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Green Criminology and Environmental Justice: An Exploratory Analysis of Oil Spills in North America.

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GREEN CRIMINOLOGY AND ENVIRONMENTAL JUSTICE:

AN EXPLORATORY ANALYSIS OF OIL SPILLS IN NORTH AMERICA

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By

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The underlying principle of green criminology is understanding environmental harms from a criminological lens, a variation from mainstream criminology's focus on street crimes. Environmental harms and contamination, such as oil spills, remain a growing concern for nations especially disadvantaged communities (low-income and communities of color). This dissertation analyzed the environmental pollution of 3 oil spills in North America to ascertain their impact on disadvantaged communities. This was achieved through secondary research inquiry using a case study analysis. This dissertation also highlighted the impact of forensic science and environmental forensics in oil spill cases.

Using an independent sample t-test, this dissertation investigated the occurrence of lung cancer in minority and nonminority communities for the 3 oil spill cases. The results indicated a significant difference between lung cancer cases in 4 out of 13 counties indicating the presence of "unintentional environmental racism" (inadvertent discharge of oil spills leading to environmental racism) coined by this dissertation. Furthermore, this dissertation compared cleanup timelines and compensation structure in minority and nonminority communities but found no indication of environmental racism. Being the first of its kind, this dissertation contributes to the body of green criminology by creating awareness through its analysis of the negative impact of environmental pollution (oil spills) in disadvantaged communities. This dissertation also promotes the adoption of sustainable policies and the transition to renewable energy sources to help disadvantaged communities. It underscores the importance of environmental protection efforts by green criminologists to help disadvantaged communities in the fight for environmental justice.

Keywords: green criminology, environmental justice, environmental racism, unintentional environmental racism, oil spill, environmental contamination, pollution, disadvantaged communities, minority, nonminority, communities of color, low-income communities, environmental forensics, energy, climate change, energy transition, renewable energy, sustainability

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CHAPTER 1

INTRODUCTION

Historical Background and Statement of the Problem

Mother Earth provides a sanctuary for all. However, discriminatory practices found in environmental pollution and racism have robbed communities of color and low-income communities the privilege of enjoying this sanctuary. These communities are victims of environmental pollution and are collectively regarded as disadvantaged communities for the purpose of this dissertation.

Disadvantaged communities are regions that suffer from socioeconomic, health, or environmental burdens (California Public Utilities Commission, 2020; Climate Leadership and Community Protection Act, 2020). According to the Climate Leadership and Community Protection Act CLCPA (2020), disadvantaged communities are:

> communities that bear burdens of negative public health effects, environmental pollution, impacts of climate change, and possess certain socioeconomic criteria, or comprise high-concentrations of low- and moderate-income households. (p. 5)

The discrimination suffered by disadvantaged communities through environmental pollution has developed in the origination of the concept of environmental racism, that is, the unfair treatment of low-income communities and communities of color as seen in environmental harms and crimes (Bryant & Mohai, 1992; Bullard, 1990; Bullard, 2010b; Bullard & Wright, 2012). Environmental racism is a major problem in society because disadvantaged communities bear the brunt of environmental pollution.

The fight against environmental racism gave birth to the environmental justice movement in the 1980s, advocating for environmental equality and protection. That movement, which was brought to light by Bullard (1990), highlighted discriminatory practices of environmental racism that disadvantaged communities face. It has been 41 years since the emergence of environmental justice movements of the 1980s, and disadvantaged communities are still victims of environmental racism.

Environmental justice directives through executive orders (U.S. Environmental Protection Agency [EPA], 1994) have arisen due to the environmental justice movements. Despite these strides, the welfare of disadvantaged communities is still compromised, necessitating more actions of environmental protection, which this research will outline.

An example of environmental racism experienced in disadvantaged communities arises from environmental pollution found in oil spills. An oil spill destroys the ecosystem and its surrounding economies. Thus, it is essential to scientifically understand the aftermath and response to environmental pollution in disadvantaged communities. Therefore, this dissertation analyzed three oil spills as its case studies to ascertain their impact on disadvantaged communities. It further proffers strategies for change to provide a safe and healthy ecology for society, especially disadvantaged communities. The effectiveness of such strategies to protect disadvantaged communities is heavily dependent on the actions of the criminal justice system, that is, to hold polluters accountable and enforce appropriate punishments for environmental harms.

Importance of the Study

The environment provides shelter and a source of livelihood to different creatures as well as humans. The threat of environmental pollution (air pollution or oil spill) requires appropriate remedial actions. Against the backdrop of equality, equity, and the need to end racism in U.S. society, this dissertation addresses a vital area of racism that is frequently overlooked: environmental racism. Environmental racism affects low-income communities and communities of color (Bryant & Mohai, 1992; Bullard, 1990; Bullard, 2010b; Bullard & Wright, 2012), and its victims are those from a different ethnicity than the perpetrators, with the culprits often being White-owned and wealthy corporations (Potter, 2010).

This research aims to examine the aftermath of environmental pollution of oil spills in disadvantaged communities to ascertain the presence or absence of environmental racism. Relying on green criminology principles, this research analyzes environmental crimes and harms and suggests reform policies in society to aid environmental justice efforts. Being the first of its kind, this research will contribute to green criminology by examining the different efforts and responses to environmental disasters (oil spills, air pollution) on both minority and nonminority communities.

This research further highlighted the impact of climate-induced human action (oil spill pollution) in disadvantaged communities. In doing so, it contributes to the body of knowledge by creating awareness of the effects of climate change on disadvantaged communities and proposes solutions in later sections.

It also underscores the importance of expanding environmental protection efforts by green criminologists in disadvantaged communities to reduce crime.

CHAPTER 2

LITERATURE REVIEW

This section addresses the underlying factors leading to environmental racism, such as environmental pollution (air and soil pollution). This section further analyzes environmental racism and environmental justice through the lens of green criminology and white-collar crime. It highlights the role of environmental forensics in identifying the causes of oil spills and discusses the impact, and role the criminal justice system must play in the fight for environmental justice.

