statistical value of a wrongful death related to exposure to carcinogens were used, "–one based on the U.S. tort system and the second based on the economic concept of the "value of a statistical life" as employed by the US EPA" (17). The average asbestos-related lung cancer award is US$ 7.0 million and the average benzene-related leukemia award is US$ 6.0 million. The products of the number of excess cancer deaths within the C.A. and within five km of oil facilities with the average award for hydrocarbon-related cancers produced the final estimates of the cost of excess cancer deaths associated with residence in the oil-producing areas of the Sucumbíos and Orellana provinces of Ecuador of US$ 46.9 billion within the C.A. and US$ 27.5 billion within five km of oil facilities.

Exposures and Cancer Incidence near Oil Fields in the Amazon Basin of Ecuador

Armstrong, B., Córdoba, J.A., Sebastián, M.S., & Stephens, C. (2001). Exposure and CancerIncidence Near Oil Fields in the Amazon basin of Ecuador. *Journal of Occupational and Environmental Medicine*, 58, 517-522.

Summary:

This study examines the environmental exposure and incidence and mortality of cancer in the village of San Carlos, Ecuador, which is surrounded by over 30 oil wells. Currently, the most volatile petroleum hydrocarbons are the organic compounds: benzene, xylene, and toluene, and polynuclear aromatic hydrocarbons (PAHs). Benzene is a well-known cause of leukemia and

other hematological neoplasms and disorders. In the US, age adjusted incidences of cancers of the stomach, lung, prostate, and kidney and urinary organs were associated with petroleum and airborne chemical plant emissions. Additionally, high incidences of leukemia were found in oil field workers in China. In San Carlos, the pumping station –which sits at the entrance to the village –and the surrounding oil wells, most of which are only a few meters from houses, dump untreated waste directly into streams that cross the village and are the only source of water. Locals use water from the streams for drinking, cooking, bathing, and washing clothes. There are also four flare stacks that burn excess gas day and night. No other chemical or other industries operate in the area.Samples from four bodies of water were taken and analyzed for total petroleum hydrocarbon levels (TPH). The values found were well above the permitted limit for hydrocarbons according to European Community law of 0.01 ppm.

Ten cases of cancer occurring between 1989 and 1998 were found. An additional 3 people had benign tumors and another 5 had cancer but no medical history to confirm they were residents of San Carlos. Of these patients, one had worked in the oil industry as a guardian of an oil field. Compared to cancer rates in Quito, the country's capital, and only place with an adequate cancer registry, these numbers are much higher. Using the male population as a model, the researchers calculated a risk of cancer 2.26 (95% CI 0.97 to 4.46) times higher in San Carlos than in Quito from a comparison of 8 actual cases versus the 3.5 expected cases. No excess of cancer was found in women.

To adjust for the likelihood of chance, the population of San Carlos was overestimated and migration was considered low. While it is apparent that there is an increased incidence of cancer in men living in San Carlos, more evidence is needed on outside risk factors that could be producing the potentially high cancer rates. Further research is also needed to determine the extent of exposure of people living in the village.

Geographical differences in cancer incidence in the Amazon basin of Ecuador in relation to residence near oil fields

Hurtig, A.K. & Sebastián, M.S. (2002). Geographical Differences in Cancer Incidenc in the Amazon Basin of Ecuador in Relation to Residence Near Oil Fields. *International Journal of Epidemiology,* 31, 1021–1027.

Summary:

This study, carried out in the provinces of Sucumbios, Orellana, Napo and Pastaza, sought to find if differences in cancer rates exist between populations living near oil fields to those free of petrochemical exposure. Of all cancer sites studied, there were significantly elevated relative risks (RR) in both men and women in exposed counties. This study reveals notably higher prevalence of cancers especially in the stomach, rectum, skin melanoma, soft tissue and kidney in men and cancers of the cervix and lymph nodes in women for all sites in proximity to oil fields. This study revealed a great increase in haematopoietic cancers among children less than 10 years of age. Childhood leukaemia and other childhood cancers have been geographically associated petrochemical exposure.

Incidence of Childhood Leukemia and Oil Exploitation in the Amazon Basin of Ecuador

Hurtig, A.K. & Sebastián, M.S. (2004). Incidence of Childhood Leukemia and Oil Exploitation in the Amazon Basin of Ecuador. *International Journal of Occupational and Environmental Health*. 10, 245–250.

Summary:

Anna-Karin Hurtig and Miguel San Sebastián examine leukemia rates of children aged 0-14 living in close proximity to the oil fields of Northeast Ecuador and compared them to a

control population. The study examined the provinces of Sucumbios, Orellana, Napo, and Pastaza, which are all located in Northeast Ecuador. A cancer registry is not available in the Amazon region specifically, but information on cancer can be found in the National Cancer Registry in Quito, the capital of Ecuador. From 1985-2000, the authors found that there had been 91 cancer incidences and 42 leukemia incidences in the areas of Northeast Ecuador investigated. The relative risk for both genders to experience leukemia in all age groups was determined to be significantly increased in areas affected by the oil contamination (relative risk 2.56 with a confidence interval of 95% 1.35-4.86). In Ecuador, 60% of the deaths in children less than 14 years of age are due to leukemia. However, in Quito there has been no change in the incidence of cancer in the 0-14 age group in the 15 years that the National Cancer Registry has existed. Crude oil contains benzene which is a known cause of leukemia. Studies have been conducted in the United States and China on oil field workers who have experienced higher rates of cancer due to this compound. It is possible that due to geographic and socioeconomic impediments, many cancer cases were never referred to Quito and the National Cancer Registry.

Pregnancy and Early Childhood Development

Outcomes of Pregnancy among Women Living in the Proximity of Oil Fields in the Amazon Basin of Ecuador

Armstrong, B., J.A., Sebastián, M.S., & Stephens, C. (2002). Outcomes of Pregnancy among Women Living in the Proximity of Oil Fields in the Amazon Basin of Ecuador. *International Journal of Occupational and Environmental Health*, 8(4), 312-319.

Summary:

This study was conducted in Ecuador on the pregnancy outcomes of women aged 17 to

45. Women living in areas contaminated by oil for at least 3 years were studied and interviewed along with a control group living in areas of the Amazon Basin in Ecuador that were untouched by oil. Local streams and rivers used for drinking, bathing and fishing were tested from both contaminated and uncontaminated areas and the former revealed concentrations of polynuclear aromatic hydrocarbons that were 10 to 10,000 times greater than those considered acceptable according to the U.S. Environmental Protection Agency guidelines. Miscarriage rates were found to be much more prominent in oil-contaminated areas as the study revealed a risk for spontaneous abortion 2.34 times higher among communities situated near oil contamination.

Psychological

The Study of the Psychosocial Impact of Texaco's Oil Production Facilities on Amazonian Communities in Ecuador

Cabrera, R. (2008). Study of the Psychosocial Impact of Texaco's Oil Production Facilities on Amazonian Communities in Ecuador. In *The Cabrera Report* (Appendix L).

Summary:

This study was conducted upon request of the court appointed expert, Mr. Cabrera. The results were used to conclude whether or not Texaco's oil production had any effect on the lives of the people living in close proximity to the pollution. Both quantitative and qualitative data were collected. Surveys were administered to the surrounding populations. A sample size of 1,064 was used to "assess the impact of oil contamination, the level of health perception, and any change in lifestyle and significant experiences linked to Texaco's oil production." Each survey used appropriate methods so as to avoid any bias. Data was collected using 6 different

focus groups comprising of 203 people, 64% men and 36% women. Each focus group took into account culture as well as age in order to gather accurate and varied data. The evidence suggests that there was psychological damage present in the surrounding communities of the contamination. The damages related to different aspects including the contamination in general, loss of land or culture, health impacts, Texaco's behavior, and perception of the remediation.

General Health

Estimated Cost of Delivering Health Care to the Affected Population of the Concession Area of Ecuador

Picone, C.E. (2010). Estimated Cost of Delivering Health Care to the Affected Population of the Concession Area of Ecuador.

Summary:

This article addresses the undefined cost of health care for the affected people of the Ecuadorian communities. The current health care infrastructure was examined. The majority of Ecuadorians lives in poverty and has very limited healthcare resources. Estimates approximate that there were less than 5 doctors, 2 nurses, and 1 dentist per every 10,000 inhabitants of the Sucumbios and Orellana regions. There were approximately 5 hospital beds per every 10,000 inhabitants in those same regions.

The three critical components of the health care program that the article points out are primary healthcare delivery, preventative and rehabilitative services, and education and training. A comprehensive cost estimate was proven to be impossible to determine from the limited data available. Picone then used the per capita approach to determine a cost estimate.

The average health care cost in Ecuador during 2008 was US$231 per person according to World Health Organization (WHO). The multiplication of that number by the estimated population in the affected area, 178,517, predicts the cost of health care to be more than US$41 million per year. Projected over 30 years the number rose to approximately $1.4 billion. Estimations on population and average health care cost indicate that this number is likely an underestimate. This estimation only covers general health care and urgent primary care.

A comparable situation was used in assessing the validity of these estimates. A similar health care program implemented after the tragic 9/11 World Trade Center attack was examined. The range of health effects was comparable as they were caused by ill defined environmental exposures. The estimate, projected over 30 years for this program, was estimated to be around $1.6 billion.

Oil Exploitation in the Amazon Basin of Ecuador: a Public Health Emergency

Hurtig, A.K. & Sebastián, M.S. (2004). Oil Exploitation in the Amazon Basin of Ecuador: a Public Health Emergency. In *Pan American Journal of Health*. 15(3), 205-211.

Summary:

Oil is an important source of income for Ecuador. Between 1972, when drilling in the Amazon Basin of Ecuador began, and 2000, the per capita income rose from US$ 290 to US$ 1200. Today, oil is responsible for 40% of Ecuador's export earnings. In 2003, over 300 producing wells and 29 production camps operated across 1 million hectares producing 390,000 barrels of oil per day. Petroecuador aimed to increase production from 215,000 barrels per day to 600,000 barrels per day by 2005.

Approximately 500,000 people or 4.5% of Ecuador's population live in the Oriente region. This population consists of 8 groups of indigenous people as well as peasants who,

“encouraged by land policies of the national Government, moved to the area from Ecuador’s coastal and highland regions in the 1970’s and the 1980’s” (205).

“Oil is usually mixed with natural gas and ‘formation water’, which contains hydrocarbons, heavy metals, and a high concentration of salts” (206). These wastes were often put in unlined pits called separation ponds from which waste is either directly discharged into the environment or leaches out as the pits degrade or overflow with rainwater. Currently close to 200 open ponds exist. When production commences, over 4.3 million gallons of liquid wastes are generated daily and discharged without treatment into these pits. Additionally, 53 million cubic feet of waste gas is burned by flare stacks daily without temperature or emissions controls (207).

Between 1972 and 1993, more than 30 billion gallons of crude and toxic wastes were spilled into the environment. Concentrations of polynuclear aromatic hydrocarbons were 10-10,000 times greater than recommended by the US EPA. Streams, which cross the village and are the only source of water, had concentrations of total petroleum hydrocarbons over 500 times the limit permitted by European Community regulations. Streams once rich in fish are now barren comparatively. Some villagers have even reported their cattle dying from drinking the water of the streams.

A 1993 study by a community health workers association found increased morbidity, abortion, dermatitis, skin mycosis, malnutrition, and mortality rates in this region. There is also an increase incidence of cancer and approximately 2.5 times higher risk of spontaneous abortions.

Expected socioeconomic improvements made by the adoption of oil development have fallen short. Actions taken by oil companies and the National Government, like covering waste pits, building some schools, and constructing roads, are only ‘patches’ that fail to address the

root of the problem. To resolve these problems the Government should use the Precautionary Principle when considering future oil development. Oil companies should change practices to minimize impact and to build partnerships with local communities. Environmental standards and management plans should be available to all. The community must work with regional, national, and international environmental groups to enforce new Ecuadorian legislation that gives communities the right to be consulted before new oil exploration. Finally, a shift in trade policies in the direction of environmental sustainability is required.

"Yana Curi" Report: The impact of oil development on the health of the people of the Ecuadorian Amazon

Córdoba, J.A. & Sebastián, M.S. (1999). *"Yana Curi" Report: The impact of oil development on the health of the people of the Ecuadorian Amazon*.

Summary:

Prior to the Yana Curi report, there was limited knowledge regarding the health effects caused by exposure to the oil contamination surrounding the oil wells in Northeast Ecuador. This report aimed to give explanations to the concerns that the people of the Oriente region of Northeast Ecuador had about the health impact of oil contamination exposure. The report also intended to increase the limited knowledge about the health effects of living in an oil contaminated region of Ecuador. There is no clear policy regarding the reduction of the contamination caused by oil extraction and there has been little long term effort to remediate the areas that are the most contaminated. In response to the contamination, the people formed the group Amazon Indians and Farmers in 1993 that represented 30,000 affected individuals. This group went to New York to take legal action against the oil companies involved. This lawsuit was accepted after a few

months. The people of Ecuador began the Amazon Defense Front in 1994 to supervise the trial against the oil companies of Ecuador.

The Yana Curi report examines the community of San Carlos that was affected by oil contamination. The study inspected cancer rates, and was broken down by discovery and confirmation of cancer cases between 1989 and 1998, calculating the cancer rate, and investigation of water contamination in the area. There were 10 confirmed cases of cancer in those years. The standard cancer rates for each type of cancer were calculated. The total cancer rate for all types of cancer was calculated to be 2.3 times the standard. A basic environmental evaluation of the region of San Carlos was also conducted. Hydrocarbons in the water supplies greatly exceed the safety limits recognized internationally. Through the collected data, it was determined that people in San Carlos have a much higher risk of cancer

The Yana Curi report also performs a basic evaluation of the environment of the region of San Carlos. It is determined by the researchers that hydrocarbons in the water supplies greatly exceed the safety limits recognized internationally. The hydrocarbon limit according to the European community is 0.01ppm. The hydrocarbons in San Carlos' waters range from 0.097-2.888ppm.

Through the collected data, it was determined that people in San Carlos have a much higher risk of getting cancer. The risk was high enough to suspect that something was causing the elevated cancer levels. The authors explicitly state however that "no study to date had investigated the relationship between cancer incidence and the residence in areas of oil exploitation (San Sebastián and Córdoba, 1999 pg. 15)."

Other

Comments on the Report of the Court-Appointed Expert Richard Cabrera Vega in the Case of Maria Aguinda y Otros v. Chevron Corp.

Beltman D., Chapman D., Maest A., Mills D., & Peers J. (2008). Comments on the Report of the Court-Appointed Expert Richard Cabrera Vega in the Case of Maria Aguinda y Otros v. Chevron Corp. Boulder, CO: Stratus Consulting Inc.

Summary:

This document comments on the report done by Richard Cabrera, who served as a neutral expert to the court in the trial between the people of Ecuador and Chevron. He was charged with reviewing technical and scientific information to recommend action on liability and damages as well as actions that are required to remediate the area of Northeast Ecuador. Beltman, Chapman, Maest, Peers, and Mills were a few of approximately 20 prominent researchers reviewing the Cabrera report. Their conclusion was that Cabrera's approach was sound, reasonable, and consistent with approaches used in similar cases around the world. Cabrera relied on information from concession, other comparable contaminated sites, scientific literature, and environmental regulations to estimate costs associated with the remediation of the oil contamination in Northeast Ecuador. The same approach employed by United Nations Compensation Committee when determining Iraq's responsibility for Kuwait's remediation after the Gulf war was used. It was determined that Cabrera's recommendations followed standard technical and legal practice for assessing and rewarding environmental pollution damages.

The report concluded that TexPet contaminated a large area of the Amazon. There were great damages to the environment and the inhabitants of that area. Cabrera based his conclusions on data on environmental contamination and a history of TexPet operations. TexPet was found to be responsible for approximately 900 oil waste pits. Cabrera studied the health and well being of the people as well as the plant and animal ecosystems. He concluded that

TexPet was responsible for between $18.1 and $18.9 billion in environmental damages. Breaking down this value, he determined that $6.8 million in payment be made per life lost. Comments made by Beltman, Chapman, Maest, Peers, and Mills discuss Chevron's illegitimate attacks on the Cabrera report.

Judicial Inspection of Lago Agrio

Carvajal, L.V. (n.d.) Judicial Inspection of the Lago Agrio Central Production Station. Retrieved November 9, 2010, from the ChevronToxico websit: http://chevrontoxico.com

Summary:

After a review of all field data, lab results, and related documents, a conclusion was made that the contamination still exists at this site. The pollution was caused by the "sub-par" standards of Texaco's oil production operations. Their construction permanently altered the ecosystems in the surrounding areas. The lack of lining of the waste pits caused severe harm to the region. This pollution caused massive amounts of damage to the environment as well at the inhabitants of the area. The pollution has been proven to have contaminated the surrounding bodies of water, specifically the Aguarico river.

Judicial Inspection of the Sacha Sur Station

Felicita, O. (n.d.). Judicial Inspection of the Sacha Sur Station. Retrieved November 9, 2010, from the ChevronToxico websit: http://chevrontoxico.com.

Summary:

Three sites were studied in the Sacha Sur Station where soil and water pollution levels surpassed applicable environmental laws. Through aerial photos, it was concluded that Texaco

was responsible for three oil pits in the Sacha Sur Station that contaminated marshland. The contamination was directly associated with the subpar practices that Texaco employed. The report cites unlined pits, the dumping of formation water directly into rivers without treatment and the direct burning of millions of cubic feet of gas. There is evidence that these toxins have created adverse effects to both human health and the environment. Contaminates leach from the soil into local water supplies used for drinking, bathing, irrigation, and washing. Adverse effects to nervous, digestive, respiratory, and immunologic systems, as well as damages to skin, eyes, heart, liver and kidneys and the creation of different types of cancers have been linked to exposures to byproducts of petroleum. Samples taken by Texaco to test for contaminates were taken from areas less severely and not directly polluted. Samples were prone to dilution, as some were taken upstream from contaminated sites. Texaco did not follow laws that required more eco-friendly operations and practices imposed to protect the environment. There was a great disparity between Texaco's practices in the United States when compared to those in Ecuador, as environmental guidelines were followed within the U.S. This report identifies three of Ecuador's laws that were blatantly ignored by Texaco.

Judicial Inspection of the Shushfindi – 18 Well Site

Carvajal, L.V. (n.d). Judicial Inspection of the Shushfindi – 18 Well Site. Retrieved November 9, 2010, from the ChevronToxico websit: http://chevrontoxico.com.

Summary:

According to analyzed documents, Texaco was the sole operator of Sushufindi-18. Oil-extraction was undertaken at this site between 1973 and 1980. Attempts at reactivation of the well occurred between 1983 and 1985 but were abandoned. Finally, the well became injecting well WIW-09, serving as a processing center for production water created by the Shushufindi

Central Station. Remediation occurred on one of Texaco's oil pits, but lab results indicate an abundance of residual contamination and the existence of at least one pit which was never considered for cleanup.

Current levels of contamination in these pits and the areas surrounding the well exceed three Ecuadorian Environmental laws governing soil and water pollution. At Shushufindi 18, contamination even exceeds standards set by Texaco for satisfactory cleanup.

Soil samples taken by the defendant's expert surpass Ecuadorian Legal Standards by almost 10 times. Groundwater levels of cadmium, TPH, Barium, Nickel, and HAPs exceed legal standards by 2, 3.65, 1.01, 0.6, and 0.81 times respectively. Several graphs, indicating levels of toxins as well as two maps of the polluted area exist at the end of this document.