Oil Spill

Oil and gas activities make the environment susceptible to contaminations such as oil spills. This research focuses on a specific type of pollution found in oil spills. This is slightly different from the conventional type of pollution found in hazardous wastes associated with dumping in landfills. The focus on oil spill pollution stems from the limited data in this field on its direct impact on disadvantaged communities.

An oil spill is the “accidental or intentional discharge of oil to the environment [land and coastal waters]” (U.S. EPA, 2021a). The U.S. Coast Guard (USCG) and the U.S. EPA handle cleanup actions in the United States.

There are numerous consequences of oil spills. Oil spills contaminate the environment and food consumed by individuals such as seafood.

Furthermore, the adverse impact of oil spills further results in fatalities and the destruction of many communities' ecosystems. For example, industry accidents of oil spills such as the Deepwater Horizon explosion resulted in fatalities, property loss, and environmental contamination (Deepwater Horizon Study Group, 2011).

The consequences of oil spills also have devastating financial implications for companies because they are held financially responsible for their actions. That is, when a spill occurs, the responsible party must pay for clean-up (Office of Response and Restoration, 2015) in line with the "polluter pays principle." The polluter pays principle (PPP) affirms that the polluter who contaminates the environment bears the cost of pollution in the interest of the public (United Nations Department of Economic and Social Affairs, 2011). Thus, any activity by the polluter that leads to the deterioration of the environment must be adequately compensated for by the contaminator.

Following the Exxon Valdez spill, the Oil Pollution Act, or OPA (1990), was implemented to regulate oil spills. This Act stated specific standards to be followed in the event of a spill. It also specified penalties for polluters. It further created the Oil Spill Liability Trust Fund, which provides for emergency funds if a spill occurred (OPA, 1990). The OPA served as the statutory authority to regulate spill occurrences in the United States.

The OPA (1990) identifies action items for the cleanup of the environment during a spill. That is, state, and federal trustees will be appointed who will ensure the "restoration, rehabilitation, replacement, or acquisition of the equivalent, of the natural resources under their trusteeship" (OPA, 1990, Section 1006 33 USC 2706).

Oil spills remain a major threat to the environment because of their polluting effect. Environmental pollution has come under the study of the criminology discipline. The subsequent section further addresses this in detail.

Green Criminology

The focus of traditional and mainstream criminology has been developing and analyzing theories to explain offending behaviors and street crimes (Agnew, 2012b; Braithwaite, 2000). This does not take into account environmental pollution such as oil spills. This deficiency has now been addressed with the emergence of green criminology.

Green criminology addresses the criminogenic effect of environmental harms/crimes different from the traditional notions of crime (Lynch & Stretesky, 2011; Lynch & Stretesky, 2014, p. 1). The discipline of green criminology is essential to maintaining law and order because of its target audiences: people and the environment. No wonder Lynch and Stretesky (2014, p. 92) stated that humans are more likely to be victims of violent green victimization than victims of violent acts.

Green criminology is a paradigm shift from the traditional notion of offenses seen in street crimes to offenses committed against the environment. Against this backdrop, green criminology's underlying principle emerged in the early 1990s (Frank & Lynch, 1992; Lynch, 1990; South, 1998). That is, understanding environmental harms from a criminological lens (Halsey & White, 1998), which is a variation from mainstream criminology's focus on street crimes. The crux of green criminology is using theory to analyze environmental harm, the applicable law available to fight such crimes, and ensuring environmental justice (Lynch et al., 2017; Lynch et al., 2018; White, 2008).

The concept of ecocide has also emerged to address issues of contamination that destroy the environment (Agnew, 2012a). The need for eco-global criminology (addressing ecological concerns and harms through a criminological lens) and criminalizing environmental harms has also been highlighted by scholars (White, 2009; White, 2016).

This shows the efforts required by criminologists in fighting environmental harms and issues of climate change.

Green Criminology and Climate Change

Green criminology spans different core principles such as climate change, public health concerns, and so on. Although traditional theories of criminology have explained crime in society using sociodemographic variables (such as race, gender, age, socio-economic status, location, and so on.), changes in societal factors have revealed variables such as climate and weather conditions as impacting criminality.

M. de Guerry de Champneuf, a French civil servant, collected data that first highlighted the impact of climate and crime—violent crime increasing in the summer and property crime increasing in the winter (Elmer, 1933, as cited in Cohen, 1941, p. 29). This causal relationship between climate and crime was further espoused by sociologist Lambert Adolphe Jacques Quetelet in the 1800s in his "thermic law of delinquency" principle (Bernaldo de Quiros, 1911, p. 10, as cited in Cohen, 1941, p. 30).

Different scholars and researchers have further addressed the intersection of crime and climate. Research conducted shows that the effect of climate change will result in a breakdown of social order and an increase in crime rates (Agnew, 2012a) because weather conditions affect criminal activity (Agnew, 2012a; Anderson et al., 1997; Brunsdon et al., 2009; Cohn, 1990; Horrocks & Menclova, 2011; Mares & Moffett, 2019; Ranson, 2014; Rotton & Cohn, 2003).

Furthermore, research shows that climate change will increase social conflict, scarcity, competition for resources, migration, and so on. (Abbott, 2008; Agnew 2012a; Global Humanitarian Forum, 2009; Homer-Dixon, 1994, 1999; Intergovernmental Panel on Climate Change, 2007; Kolmannskog, 2008; Nordas & Gleditsch, 2007; Pumphrey, 2008; White, 2009).

Although climate change would have a global effect, it is asserted that its most severe impact would affect the poor or vulnerable group (Bartlett, 2008; Global Humanitarian Forum, 2009; Hardoy & Pandiella, 2009). That is, these groups would disproportionately bear the burden of extreme heat exposure due to the financial implications involved with utility costs. Particularly, it has been argued that the poor would be less able to achieve air conditioning resulting from climate change (Agnew, 2012a, p. 26; McGeehin & Mirabelli, 2001). This research's focus on disadvantaged communities bridges this gap in bringing to light real-life case studies of the effects of human-induced climate actions (oil spill pollution) on such communities.

Environmental harms and pollutions raise the need for environmental protection in society. The unchecked excesses of environmental harms are part of the resulting factors of climate change experienced in society. For example, studies have argued that Texas and Louisiana's Hurricane Harvey of 2017 could not have naturally occurred without it being "human-induced climate change" (Trenberth et al., 2018). Research indicates that extreme weather (heat waves, wildfires, flooding, coastal storms) and climate events affect human systems and ecosystems (Handmer et al., 2012). Particularly, counties in the southern U.S. states have been shown to be at a disadvantage and more vulnerable to climate change impacts (Wilson et al., 2010).

Climate change impacts are evident in the United States as some states (Texas winter storm/freeze of 2021 and incessant California wildfires) have already started undergoing these changes through extreme temperatures. Reports indicate that Texas and

California are among the most vulnerable states to the effects of climate change (McKillop et al., 2021). Climate change remains a growing concern in our society because it destroys the ecosystem and causes environmental pollution, negatively affecting human health. As such, there will be no tomorrow if today's reality is extinguished due to climate change.

Environmental protection issues are critical to a sustainable future, which places the onus of protecting the environment from environmental harms and crimes on the criminal justice system. As a society, the world must not sit by and look the other way in the face of environmental harm. This is because human beings are potential environmental harm victims as people are heavily reliant on the planet for air and food (Potter, 2010). This research reinforces the need for criminologists and justice experts to speak up and advocate for better policies that protect the environment and ensure accountability for environmental crimes.

Green Criminology and Renewable Energy

To address issues of climate change, collaborative actions toward climate change mitigation must be encouraged in disadvantaged communities. For example, states should work in conjunction with utility companies, energy agencies and organizations, and community-based organizations to encourage rebates and subsidy programs that encourage the installation of renewable heating and cooling technologies (RHC) in disadvantaged communities and households. Rebates (subsidies) have been particularly advised as a strategy to encourage the deployment of energy-efficient technologies (IEA, 2020a).

RHC involves the “generation of energy from renewable technologies and resources” (U.S. EPA, 2017d), and RHC technologies are those technologies that serve this purpose.

> RHC technologies are classified into **solar** [concentrating solar, evacuated tube, flat-plate collector, transpired air collector, unglazed collector], **geothermal** [deep geothermal, direct use, heat pump], and **biomass** [woody biomass] (Rickerson et al., 2009; U.S. EPA (2017e), **hydro**, **wind, ocean thermal, wave action, tidal action.** (Nada & Alrikabi, 2014; U.S. Energy Information Administration, 2021)

RHC technologies offer numerous advantages, such as cost-effectiveness, and they provide great health benefits by reducing emissions and air pollutants for its users, job creation, energy security, and so on. (Langniss, 2007; Nada & Alrikabi, 2014; U.S. EPA, 2017d). Different pathways of transition to renewable sources such as electrification and direct use of solar and geothermal heat have been recommended (IEA, 2020b). These are pathways to pursue to help disadvantaged communities mitigate the negative effects of climate change.

Some U.S. states (e.g., California, Minnesota, and New York) are currently involved in carbon emissions reduction; rebates or subsidies are adjusted in an eligible consumer's energy consumption, resulting in slightly cheaper electricity bills over time. Most states offer large incentives or rebates to eligible homeowners. In some cases, homeowners receive a 100% incentive whereby the installation of RHC technologies becomes free or rebates are combined with other incentives to offset energy costs. Eligibility for such programs varies from state to state and could be impacted by zip codes and household earnings.

Currently, states like California, Minnesota, and New York are involved in major climate change mitigation to achieve carbon neutrality. Actions taken involve beneficial electrification, among other things. Beneficial electrification involves the sustainable replacement or conversion of fossil fuels (natural gas, diesel, fuel oil/gasoline, propane, and so on) with electricity to reduce its emissions and energy costs (Dennis, 2015). Incentivizing beneficial electrification with RHC has been cited as a way to facilitate carbon dioxide emissions reduction (Dennis, 2015).

States have also enacted legislation aimed at climate change mitigation. For example, the New York state legislature passed the Climate Leadership and Community Protection Act (CLCPA, 2020) into law to address and mitigate issues of climate change through emissions reduction, incorporation of renewable sources, and creation of green jobs to advance environmental justice. CLCPA has been adjudged "one of the world's most ambitious climate plans" (McKinley & Plumer, 2019; New York State Senate, 2019; Roberts, 2019).

To reduce New York's carbon footprint in the ecosystem, the New York State Energy Research and Development Authority is focused on reducing emissions and reducing customers' energy bills (New York State Energy Research and Development Authority, 2020a). One of its intended goals in ensuring beneficial electrification is achieved through its Clean Heating and Cooling Team in providing New York households and communities (especially low and moderate-income [LMI] communities and households) with energy-efficient programs and technologies (New York State Energy Research and Development Authority, 2020b; 2020c). These actions geared at helping the LMI communities are a step worthy of emulation in other disadvantaged communities. This research highlights the need for more states' involvement in environmental protection efforts, especially in helping disadvantaged communities break away from environmental injustices.

Environmental harms and pollution also negatively affect the environment (animals, plants, water, soil) and humans alike. Studies conducted on several oil spills indicate a correlation between spilled oil and the health of exposed persons (Aguilera et al., 2010). This research builds on this by identifying some health concerns experienced in communities affected by oil spills.

The well-being of the ecosystem and human lives rests on a safe and sustainable environment that is destroyed by pollution. Thus, there is a need to understand the criminogenic effect and public health consequences of environmental harm. Scholars have highlighted the necessity for green criminologists to collaborate with public health officials and epidemiologists to identify environmental harms because these disciplines work with marginalized communities (Akers & Lanier, 2009; Lynch et al., 2017). The cooperation of the criminal justice and public health disciplines in working toward a common goal is exhibited in the principle of "criminal epidemiology or epidemiological criminology/EpiCrim"—a theoretical and methodological framework for understanding the role of public health in the criminal justice context (Akers & Lanier, 2009; Lanier, 2010).