Oil development and health in the Amazon basin of Ecuador: the popular epidemiology process

Hurtig, A.K. & Sebastián. (2004). Oil development and health in the Amazon basin of Ecuador: the popular epidemiology process. In *Social Science & Medicine*, 60, 799-807.

Summary:

This study examines the popular epidemiology process and outlines methods to complete one. Specifically, the report focuses on the oil contamination problem in Northeast Ecuador and how the popular epidemiology process was implemented to assist those affected by oil exposure. The popular epidemiology process aims to promote action and social change. In this process, communication between the epidemiologist and the community is essential and a focus on involvement and control is needed so the community is represented.

As of 1993, approximately 30 billion gallons of toxic wastes and crude oil were discharged into Northeast Ecuador where 500,000 people and 8 indigenous groups live. In

attempts by communities to confront those who were contaminating their homeland, the lawsuit against Texaco began. The people of Northeast Ecuador made up mostly of peasants and people form indigenous communities founded the Front of Amazon Defense in 1994 in order to watch over the lawsuit against Texaco. The Yana Curi Report, an epidemiologic investigation of Northeast Ecuador aimed at assisting the people impacted by oil contamination, was developed as a simple termed paper revealing the fundamentals of the contamination and how the indigenous are suffering from it.

The first step, defining a research problem, begins with an interaction between the epidemiologist and the community being studied. The community relays their concerns, needs, and concrete knowledge on the topic and the epidemiologist exchanges academic knowledge. It is important for the community and the epidemiologist to meet on a common interest for the epidemiologic study to be successful. The authors presented this process as a general study on their health status. A collaborative partnership with the community was very important to gather data for the study. Once scientific data had been gathered on the oil contamination issue, it was presented to the Front of Amazon Defense who wanted to publicize it to the communities of Northeast Ecuador. This report had a large affect on the impact of Ecuadorian involvement in the lawsuit against Texaco. There is no single correct method for developing an epidemiologic study but trust between the epidemiologist, dialog, and sharing of power is key for a successful one.

Responses to the plaintiffs' questions concerning the expert report

Cabrera, R. (2003). *Responses to the plaintiffs' questions concerning the expert report*. Court of Justice of Nueva Loja.

Summary:

Richard Cabrera responds to comments made by the plaintiffs on his export report regarding the condition of the oil contaminated region of Northeast Ecuador. In this report, Cabrera responds to 44 different questions as well as a few other requests for explanations on certain topics. Cabrera addresses each comment and question to further explain his rationale for methods used or aspects excluded from his report. The plaintiffs questioned five main topics concerning technical conditions and TexPet's prior knowledge, compensation and economic assessment, sampling and analysis, indigenous peoples, and miscellaneous requests.

The plaintiffs requested that Cabrera assess technical conditions that were used when TexPet was extracting oil from the Amazon basin. They questioned whether Cabrera could determine if Texaco had knowledge about any poor equipment causing environmental harm. The plaintiffs noted that Cabrera did not assess compensation values for remediating underground water in the area. Typing errors were clarified, and clarifications on cost of remediation were made. The plaintiffs requested that Cabrera indicate a method used to determine the cost of compensating the indigenous for damages and losses. Cabrera explained the difficulty in that life, clean air, and water have no monetary value. Further explanations were provided on procedures used to administer and conduct surveys on the various populations of the region. Calculation of the population in the concession area and the number of excessive cancer deaths was also explained.

<u>Rights Violations in the Ecuadorian Amazon: The Human Consequence of Oil Development</u>

The Center for Economic and Social Rights. (1994). Rights Violations in the Ecuadorian Amazon: The Human Consequence of Oil Development. In *Health and Human Rights*, 1(1), 82-100.

Summary:

This article explores the oil contamination of Northeast Ecuador and its impact on the lives of the local population. The Center for Economic and Social Rights (CESR) examines the conflict between the development policy of the Ecuadorian Government in regards to oil extraction, and the citizens' human rights to health and a clean environment. The objectives of the CESR were to collect data on contamination levels present in the Ecuadorian Amazon and the health effects associated with it. They aimed to create a report addressing the Ecuadorian Government's policies on oil development and the human rights of the indigenous people affected by the oil contamination. In conclusion, the report states that failure to prevent contamination of the Oriente by the Government of Ecuador was in violation of the human rights of the people who inhabit this region.

Cabrera Report (English)

Cabrera, R. (2008). Technical Summary Report. Retrieved November 9, 2010, from the ChevronToxico website: http://chevrontoxico.com.

Summary:

This extensive report is an expert and technical assessment of the current contamination situation in Ecuador. The four specific areas that were examined for this report are the environmental damage, the specific origin of the damage, verification of the current existence harmful substances, and development of a remediation plan. When all of the samples were collected and examined a statement of their findings was drafted. The blame of the established contamination was placed on Texaco because of their 100% operation of the oil wells and stations. It was found that the contamination was caused by the poor disposal of crude petroleum, drilling mud, production water, and other additives. In conjunction with the

health effects from the contamination, damages to the ecosystems and indigenous culture around the contamination were also examined. Samples far from oil contamination were tested for naturally occurring chemicals to compare results.

Examinations of 82 well sites and 12 stations were conducted from samples collected by both plaintiff and defendant experts. This amount was determined to be an accurate representation of the entire body of potentially contaminated sites. The samples of soil, ground water, and surface water were all collected and tested in an unbiased manner and presented a fairly good depiction of the amount of contamination left by Texaco.

The adverse health effects relating to this contamination were also examined. Surveys were conducted to speculate the number of excess cancer deaths that have occurred as well as spontaneous abortions and moral, social, and economic damage. Along with these health effects, psychological impacts and human rights violations were also addressed. There were reported cases of rape and sexual assaults by Texaco workers that had severe effects on both the families and communities of the area. Health impacts on indigenous cultures from loss of land and forced displacement were also examined.

Estimated costs for all damages were calculated. The damages include remediation, prevention, and compensation for all losses. The total estimate for remediation and prevention was totaled at $3,413,000,000 and the estimated amount for compensations was totaled at $3,785,400,000.

Texaco and it's Consultants

Texaco and it's Consultants. (2005). In *International Journal of Occupational and Environmental Health*, 11(2), 217-220.

Summary:

Texaco released an ad where their scientists pointed out alleged weaknesses in the published studies on the adverse health effects associated with petrochemical exposure. The articles that Texaco attacked were published in peer reviewed articles however, and so were accepted by the scientific community. Texaco claims that disease in Ecuador is a result of poverty, poor sanitation and lack of clean water among other things, without accepting that oil development has severely altered these conditions. The main concern of this article was that Texaco's critiques of scientific studies were not published in research literature which is the place to air legitimate scientific concerns, and would be subject to peer review. The article states, "We encourage our colleagues to submit their critiques of published studies to the scientific literature, not to industries that may be assumed to have vested interests in gainsaying inconvenient scientific evidence, such as Texaco's apparent interest in protecting itself by undermining the Amazonian people's quest for environmental justice."

Kuwait

Oncological

Cations in Malignant and Benign Brain Tumors

Hayat, L. (1996). Cations in Malignant and Benign Brain Tumors. In *Journal of Environmental Science and Health*, 31(8), 1831 – 1840.

Summary:

Certain cations are detrimental to human health when in high concentrations. A number of these have been found in cancer tissues. During the Persian Gulf War the levels of many of these metals were found to be much higher than normal. Contributing to a host of human health problems, these levels have also been associated with an increase of cancer incidence in the region. Different metals found in human tumors, both benign and malignant, were studied.

Investigating the Risk of Cancer in 1990-1991 US Gulf War Veterans With the Use of State Cancer Registry Data

Kang, H.K., Levine, P.H., Mahan, C.M., Maillard, J.D., Simmens, S.J., & Young, H.A. (2010). Investigating the Risk of Cancer in 1990-1991 US Gulf War Veterans With the Use of State Cancer Registry Data. In *Annals of Epidemiology*, 20(4), 265-272.

Summary:

The objective of this study was to determine if Gulf War veterans are at greater risk for developing cancer. Comprehensive data for over 600,000 Gulf War veterans deployed to the Persian Gulf and over 700,000 non-Gulf War veteran controls were collected. Cancer incidence ratios were calculated by the use of logistic regression. They evaluated specific cancer types among all cancers found in the veterans and compared them to the same specific cancer type

among all cancers found in the control group. Lung cancer showed elevated levels in Gulf War veterans. All other cancer types show minimal evidence in support of the link to Gulf War deployment.

Pregnancy and Early Childhood Development

Infertility among male UK veterans of the 1990-1 Gulf War: Reproductive Cohort Study

Carson C., Doyle, P., & Maconochie, N. (2004). Infertility among male UK veterans of the 1990-1 Gulf War: Reproductive Cohort Study. In *BMJ*.

Summary:

The aim of this study was to examine the theory that exposure to toxicants in the Gulf War led to increased levels of infertility among male veterans. A postal questionnaire was administered, out of which 42,818 responses were received. Reported infertility was higher among those deployed to the Gulf theatre. This compared to analysis strictly based on clinically confirmed diagnoses. This study shows evidence of an increased risk of infertility along with a longer time to conceive among those who served in the Gulf War.

Reproductive Health and Pregnancy Outcomes among French Gulf War Veterans

Bégassat, M., Bensefa-Colas, L., Brochard, P., Jutand, M.A, , Salamon, R., Vigan, C.D., & Verret, C. (2008). Reproductive Health and Pregnancy Outcomes among French Gulf War Veterans. In *BMC Public Health*, 8, 141-151.

Summary:

From 2002-2004 this cross-sectional study was conducted to evaluate birth defects in children born to French Gulf War Veterans. Through information gathered from a mailed out survey,

there were reports of fertility disorders, miscarriages, and children with birth defects. The percentages were comparable to those of the civilian population. This study does not support an increased frequency in fertility disorders or miscarriages among veterans of the Gulf War, and didn't find any evidence linking paternal exposure to birth defects of children.

Reproductive Health of Gulf War Veterans

Doyle, P., Maconochie, N., & Ryan, M. (2004). Reproductive Health of Gulf War Veterans. In *Philosophical Transactions of the Royal Society B*, 361, 571–584.

Summary:

This review summarizes the body of scientific research done on the reproductive health of the servicemen of the 1991 Gulf War. Interpretation of these studies was complicated as many methodological constraints existed. According to the US General Accounting Office in 1994, there were at least 21 different toxins present in the Gulf War with the potential for causing birth defects, infertility, stillbirths and miscarriages. It was concluded however that there is no clear evidence that a higher prevalence of birth defects is associated with the progeny of those who served in the Gulf theatre.

Reproductive Health of Male Australian Veterans of the 1991 Gulf War

Forbes, A.B., Glass, D.C., Ikin, J.F., Ittak, P., Kelsall, H.L., McKenzie, D.P., & Sim, M.R. (2007). Reproductive Health of Male Australian Veterans of the 1991 Gulf War. In *Philosophical Transactions of the Royal Society B*, 7, 79-86.

Summary:

An assessment of the reproductive health of Australian Gulf War veteran males was conducted. A postal questionnaire was administered to over 3000 veterans from 2000-2002. Inquiries were

on that of difficulty achieving pregnancy and various pregnancy outcomes. Through evaluation of responses, this study didn't conclude that there was any increase in the risk of adverse reproductive outcomes.

Self-Reported Reproductive Outcomes among Male and Female 1991 Gulf War era US Military Veterans

Gray, G.C., Hiliopoulos, K.M., Kamens, D.R., Sato, P.A., Smith, T.C., Spooner, C.N., Wang, L.Z., & Wells, T.S. (2006). *Self-Reported Reproductive Outcomes among Male and Female 1991 Gulf War era US Military Veterans*. San Diego, CA: U.S. Naval Health Research Center.

Summary:

The objective of this study was to determine whether an association between Gulf War deployment and adverse pregnancy outcomes existed. A postal questionnaire was administered to both deployed and non-deployed Gulf War era veterans and responses were received from 8742 individuals. Analysis didn't show considerable disparity between the two groups relating to pregnancy outcomes during the 4 years following the war.

The Risk of Birth Defects among Children of Persian Gulf War Veterans

Cowan, D.N., DeFraites, R.F., Gray, G.C, Goldenbaum, M.B., & Wishik, S.M. (1997). The Risk of Birth Defects among Children of Persian Gulf War Veterans. In *The New England Journal of Medicine*, 336(23), 1650-1656.

Summary:

There has been concern over an alleged increase in birth defects in children born to Persian Gulf War veterans. An evaluation of medical records of over 75,000 newborns born in 1991-1993 was

conducted, including a control group. The percentage of birth defects compared to that in the civilian population. This study did not find any evidence of increased birth defects among Gulf War Veterans' children.

Psychological

Post-Traumatic Stress Disorder and Chronic Fatigue Syndrome-like Illness among Gulf War Veterans: A Population-based Survey of 30,000 Veterans

Kang, H.K., Lee, K.Y., Mahan, C.M., Murphy, F.M., & Natelson, B.H. (2002). Post-Traumatic Stress Disorder and Chronic Fatigue Syndrome-like Illness among Gulf War Veterans: A Population-based Survey of 30,000 Veterans. In *American Journal of Epidemiology*, 157(2), 141-148.

Summary:

A health survey was conducted to examine the relationship between Gulf War veterans and Post Traumatic Stress Disorder (PTSD) and an illness resembling Chronic Fatigue Syndrome (CFS). Gulf War veterans when compared to a control group had significantly higher rates of PTSD and CFS. An evaluation was performed on the association between extent of deployment related stress and the risk of contracting PTSD or CFS. Aspects exclusive to the Gulf theater in 1991 may have contributed to the contraction of these diseases by veterans.

Pulmonary

Exposures to the Kuwait Oil Fires and Their Association with Asthma and Bronchitis among Gulf War Veterans

Doebbeling, B.N., Heller, J.M., Lange, J.L., Schwartz, D.A., & Thorne P.S. (2002). Exposures to the Kuwait Oil Fires and Their Association with Asthma and Bronchitis among Gulf War Veterans. In *Environmental Health Perspective*, 110(11), 1141–1146.

Summary:

This report examines the relationship between the soldiers' proximity to oil fires and the severity of their symptoms in the analysis of the information gathered. Telephone interviews were conducted with veterans five years after their time in the Gulf to get information on their health, demographics, and exposures. Asthma and bronchitis were the main respiratory effects followed. Models were constructed with the help of satellite imagery to track the location and density of the smoke plume. The article raises concern over the possibility of recall bias and doesn't support the hypothesis that the oil smoke has any effect on veteran's reports of asthma and bronchitis.

Respiratory Health Status of Australian Veterans of the 1991 Gulf War and the Effects of Exposure to Oil Fire Smoke and Dust Storms

Abramson, M.J., Forbes, A.B., Glass, D.C., Ikin, J.F., Ittak, P., Kelsall, H.L., McKenzie, D.P., & Sim, M.R. (2004). Respiratory Health Status of Australian Veterans of the 1991 Gulf War and the Effects of Exposure to Oil Fire Smoke and Dust Storms. In *Thorax*, 59, 897–903.

Summary:

The health of veterans of the Persian Gulf War has been a concern due to exposure to the toxic smoke of the oil fires. A random sample of Australian veterans was given a questionnaire that asked about respiratory conditions, exposures, medications, tobacco use, demographic characteristics, and military service details. The study revealed a higher prevalence of

respiratory symptoms such as asthma and bronchitis in those exposed to the oil fires. The study's findings do not suggest long term respiratory health effects.

General Health

Acetylcholinesterase inhibitors and Gulf War illnesses

Golomb, B.A. (2008). Acetylcholinesterase inhibitors and Gulf War illnesses. In *Proceedings of the National Academy of Sciences of the United States of America*, 105(11), 4295–4300.

Summary:

Evidence exists that the multi-symptom illnesses of the Gulf War veterans is attributed to exposure to organophosphate (OP) and carbamate acetylcholinesterase inhibitors (AChEis), including pyridostigmine bromide (PB), pesticides, and nerve agents. This study examines this link. A casual relationship is supported between AChEis and Gulf War Illness, but is not deemed to be the cause of it. This report finds a plausible relationship between OP and carbamate AChEi exposure and Gulf War Illness and states that the connection may be relevant to future deployments as well as to those experiencing unexplained chronic multi-symptom illnesses.

Are Gulf War Veterans Experiencing Illness due to Exposure to Smoke from Kuwaiti Oil Well Fires? Examination of Department of Defense Hospitalization Data

Gackstetter, G.D., Gray, G.C., Heller, J.M., Hooper, T.I., & Smith, T.C. (2002). Are Gulf War Veterans Experiencing Illness due to Exposure to Smoke from Kuwaiti Oil Well Fires? Examination of Department of Defense Hospitalization Data. In *American Journal of Epidemiology*, 155(10), 908-917.

Summary:

Both the public and veterans have had concerns that exposures during the Persian Gulf War have caused illness. This study compared the health of those exposed to the oil fires in the Gulf theater to those not exposed. Included are tables of different health effects relating to demographics. This study doesn't support the hypothesis that exposure to the oil well smoke has caused any increased risk of illness.

Are Gulf War Veterans Suffering from War-related Illnesses? Federal and Civilian Hospitalizations Examined, June 1991 to December 1994

Gray, G.C., Kang, H.K., Knoke, J.D., & Smith, T.C. (2000). Are Gulf War Veterans Suffering from War-related Illnesses? Federal and Civilian Hospitalizations Examined, June 1991 to December 1994. In *American Journal of Epidemiology*, 151(1), 63-71.

Summary:

This study reviewed hospitalization data of veterans after the Arabian Gulf war. The authors concluded that there have been an increased proportion of veterans hospitalized for fractures and bone and soft-tissue injuries along with various diseases of the respiratory (including asthma) and digestive systems. Further studies using different methods were recommended for more thorough analyses of Gulf War health effects.

Assessing the potential health Impact of the 1991 Gulf War on Saudi Arabian National Guard Soldiers

Al Qahtani, M.S., Barrett, D.H., Cruess, D.F., Gackstetter, G.D., Gray, G.C., Hooper, T.I., Memish, Z.A., Ryan, M.A., Schlangen, K.M., & Smith, T.C. (2005). Assessing the potential health

Impact of the 1991 Gulf War on Saudi Arabian National Guard Soldiers. In *International Journal of Epidemiology*, 34, 801–808.

Summary:

The health impacts haven't been studied on military personal native to the gulf region. This paper seeks to address this. Over 15,000 soldiers from two different combat areas had medical data and hospitalization records investigated. Out of this group, 148 had at least one hospitalization over the 1991 to 1999 period. As this is the first epidemiological investigation to date, there were severe data limitations and so should be interpreted with caution.