Such collaboration dates back to eras when sociologist/criminologist Emile Durkheim studied social problems, social norms [climate, human behavior, religion, and so on] and found these variables to be directly relevant to the occurrence of suicide rates that were prevalent in France during the time (Durkheim, 1897, as cited in Mutchnik et al., 2009, p. 44). Akers and Lanier (2009) argued that suicide (which is a public health concern), discussed in Durkheim's treatise, and the fact that social epidemiology addresses the effects of social factors on people's health set the groundwork for the disciplines of criminology and public health to continue this long-standing relationship. Lanier and Henry (2008) also argued in favor of this collaboration, saying that the Chicago School scholars (from the criminology disciplines) in their studies on human ecology and social disorganization adopted epidemiological factors by using maps and official statistics to study communities.

According to Lanier (2010), health issues are the lead variables for criminal justice policies. This is not far removed from disproportionate criminal justice policies that have targeted minorities for drug use. Specifically, the "war on drugs" era in United States in the 1970s ushered in a new trend of regulation to end drug dependency through severe criminal justice policies, reinforcing the need for the study of epidemiological criminology. Although excessive drug dependency during the era of the war on drugs is similar to the opioid era in the 2010s, the health effect was dissimilar. Opioid drug overdose was declared a public health emergency in the United States (U.S. Department of Health & Human Services, 2017). This action has been described as discriminatory because during the crack cocaine era (the war on drugs of the 1970s), when similar drug use was prevalent, the users (mainly Black males) were incarcerated and punished. Scholars highlighted the prevalent racial disparities in imprisonment during the war on drugs because the number of arrests of Blacks for drug crimes was significantly higher than the arrests of Whites (Davis, 2017; Tonry, 2011, p. 54; Tonry & Melewski, 2008; Travis & Western, 2017, p. 300). Researchers clearly alluded to the fact that the war on drugs ushered in a new system of mass incarceration, which is now the new caste system that discriminates against minorities and communities of color (Alexander, 2012, p. 188; Loury, 2008; Tonry, 2011).

Using the war on drugs model, the bigger public health emergency should be the effect on children of color being brought into the world without both parents, largely because of the mass incarceration of their fathers (Black males, a majority of whom are incarcerated by the criminal justice system). Such questions and harsh criminal justice policies raise the essential need for a merger between the criminal justice and epidemiology disciplines.

The collaboration between these disciplines serves a purpose that is altruistic to ecological needs. This altruistic concern has been categorized as the binding norm needed to advance human life in a mechanical or gemeinschaft society (Durkheim, 1893; Toennies, 1887 as cited in Mutchnik et al., 2009, p. 44). Although altruism in the ecological sense may be hard to achieve, as the United States is mainly categorized as an organic/urban/gesellschaft society (heterogeneous, large population, and so on), the fight to attain sustainability must persist because of its long-standing rewards to current and future generations. In modern parlance, the nexus of criminal justice disciplines with epidemiology offers a heightened necessity in ecological harms. The harm done to disadvantaged communities as victims of environmental racism raises a burning need for practitioners in both the criminal justice and epidemiology disciplines to work together toward a sustainable resolution. The section below addresses environmental racism in detail.

Environmental Racism

Environmental harms and contaminations such as oil spills remain a growing concern for nations as they develop into environmental racism (disproportionate treatment of its victims, often disadvantaged communities). Environmental racism affects low-income communities and communities of color (Bryant & Mohai, 1992; Bullard, 1990; Bullard, 2010b; Bullard & Wright, 2012), and its victims are those from a different ethnicity than the perpetrators, with the culprits often being White-owned and wealthy corporations (Potter, 2010).

The prevalence of environmental racism was given national attention with the dumping cases in North Carolina. Robert Ward hired Robert Burns to dispose of liquid containing polychlorinated biphenyls (PCBs) in North Carolina. Burns and his two sons disposed of these PCBs at night by driving and releasing them into the soil as they drove.

To clean up the contaminated site, which was on government property, the EPA designated Warren County (a predominantly Black community) as an eligible landfill site to receive the contaminated soil. In this instance, environmental racism was experienced when soil containing polychlorinated biphenyls, a toxic substance, was illegally dumped in 14 counties in North Carolina (Geiser & Wanec, 1983). In a determination on this issue in North Carolina, it was deemed that race was the central element identified in hazardous waste facilities as findings showed that toxic waste sites were mainly located in Black and Hispanic urban areas (Commission for Racial Justice, 1987).

Environmental racism is predicated on several factors. These include benefits it provides to Whites by shifting the cost burden to Blacks (Bullard & Johnson, 2000); social stratification based on race, ethnicity, and class (Keller, 2010; Mohai, Pellow, & Roberts, 2009; Wu & Turner, 2002); and the targeting of poor Black neighborhoods for "lack of environmental consciousness" (Collette, 1985). These factors are in no way an exhaustive list, but we must not lose sight of the fact that discriminatory practices are not only those seen in human-to-human interactions but also extend to biased practices that affect the environment and its inhabitants.

Indeed, the nexus between environmental harms and environmental racism lies in the criminal justice system's ability to step in as arbiter in such circumstances. For example, environmental harms and pollutions are studied by green criminologists and brought before the court for analysis to aid the apportionment of liability. Hence, this dissertation's analysis of oil spill pollution further echoes the involvement of green criminology in helping to bring to justice instances of environmental pollution and its discriminatory practices toward disadvantaged communities.

Discriminatory environmental practices seen in environmental racism particularly affect disadvantaged communities. For instance, scholars reported that the Deepwater Horizon incident affected shorelines of communities of color in Florida, Alabama, Mississippi, and Louisiana, and damaged their economic contributions to society (Yin, 2015). Cases like these call into play the need for criminal justice to be actively involved in environmental pollution.

Understanding what constitutes a minority is essential to help streamline the groups affected by environmental racism. According to the U.S. EPA (2004), minorities include Black American, Hispanic, Asian American or Pacific Islander, and American Indian or Alaskan Native. Minority populations involve minority people residing in a location that will be affected by a proposed project. Louis Wirth also described a minority thus:

> A group of people who, because of their physical or cultural characteristics, are singled out from the others in the society in which they live for differential and unequal treatment, and who therefore regard themselves as objects of collective discrimination. (1945, p. 347)

From the definition above, it is clear that the first environmental racism crisis in Warren County affected a minority population (Blacks). This dissertation also uses a case study method to determine whether certain oil spills affected minority communities or populations. This is addressed in later sections of this dissertation.