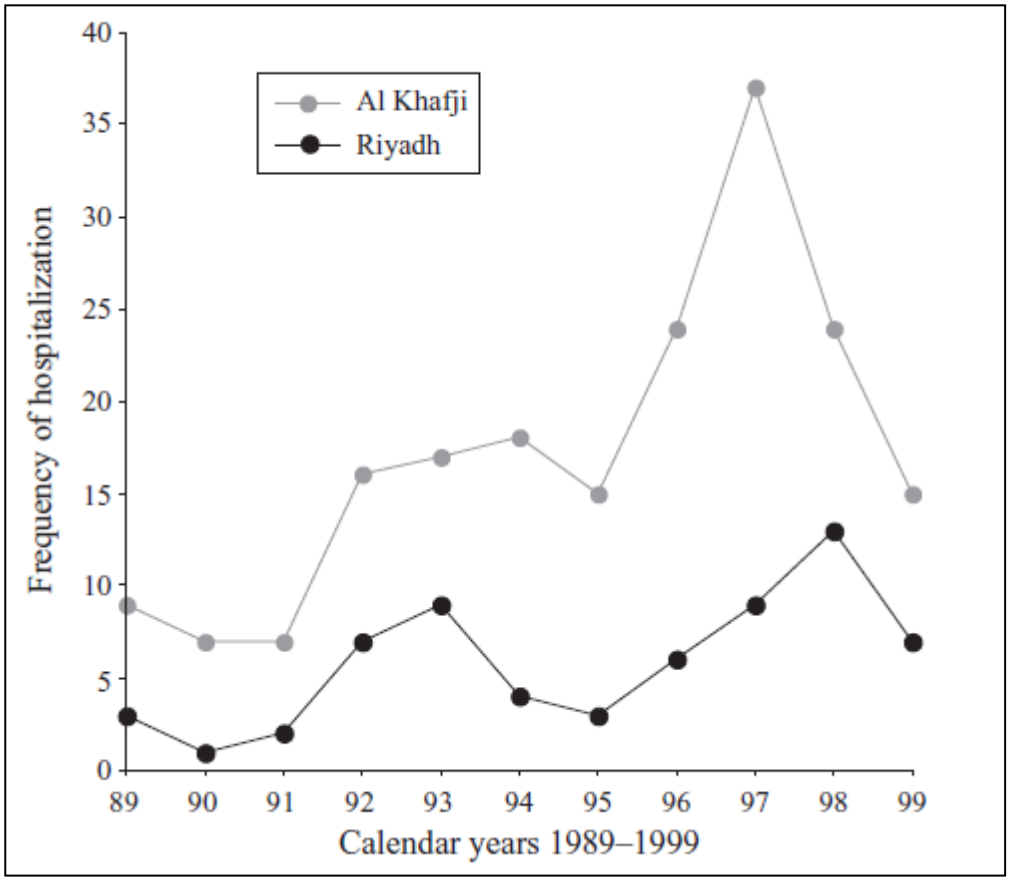

Figure 15: Frequency of post-war hospitalizations at KAMC among SANG soldiers stationed at Riyadh at Al Khafji, 1989-1999

ICD-9-CM Codes	Major diagnostic categories	Number (% hospitalized with diagnosis) Al Khafji (n = 8342)	Riyadh (n = 7270)	Adjusted RR	95% CI
001–139	Infection and parasitic diseases	12 (0.14)	2 (0.03)	3.83	0.84–17.38
140–239	Neoplasms	8 (0.10)	1 (0.01)	5.22	0.65–42.09
240–279	Endocrine, nutritional, and metabolic diseases	16 (0.19)	6 (0.08)	1.50	0.58–3.90
280–289	Blood diseases	9 (0.11)	0 (0.00)	—	—
290–319	Mental disorders	4 (0.05)	0 (0.00)	—	—
320–389	Nervous system diseases	13 (0.16)	4 (0.06)	2.24	0.72–6.89
390–459	Circulatory system diseases	25 (0.30)	9 (0.12)	1.76	0.82–3.81
460–519	Respiratory system diseases	25 (0.30)	13 (0.18)	1.30	0.66–2.56
520–579	Digestive system diseases	37 (0.44)	17 (0.23)	1.36	0.76–2.43
580–629	Genitourinary system diseases	12 (0.14)	4 (0.06)	2.37	0.76–7.35
680–709	Skin diseases	10 (0.12)	3 (0.04)	2.21	0.60–8.15
710–739	Musculoskeletal system diseases	17 (0.20)	5 (0.07)	2.37	0.87–6.47
780–799	Symptoms, signs, ill-defined conditions	9 (0.11)	2 (0.03)	2.78	0.60–12.94
800–999	Injury and poisoning	18 (0.22)	4 (0.06)	2.84	0.95–8.50
Total number of diagnoses		215 (2.58)	70 (0.96)		

ICD-9-CM, *International Classification of Diseases, 9th Revision, Clinical Modification;* RR, risk ratio; CI, confidence interval.

Figure 16: Adjusted Relative Risks for the major diagnostic categories of post-war hospitalization at KAMC, January 1-December 31, 1991.

Effect of Kuwait oil field fires on human comfort and environment in Jubail, Saudi Arabia

Hicks, N.G., Riley, J.J., & Thompson, T.L. (1992). Effect of Kuwait oil field fires on human comfort and environment in Jubail, Saudi Arabia. In *The International Journal of Biometeorology*, 36, 36-38.

Summary:

The smoke plume from the Kuwaiti oil well fires reduced solar radiation 26-36 percent in the region around Jubail. Temperature and shade of the region changed along with the level of comfort of those residing in the area. This paper dwells on the human response to solar radiation load.

Gulf War Exposures

Committee on Veterans' Affairs US House of Representatives. (2007). *Gulf War Exposures*. Washington, DC: U.S. Department of Veterans' Affairs, Serial No. 110–38.

Summary:

This committee hearing discussed the various health effects of the veterans who served in the 1990-1991 Gulf War. Various veterans, scientists, and clinicians spoke at this hearing to provide information on what health effects were present, what medical treatment has been done, and recommendations for future treatment and prevention. The US Department of Veterans' Affairs spoke of research on Gulf War exposures and current exposures in Operation Enduring Freedom and Operation Iraqi Freedom.

Gulf War Illness and the Health of Gulf War Veterans: Scientific Findings and Recommendations

Research Advisory Committee on Gulf War Veterans' Illness. (2008). *Gulf War Illness and the Health of Gulf War Veterans: Scientific Findings and Recommendations*. From the Washington, DC: U.S. Department of Veterans' Affairs website: www.va.gov/RAC-GWVI.

Summary:

The Research Advisory Committee on Gulf War veterans' illnesses has reviewed a vast amount of the research done on the health effects from exposure in the Persian Gulf. The committee's goal was to determine the health outcomes from deployment to the Gulf War. Identification of the root causes of the veteran's multi-symptom illnesses along with descriptions of their biological characteristics is given. Recommendations to guide future research on the topic are also provided. Tables 2 and 3 show studies that assess the health outcomes of oil-fire exposure.

Study	Veterans Studied	Exposure Assessed	Health Outcome	Association of Health Outcomes with Oil Well Fire Exposures During Deployment: Crude (no adjustments)	Adjusted only for military, demographic variables	Adjusted for other deployment exposures
Cherry 2001	7,791 U.K. GWV	Days exposed to oil fire smoke	Overall symptom severity			sign. corr, p < 0.001*
Gray 1999	527 U.S. Navy Seabees	Oil fire smoke	23 individual symptoms	15 of 23 symptoms sign; ORs = 2.1-5.7		
Gray 2002	3,831 U.S. Navy Seabees	Oil fire smoke Oil fire smoke (modeled: yes/no)	GWI (study-defined)	OR (CI) = 2.2 (1.9-2.7)* OR (CI) = 1.5 (1.3-1.8)*		ns OR (CI) = 0.4 (0.3-0.7)*
Haley 1997	249 Seabees, 24th NMCB	Lived/worked in air filled with oil well smoke	Haley Syndrome 1 Haley Syndrome 2 Haley Syndrome 3	RR (CI) = 0.9 (0.1-6.3) RR (CI) = 1.6 (0.2-11.0) RR (CI) = 1.6 (0.2-11.5)		
		Scaled smoke exposure	Haley Syndrome 1 Haley Syndrome 2 Haley Syndrome 3	trend test, p = 0.854 trend test, p = 0.021* trend test, p = 0.072		
Iowa 1997	1,896 Iowa GWV	Smoke/combustion products	Cognitive symptoms Fibromyalgia symptoms	Prev diff = 5.1, p < 0.001* Prev diff = 5.7, p < 0.001*		
Ishoy 1999	686 Danish GWV	Fumes from burning oil wells	Gastrointestinal symptoms	ns		
Kang 2002	10,423 U.S. GWV	Food contaminated with oil, smoke	GW-unique neurological symptom complex	OR (CI) = 10.6 (8.1-13.9)*!		
Nisenbaum 2000	1002 U.S. Air Force GWV	Direct contact with smoke/ crude oil from oil well fires	CMI - Mild-moderate CMI - Severe	OR (CI) = 1.3 (1.0-1.7) OR (CI) = 2.0 (1.2-3.5)*		OR (CI) = 1.3 (0.9-1.8) OR (CI) = 1.6 (0.8-3.4)

Table 2: The health of veterans exposed to the oil fires was assessed in various studies. The major health outcomes associated with the exposure are shown.

Study	Veterans Studied	Exposure Assessed	Health Outcome	Association of Health Outcomes with Oil Well Fire Exposures During Deployment: Crude (no adjustments)	Adjusted only for military, demographic variables	Adjusted for other deployment exposures
Proctor 1998	252 U.S. GWV	Oil fire smoke	Cardiac symptoms Neuro symptoms Pulmonary symptoms		ns ns ns	
Reid 2001	3,531 U.K. GWV	Oil fire smoke	CFS MCS	OR (CI) = 0.9 (0.5-1.4) OR (CI) = 4.3 (1.6-12.2)*	OR (CI) = 1.1 (0.6-2.0) OR (CI) = 4.6 (1.6-13.3)*	
Spencer 2001	1,119 GWV from OR, WA	Eye irritation from burning oil wells				
		1-5 days 6+ days	GWUI (study-defined)	OR (CI) = 1.5 (0.9-2.8) OR (CI) = 3.6 (2.0-6.3)*		
		1-5 days 6+ days	CMI	OR (CI) = 2.6 (1.3-5.2)* OR (CI) = 4.5 (2.1-9.6)*		
Unwin 1999	2,735 U.K. GWV	Oil fire smoke	CMI		OR (CI) = 1.8 (1.5-2.1)*	
Wolfe 2002	945 U.S. Army GWV	Oil fire smoke odor	CMI - Mild-moderate CMI - Severe CMI - Mild, mod, severe	OR (CI) = 2.1 (1.5-2.9)* OR (CI) = 2.9 (2.1-4.1)*		 OR (CI) = 1.6 (1.2-2.1)*

GW = Gulf War; GWV = Gulf War veterans; GWI = Gulf War illness; GWUI = Gulf War unexplained illness; CMI = chronic multisymptom illness;[464] CFS = chronic fatigue syndrome; MCS = multiple chemical sensitivity; OR = odds ratio ; RR = risk ratio; corr = correlation; prev diff = prevalence difference; CI = 95% confidence interval; p = p value; sign. = statistically significant; ns = not significant; * statistically significant; ! calculated from reported data

Table 3: continued. The health of veterans exposed to the oil fires was assessed in various studies. The major health outcomes associated with the exposure are shown.

Gulf War Illness Research – Is Enough Being Done?

Committee on Veterans' Affairs US House of Representatives. (2009). *Gulf War Illness Research – Is Enough Being Done*. Washington, DC: U.S. Department of Veterans' Affairs, Serial No. 111–21.

Summary:

This committee meeting was the first in examining the impact of chemical exposures on the health of Gulf War veterans. This hearing was an attempt to identify the research that has been done on the illnesses of Gulf War veterans. To better assess these illnesses, veterans of Vietnam exposed to harmful toxins were examined.

Gulf war Veteran Health Care Utilization – After more than 10 Years of Study, What Have We Learned?

Gackstetter, G.D., Kang, Graham, J.T., Gray G.C., H.K., & Scott, K.C. (2003). *Gulf war Veteran Health Care Utilization – After more than 10 Years of Study, What Have We Learned*. San Diego, CA: Naval Health Research Center, Report No. 00-26.

Summary:

A review of clinical and epidemiological studies of morbidity among Gulf War veterans was conducted focusing on healthcare registries, hospitalizations, and outpatient visits. To understand the effects that the research to date has had, the authors provide an assessment. Research and studies have reduced speculation on the multi-symptoms of the Gulf War veterans. A greater access is now available for veterans to healthcare. Recommendations have been made for further research.

Health Effects of the 1991 Kuwait Oil Fires: A Survey of US Army Troops

Deeter, D., Elliott, E., Francis, M., Goldenbaum, M., Kanjarpane, D., Lachiver, R., McDiarmid, M., Petruccelli, B.P., & Scott, B. (1999). Health Effects of the 1991 Kuwait Oil Fires: A Survey of US Army Troops. In *International Journal of Occupational and Environmental Health*, 41(6), 433-439.

Summary:

Questionnaires were administered to soldiers to determine the effects of the Kuwaiti oil fires on the health of those exposed. Questions inquired about symptoms before, during, and after their stay in the Gulf theater. The smoke from the burning oil wells may have been a contributing factor of the reported symptoms.

Healthcare utilization and mortality among veterans of the Gulf War

Gray, G.C. & Kang, H.K (2006). Healthcare utilization and mortality among veterans of the Gulf War. In *Philosophical Transactions of the Royal Society B*, 361, 553–569.

Summary:

With the wide array of symptoms reported by veterans of the Persian Gulf War, this study was conducted in attempts to conclude whether or not these symptoms were a result of unusual exposures in the middle east. The delay of up to a year in veterans reporting symptoms backs the hypothesis that illnesses were not caused by toxic exposures.

Impaired Immune Function In Gulf War Illness

Fletcher M.A., Klimas N.G., LaPerriere A., Lin J.M.S., Lonergan W., Vernon S.D., Whistler T., & Zeng X.R. (2009). Impaired Immune Function In Gulf War Illness. In *BMC Medical Genomics*, 2, 12-25.

Summary:

Gulf War Illness (GWI) shares many common characteristics with Chronic Fatigue Syndrome (CFS) and appears to alter immune system function. This report examines immune cell function in patients with GWI when undergoing specific exercises. GWI patients showed impaired immune function.

In-Theater Hospitalizations of US and Allied Personnel during the 1991 Gulf War

Corbeil, T.E., Gray, G.C., Heller, J.M., Ryan, M.A.K., & Smith, T.C. (2004). In-Theater Hospitalizations of US and Allied Personnel during the 1991 Gulf War. In *International Journal of Epidemiology*, 159(11), 1064-1076.

Summary

This article reports the hospitalizations of US military veterans exposed to the oil fires of the Persian Gulf War. Various tables document percentages of health effects of those hospitalized. The study aims to help understand if oil fire smoke exposure or chemical warfare from the destruction of the Khamisiyah depot resulted in any specific health effects or hospitalization. This study did not find a significant amount of evidence of symptoms from exposure of the oil fire smoke severe enough to warrant hospitalization.

Multi-Symptom illnesses, unexplained illness and Gulf War Syndrome

Ismail, K. & Lewis, G. (2006). Multi-Symptom illnesses, unexplained illness and Gulf War Syndrome. In *Philosophical Transactions of the Royal Society B*, 361, 543-551.

Summary:

Many symptoms were reported from veterans of the 1991 Gulf War. There is an increasing consensus that these veterans are experiencing many more multi-symptom conditions

compared to those not deployed to the Arabian Gulf. A variety of physical exposures were considered possible causes of these symptoms. Many Gulf War veterans believe that they are suffering Gulf War Syndrome, a physically unexplained multi-symptom condition, usually relating to changes in mood and cognitive functioning. It is concluded that the majority of the symptoms reported by Gulf War veterans fall under the category of medically unexplained.

Progress of Research on Undiagnosed Illnesses of Persian Gulf War Veterans

House of Representatives, Subcommittee on Hospitals and Health Care. (1995). *Progress of Research on Undiagnosed Illnesses of Persian Gulf War Veterans*. Washington, DC: U.S. Committee on Veterans' Affairs.

Summary:

This hearing addresses the progress that has been made in terms of research done on the undiagnosed illnesses of Persian Gulf War veterans. Testimonies are given by members of the Department of Defense and the Unites States Veterans' Affairs Office on the current state of the research. Testimonies are given by veterans who served in the Gulf theater in 1990-1991.

Self-reported Symptoms and Medical Conditions among 11,868 Gulf War-era Veterans: The Seabee Health Study

Gastañaga, V.M., Gray, G.C., Kaiser, K.S., Reed, R.J., & Smith, T.C. (2002). Self-reported Symptoms and Medical Conditions among 11,868 Gulf War-era Veterans: The Seabee Health Study. In *American Journal of Epidemiology*, 155(11), 1033-1044.

Summary:

This study focused on the health of US Navy Seabees. This group of veterans was characterized as the most symptomatic of those who took part in the Gulf War. Health information relating to

different personal aspects was obtained through a survey questionnaire. The results are presented in various tables. Tables 2 and 3 below show a comparison between different deployment statuses of Navy Seabees.

Self-reported physician-diagnosed illness	Affirmative response (%)			Gulf War Seabees versus Seabees deployed elsewhere		Gulf War Seabees versus nondeployed Seabees	
	Gulf War Seabees (n = 3,831)	Seabees deployed elsewhere (n = 4,933)	Nondeployed Seabees (n = 3,104)	Odds ratio†	95% confidence interval	Odds ratio†	95% confidence interval
Leishmaniasis	0.50	0.04	0.00	6.76	1.52, 30.13		
Chronic fatigue syndrome	5.17	0.79	0.68	5.76	4.03, 8.24	7.60	4.76, 12.13
Posttraumatic stress disorder	3.08	0.61	0.71	4.27	2.79, 6.52	4.23	2.59, 6.92
Multiple chemical sensitivity	1.62	0.32	0.39	4.08	2.29, 7.24	4.47	2.30, 8.69
Irritable bowel syndrome	2.48	0.67	0.81	3.54	2.32, 5.39	3.57	2.22, 5.73
Cirrhosis	0.23	0.08	0.23	3.60	0.94, 13.82	1.30	0.45, 3.79
Skin rash	20.28	7.64	5.64	3.07	2.67, 3.52	4.22	3.51, 5.07
Impotence	2.27	0.93	0.97	2.23	1.51, 3.27	3.06	1.95, 4.83
Depression	7.73	3.67	4.61	2.10	1.72, 2.58	1.77	1.41, 2.27
Peptic ulcer disease	1.54	0.71	0.45	2.14	1.38, 3.34	3.11	1.67, 5.78
Migraines	6.60	3.14	2.58	2.24	1.80, 2.78	2.71	2.04, 3.60
Tinnitus	6.53	3.79	4.16	1.75	1.43, 2.15	1.86	1.47, 2.36
Lumbago	4.05	2.45	1.84	1.67	1.29, 2.15	2.49	1.78, 3.47
Bronchitis	7.36	4.54	4.38	1.55	1.28, 1.88	1.49	1.18, 1.87
Thyroid condition	1.15	0.69	0.97	1.87	1.16, 3.03	1.49	0.89, 2.50
Hypertension	8.09	5.41	5.38	1.63	1.36, 1.95	1.82	1.48, 2.26
Prostatitis	2.38	1.58	1.90	1.38	0.99, 1.91	1.54	1.07, 2.21
Mononucleosis	0.55	0.36	0.23	1.66	0.85, 3.21	1.99	1.80, 4.96
Urinary tract infection	4.62	3.14	2.32	1.55	1.23, 1.96	2.50	1.83, 3.44
Kidney disease	0.34	0.24	0.26	1.18	0.52, 2.69	1.57	0.61, 4.05
Asthma	2.38	1.72	1.45	1.36	0.99, 1.87	1.82	1.23, 2.69
Arthritis	5.87	4.42	4.38	1.44	1.17, 1.76	1.63	1.29, 2.08
Diabetes mellitus	1.04	0.91	1.61	1.06	0.67, 1.68	0.77	0.49, 1.23
Kidney stones	2.57	2.27	2.19	0.86	0.65, 1.14	1.08	0.77, 1.51

* Only conditions with an onset after August 1991 were counted.
† Odds ratios were derived by logistic regression analysis and were adjusted for age, gender, active-duty/Reserve status, race/ethnicity, current smoking, and current alcohol drinking.

Table 4: A comparison of Navy Seabees. Self reported health outcomes by deployment group.

Self-reported medical problem	Affirmative response (%)			Gulf War Seabees versus Seabees deployed elsewhere		Gulf War Seabees versus nondeployed Seabees	
	Gulf War Seabees (n = 3,831)	Seabees deployed elsewhere (n = 4,933)	Nondeployed Seabees (n = 3,104)	Odds ratio†	95% confidence interval	Odds ratio†	95% confidence interval
Multiple chemical sensitivity	4.25	0.67	0.71	5.49	3.72, 8.12	5.95	3.71, 9.55
Nightmares/flashbacks	11.77	2.59	2.29	4.58	3.72, 5.64	4.58	3.50, 6.00
Rash or skin ulcer	22.37	6.12	5.06	4.13	3.58, 4.78	4.85	4.02, 5.85
General muscle weakness	16.29	4.62	4.19	3.69	3.13, 4.35	4.11	3.34, 5.06
Unusual irritability	27.15	8.55	7.06	3.73	3.28, 4.24	4.25	3.60, 5.02
Unusual muscle pains	22.58	6.85	5.67	3.58	3.12, 4.12	4.41	3.68, 5.28
Chills	8.98	2.45	2.55	3.51	2.81, 4.37	3.14	2.41, 4.10
Short-term memory problems	39.49	14.33	12.85	3.59	3.23, 4.00	3.93	3.45, 4.49
Unusual fatigue	38.95	14.13	13.43	3.62	3.25, 4.03	3.65	3.20, 4.16
Frequent rage	17.83	5.66	4.99	3.29	2.83, 3.83	3.31	2.73, 4.02
Night sweats	17.12	5.45	4.61	3.23	2.76, 3.77	3.67	3.00, 4.47
Sudden hair loss	6.37	1.86	1.80	3.33	2.58, 4.30	3.05	2.23, 4.16
Shortness of breath	16.08	5.29	4.54	3.14	2.68, 3.68	3.62	3.01, 4.51
Joint stiffness	30.10	11.23	9.79	3.18	2.83, 3.58	3.85	3.32, 4.46
Sleepiness	22.61	8.03	6.83	3.16	2.77, 3.62	3.38	2.85, 4.01
Diarrhea	24.04	8.86	6.77	2.98	2.62, 3.39	3.75	3.17, 4.44
Bleeding gums	10.42	3.49	2.42	2.90	2.40, 3.51	3.91	3.00, 5.10
Continual cough	9.50	3.22	3.16	3.03	2.48, 3.71	2.70	2.11, 3.44
Trouble sleeping	38.58	16.70	15.46	3.02	2.72, 3.35	3.08	2.71, 3.50
Depression	17.65	6.55	6.02	2.83	2.44, 3.28	3.07	2.55, 3.69
Joint pain	37.85	16.81	13.60	2.83	2.56, 3.14	3.65	3.20, 4.16
Chronic worry/anxiety	17.93	6.83	6.31	2.89	2.50, 3.34	2.79	2.33, 3.34
Appetite loss	9.37	3.43	3.03	2.69	2.21, 3.28	2.54	1.98, 3.26
Chest pain	16.00	6.12	5.09	2.72	2.34, 3.17	3.06	2.52, 3.71
Stomach pain/ulcer	13.44	5.05	4.35	2.75	2.33, 3.24	3.08	2.49, 3.80
Severe headache	26.89	11.31	9.83	2.80	2.48, 3.15	3.03	2.60, 3.52
Constipation	6.89	2.55	2.29	2.74	2.18, 3.45	2.78	2.09, 3.71
Sudden weight loss	6.94	2.70	2.03	2.60	2.08, 3.25	2.99	2.22, 4.03
Sore throat	16.00	6.73	5.67	2.52	2.17, 2.92	2.98	2.47, 3.61
Suicidal thoughts	6.42	2.59	2.67	2.40	1.90, 3.01	2.16	1.64, 2.84
Sudden weight gain	12.03	5.03	4.38	2.50	2.11, 2.96	3.11	2.50, 3.86
Joint swelling/redness	11.38	5.21	3.67	2.28	1.93, 2.70	3.39	2.71, 4.26
Marital stress	19.45	10.12	7.70	1.99	1.75, 2.26	2.61	2.21, 3.08

* Only conditions with an onset after August 1991 were counted.
† Odds ratios were derived by logistic regression analysis and were adjusted for age, gender, active-duty/Reserve status, race/ethnicity, current smoking, and current alcohol drinking.

Table 5: Self reported chronic medical health problems during the 12 months prior to this study of Navy Seabees, 1997-1999.

Testimony on Gulf War Veterans' Illnesses

Barrett, D.H. (200). *Testimony on Gulf War Veterans' Illnesses*. Washington, DC: U.S. Department of Health and Human Services.

Summary:

This testimony before the House Committee on Government Reform, Subcommittee on National Security, Veterans' Affairs, and International Relations provides an update on the CDC's

Gulf War research activities. Provided are explanations of the extents, products, and coordination of current research. Continued efforts are being put forth to address the illnesses of Gulf War veterans. Research will provide aid to those affected as well as shape new deployment techniques and preventative treatment.

The Health Impact of Chemical Exposures During the Gulf War: A Research Planning Conference

The Centers for Disease Control and Prevention. (1999). *The Health Impact of Chemical Exposures During the Gulf War: A Research Planning Conference*.

Summary:

A conference convened bringing together government officials, scientists, clinicians, and veterans to discuss health issues concerning the servicemen of the 1990-1991 Gulf War. The attendees were divided into four different work groups to brainstorm recommendations for future research on the undiagnosed illnesses of Gulf War veterans and their links to chemical and environmental exposures. The work groups focused on pathophysiology, etiology, and mechanisms of action; assessment and diagnosis; treatment; and prevention.

The Long-Term Hospitalization Experience Following Military Service in the 1991 Gulf War among Veterans Remaining on Active Duty 1994-2004

Bellis, K.S., DeBakey, S.F., Gackstetter, G.D., Hooper, T.I., Nagaraj, B.E., Smith. B., & Smith, T.C. (2008). The Long-Term Hospitalization Experience Following Military Service in the 1991 Gulf War among Veterans Remaining on Active Duty 1994-2004. In *BMC Public Health*, 8, 60-73.

Summary:

This describes the long-term hospitalizations of Gulf War veterans still on active duty at least three years following the 1991 Gulf War. Demographic and military service characteristics along with environmental exposure data were used in modeling. The complex health issues associated with deployment to the 1991 Gulf War are still not resolved. Only in-theater hospitalizations were found to be a significant predictor of long term hospitalizations of this selected group of veterans.

The Postwar Hospitalization Experience of Gulf War Veterans Possibly Exposed to Chemical Munitions Destruction at Khamisiyah, Iraq

Gray, G.C., Heller, J.M., Knoke, J.D., & Smith, T.C. (1999). The Postwar Hospitalization Experience of Gulf War Veterans Possibly Exposed to Chemical Munitions Destruction at Khamisiyah, Iraq. In *American Journal of Epidemiology*, 150(5), 532-540.

Summary:

Through use of hospitalization data and models the authors aimed to investigate the comparison between the health of those exposed to a plume from munitions destruction in Iraq to those not exposed. This study does not suggest that veterans exposed to the detonated munitions plume had an increased risk of illness or morbidity after the war when compared to the rest of the veterans. This leaves the question of the cause of the wide spread multi-symptom Gulf War Illness unanswered.

Unexplained Illness Among Persian Gulf War Veterans in an Air National Guard Unit: Preliminary Report - August 1990-March 1995

CDC. (1995). Unexplained Illness Among Persian Gulf War Veterans in an Air National Guard Unit: Preliminary Report - August 1990-March 1995. In *Morbidity and Mortality Weekly Report*, 44(23), 443-447.

Summary:

The CDC was requested to examine illness of Persian Gulf War veterans who served in an Air National Guard (ANG) unit. A three stage investigation took place which began with verifying and characterizing the symptoms of the veterans. The study continued with the determination of whether this particular unit contracted more symptoms than others deployed to the Gulf theater. Concluding the study was a characterization of the illness and identification of associated risk factors.

Other

Cleaning up the Arabian Gulf: Aftermath of an oil spill: The Gulf Oil Spill: Two Years On

Saenger, P. (1994). *Cleaning up the Arabian Gulf: Aftermath of an oil spill: The Gulf Oil Spill: Two Years On*. School of Environmental Science and Management Papers at Southern Cross University's.

Summary:

This paper largely has to do marine life ecosystems and the effects that oil contamination has on them. The United Nations Inter-agency Plan of Action (UNIPA) was able to roughly estimate the extent of the environmental damage and gathered enough information to commence efforts to protect sensitive habitats. They also aimed to determine the delayed effects after the initial spill impact. Results from the Mt. Mitchell 100 day scientific data gathering cruise are outlined. The studies discussed in this report have set the scene for others that focus on more chronic life-

history impacts. Such studies as the disruption of normal cellular histopathology, genetic impairment or disruption, and alteration or modification of normal physiological pathways have been implemented by the Kuwaiti and Saudi Arabian Research Institutes, the Environmental Protection Agencies and by the Regional Organization for the Protection of the Marine Environment (ROPME).

Effect of oil pollution on fresh groundwater in Kuwait

Al-Sulaimi, J., Szekely, F., & Viswanathan, M.N. (1993). Effect of oil pollution on fresh groundwater in Kuwait. In *Environmental Geology*, 22(3), 246-256.

Summary:

The only regions in Kuwait where fresh groundwater exists are in the Raudhatain and Umm A1-Aish regions. This study is the first in assessing the effects of groundwater pollution in these areas by three mechanisms. The means by which oil contaminates ground water outlined in this report are by direct infiltration of oil from oil lakes on the desert land, infiltration of rain water leaching surface oil products into the ground, and by surface leakage of oil from damaged oil well castings.

Environmental Terrorism: Lessons from the oil fires of Kuwaiti

Seacor, J. E. (1994). Note and comment: Environmental terrorism: Lessons from the oil fires of kuwait. In *The American University Journal of International Law & Policy*, 10(1), 481-523.

Summary:

Part 1: Overview of the Persian Gulf War

This section explains the history behind the Gulf war and what led to the disaster.

Part 2: The Kuwaiti Oil Fires

This section describes the impacts of the oil well fires on human health and the environment. It explains the hazards associated with the spills including air and water pollution and the lingering environmental damage.

Part 3: Suppression of Information

This section explores why certain governments continue to suppress information relating the exposure to petrochemicals to human health and the environment.

Part 4: Recommendations under International Law

Through confronting international legal mechanisms, this section outlines a need for more proactive remedies. Discussed are an international criminal court, a "Green Cross" and a fifth Geneva Convention.

Hydrocarbon Contamination of Groundwater in Kuwait due to the Gulf War

Bretzler, A. (n.d.). *Hydrocarbon Contamination of Groundwater in Kuwait due to the Gulf War*. Freiberg University of Mining and Technology.

Summary:

The oil lakes and overall pollution of Kuwait during the Gulf War still pose a great threat to the limited groundwater of the area. This study examines the methods by which the groundwater reserves are being contaminated. The groundwater has been affected by direct penetration through the soil from the oil lakes, by rainwater leaching contaminates deeper into the earth, and by subsurface leakage of oil from damaged oil well castings.

Kuwaiti Oil Fires: Source Estimates and the Plume Characterization

Husain, T. (n.d.). Kuwaiti Oil Fires: Source Estimates and the Plume Characterization. In *Pergamon-Elsevier Science Ltd, Atmospjeric Environment*, 28, 2149-2158.

Summary:

This paper indentifies statistics on the Kuwaiti oil fires, data on Kuwaiti Oil, estimates flow rates and emissions released, and characterizes the smoke plume.

Preliminary Exposure Assessment for Kuwaiti Consumers to Polycyclic Aromatic Hydrocarbons in Seafood

Al-Bahloul, M., Al-Hashash, H., Al-Yakoob, S., & Saeed, T. (1995). Preliminary Exposure Assessment for Kuwaiti Consumers to Polycyclic Aromatic Hydrocarbons in Seafood. In *Environmental International*, 21(3), 255-263.

Summary:

This study aimed to evaluate the extent of pollution in seafood being sold in Kuwaiti markets. The primary purpose was to calculate the exposure to contaminates by consumers through the consumption of this seafood. A wide variety of toxins at high concentrations were found in fish and shrimp samples taken from Kuwaiti fishing waters. Elevated levels of one chemical, naphthalene, omnipresent in seafood samples, were indicative of the pollution of Kuwait's territorial waters with crude oils.

Ten Years After – Lessons from the Gulf War

Committee on Veterans' Affairs House of Representatives. (2002). *Ten Years After – Lessons from the Gulf War*. Washington, DC: U.S. Department of Veterans' Affairs, Serial No. 107–19.

Summary:

The meeting was held in 2002 to examine the preventative procedures in place regarding healthcare at the Department of Defense and the Department of Veterans' Affairs. The goal was to establish whether these departments have employed new methods developed from lessons learned in 1991 in the Persian Gulf to better protect the health of servicemen. Testimonies are given by officials of the DoD and VA among others as well as past senators who have conducted investigations on the Gulf War.

Terrestrial and Atmospheric Environment During and After the Gulf War

Husain, T. (1998). Terrestrial and Atmospheric Environment During and After the Gulf War. In *Environmental International*, 24(1), 189-196.

Summary:

Evaluation of the pollutants in the atmosphere during and after the Gulf War of 1991 was carried out. Impacts on marine life and human health are discussed. The air quality was tested both during and after the war revealing a decrease in pollutants in 1993.

The Impacts of Oil Lakes on the Fresh Groundwater Lenses in Kuwait

Hadi, K. (n.d.). *The Impacts of Oil Lakes on the Fresh Groundwater Lenses in Kuwait*. Water Resource Division at the Kuwait Institute for Scientific Research.

Summary:

This study aimed to establish the extent of groundwater pollution in Kuwait in 1992-1993 after the Persian Gulf War. Concentrations of heavy metals and hydrocarbons were measured and estimated for different groundwater reserves. Impacts of the pollution on the groundwater quality were assessed. Certain samples taken from wells close to the surface contamination far

exceeded international standards on contaminate concentrations. Other wells far from surface contamination did not show high levels of contaminates thus far.

Exxon-Valdez

Psychological

Community Impacts of the Exxon-Valdez Oil Spill: A Synthesis and Elaboration

Arata, C., Formichella, C., Marshall, B.K., & Picou, J.S. (2009). Community Impacts of the Exxon Valdez Oil Spill: A Synthesis and Elaboration. In *Synthesis: Three Decades of Research on Socioeconomic Effects Related to Offshore Petrolium Development in Coastal Alaska* (Chap.9), MMS OCS Study Number 2009-006.

Summary:

This is Chapter 9 of the study entitled Synthesis: Three Decades of Research on Socioeconomic Effects Related to Offshore Petroleum Development in Coastal Alaska. This chapter focuses on community and individual impacts of the Exxon-Valdez oil Spill and the social science literature on the topic. As a result of the spill, the population of the area increased significantly, which led to stressed communities for lodging, food, recreation, transportation as well as other issues. There was also psychological stress identified in commercial fishers residing in Cordova six years after the oil spill. The authors also describe a community recovery program called a "Growing Together Community Education Program", which uses educational intervention as a mitigation strategy.

Disaster Recovery as Translational Applied Sociology: Transforming Chronic Community Distress

Pico, J.S. (n.d.). Disaster Recovery as Translational Applied Sociology: Transforming Chronic Community Distress. In *The Humboldt Journal of Social Relations*, 32(1), 123-157.

Summary:

This study examines the Exxon-Valdez oil spill and the social and psychological impacts. Specifically, a town with 2,500 residents in Cordova, Alaska was studied where inhabitants have experienced many psychological problems such as depression, social problems, post traumatic stress disorder and many others. In Cordova, the salmon and herring fisheries were linked directly to the survival of the local residents cultural and economy. When the Exxon-Valdez oil spill occurred, commercial fisherman experienced devastating environmental impacts. Many people experienced psychological issues as the economy of Cordova is primarily commercial fishing based.

This study examines programs for mitigating chronic impacts of disasters such as the Exxon-Valdez oil spill. Alaska is making the people of Cordova "active participants" in participatory social networks to help the community who has been affected by a disaster. One example is to establish a "growing together" community education program. This program, known as a Peer Listener Training Program (PLTP), was established in Cordova, Alaska with a goal of mitigating of the chronic social and psychological impacts of the Exxon-Valdez oil spill. As a result of this implemented program, residents demonstrated slightly greater knowledge of disasters. Spill related stress declined faster among Cordova residents than non-residents. Psychological stress associated with the Exxon-Valdez oil spill remained high however.

Picou states that community recovery is difficult in the aftermath of a contamination disaster. It is argued that community recovery from toxic disasters such as the Exxon-Valdez oil spill may be socially impossible. However, disaster recovery strategies are being created with necessary partnerships between researchers and residents. A community based participatory action approach is thought to best enable people affected by a disaster to recover from distress.

Disruption and Stress in an Alaskan Fishing Community: Initial and Continuing Impacts of the Exxon-Valdez Oil Spill

Curry, E.W., Dyer, C.L., Gill, D.A., & Pico, J.S. (1992). Disruption and Stress in an Alaskan Fishing Community: Initial and Continuing Impacts of the Exxon-Valdez Oil Spill. In *Industrial Crisis Quartd*, 6, 235-257.

Summary:

The primary objective of this study was analysis of the initial and continuing patterns of community disruption and stress in the aftermath of the Exxon-Valdez oil spill. Picou et al take an ecological-symbolic theoretical approach to show that disasters that contaminate biophysical resources are more prone to happen to natural resource communities. The research setting of this study was Cordova, Alaska where approximately 50% of the economy is commercial fishing. Communities such as Cordova experiencing technological accidents encounter 3 distinct problems: Ambiguity of biophysical damage, likelihood of a corrosive post disaster phase, and tendencies toward sociocultural disruption. By collecting data from a random sample of households and random telephone surveys of residents in Petersburg and Cordova, it was determined that significantly higher levels of social disruption and psychological stress such as uncertainty, fear, outrage, and disruption among residents were present in affected communities in 1989 and 1990. With the completion of this study, the general findings adds to the increasing research literature documenting long term social impacts of disasters such as the Exxon-Valdez oil spill.

Ethnic Differences in Stress, Coping, and Depressive Symptoms after the Exxon-Valdez Oil Spill

Downs, M.A., Palinkas, L.A., Petterson, J.S., & Russel, J. (1992). Ethnic Differences in Stress, Coping, and Depressive Symptoms after the Exxon-Valdez Oil Spill. In *Journal of Nervous & Mental Disease*, 180(5).

Summary:

In this document by Palinkas et al, depressive symptamatology in Alaskan natives and Euro-Americans living in 13 Alaskan communities affected by the Exxon-Valdez oil spill is looked at. The role of family support in these communities as well as differences in depressive syptomatology and exposure in the different ethnicities were looked at. Natives were determined to have significantly higher exposures to oil contaminants, and were more likely to work leaning up the spill. It was also found that depression was linked with participation in cleanup activities while family support served to buffer effects of exposure on depressive symptoms in Euro-Americans, and cultural differences play an important role in determining psychological impacts of a technological disaster.