In addition to the discrimination experienced with environmental contamination such as oil spills, there are severe health consequences associated with environmental pollution. Research has highlighted that health issues are associated with oil spills. Predominantly, environmental exposure causes cancer (Aguilera et al., 2010) and underlying medical conditions such as depression and post-traumatic stress disorder, or PTSD (Palinkas et al., 1993). Furthermore, research has shown that participation in cleanup activities post-oil spill has led to exposure to several respiratory tract diseases (Perez-Cadahia, 2008; Rodriguez-Trigo et al., 2010; Zock et al., 2006; Zock et al., 2011). All of these adverse effects that normally occur in disadvantaged communities point to the discrimination suffered by these groups through environmental pollution.

The callous disregard for victims of environmental racism is to turn a blind eye to environmental harms and pollution. The "Not in My Backyard" (NIMBY) syndrome fits this description. NIMBY refers to a policy where people turn their faces away from pollution in disadvantaged communities because it does not directly affect them, yet would object to such pollution if it were their community. Arguments of NIMBY and unfairness erupted during the Warren County contamination (McGurty, 1997). The NIMBY indifference to ecological harms must be called out and addressed. This research brings to light instances of how such conversations can be addressed in society.

Environmental Justice

The discriminatory treatment of environmental racism has sparked the need for activists and grassroots organizations to engage in various forms of environmental justice.

The first environmental justice action was seen in the Memphis Sanitation Strike of February 11, 1968. Rev. Dr. Martin Luther King, alongside other Blacks, mobilized a protest after the death of two sanitation workers who died while on the job. This strike advocated for better working conditions and higher pay for Memphis sanitation workers.

The prevalence of environmental racism further led to the environmental justice movements in the 1980s and 1990s. This was seen in the protest held in Warren County in North Carolina (Bullard, 1990). In Warren County, African Americans protested a polychlorinated biphenyls (PCBs) landfill, a toxic chemical in their community, asserting that the community was selected as a landfill site because of its minority status and being poor (Bullard, 1990).

The protests from environmental justice activists and organizations prompted the creation of the Environmental Equity Workgroup in 1990 under the administration of Mr. William K. Kelly (United States Environmental Protection Agency, 1992). The Environmental Equity Workgroup was tasked with the responsibility of reviewing whether racial minority and low-income communities suffered an unequal environmental burden (U.S. EPA, 1992).

Environmental racism protests in North Carolina further promoted the release of the U.S. General Accounting Office Report (1983), which found that the communities affected by the landfills were disproportionately African American.

The second wave of the environmental justice movement and its impact was experienced in 1991 with the First National People of Color Environmental Leadership Summit (Natural Resources Defense Council, 1991). This led to the adoption of 17 environmental justice principles which serve as a guiding light for growing grassroots movements or collaborations for environmental justice causes.

Flowing from environmental justice movements, the U.S. EPA (2017a) defined environmental justice as the fair treatment of persons in environmental protection through regulations and policies irrespective of “race, color, culture, national origin, income, and educational levels.”

The premise of environmental justice is a continuing phenomenon that must be upheld by the criminal justice system. Therefore, the theories of offending (postulated in the criminology discipline) must be expanded to environmental crimes and punishment to ensure a just society. Particularly, there is a fundamental need to protect minority populations and low-income populations from environmental harm that stems from the legislation. This has been made evident by governmental influences through regulations protecting disadvantaged communities on environmental justice concerns. For example, according to President Bill Clinton’s Environmental Justice Executive Order 12898 (Presidential Documents, 1994), federal agencies are mandated to “develop an environmental justice strategy and address the health and environmental impact of their actions on minority and low-income populations.”

President Joseph Biden recently amended the above executive order in his January 27, 2021, executive order to hold polluters responsible for their actions (Executive Order Sec. 201, 2021). Specifically, Biden's executive order on environmental justice extends protection such as economic opportunities to disadvantaged communities (Executive Order Sec. 219, 2021). Through this order (Executive Order Sec. 233. Justice40 Initiative a, 2021), 40% of benefits from certain federal investments could flow to disadvantaged communities. Although the language of this order is vague as to the specific federal investments from which the benefits flow, this section outlines that the investment will be focused on remediation and reduction of pollution.

The issuance of executive orders for environmental protection in disadvantaged communities is a significant step toward environmental justice. But the fight for environmental justice does not end with executive orders because executive orders do not have the permanence of law. In times of crisis, marginalized and disadvantaged communities stand to lose a lot. It has been stated that poor communities and communities of color lack the resources to defend themselves against ecological harm (Faber & McCarthy, 2001). In his book, Steve Lerner (2010) addressed a similar situation where residents of disadvantaged communities were affected by pollution for which he adjudged their regions as sacrifice zones. Thus, there is a need for collaboration among grassroots organizations, environmental foundations, and environmental justice movements with these groups (Faber & McCarthy, 2001). This collaboration is encouraged because community-based organizations, academics, and other advocates have been instrumental in connecting "environmental issues to social justice" in the fight for environmental justice (Ewoh, 1998).

Criminologists study justice and injustice in society (Lynch et al., 2015), the effects of crime, and social issues that surround disadvantaged communities or communities of color. Criminologists' knowledge from working with marginalized groups provides a core need for these experts (especially green criminologists) to take up environmental justice causes in disadvantaged communities.

Likewise, the adjudication of law and order lies within the purview of the criminal justice system. Criminologists through theoretical and empirical studies are among the agents involved in the effective implementation of the objectives of criminal justice. Green criminologists in particular have contributed greatly to the discourse on ecological destruction and environmental repairs. Again, this involvement of green criminologists highlights the importance of these groups in environmental issues. Previous articles have echoed this necessity for green criminologists' involvement in environmental justice issues (Lynch & Stretesky, 1998; Lynch et al., 2015; Zilney et al., 2006). Through its case studies, this research highlights the negative impact of environmental pollution as documented in its oil spill cases. This indicates that environmental contamination extends to the oil and gas industry, which requires the attention of green criminologists. Jarrell and Ozymy (2010) alluded to this fact by highlighting the need for academicians and environmental advocates to be involved in environmental justice measures. Their rationale is based on the fact that air pollution cases emanating from the petroleum industry affect disadvantaged communities. Green criminologists need to spearhead and be involved in environmental justice causes to continue the flow of achieving fairness in society.

Furthermore, there is room for growth and involvement of other advocates and criminal justice personnel in the fight for environmental justice. This dissertation advocates for collaboration with green criminologists and other justice agencies such as environmental activists, environmental grassroots organizations and agencies, the prosecution offices needed to prosecute culprits of environmental destruction, forensic chemists, forensic scientists, and forensic toxicologists involved in analyzing chemical substances or samples from affected oil spill sites to determine causation of spills. Further sections of this research address the impact of environmental forensics and the role of forensic science personnel in oil spill identification. This research addresses the impact of forensic science on environmental issues and lays the groundwork for beneficial collaborations (between forensic science personnel and green criminologists).

One cannot address environmental justice policies without first understanding their economic implications. The first form of environmental racism experienced in the United States started as a cost-saving mechanism initiated by Robert Burns through illegally dumping polychlorinated biphenyls (PCBs) in Warren County, North Carolina. The treadmill of production theory is useful in explaining this action because it highlights environmental damage from a social science perspective (Gould et al, 2004, p. 2).

Schnaiberg (1980) proposed the treadmill of production theory to explain that the driving force of economic growth has pushed states and corporations to a frenzy of increased production, ultimately resulting in depletion and pollution of the ecosystem. This increased need for economic growth makes economies fixated on a treadmill, thereby compromising economic well-being at the expense of environmental damage (Gould et al, 2004). This analogy explains the actions undertaken by Burns in illegally dumping toxic waste in Warren County, North Carolina.

The treadmill of production theory considers environmental changes and harms from an economic perspective. Global economies are driven by production, thus requiring an extensive understanding of the treadmill of production. In this light, Ruggiero and South (2013) correctly highlighted the oil industry as a major driver of the global economy. This research adds to this discourse by analyzing three case studies of environmental crimes in the oil and gas industry. This is because green crimes have also been tied to the treadmill of production in the sense that they are committed in a way that enhances production (Lynch & Stretesky, 2014, p. 139).

The treadmill of production theory argues for the implementation of sustainable based practices that encourage production reduction to bring environmental justice (Gould et al., 2008). An example of a sustainability-based practice is the provision of green jobs in disadvantaged communities and utilizing the talents from such communities. Reports have advocated for opportunities for a successful transition to clean energy resulting in mass green jobs in disadvantaged communities (Hoerner & Robinson, 2008). Many scholars and reports have highlighted the beneficial impact of green jobs on disadvantaged communities. The creation of green jobs serves two purposes: it provides employment and also makes available energy-efficient resources for communities that may not be able to afford RHCs on their own.

Employment opportunities can be created through different workforce development and training options in disadvantaged communities, supporting minority-owned business and corporations in disadvantaged communities, collaboration with schools in disadvantaged communities (particularly minority-serving institutions [MSIs] such as historically Black colleges and universities [HBCUs,] etc.) by providing feeder programs or internships to recruit talent on how best to utilize RHCs into practical positions in the renewable sector from such MSIs.

Environmental justice actions are also found in mechanisms of accountability such as carbon pricing or carbon tax. Specifically, carbon pricing mechanisms, by placing a tariff or tax on greenhouse gas emitters, hold these groups responsible for their pollution in line with the “polluter pays principle.” These market mechanisms show that no one is above the law and polluters are held accountable.

Environmental justice is an ongoing and intentional phenomenon. The cause of environmental justice does not start and end with one, two, three, or several policies and resources. This cause must be upheld in perpetuity. To this end, this research calls for an ongoing collaborative action from environmental justice advocates, corporations, coalitions, grassroots organizations, energy and research institutes, governmental institutions, and private citizens to continue the fight to protect our ecosystem with the voices, platforms, ideas, and resources that they have.

White-Colllar Crime and Environmental Crime

The concept of white-collar crime extends beyond street crimes and traditional crimes studied by criminologists. Edwin Sutherland first introduced the term “white-collar crime” in 1939 during his presidential address at the American Sociological Association. Through this address and his subsequent published paper, Sutherland (1940) discussed the concept of white-collar crimes as crimes performed by the “upper or white-collar class,” thereby debunking the stereotype that people from lower classes are the main culprits of crimes.

White-collar crime has been defined as a crime committed by a person of top skills and social status in relation to an occupation (Sutherland, 1983; Maggio, 2009, p. 170), or “committed by those within legitimate occupations or organizations” (Hagan & Daigle, 2020, p. 317). Lynch and Stretesky (2014, p. 82) identified crimes of the powerful to include corporate, white-collar, or environmental crimes.

Environmental crime has been defined as behaviors or crimes against the environment, in violation of a jurisdiction’s environmental statutes, and carrying criminal sanctions (Clifford & Edwards, 1998; Clifford & Edwards, 2012, p. 114). Environmental crimes (sometimes called green-collar crimes) are committed against the environment for profit. Environmental crime is a subset of white-collar crime because it is committed by white-collar offenders. We see these similarities (for-profit crimes by white-collar offenders) in the case studies of this research. Using the Deepwater Horizon case, it can be gleaned that the driving goal for BP was profit over safety, resulting in the spill.

Environmental pollution of the types studied in this research is not left out of the discussion of what constitutes environmental crimes. These acts (environmental pollution) harm the environment, resulting in loss of human lives, loss of livelihoods, loss of resources, deterioration of the ecosystem, and health disorders. Thus, it results in environmental crimes. Incidental costs such as emotional distress and psychological harm are not addressed in this dissertation but should also be mentioned as consequences of environmental crimes. Specifically, the perpetrators of environmental pollution (white-collar offenders) are those of top skills and social status (wealthy corporations), bringing environmental pollution within the purview of white-collar crimes. The case studies relied on by this research fall under the general ambit of white-collar crimes and a subset of environmental harms. It further brings to light the consequences of environmental crimes that require severe punishments.