<u>Ethnic Differences in Symptoms of Post-traumatic Stress after the Exxon-Valdez Oil Spill</u>

Downs, M.A., Palinkas, L.A., Petterson, J.S., & Russell, J. (2004). Ethnic Differences in Symptoms of Post-traumatic Stress after the Exxon-Valdez Oil Spill. In *Prehospital and Disaster Medicine*, 19(1), 102-112.

Summmary:

In this study by Palinkas et al, symptoms of post-traumatic stress disorder (PTSD) after the Exxon-Valdez oil spill in natives and Euro-Americans in Southern Alaska are examined. Prior to this study, reasons for ethnic differences in prevalence of post-traumatic stress disorder were unclear. Ethnic differences were examined in 188 Alaskan natives and 371 Euro-Americans who were exposed to the Exxon-Valdez oil spill. One year after the spill PTSD in both ethnic groups

was evident. Low family support, decline in subsistence lifestyle, and participation in spill clean-up activities were strongly associated with PTSD in the native community. The results of this study suggest that the Exxon-Valdez oil spill is sufficiently traumatic to warrant post-traumatic stress disorder diagnosis. Prevalence of PTSD was slightly higher in natives, and native women were more likely to have a diagnosis of PTSD than native men. There was no gender difference in Euro Americans.

Social, Cultural, and Psychological Impacts of the Exxon-Valdez Oil Spill

Downs, M.A., Palinkas, L.A., Petterson, J.S., & Russell, J. (1993). Social, Cultural, and Psychological Impacts of the Exxon-Valdez Oil Spill. In *Human Organization*, 52(1), 1-13.

Summary:

This study examines the impact of the Exxon-Valdez oil spill on the people of Southern Alaska. Specifically, the sociocultural and psychological impacts one year after the spill were studied. In the Exxon-Valdez oil spill, approximately 11 million gallons of oil were spilled in to the once pure and clean Prince William Sound. With this oil spill, came a long grueling cleanup process. Hourly wages of $17.69 attracted people from all over the country to clean up the spill, but many psychological problems were seen as a result. There was an unequal distribution of jobs to clean up the oil, and compensation for use of boats and equipment was uneven as well. This caused numerous social problems as an increase in drinking, drugs, and domestic violence was observed.

This study was conducted between March 30th and May 15th of 1990, one year after the spill. The sociocultural and psychological impacts of the Exxon-Valdez oil spill were observed in a population of 594 men and women over the age of 18 in 13 different Alaskan Communities.

The areas observed included Prince William Sound, Kenai Peninsula, Kodiak Island, the Alaskan Peninsula, and Southeast Alaska. In these areas, especially in Kodiak and Cordova, Alaska, commercial fishing is a very large part of the economy. In other areas, the lifestyle and quality of life of the residents was tied to the ocean and its resources. In native communities the marine life provided important foods valued and preferred over western foods. With the contamination of the oceans, these natives were unable to acquire the foods they once relied on. The income of people who once relied on fishing was largely affected. Interviews and surveys were conducted on the observed populations. Six separate questions were asked regarding the impact of the contamination on different aspects of everyday life. If the answer to a question was a no the person was given a score of 0 and if the answer was yes they were given a score of 1. The scores were added up over the six questions for a maximum score of six. This provided a measure to the exposure that each person was dealing with. The mean exposure score was 2.54. As a conclusion to this report, the authors were able to determine that there was a decline in social relations as a result of the oil spill as well as an increase in anxiety disorders, post traumatic stress disorders, and depression.

The Exxon-Valdez Oil Spill and Chronic Psychological Stress

Gill, D.A. & Pico, J.S. (1996). The Exxon-Valdez Oil Spill and Chronic Psychological Stress. In *American Fisheries Society Symposium*, 18, 879-893.

Summary:

In this study done by Picou and Gill, the long-term psychological impacts of the Exxon-Valdez oil spill on the structure of the communities that it affected is examined, as well as the stress associated with resources that were contaminated. Many communities in Southern Alaska are renewable resource communities (RRCs), some of which were largely dependent on commercial

fishing in their economies. The authors examine the communities of Cordova, Valdez, and Petersburg by conducting face-to-face survey interviews, telephone interviews, and mail surveys. It was found that chronic psychological stress was tied to communities that were dependent on commercial fishing, and that the communities affected by the Exxon-Valdez oil spill had negative psychological impacts as a result.

The Day Water Died: The Cultural Impacts of the Exxon-Valdez Oil Spill

Gill, D.A. & Pico, J.S. (1997). The Day Water Died: The Cultural Impacts of the Exxon-Valdez Oil Spill. In *The Exxon-Valdez Disaster: Readings on a Modern Social Problem*, pp. 167-187.

Summary:

This study examines the Exxon-Valdez oil spill and its direct effect on the native communities of Southern Alaska. Natives in this region relied on the ecosystem for survival. The life cycle of the salmon fisheries was an integral part of the natural and cultural rhythms of the area, and when these were polluted the subsistence lifestyle that many native tribes practiced were disrupted. The subsistence lifestyle of Alaska includes much hunting and gathering and follows a cycle based on the seasons. When the oil spill occurred, the ecosystem was at the peak of the preparation phase of the subsistence cycle. In this phase the fisheries begin to flourish, but due to the oil contamination many salmon fisheries died out or were too contaminated to eat. Cleanup activities also led to disruption and dislocation of Natives. This made them feel threatened and uneasy in their own communities. Many people experienced psychological problems as a result of the Exxon-Valdez oil spill such as post traumatic stress disorder, and higher levels of anxiety. Social disruption along with the subsistence disruption was also present and continued in years after the spill.

General Health

Health Hazard Evaluation

Bender, T.R., Berardinelli, S.P., & Gorman, R.W. (1991). Health Hazard Evaluation, HETA 89 200 & 89-273-2111.

Summary:

The authors, working under the National Institute of Occupational Safety and Health (NIOSH), focused this health hazard report on occupational exposures that workers involved in the 1989 cleanup of the Exxon-Valdez oil spill were exposed to. This report also attempted to evaluate illness and injury issues associated with the cleanup. Interviews conducted with nurses indicated that skin rashes and upper respiratory infections were present in people who had worked in the cleanup. Much of this report is about cleanup worker exposure to oil products, and a record-based review of health and injury data in the field was unsuccessful in this study.

Other

Review on the Effects of Exposure to Spilled Oils on Human Health

Aguilera, F., Laffona, B., Méndez, J., & Pásaroa, E. (2010). Review on the Effects of Exposure to Spilled Oils on Human Health. In *Applies Toxicology*, 30(4), 291-301.

Summary:

The purpose of this study by Aguilera et al was to gather studies that have been done dealing with health problems associated with exposure to oil and to analyze possible consequences of exposure to varying human health problems. This study looks at a few spill sites, including the 1989 Exxon-Valdez oil spill in Southern Alaska where they note that

numerous psychological health issues were prevalent in Alaskan communities as a result of the spill and studies have been done on these various psychological health problems. Other oil tanker spill sites discussed included the Braer, Sea Empress, Nakhodka, Erika, Prestige, and Tasman Spirit, and the authors discuss what research has been done on these numerous spill sites in regards to health effects of oil exposure.

Social Disruption and the Valdez Oil Spill: Alaskan Natives in a Natural Resource Community

Dyer, C.L., Gill, D.A., & Pico, S.J. (1992). Social Disruption and the Valdez Oil Spill: Alaskan Natives in a Natural Resource Community. In *Sociological Spectrum*, 12, 105-126.

Summary:

This study examines the social impacts of the Exxon-Valdez oil spill on communities dependent on natural resources. A conceptual model called the natural resource community model (NRC) for studying natural resource-dependent communities is presented which depicts the interaction between cultural and biological cycles. The community of Cordova, which is highly dependent on commercial fishing, was examined. Individuals were interviewed in 1989 as well as 1990 which ultimately demonstrated that there were continuing social impacts such as fear and concern in the inability to continue subsistent lifestyle as well as the uncertainty in the ability to restore damaged resources as a result of the Exxon-Valdez oil spill.

When the Solution Becomes the Problem: The Impacts of Adversarial Litigation on Survivors of the Exxon-Valdez Oil Spill

Gill, D.A. & Pico, J.S. (2009). When the Solution Becomes the Problem: The Impacts of Adversarial Litigation on Survivors of the Exxon-Valdez Oil Spill. In *University of St. Thomas Law Journal*, 7(1), 68-88.

Summary:

As a result of the Exxon-Valdez oil spill, many residents of Southern Alaska were severely traumatized and were in shock due to the dependence on the Prince William Sound. The methodology of this report aims to document social and psychological impacts of the Exxon-Valdez oil spill. This report characterizes the Exxon-Valdez oil spill as a technological disaster. Technological disasters occur when systems thought to be under human control fail. There was extreme uncertainty regarding legal rulings and resolution over the litigation in the aftermath of the spill. This article describes the agenda for Picou and some of his colleges focusing on identifying community, economic, cultural, social, and psychological impacts of the spill.

Nigeria

Psychological

Youths, Violence, and the Collapse of Public Order in the Niger Delta of Nigeria

Ukeje, C. (2001). Youths, Violence, and the Collapse of Public Order in the Niger Delta of Nigeria. In *Africa Development*, 26(1), 337-366.

Summary:

This paper examines the role of youth activists in violent conflicts in the Niger Delta region of Nigeria. These conflicts are most common in oil producing regions and occur between activists from regional ethnic groups and the Nigerian State and foreign oil companies. The author overviews community strife in oil producing communities in the Delta, then examines security implications of the conflicts and various reactions by the national government and foreign oil companies. Lastly, he makes recommendations for resolving the youth crisis in the Delta.

General Health

Oil Induced Environmental Degradation and Internal Population Displacement in the Nigeria's Niger Delta

Ibaba, I.S. & Opukri, C.O. (2008). Oil Induced Environmental Degradation and Internal Population Displacement in the Nigeria's Niger Delta. In *Journal of Sustainable Development in Africa*, 10(1), 173-193.

Summary:

This study seeks to address internal population displacement caused by oil based environmental degradation and the resulting losses in productivity in the Niger Delta. The authors summarize the negative implications of each phase of the drilling process and compare current oil practices in the delta to those elsewhere in the world. Citing the connection between oil exploitation and underdevelopment, poverty, violence, and population displacement, the authors determine that multinationals must adhere to standard operational procedures and modern technologies of extraction.

Other

Bioaccumulation of Heavy Metals in Water, Sediment, and Periwinkle (Tympanotonus fuscatus var radula) from the Elechi Creek, Niger Delta

Allison, M.E., Davies, O. A., & Uyi, H. S. (2006). Bioaccumulation of Heavy Metals in Water, Sediment, and Periwinkle (Tympanotonus fuscatus var radula) from the Elechi Creek, Niger Delta. In *African Journal of Biotechnology*, 5(10), 968-973.

Summary:

This study examines the accumulation of heavy metals Cr, Cd, and, Pb in water, sediment, and soft tissues and shells of periwinkles in the Elechi Creek in Nigeria's Niger Delta. Periwinkles are an important source of food in the region and are equally important to commerce. Untreated effluents that contain heavy metals, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs) are routinely discharged into these waters. According to the study, wastes are generated by municipal effluents (>1500 metric ton/day), solid waste (3500 kg/day), and oil waste from garages (150litre/day) in addition to other discharges from sawmills and abattoir. A

map in this document indicates that test sites 2, 3, and 4 are downstream from a Nigerian Agip Oil Company site.

Gas Flaring in the Niger Delta: the Potential Benefits of its Reduction on the Local Economy and Environment

Ishisone, M. (2004). *Gas Flaring in the Niger Delta: the Potential Benefits of its Reduction on the Local Economy and Environment*. Environmental Sciences Group Major, University of California at Berkeley.

Summary:

This is an academic paper on the potential benefits of reduction of gas flaring in the Niger Delta. It provides data on ambient CO levels from four different villages as well as data on other emissions related to flaring. The paper concludes that a reduction of gas flaring would benefit both human health and the environment. Additionally, collecting natural gas and using it as a fuel for electricity generation would greatly improve living conditions in the region by providing energy to many and improving economic conditions.

Impact of Refinery Effluent on the Physicochemical Properties of a Water Body in the Niger Delta

Obiukwu, C. & Otokuneror, T.V. (2005). Impact of Refinery Effluent on the Physicochemical Properties of a Water Body in the Niger Delta. In *Applies Ecology and Environmental Research*, 3(1), 61-72.

Summary:

This study explores the quality of post-treatment refinery effluent and its effects on the Okrika arm of the Bonny River estuary. This body of water receives effluent discharge from the Nigerian

National Petroleum Corporation's refineries in Port Harcourt, Nigeria. This study found that toxicants present in the water and sediment existed in concentrations which individually may be toxic to aquatic life.

Nigeria: Petroleum, Pollution, and Poverty in the Niger Delta

Amnesty International. (2009). *Nigeria: Petroleum, Pollution, and Poverty in the Niger Delta*. London, UK: Amnesty International Publications.

Summary:

This document is a report on oil's effects on the Niger Delta. It provides a comprehensive look at the structure of the oil industry in the Niger Delta as well as pollution and environmental damage in the Delta caused by oil spills, waste disposal, gas flaring, construction of roads, dredging, poor cleanup, and the cumulative effect of all of these problems. The report discusses the human rights impacts of oil pollution as well as how oil companies and the national government have avoided accepting responsibility for the problems oil is causing in the Delta. Lastly, they make recommendations to the President, the National Assembly, the oil companies, and to the State Governments of Nigeria.

Niger Delta Human Development Report

United Nations Development Programme. (2006). *Niger Delta Human Development Report*. Garki, Abuja, Nigeria: United Nations Development Programme.

Summary:

The UNDP is a UN organization that advocates connecting countries to knowledge, experience, and resources in an attempt to "help people build a better life" (UNDP.org). They

focus on helping countries resolve issues relating to democratic governance, poverty issues, crisis prevention and recovery, environment and energy, and HIV/AIDS.

This document identifies problems in the Niger Delta that require attention and solutions. It presents seven agendas for achieving a better Delta region: promote peace as the foundation for development, make local governance effective and responsive to the needs of the people, improve and diversify the economy, promote social inclusion and improved access to social services, promote environmental sustainability to preserve the means of people's sustainable livelihoods, take an integrated approach to HIV&AIDS, and build sustainable partnerships for the advancement of human development.

A background on the current condition of the region is given including economic, geographic, social and environmental factors. A large part of the oil problem in the Delta is enabled by a "crumbling social infrastructure [and] administrative neglect" (9). Oil is responsible for 79.5% of total government revenues and 97.5% of the GDP and thus is beneficial to the Nigerian economy. However, there are negative results associated with oil development as well.

This document describes in depth the justification and methodology for a human development program in the Niger Delta region. They discuss what needs to be done with funding, how the government can reform to better assist and protect its constituents, and how oil development needs to be restricted and policed. Many aspects of Nigerian life are covered in this report, but because oil is such an integral part of the Nigerian economy and directly affects so many both financially and physically it is discussed in detail. Because this is a comprehensive report on the quality of life in the Niger Delta, this document provides data not just on oil and its effects on people but also information of the relationship between oil and many other aspects of life in the delta.

Niger Delta Natural Resource Damage Assessment and Restoration Project: Phase 1 – Scoping Report

Commission on Environmental, Economic, and Social Policy Federal Ministry of Environment; Nigeria Conservation Foundation; & WWF UK. (2006). *Niger Delta Natural Resource Damage Assessment and Restoration Project: Phase 1 – Scoping Report*.

Summary:

From May 21 – May 29, 2006, a team of experts from Nigeria, the UK, and the United States, representing Nigeria's Ministry of Environment, WWF UK, and the IUCN Comimission on Environmental, Economic, and Social Policy, determined that the Niger Delta is among the 5 most petroleum-impacted ecosystems globally.

The team performed a Natural Resource Damage Assessment and Restoration scoping visit, and concluded several things. Through a combination of data collection, estimation, and statistical analysis they determined that roughly 9-13 million barrels of oil have spilled in the Niger Delta over the last 50 years. This environmental damage can be valued at tens of billions of dollars. In addition to spills: road building, forest clearing, dredging and filling; pollution from gas flaring and operational discharges, and increased population pressure from immigration have all contributed to environmental degradation.

They were able to determine that oil development occurred in the Delta without a "comprehensive, strategic plan which would have protected its natural resources" (2). Many oil facilities reside in sensitive habitats including areas vital to fish breeding and sea turtle nesting, as well as mangroves and rainforests which increase poverty and biodiversity loss when damaged. Rural communities have suffered the most from oil development which has triggered increased violence and vandalizing of pipelines and machinery. Lastly, they determined that oil companies in this region operate on a double standard, as they have not employed the better

technology and practices that they use elsewhere in the world. Thus, a comprehensive "Environmental Restoration Programme" should be developed and implemented immediately. The scoping report gives an overview of the issues, damages, natural resources in need of restoration, restoration models, and preliminary recommendations. The appendices provide data on severly oil-polluted sites in the Delta, calculations for the spill sizes, as well as a list of names with contact information (much of it out of date) for those who attended this workshop.

Oiling the Friction: Environmental Conflict Management in the Niger Delta, Nigeria

Ibeanu, O. (2000). Oiling the Friction: Environmental Conflict Management in the Niger Delta, Nigeria. In *Environmental Change & Security Project Report*, 6, 19-32.

Summary:

This study examines the management of conflicts between the oil companies and Nigerian federal government and various ethnic groups living in the Niger Delta region. The author summarizes the environmental conditions of the region past and present, and provides data on gas flaring. He discusses causes of conflict and several management attempts including violent resistance from both the federal government and ethnic groups like the Ogoni and community-based approaches. The author recommends that oil companies distance themselves from the federal government and that the federal government establish a trust fund to be run by trustees elected on a non-party basis from the communities in the Niger Delta.

Gulf of Mexico

Pregnancy and Early Childhood Development

Children's Health: AAP Publishes Oil Protection Guidelines for Children

Weinhold, B. (2010). Children's Health: AAP Publishes Oil Protection Guidelines for Children. In *Environmental Health Perspect*, 118(10), A431.

Summary:

The American Academy of Pediatrics developed a list of guidelines for parents to follow to limit their child's exposure to oil. These recommendations apply to air, water, beach, and food issues. They also are applicable for a variety of oil exposure situations.

Psychological

Anger and anxiety on the Gulf Coast

Devi, S. (2010). Anger and anxiety on the Gulf Coast. In *The Lancet*, 367(9740), 503-504.

Summary:

Addressing the mental health effects of the Gulf oil spill, this article examines the increase in different mental disorders. Health officials in the area are beginning to see increases in anxiety, depression, substance abuse, and domestic violence that they believe to be caused by the stress over the spill. Health officials anticipate that similar metal health disorders seen after hurricane Katrina will arise. Experts are beginning to collect health records from clean up workers identifying what types of health effects to look out for in the near future.

Managing Traumatic Incident Stress for Deepwater Horizon Response and Volunteer Workers

NIOSH. (2010). *Managing Traumatic Incident Stress for Deepwater Horizon Response and Volunteer Workers*. Retrieved November 30, 2010, from NIOSH website, Workplace Safety and Health Topics section: http://www.cdc.gov/niosh.

Summary:

This article identifies recognition and prevention methods for the stress that workers might experience when assisting in the clean up of the Gulf oil spill. Because these volunteers are involved in the clean up of a "traumatic incident" certain stresses may arise. Symptoms of these stresses may occur during the work and sometimes weeks or even months after they have finished. The symptoms described in the article are in three categories, physical, emotional, and thinking. The article also gives recommendations for monitoring your health while you are on site as well as after the work is completed.