The importance of understanding white-collar crimes has been credited with creating an awareness of class inequalities when it comes to offending (Braithawaite, 1985). Nevertheless, although white-collar crimes exposed societal inequalities, such crimes are still on the rise, requiring an extensive study into the issue.

Podgor and Israel (1997, p. 2) indicated the insufficiency of the law in creating a set category of offenses that make up white-collar crimes. The uncertainty leaves a gap for prosecution purposes because some offenses falling on the fence may be left unprosecuted. In this sense, rich corporations and businesses perpetuate environmental crimes against disadvantaged communities and individuals with no definitive punishment unless they are caught through manifest pollutions such as oil spills. Sutherland (1983) stated that white-collar offenders (committed mainly by the upper class) are often not in the criminal purview but adjudicated under civil, regulatory, and administrative contexts. Thus, a better accountability metric for white-collar crimes should be the enforcement of commensurate punishments befitting of such crimes.

For crimes that fall within the scope of what constitutes white-collar crimes, it is expected that they should carry similar punishments as street crimes. This proposition was asserted by Sutherland (1985), who believed that white-collar crimes ought to be given similar punishments as other crimes. One of the premises of this dissertation is that environmental crimes should be made criminal. According to Wolf (2011), the focus of environmental justice movements has been on the inequalities of environmental harms inflicted on victims rather than the elites perpetuating the harms. This is essential because most environmental crimes are considered civil actions, and they incur civil punishments such as damages. In ensuring that environmental crimes receive the appropriate punishments, the criminal justice system must play an active role in addressing such concerns.

So much has been said about environmental justice causes, the environmental justice movement, and environmental policies. However, an essential part of seeing the results of these actions involves penalizing and criminalizing environmental crimes and harms. Beccaria ([1764] 1963) puts it plainly as follows:

> The certainty of a punishment, even if it be moderate, will always make a stronger impression than the fear of another which is more terrible but combined with the hope of impunity. (pp. 58-59)

White (2008b) advocated for the involvement of the courts in sentencing and sanctioning environmental harms because fines are less effective as a deterrence for white-collar offenders. This premise of criminalizing environmental crimes would lay the groundwork for how environmental harms, including oil spills, are handled in society. This dissertation has further highlighted instances of environmental crimes that exist in the corporate world to espouse the criminalization of these crimes.

Regarding environmental violations, the EPA is charged with the protection of human health and the environment. In 1982, the EPA and the U.S. Department of Justice (DOJ) established the Environmental Crimes Unit (ECS), responsible for the enforcement of criminal provisions of environmental laws (U.S. DOJ, 2015a, 2015b). There are several environmental laws to protect human health and the environment in the United States. These include the Clean Air Act (CAA); Clean Water Act (CWA); Resource Conservation and Recovery Act (RCRA); Superfund Comprehensive Environmental Response, Compensation and Liability Act (CERCLA); Toxic Substances Control Act (TSCA); and so on (U.S. EPA, 2021b). These regulations all provide penalties (criminal or civil) for violation or noncompliance. Of importance to this dissertation is the CERCLA, which provides a superfund for the cleanup of uncontrolled substances or contaminants such as spills and ensuring the compliance and cooperation of responsible parties in such cleanup efforts (U.S. EPA, 2020b). This dissertation relies on its case studies documenting oil spills and the need for cleanup efforts by the superfund.

Federal environmental protection efforts include punishments for environmental crimes. For example, to ensure enforcement on environmental regulations, the RCRA Amendments of the 1980s introduced felonies as a punishment for waste pollution (U.S. DOJ, 2015b). The OPA (1990) outlines criminal penalties of jail terms and civil penalties through the imposition of fines for breach of environmental harms. Arguments have been raised as to whether environmental crimes and white-collar offenders receive justifiable punishments for the harms caused. This dissertation further addresses the different types of punishments received for environmental crimes (oil pollution) in the theoretical section. It analyzes the prevalence of environmental crimes committed by employees in the different case studies as seen in environmental pollution of oil spills. For example, in the BP case study, the facts indicate BP officials ignoring safety protocols resulting in a more devastating result: loss of lives and environmental harms. Sutherland (1949), in his crime analysis of "definitions favorable to law violation," alluded to the fact that organizational culture had a causal effect on white-collar crime. That is, employees, learn certain norms in the course of their employment. This is no doubt true in the BP case, wherein BP was formerly adjudged to have a cost-cutting culture that compromised safety for profit (U.S. Chemical Safety and Hazard Investigation Board, 2007).

Environmental Victimology and Victims

The topic of environmental harms affects an indispensable group of persons: its victims. Although environmental victims are compensated in pollution cases, this compensation can never be commensurate to the harm caused. This section discusses the profile of environmental victims from a criminological standpoint.

In the criminological subtext, criminology refers to the scientific study of crimes and criminals, while victimology (a subset of criminology) is the scientific study of crime victims (Mendelsohn, 1947 as cited in Hagan & Daigle, 2020, p. 91). Understanding the victims' perspectives in crime helps provide context for solutions for moving past the harm toward recovery. Victims of environmental crimes are not left out of this framework; discussions promoting their well-being must be constantly addressed.

According to White (2015), environmental victimology is the study of the social processes related to victims of environmental crimes. Although classifying the victims of environmental harm is not a straightforward phenomenon, scholars have acknowledged victims of green and environmental crimes to include human victims, non-human beings, and ecosystems (Lynch and Stretesky, 2014, p. 100; White, 2018).