Pulmonary

Reducing Occupational Exposures while Working with Dispersants During the Deepwater Horizon Response

NIOSH. (2010). *Reducing Occupational Exposures while Working with Dispersants During the Deepwater Horizon Response*. Retrieved November 30, 2010, from NIOSH website, Workplace Safety and Health Topics section: http://www.cdc.gov/niosh.

Summary:

Dispersants have been used in the Gulf to assist the cleanup of the oil spill. It is important that the right precautions be taken when working with these chemicals. This report identifies the safety methods that should be used around these chemicals. Chemicals such as COREXIT

EC9527A and COREXIT 9500 are being used. These chemicals contain sulfonic acid and propylene glycol, which were deemed non-hazardous, but also contain 2-buloxyethanol which is known to cause skin and respiratory irritations.

General Health

Assessing the Effects of the Gulf of Mexico Oil Spill on Human Health

Institute of Medicine. (2010). *Assessing the Effects of the Gulf of Mexico Oil Spill on Human Health.* Washington, DC: The National Academies Press.

Summary:

In June of 2010 a conference lead by the Institute of Medicine was held in Louisiana. This conference addressed the issue of the potential health impacts of the BP oil spill. The conference addressed the best methods for dealing with the situation and the lack of information currently on health effects of oil exposure.

CDC Response to the Gulf of Mexico Oil Spill

CDC. (2010). *CDC Response to the Gulf of Mexico Oil Spill*. Retrieved November 30, 2010, from, CDC website, Emergency Preparedness and Response section: http://www.bt.cdc.gov.

Summary:

On April 20th the National Center for Environmental Health initiated a response to the BP oil spill. Following this, a series of other organizations, including the CDC, began efforts as well to help with the situation. The CDC responded with surveillance of health threats, workers safety, data analysis, and communication with the public. In the surveillance of health threats,

systems such as the National Poison Data System and others were used to track symptoms related to the eyes, skin, and respiratory, cardiovascular, gastrointestinal, and neurological systems. Safety information was shared with participating members of the clean up and evaluations were conducted on the workers. Samples from the Gulf coast area were taken and analyzed. Service announcements, fact sheets, web postings, and news media were used to keep the public informed.

Chemical Exposure Assessment Considerations for Use in Evaluating Deepwater Horizon Response Workers and Volunteers

NIOSH. (2010). *Chemical Exposure Assessment Considerations for Use in Evaluating Deepwater Horizon Response Workers and Volunteers*. Retrieved November 30, 2010, from NIOSH website, Workplace Safety and Health Topics section: http://www.cdc.gov/niosh.

Summary:

Occupational safety measures are provided for the workers and volunteers who helped with the cleanup of the Gulf oil spill. The content focuses on protection against chemical exposures. Assessments were conducted to identify, characterize, estimate, and evaluate the work place exposures. These assessments provide a way to help prevent occupational injury and illness. The report also discusses the initial oil spill sampling strategy that was developed by the Occupational Safety and Health Administration. The strategy is explained including the purpose, sampling strategy, analytical consideration, and components to look for in the samples. Suggestions on how to communicate the results of the analysis and how to deal with administration and logistical considerations are addressed.

Environments and Health: Will the Deepwater Horizon Oil Spill Affect Our Health?

McCauley, L.A. (2010). Environments and Health: Will the Deepwater Horizon Oil Spill Affect Our Health? In *American Journal of Nursing*, 110(9), 54-56.

Summary:

Experts from the Institute of Medicine met in June to examine potential short and long term health effects of the Deepwater Horizon oil spill.

Interim Guidance for Protecting Deepwater Horizon Response Workers and Volunteers

NIOSH. (2010). *Interim Guidance for Protecting Deepwater Horizon Response Workers and Volunteers*. Retrieved November 30, 2010, from NIOSH website, Workplace Safety and Health Topics section: http://www.cdc.gov/niosh.

Summary:

This report provides recommendations on how to minimize the health hazards of workers of the deepwater horizon response team. A list of general recommendations is included in the report. Recommendations include the use of engineering and administrative controls to limit the exposure to toxic chemical and physical agents, heat, fatigue, and psychological stresses. Inhalation of crude oil, dispersants, and combustion products are believed to pose threats, however information is still being collected. Protective equipment is recommended for areas where inhalation of chemicals may occur. Pre-placement evaluations and the collection medical records pertaining to symptoms, injuries, and illnesses on the job are also recommended.

Lessons for Study of the Health Effects of Oil Spills

Engel, L.S., & Savitz,D.A. (2010). Lessons for Study of the Health Effects of Oil Spills. In *Ann Intern Med*, 153(8), 540-541.

Summary:

Five recommendations are made for dealing with the health effects of oil contamination. These include collecting exposure and medical histories from volunteers and workers who have participated in the cleanup and conducting detailed exposure assessments. This information allows for a detailed background leading up to the health effects seen. The importance of studying the acute symptoms as well as the delayed conditions is stressed. The authors advised that future research topics be planned to guide immediate public health interventions and to advance science. There is a need for research that provides immediate value to the affected. The authors also recommend the importance of non-partisan information. They feel it is necessary to publicize information and research that is non bias and has no political agenda.

Medical Pre-Placement Evaluation For Workers Engaged in the Deepwater Horizon Response

NIOSH. (2010). *Medical Pre-Placement Evaluation For Workers Engaged in the Deepwater Horizon Response*. Retrieved November 30, 2010, from NIOSH website, Workplace Safety and Health Topics section: http://www.cdc.gov/niosh.

Summary:

This evaluation provides techniques for treating workers and volunteers of the Deepwater Horizon response team. A pre-placement evaluation would be used to collect the medical histories of workers before they begin clean up work on an oil spill. The evaluation would provide information on workers who might be susceptible to certain health risks. This information could help determine the safest clean up job for particular people. The evaluation draws from a physical exam, medical history, and other appropriate tests. It is recommended that these evaluations be preformed immediately before deployment to the work field.

Medical Pre-Placement Evaluation Indicators for Health Professionals

NIOSH. (2010). *Medical Pre-Placement Evaluation Indicators for Health Professionals.* Retrieved November 30, 2010, from NIOSH website, Workplace Safety and Health Topics section: http://www.cdc.gov/niosh.

Summary:

This report, along with the article Medical Pre-Placement Evaluation For Workers Engaged in the Deepwater Horizon Response, assists health professionals with the overall evaluation of workers exposed to oil contamination. Provided are a list of medications, medical conditions, and potential risk factors. These will assist professionals in determining when more information on a patient should be collected.

NIOSH Ongoing Health Hazard Evaluation

NIOSH. (2010). *NIOSH Ongoing Health Hazard Evaluation.* Retrieved November 30, 2010, from NIOSH website, Workplace Safety and Health Topics section: http://www.cdc.gov/niosh.

Summary:

A health hazard evaluation was conducted on the responders to the Deepwater Horizon oil spill. This evaluation was the eighth to be carried out and was comprised of two sections. The first section was a qualitative exposure assessment of two different sites in Port Fourchon, Louisiana. The second component of the evaluation was an assessment of 499 workers at 17 different work sites across Louisiana, Alabama, Florida, and Mississippi.

Protecting Workers and Volunteers Responding On-Shore to Hurricanes from the Gulf of Mexico

NIOSH. (2010). *Protecting Workers and Volunteers Responding On-Shore to Hurricanes from the Gulf of Mexico.* Retrieved November 30, 2010, from NIOSH website, Workplace Safety and Health Topics section: http://www.cdc.gov/niosh.

Summary:

During hurricane season, the crude oil in the Gulf of Mexico has the potential to spread much further. This report explains how workers and volunteers who have assisted in the clean up might be at risk of oil exposure. Workers are most at risk when conducting debris removal. Weathered crude contains little volatile organic compounds which makes exterior contact with the oil less hazardous. However, during cutting, grinding, or other abrasive methods involved in cleanup of debris, respiratory precautions are advised.

Other

Pulmonary

Lung Health in Relation to Hydrogen Sulfide Exposure in Oil and Gas Workers in Alberta, Canada

Herbert, F.A., Hessel, P.A., Melenka, L.S., Nakaza, M., & Yoshida, K. (1997). Lung Health in Relation to Hydrogen Sulfide Exposure in Oil and Gas Workers in Alberta, Canada. In *American Journal of Industrial Medicine*, 31(5), 554-557.

Summary:

This is a 1997 study on the symptoms presented in oil and gas workers in Alberta, Canada who were exposed to H_2S, which is often present in papermaking, heavy water manufacture, rayon textile manufacture, sewage treatment, and others. H_2S often contaminated natural gas, and as a result can be present where drilling for oil and natural gas occurs. This study did not conclude that a correlation between exposure to H_2S and pulmonary health effects. However, workers who had experienced a knockdown as a result of exposure to high concentration of H_2S had statistically significant excesses of several respiratory symptoms consistent with airway hyperactivity.

General Health

Acute Health Problems Among Subjects Involved in the Cleanup Operation Following the Prestige Oil Spill in Asturias and Cantabria (Spain)

Aragone´s, N., Carrasco, J.M., Guzma´n, A., Lope, V., Lo´pez-Abente, G., Marque´s, F., Martı´n Moreno, J.M., Pe´rez-Go´mez, B., Polla´n, M., Rodrı´guez-Artalejo, F., Sua´rez, B., & Viloria, L.J. (2005). Acute Health Problems Among Subjects Involved in the Cleanup Operation Following the Prestige Oil Spill in Asturias and Cantabria (Spain). In *Environmental Research*, 99(3), 413-424.

Summary:

Through a structured questionnaire given to responders to the Prestige oil spill, data was collected on exposure conditions and health effects. A random sample of 400 workers from both Asturias and Cantabria were given the questionnaire that included questions on specific tasks, number of working days, use of protective materials, and acute health effects. The data, separated into the categories of injuries and toxic effects was analyzed and produced an outcome with a 95% confidence interval. The results concluded that bird cleaners were the most prone to injuries. Workers exposed to 20 days or more of highly contaminated areas were found to be at a higher risk of injury. The workers who were the most likely to have toxic effects were the seamen, potentially due to their high exposure rates. There were no severe disorders found among the surveyed workers however it was recommended to take precautionary measures when carrying out clean up tasks. It was also noted that similar situations of oil contamination may produce severe health effects.

Acute Health Problems among the People Engaged in the Cleanup of the Nakhodka Oil Spill

Deguchi, Y., Iki, M., Kawahara, K., Kusaka, Y., Miyazaki, S., Morita, A., Moriuchi, A., & Nakanaga, Y. (1999). Acute Health Problems among the People Engaged in the Cleanup of the Nakhodka Oil Spill. In *Environmental Research*(Section A), 81, 185-194.

Summary:

In this study, 282 people who were involved in the cleanup of the Nakhodka oil spill in the Sea of Japan were interviewed and examined to determine if they had suffered any health issues from the exposure to oil during the cleanup. It was found that symptoms most prevalent in the people examined were lower back pain, leg pain, headache, eye symptoms, and throat symptoms. It is concluded that acute health problems in local residents were suggested to have been caused by exposure to crude oil in the cleanup of the Nakhodka spill.

Association Between Health Information, use of Protective Devices and Occurrence of Acute Health Problems in the Prestige Oil Spill Clean-up in Asturias and Cantabria (Spain): A Cross-Sectional Study

Aragonés, N., Carrasco, J.M., Lope, V., López-Abente, G., Pérez-Gómez, B., Pollán, M., Rodríguez-Artalejo, F., & Suárez, B. (2006). Association Between Health Information, use of Protective Devices and Occurrence of Acute Health Problems in the Prestige Oil Spill Clean-up in Asturias and Cantabria (Spain): A Cross-Sectional Study. In *BMC Public Health*, 6, 1.

Summary:

This article examines the frequency of acute health problems and the association these health problems have with use of protective devices. The importance of health information supplied to workers of an oil spill cleanup is analyzed. The cleanup of the Prestige oil spill along Northern Spain in November of 2002 is the spill site examined in this article. Through telephone interviews people involved in the cleanup were studied and it was determined that workers informed on health-protection utilized protective devices when cleaning up the oil spill and had a lower frequency of acute health problems as a result. Seamen, the least informed group of oil spill clean-up workers on health protection, suffered the most health problems of all workers.

Biologic Effects of Oil Fly Ash

Carson, J.L., Ghio, A.J., Samet, J.M., & Silbajoris, R. (2002). Biologic Effects of Oil Fly Ash. In *Environmental Health Perspective*, 110(1), 89-94.

Summary:

This study examines residual oil fly ash resulting from the burning of oil and residual fuel oil and the effects that it can have on human health when exposed to it. This article describes problems that exposure to oil fly ash can cause to cells. It is also examines how inhalation of oil fly ash can lead to bronchitis, and exposure to high concentrations can lead to many other negative health effects. The effects of exposure to residual oil fly ash on animals are also studied in this article.

Health Effects of Exposure to Oil Spills

Montes, I.I., Rodríguez-Trigo, & G., Zock, J.P. (2007). Health Effects of Exposure to Oil Spills. In *Archivos de Bronconeumologia*, 43(11), 628-635.

Summary:

This paper's main focus is the Prestige oil spill that happened off the coast of Spain. Clinical and epidemiological data published prior to this study is summarized in the conclusion. A review of scientific studies involving similar oil tanker spills that have occurred is included. Also examined are studies of other oil tanker spills which include the Exxon-Valdez, the Braer, the Sea Empress, the Nakhodka, and the Erika. It was found that health related issues that have been associated with the Prestige oil spill include neurovegetative symptoms, skin irritation, irritation to mucus membranes and respiratory problems.

Initial Study on the Effects of Prestige oil on Human Health

Cabaleiro, T., Laffon, B., Lafuente, A., Méndez, J., Pásaro, E., & Pérez-Cadahía, B. (2007). Study on the Effects of Prestige oil on Human Health. In *Environmental International*, 33(2), 176-185.

Summary:

Pérez-Cadahía et al examine the health issues from the cytogenetic and endocrine point of view experienced by people exposed to the Prestige oil spill that happened off the Northwest coast of Spain in 2002. An exposed population of 68 people and a control population of 42 people who were not exposed to the oil were examined. Volatile organic compounds in the environment were examined and blood sampling to test for heavy metal levels was conducted. It was determined that cytogenetic damage was present in individuals exposed to oil from the Prestige spill and that the oil could be considered an endocrine disruptor. The authors conclude that these reasons are good indicators that exposure to oil from the Prestige spill was toxic.

Inupiat Health and Proposed Alaskan Oil Development: Results of the First Integrated Health Impact Assessment/Environmental Impact Statement for Proposed Oil Development on Alaska's North Slope

Wernham, A. (2007). Inupiat Health and Proposed Alaskan Oil Development: Results of the First Integrated Health Impact Assessment/Environmental Impact Statement for Proposed Oil Development on Alaska's North Slope. In *Ecohealth*, 4(4), 514.

Summary:

When and Environmental Impact Statement (EIS) is conducted, human health is usually not a part of the analysis. When Alaska's North Slope region was a sight for oil and gas development the first ever Health Impact Assessment (HIA) was implemented. As the development encroached on the communities of the region, concerns rose over the effect on human health. Through the methodology of the HIA, using stakeholder input, literature review, and qualitative analysis, the health impact was determined. The potential health problems recognized were "diabetes and related metabolic conditions as a result of dietary change; rising rates of substance abuse, domestic violence, and suicide; increased injury rates; more frequent asthma exacerbations; and increased exposure to organic pollutant, including carcinogens and endocrine disruptors." With these risks there are also some benefits to the development such as increased employment, increased revenue, and health benefits to more members of the community. Recommendations were made to look further into the health impact of the community.

Overview and Characteristics of Some Occupational Exposures and Health Risks on Offshore Oil and Gas Installations

Gardner, R. (2003). Overview and Characteristics of Some Occupational Exposures and Health Risks on Offshore Oil and Gas Installations. In *The Annals of Occupational Hygiene*, 47(3), 201-210.

Summary:

This study examines the health risks in the offshore oil and gas industry. The amount of published information on health risks of exposure to oil when working offshore is limited. The most people that have ever worked offshore in the UK sector previously was 34,000 in 1992-1993, while in 2003, when this study was completed, there were 20,000. Gardner inspects the special features of working offshore which can potentially lead to health problems. These include the major hazard potential, long workday, ageing workforce, and chance for multiple exposures. He notes that there are data pertaining to the health effects experienced in the event of oil related accidents on a rig offshore. Long term health effects of working on offshore oil rigs have been difficult to determine. Inhalation risks from mud, which is an oil and water based mixture, noise induced hearing problems, as well as dermatitis from skin contact to mud are some of the health issues examined in this study.

Review on the Effects of Exposure to Spilled Oils on Human Health

Aguilera, F., Laffon, B., Mendéz, J., & Pasáro, E. (2010). Review on the Effects of Exposure to Spilled Oils on Human Health. In *Journal of Applies Toxicology*, 30, 291-301.

Summary:

The purpose of this study was to gather studies that have dealt with health problems associated with exposure to oil and to analyze the relation of possible consequences of exposure to varying human health problems. This study looks at a few spill sites, including the 1989 Exxon-Valdez oil spill in Southern Alaska. In this particular spill, numerous psychological

health issues were prevalent in Alaskan communities as a result of the spill. Other oil tanker spill sites discussed include the Braer, Sea Empress, Nakhodka, Erika, Prestige, and Tasman Spirit. The authors discuss what research has been done on these numerous spill sites in regards to health effects of oil exposure.

Oil Exposure and Chronic Health Effects on Indigenous Populations in South America

Merlos, M.G. (2009). *Oil Exposure and Chronic Health Effects on Indigenous Populations in South America*. Institute for Risk Assessment Science at Utrecht University.

Summary:

In this study, Merlos identifies cases in South America in which indigenous people have been exposed to crude oil due to poor oil extraction practices. She also identifies other chemicals along with oil byproducts such as polycyclic aromatic hydrocarbons and volatile organic compounds that can have negative impacts on human health. Merlos also identifies and comments on epidemiological studies on the chronic health effects of crude oil exposure and notes that there is a correlation between oil exposure and respiratory problems. No population studies were found however for respiratory health in Ecuador or Bolivia. The author also examines articles completed on reproductive health and cancer incidence. It is noted that some studies that have been done are dubious, and further and efficient research is required on the health effects of oil exposure.

Other

Impacts of Petroleum Activities for the Achuar People of the Peruvian Amazon: Summary of Existing Evidence and Research Gaps

Ciborowski, S., Fabregas, X., MacLennan, G.J., Martinez, M.O., Napolitano, D.A., & O'Callaghan, C. (2007). Impacts of Petroleum Activities for the Achuar People of the Peruvian Amazon: Summary of Existing Evidence and Research Gaps. In *Environmental Research Letters*, 2, 1-10.

Summary:

In this study, the authors identify that little research has been done of the specific environmental and health impacts of oil extraction in the Achuar territory in the Northern Peruvian Amazon. The authors review existing studies to examine the evidence of pollution and health issues related to the oil extraction in this region. Along with literature reviews, interviews of the people of Peru who were affected and physical inspections of impact locations were conducted to examine the environmental and health impacts in Northern Peru. In a study previously done it was found that increased lead levels as well as cadmium were found in the blood of children aged 2-17. The authors conclude that an in-depth analysis of the health status of the people in the Achuar territory of Northern Peru needs to be conducted.

Appendix C: Email Template

This template was used when making initial contact with a researcher or other person whose knowledge or assistance was required. This template was slightly altered for each email for the purpose of personalization, but the basic structure was consistent throughout all initial correspondence.

Email Template

To gather scientific documents about the health effects of oil contamination, numerous professionals had to be contacted. Rather than re-drafting a new email each time it was necessary to email somebody, we used an email template. Each email followed this template, with basic changes to it made to compensate for the person that was being contacted.

Format of the email:

My name is (_____) and I am currently a student at Worcester Polytechnic Institute. I am currently working on an academic project with 3 other students on the health effects of oil contamination and exposure and [(have read your studies regarding (_____).) or (was given your name by (_____) from (_____) .)]

Through research of the problems associated with oil contamination, we have determined that an information portal or database which houses scientific data would be useful for future research. We aim to facilitate collaboration between researchers in an attempt to promote and support future scientific studies on the health risks of oil exposure. We aim especially to encourage communication/collaboration between researchers at different sites around the world (i.e. Ecuador, Niger Delta, Kuwait, Deepwater Horizon, etc.). It is our belief that a web portal that houses data and contact information for researchers from polluted sites

around the world would encourage sharing of information between all places affected by oil development and thus would act as a foundation for building a global initiative to protect human rights and environmental conditions.

(Reasons why the researcher or the organization the researcher is a part of would be useful to us) If you have any other scientific data on the health effects of exposure to petroleum products in other sites around the world, contact information of people who might have this information, or any comments about our ideas, any and all would be greatly appreciated.

(The documents that we have already collected regarding the health effects of oil contamination are _____)

Appendix D: Interview Template and Summaries

We conducted two interviews in order to gather feedback, scientific documents, contacts at non government organizations, and contact information for researchers. What follows is a summary of each interview followed by interview protocols and notes on the interviewee's responses.

Dr. Tom Webler 9/20/2010

The team interviewed Dr. Webler in the early stages of this project. He provided feedback on our project ideas and contributed contact information of people who would be more knowledgeable about oil spills. He also shared his personal experiences in Cordova, Alaska especially relating to the spill's psychological impact on both commercial fishermen and Native tribes.

At the time of this interview, the goal of this project had not been clearly defined and Dr. Webler was instrumental in providing us guidance. He impressed upon the team the difficulty of finding published studies as a research scientist, citing our own struggles with archival research as an example. This discussion with Dr. Webler was the inspiration behind our endeavors.

Protocol

Interview Protocol with Dr. Tom Webler – An expert on how indigenous people are impacted by environmental disasters.

Work he has done or is currently pursuing:

- Case study of long-term human impacts and vulnerabilities from the Exxon-Valdez oil spill
- Study to characterize effects, vulnerabilities, and the adequacy of existing data to inform decision-making regarding the social disruptions from oil spills and spill response
- Assessment of Oil Spill Response Planning and Performance
- Factors Influencing Participation of Local Government Officials in Environmental Policy Making and Implementation

Questions to ask:

1. What are some long-term human effects of the Exxon-Valdez oil spill that you have come across in your research?
2. We are focusing on the Oil contamination problem in Northeast Ecuador and its effects on the natives. Have you followed closely the oil contamination problems in Northeast Ecuador? What were your involvements in the projects that took place last year?
3. Our problem Statement: The physical and psychological effects of a disaster on indigenous peoples are overwhelming. In NE Ecuador, major action was taken to prosecute those responsible for a massive oil contamination, but comparatively little was done to help the indigenous peoples whose homes, crops, and drinking water were all contaminated by toxic wastes. More must be done to bring focus to improving the welfare of human beings in the event of man-made disasters.

   Our Goal: To propose ways to increase involvement of WPI and other organizations in the rehabilitation of the lives of the indigenous people in the event of man-made disasters.

   Do you have any specific tips for us to help realize our goal?

4. We plan to talk to representatives from various nonprofit organizations who have been involved with the Ecuadorian oil spill to see how they have helped the people and to make recommendations to further help the people. Do you know of any specific organizations we could contact while in Washington DC?
5. One idea that we had was to propose the implementation of a community center or health center for use by the people of Northeast Ecuador run by a nonprofit organization or any other stakeholder. How would such a thing be funded? Are there any similar things that have been implemented that you know of?
6. Are there any other tips that you could give us regarding the involvement of nonprofit organizations and universities in the helping of the indigenous of Northeast Ecuador?
7. Are there any other contacts we could make for more information on this issue?

Things to keep in mind:

- Dr. Webler is an expert on how indigenous people are impacted by global disasters.
- He knows things about how last year's projects were conducted.
- Act professional in the interview.
- Dr. Webler will be graciously giving us his time. Be sure to ask viable and important questions for better use of the time he gives us.
- Be sure to allow him to completely answer all of our questions prior to asking a new one. We are attempting to learn as much as we can from him, so ask questions to stimulate the conversation when needed.
- Be sure to thank him!

http://www.seri-us.org/projects.html

Notes

- Dr. Webler suggested that since it is difficult to research what has been done to help in the after effects of an oil spill that we make an information portal or database that everyone doing research on oil spills can refer to.
    - What are research questions that need to be asked?
- The idea of putting university researchers together was tossed around.
    - Promote a conference between researchers?
    - What are some Universities in Ecuador that could be contacted for information on the effects of the oil spill?
- Petro Brazil could be a source of funding for remediation attempts. They are an upcoming company looking to extract oil in South America and it is conceivable that they would want to learn as much as they could about oil spills to prepare for future endeavors. They want to play a larger role in recovery of oil
- Dr. Webler described his work on the Exxon-Valdez oil spill
    - Herring fish died out as a result of the oil spill. When they did not come back after the cleanup, the entire economy was affected by it. Tribes were affected because they could not harvest these fish and could not practice traditions.
- What can we learn about oil spills after Ecuador?
- Steve Picou – University of Southern Alabama, Cordova
    - Examined depression and psychological effects of oil spills
- One idea that was discussed was a collaborative with tribal people in Alaska, or to find an NGO willing to sponsor this.
    - International Group of Natives

- Look into the Society for Conservation of Biology
- Starting up a health center for people in Northeast Ecuador: Sponsored by catholic church
- Lisiel Richie – University of Boulder Colorado, Natural Hazard Center
    - Richie studied the Haiti disaster
- Look at Dr. Webler's references on his website
- As for the Access Database
    - Identify important people: Who are researchers and what have they accomplished?
- A government to government aid could be useful. MSTRU was used in the gulf. This stands for marine system transportation recovery unit. What kind of outreach can people like this have? Apply them to Ecuador
- It is important to figure out what the ecosystem's impact is.

Cindy Buhl 10/26/2010

We interviewed Cindy Buhl, the Legislative Director to Congressman Jim McGovern to gather documents the Congressman's office had on the oil contamination in Northeast Ecuador. Additionally, we were interested in using any resources his office had in other government offices such as the VA, HHS, and CDC to find information on the Deepwater Horizon spill, and the Kuwait oil contamination during the Gulf War. Additionally, we were interested in using the Congressman's office as a liaison between our project group and the Nigerian Embassy for the purpose of gathering any documents the Nigerian Federal Ministry of Environment had on oil in the Niger Delta.

Protocol

We want to show you how we are both chasing the same objective. We may be coming at it from a different direction than what your office had in mind, but ultimately we are striving for the same thing – helping the people of Ecuador. We want to show you the value of our project direction and how it aligns with your goal. Our common ground is that we both want to help improve the condition of the people in Ecuador. In doing research, as scientific minds, the first thing we found was that there is little conclusive scientific information on the health effects of oil contamination.

It was our impression from recounts of past meetings with your office that you wanted to directly help the people of Ecuador by helping them help themselves to sustain healthy living without a need for continued outside assistance. We believe that the creation a database is a great way to kick-start this.

It was difficult to find information solely on the health effects of oil contamination in Ecuador. By having research in one place, scientists can access the information that has already been done. Originally we looked at just Ecuador and the health effects, but there is only basic media driven knowledge available. There is a need for a central repository, so that we and other researchers can view scientific studies on the health effects of oil contamination. Our database will create a means by which all those interested in helping, but who can't do it alone, will be able to team up and pool resources to actually get a focused group together to help those affected by oil contamination. We would like to demonstrate that a lack in scientific information is a problem because when we first started, we greatly struggled to find scientific studies on the health effects of oil contamination. The only way to get major contributors to this situation is if there is hard scientific evidence. Major contributors are the only way that the area will actually improve.

Providing us with contacts who can help us gather scientific studies on the health effects of oil contamination would be very helpful.

Notes

- October 14th – New document on Ecuador oil spill
    - International Journal of Occupational Health
- Small group of people (i.e. the Linda Looft meeting) with PIH -> took delegation and reported on health impacts -> Linda should forward this
- Rachael Ross – Boston - Partners in health
- Our database project could provide helpful contribution for the aid of other oil sites around the world.
- Many countries in database would be helpful
- People at each site collaborate but not to people at other oil spill sites!

Contacts at Jim McGovern's office that deal with healthcare

- Lisa Salerno - domestic healthcare knows people at CDC
- McGovern has been trying to increase CDC's budget

Global health issues – looking at potential health impacts of BP oil spill

Organizations:

- HHS in Atlanta
- In DC - NGO Amazon Watch – contact Andrew Miller
- Nigera - Ogoni territory- company called Oil Watch
- Tom Lantos Human Rights Commission

- Contact Stephen Kretzmann in Washington.
    - Testified on Nigeria

There was a hearing on environmental in West Papua mining and timber

- Based in Washington

Persian Gulf War - Veterans Affairs contacts (VA)

- "Notorious about ignoring health effects"
- From Vietnam all the way through present – vets had to fight to get symptoms recognized and related to oil toxins
- Caitlin Hodgekins – from McGovern's office on veteran affairs
- Jennifer Walters – working in energy and environment (Currently on BP)
    - She used to work with veteran affairs before she got promoted recently
    - Can connect us to committees – committee hearings and meetings
        - Check online for these
        - Otherwise must search archives
        - Committees may have examined health because of vets
        - Check hearings on committee sites

Get into archival database.

- Health reports
- PIH reports
- CDC reports
- Healthcare LA
- Should sit down with LA and VA -> Email Cindy after election about this!

After the election, sit down with Cindy again to run through contacts. Also, check old IQP reports from last year

- Look at contacts and possibly arrange meeting with Ecuadorian embassy.

Cancer clinic in Lago Agrio Ecuador

- Types of treatment?
- Data collecting?

Rainforest foundation

- Sting
- UNICEF partner
- Water treatment – rainwater catchment system.

Stephen Kretzmann- Oil Change International

- Tom Lantos HRC – Steve Kretzmann testified on Nigeria

Global health NGO network - Have they been active in any of these oil contaminated areas?

- 'Global Health Coalition'

Coca – Orellana – One of the most contaminated province (NE Ecuador)

Why hasn't help been given to those in Ecuador?

- Negative impact of litigation keeps helpers out. They think that they'll be changing the outcome of the lawsuit. If the court decides who is to blame and pay for rehabilitation, then others don't want to get involved and waste their money. Once a decision is made by the courts, the decision will get appealed by the losing party and it will go on for

another 16 years. Help can't continue to get delayed. This is why the cancer clinic was established in the area.

Can't postpone activity

- Lawsuit scares away non profits
- They don't want to be involved in lawsuit
- And helping to solve the problem may look like they are commenting on the lawsuit
- They also don't want to go in and change things thus affecting the legal outcome

Medical Mobile teams -> Government Medical

- Coca – Orellanas Province (other major site is Succumbios Province)
    - Regional Health Director works here
- Always on the move
    - Should get info from Ecuadorian Embassy about these teams
- No CDC assessment on Nigeria or Ecuador
    - Maybe on Kuwait
    - Def. on Gulf spill
        - What kind of questions were they asking?
        - That's what should be looked at in Ecuador either by us or others
        - Additionally, it may help determine how the site should be structured.

Appendix E: Screenshots of the Web Database

This appendix displays screenshots of each page of the website. For pages that host documents, a screenshot of the top of the page was taken. For all other pages, all efforts were made to include the entire page whether by using one or two screenshots. The website can be found at https://sites.google.com/site/oilcontaminationhealtheffects/

Figure 17: Website Homepage. This is the first page users see when accessing the website. This image is a hotlink to the website.

Figure 18: About Page: This page provides general information about the project and the website.

Figure 19: Authorship Page. This page lists the authors of the project.

Figure 20: Useful Links. Provides links to relevant websites.

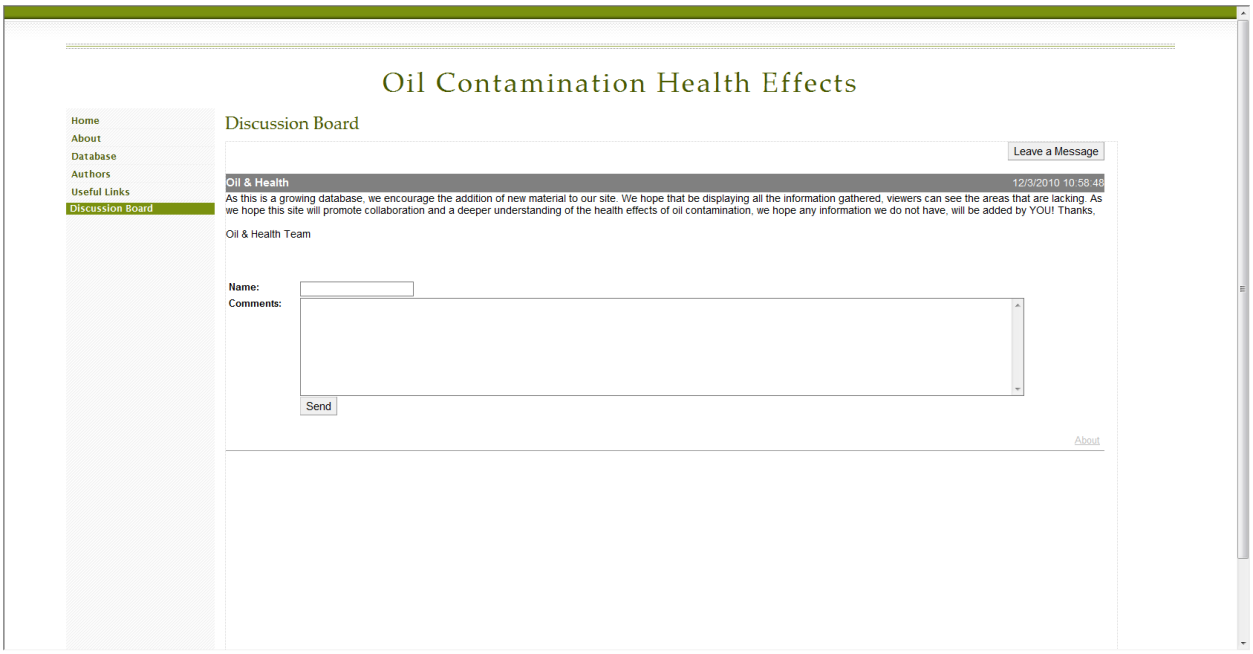

Figure 21: Discussion Board. This page allows users to engage in discussion through logged messages.

Figure 22: Database Navigation Page. Each of the links navigates to a list of documents for each health effect or each spill site.

Figure 23: Ocological Documents Page

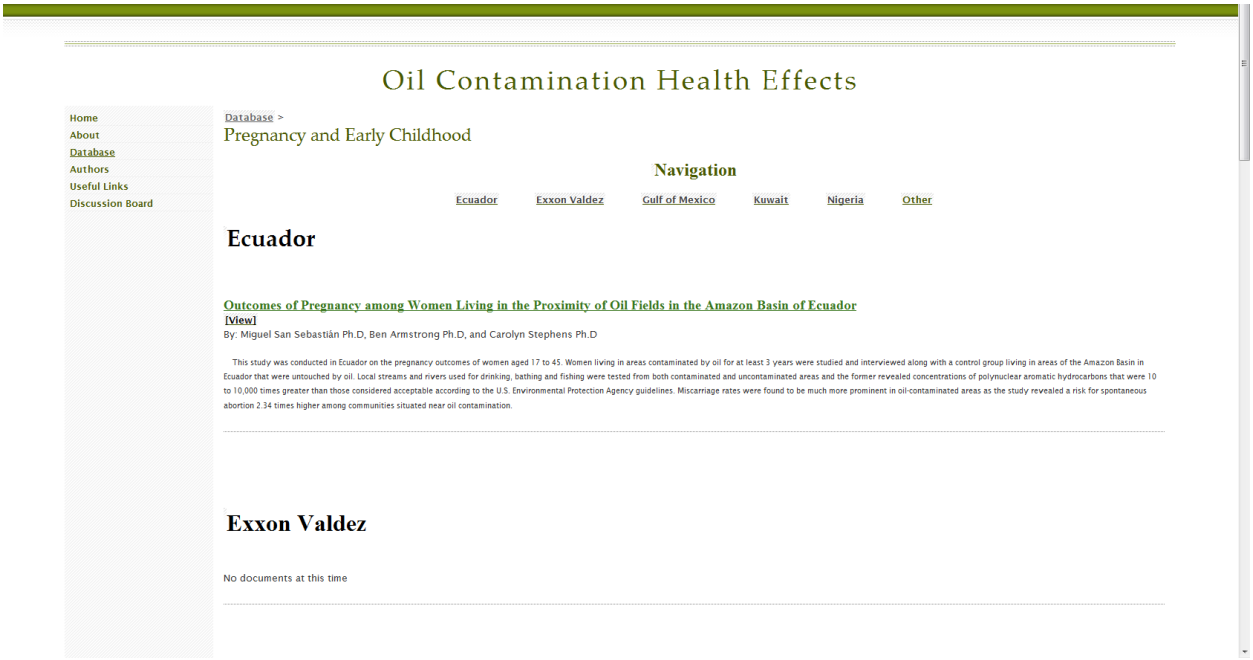

Figure 24: Pregnancy and Early Childhood Documents Page

Figure 25: Psychological Documents Page

Figure 26: Pulmonological Documents Page

Figure 27: General Health Documents Page

Figure 28: Ecuador Navigation Page

Figure 29: Ecuador Documents Page

Figure 30: Ecuador Audio/Visual Page: Pictures

Videos:

60 Minutes: Amazon Crude
[Video]

Ecuadorians are suing the oil giant Chevron for the actions of Texaco, who they acquired in 2001. Texaco's oil drilling in the Amazon jungle polluted their fragile environment. Scott Pelley reports.

Trailer for Crude
[Video]

This movie reflects the struggles of the Ecuadorian people in their fight for justice against Chevron Texaco, whose oil practices have contaminated their homeland.

Ecuador and Oil
[Video]

This video examines the devastation of the Ecuadorian Amazon that was caused by oil extraction processes.

Chevron: The Real Human Story in Ecuador
[Video]

Testimonies were given by some of the inhabitants of Ecuador who have been affected by the oil contamination in their environment.

Ecuador: The Tribes vs. Chevron-Texaco
[Video]

This documentary examines the current lawsuit between Chevron and the Ecuadorians who have been adversely affected by their oil extraction practices.

Figure 31: Ecuador Audio/Visual Page: Videos

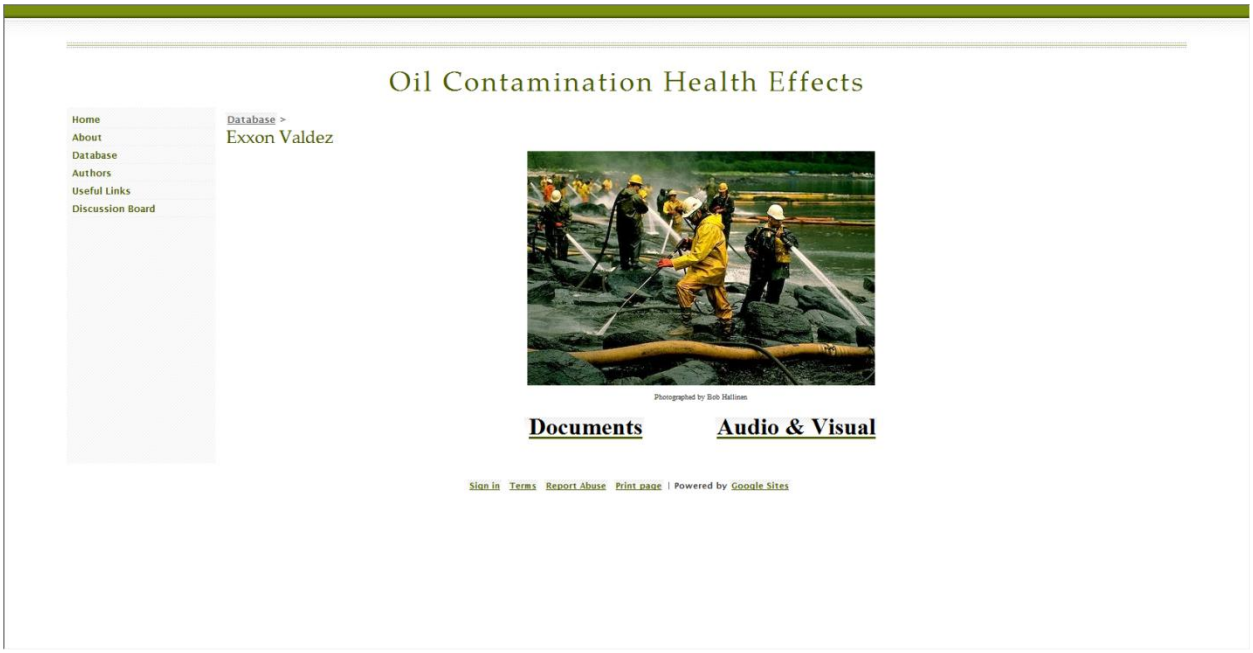

Figure 32: Exxon-Valdez Navigation Page

Figure 33: Exxon-Valdez Documents Page

Figure 34: Exxon-Valdez Audio/Visual Page: Pictures

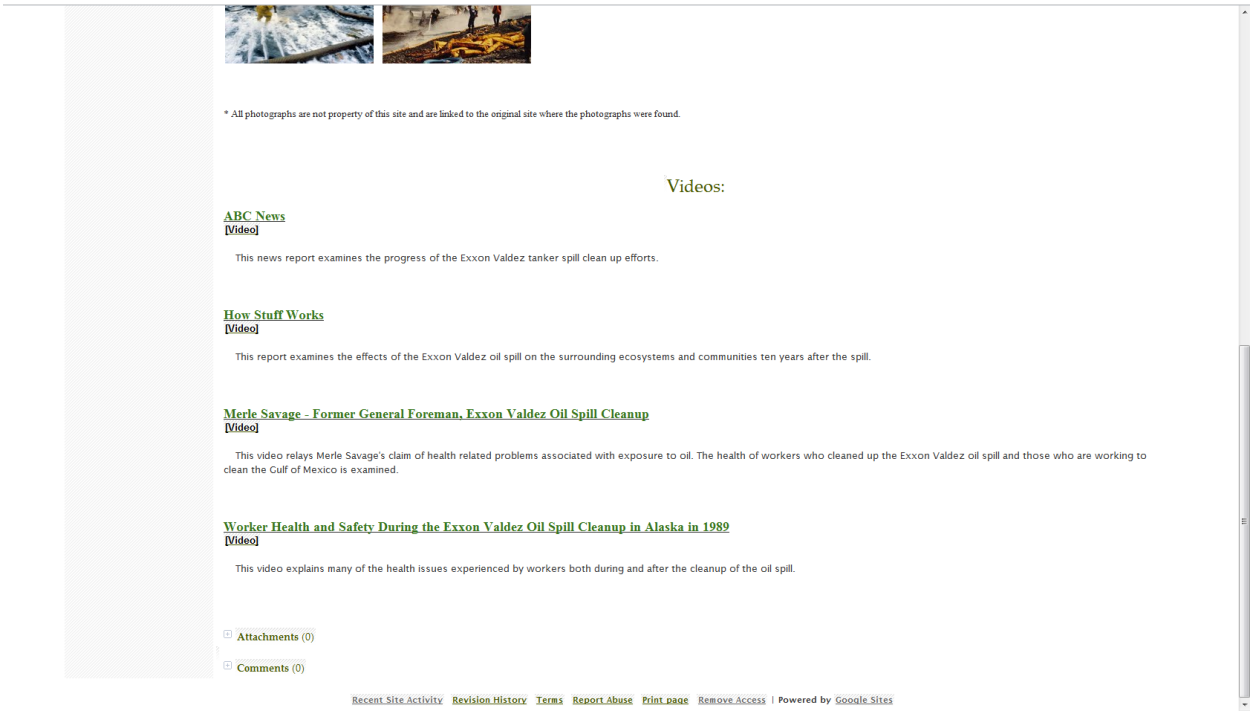

Figure 35: Exxon-Valdez Audio/Visual Page: Videos

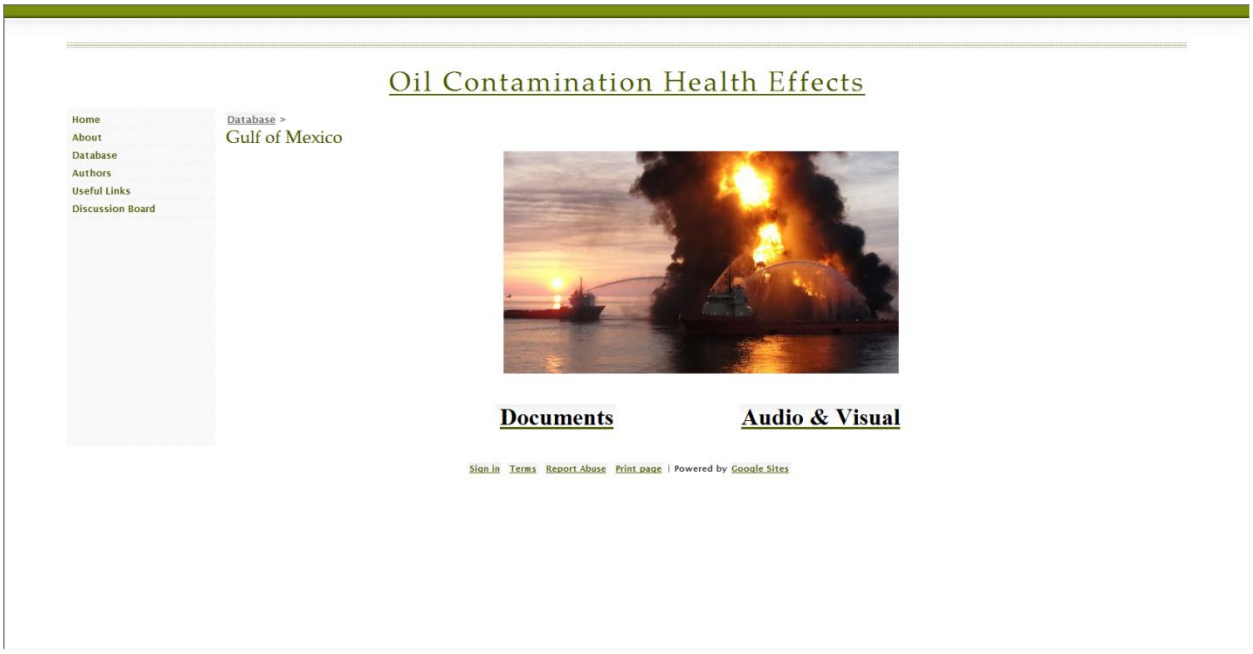

Figure 36: Deepwater Horizon Navigation Page

Figure 37: Deepwater Horizon Documents Page

Figure 38: Deepwater Horizon Audio/Visual Page: Pictures

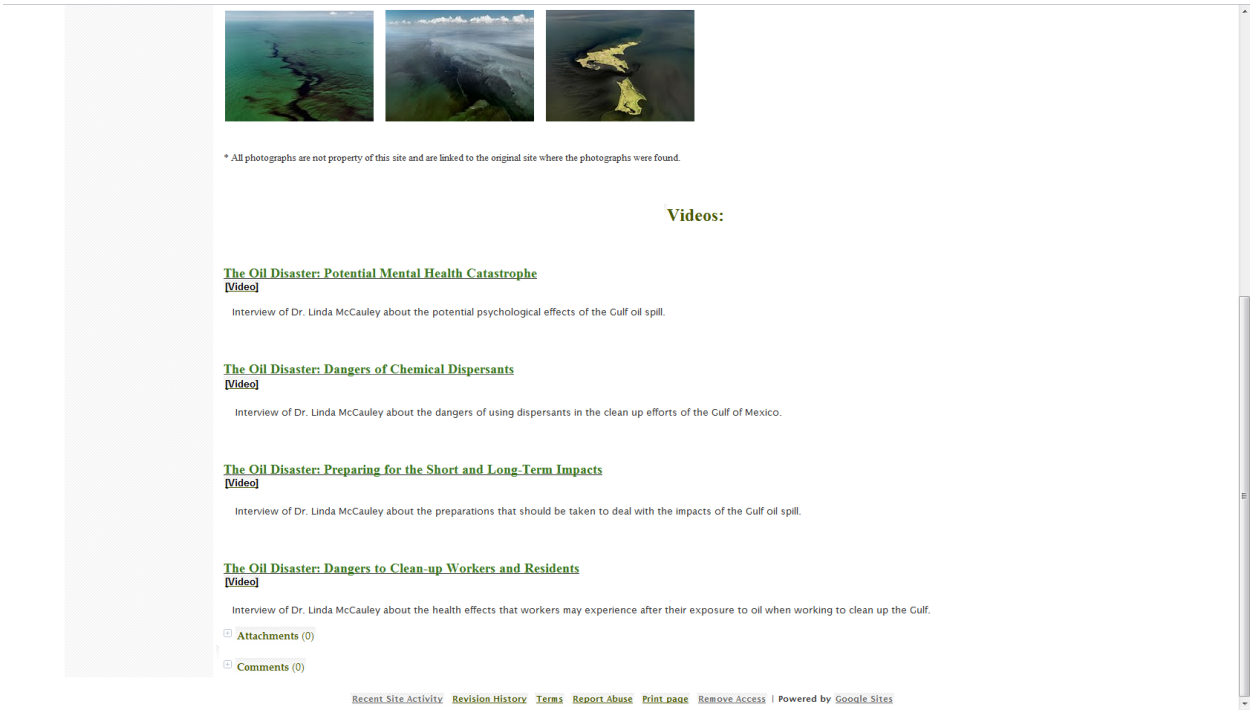

Figure 39: Deepwater Horizon Audio/Visual Page: Videos

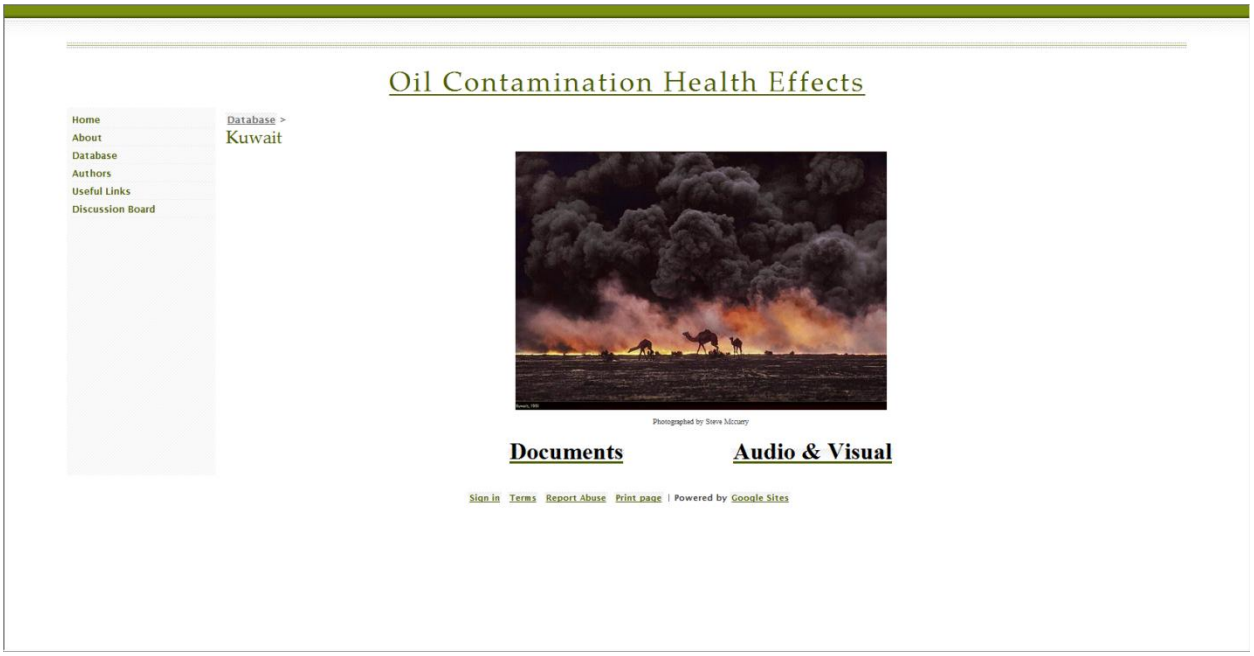

Figure 40: Kuwait Navigation Page

Figure 41: Kuwait Documents Page

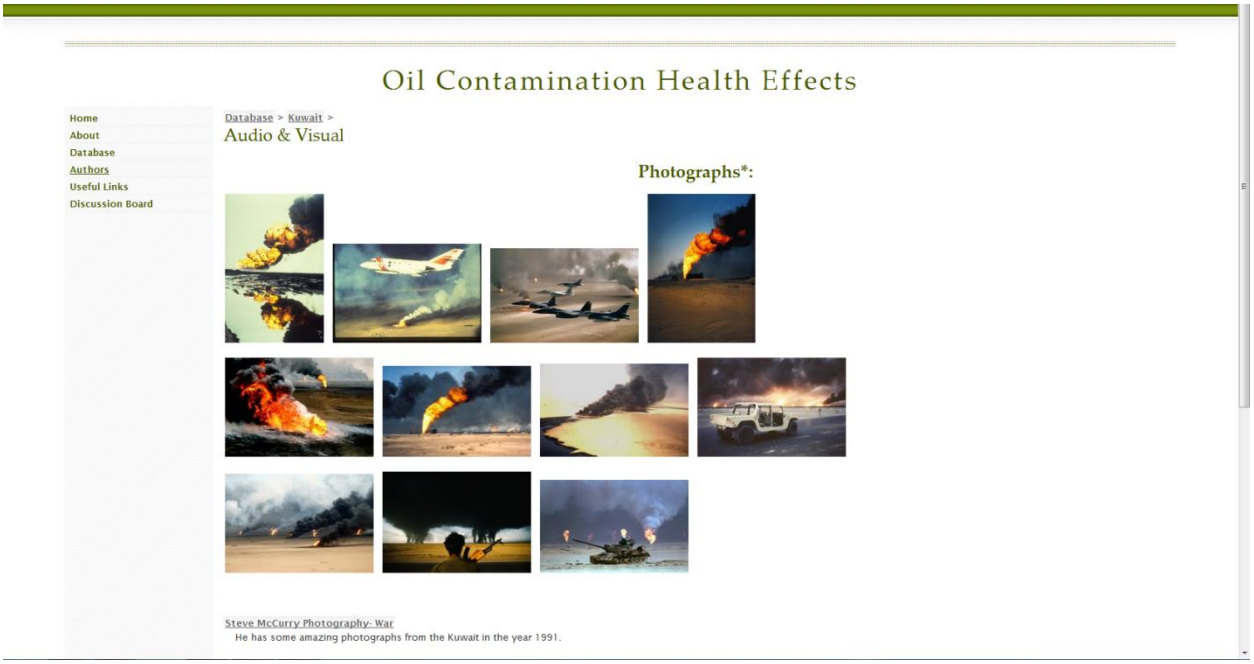

Figure 42: Kuwait Audio/Visual Page: Pictures

Figure 43: Kuwait Audio/Visual Page: Videos

Figure 44: Nigeria Navigation Page

Figure 45: Nigeria Documents Page

Figure 46: Nigeria Audio/Visual Page: Pictures

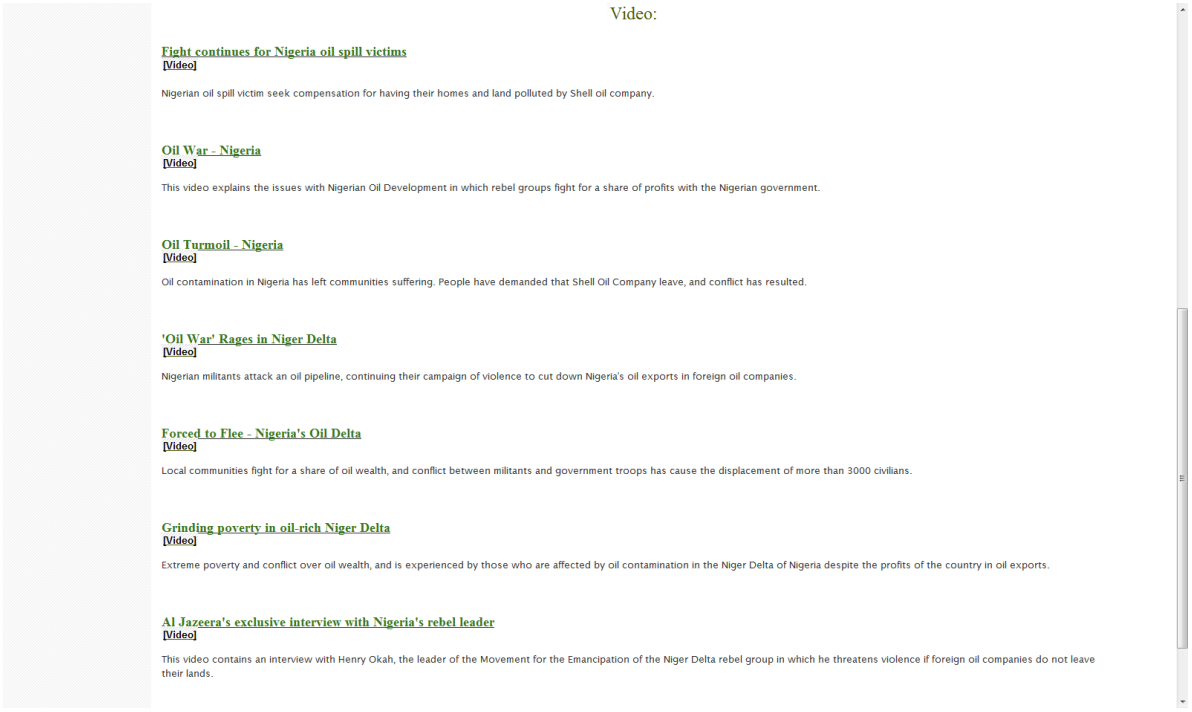

Figure 47: Nigeria Audio/Visual Page: Videos

Figure 48: 'Other' Documents Page