Environmental crimes occur mainly in disadvantaged communities due to factors such as the low property value of the homes, the inability of residents to fight against such actions, and so on. In other instances, violators may continue their conduct if there is insufficient oversight in enforcing the law against them. The criminal justice system should therefore ensure that the culprits of environmental atrocities are made to pay severely for environmental violations. One such measure is the use of market-based strategy (emissions trading systems) to regulate environmental harms. For example, carbon pricing is a way to put a tax and penalty for polluters on emissions released to the environment. The United States is not exempt from the discussion on carbon pricing. For example, on April 1, 2021, Representative Ted Deutch (D-FL) reintroduced the Energy Innovation and Carbon Dividend Act H.R. 2307 (U.S. Congress, 2021). This bill would place a fee on carbon pollution by businesses importing or mining fossil fuels. The fee is paid to the government, and the revenue will be returned to the American people as a monthly dividend or "carbon cashback" to spend without restrictions. Similarly, a default mode of punishment like that for other crimes should be set for different forms of environmental harm. More severe punishments should also be administered in extreme circumstances because criminal prosecution of environmental offenses is rarely administered. Finally, enforcement of such tasks should be regulated by justice personnel from the criminal justice system.

Policies that regulate environmental pollutions or harms will help in environmental protection efforts, especially for disadvantaged communities. These policies are highly recommended, and their execution must be unbiased. This research therefore calls to action the efforts of green criminologists and the criminal justice system in the implementation of such policies.

Environmental Forensics

The occurrence of oil spills sometimes leaves room for speculation as to its cause because, in some situations, experts are unable to tell the cause of the spill just by observing the scene. In these instances, there is no way to apportion liability to a guilty party that caused the spill because such a person or organization cannot be identified. This becomes problematic, considering the "polluter pays principle" which asserts that a contaminator must bear the cleanup cost for a spill. Despite various regulatory frameworks to deal with an oil spill, the possibility of a disaster occurring is still high, thereby creating a need for a methodical inquiry as to its cause. Environmental forensics emerged to address this gap. This section highlights the impact of environmental forensics (forensic investigation and laboratory impact) on different oil spills as examined in the current case studies.

Oil spill investigations are essential because they help the justice system to identify the guilty parties and assign responsibility. Such investigations are conducted through scientific procedures as contained in environmental forensics.

Environmental forensics is a systematic examination of environmental contaminations by determining pollution sources to apportion liability to the responsible parties (Wenning & Simmons, 2000). It answers questions of what, when, where, and who are involved in harmful chemical releases to the atmosphere (Murphy & Morrison, 2014).

This is done by using forensic analysis and techniques to detect the causes of spills. One such method is oil spill identification.

Oil spill identification ensures that spilled oils are linked adequately to known sources to resolve environmental impact issues and apportion liability to negligent parties (Wang, Fingas, & Page, 1999). These identifications are essential because there is little or no evidence to tell what occurred resulting in the spills. Thus, experts are involved in retrieving samples of chemical components from oil spill sites to determine their cause. Therefore, the environmental forensics discipline is critical in explaining the causes of oil spills and liability purposes.

This section addresses the impact of environmental forensics as it relates to laboratory impact and forensic techniques that are used during the investigation of the contamination.

Forensic Science Regulatory Procedures

Forensic analyses and processes are conducted in compliance with accepted specifications and requirements. These specifications also known as standards, guide and provide best practices for forensic investigations. The U.S. National Research Council (2009, p. 6) highlighted the importance of having an enforceable and unified standard in the forensic science discipline to ensure quality and credibility. Quality is especially needed to give an impartial result in oil spill investigations, and this can be achieved by complying with the necessary industry standards.

Standards are benchmarks agreed upon by experts in the field such as “manufacturers, sellers, buyers, customers, trade associations, users or regulators” (International Organization for Standardization, 2021). Standards provide confidence in the products because they ensure that the results are reliable, valid, and safe (U.S. National Research Council U.S., 2009, p. 201; Wilson-Wilde, 2018). Standards are voluntarily adopted and are independent of the forensic facility's procedures unless mandated by the government, contract (Wilson-Wilde, 2018), or statute. Different standards exist in the field of forensic science such as International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), American Society for Testing and Materials (ASTM) International Standards, and so on. This section emphasizes how different standards, such as those of ASTM, were adopted in this dissertation's oil spill case studies.

Standardization also extends to the procedure through which evidence is collected and handled, as well as the laboratories and personnel handling such evidence. Thus, there are certain quality standards, accreditations, and certifications that must be met to ensure that evidence is properly analyzed in a forensic investigation. This is because scientific assessment in a forensic investigation should be conducted in a neutral manner independent of law enforcement to eliminate bias (U.S. National Research Council, 2009, p. 23, 87).

Evidence Management

Evidence collection and analysis play a key role in its validity for liability purposes because a piece of tainted evidence loses its credibility. Evidence must be obtained properly and managed for it to be admissible in court. Such evidence must also be transferred to the appropriate laboratory. This is called evidence handling.

Evidence management involves the proper collection of evidence from the scene of the event to the laboratory where it will be analyzed (Mozayani & Parish-Fisher, 2017). To achieve this, different steps are required, such as ensuring the evidence is marked for identification, for example, analyzing the crime scene through an initial survey, documenting all evidence gathered from the scene, and so on. Thus, there is an urgent need to properly handle all evidence from the collection point to the endpoint in the laboratory for testing. This is in fulfillment of Locard's Exchange Principle that "every contact leaves a trace." Suffice it to say that the admissibility of evidence rests primarily on how it was obtained (Mozayani & Parish-Fisher, 2017). It is therefore imperative that appropriate safeguards are applied during the evidence collection and analysis stages.

Evidence management extends to oil spill investigations. This is because evidence recovered from oil spill sites may be used by the criminal justice system in assigning liability to the guilty parties. Good evidence management protocols are often based in the legality and validity of such evidence. That is, maintaining the condition and integrity of the evidence.

The evidence retrieved from oil spill sites could serve as a basis for apportioning liability to guilty parties by the criminal justice system. This reinforces the need for compliance with all necessary protocols. According to Williams (2015, p. 177), the initiation of a criminal investigation begins with collecting evidence. Oil spill sites are classified as potential crime scenes because samples retrieved from these locations can be used as evidence to assist the legal system to apportion liability to guilty parties.

Another evidence management procedure is chain of custody. Maintaining a good chain of custody is also important to the evidence collection stage, either at the crime scene or oil spill investigation. Chain of custody refers to the documentation of personnel in the crime scene and evidence obtained in an ethical manner. This ensures that the evidence from the crime scene is not altered before it arrives at the laboratory for analysis. The importance of this procedure is to avoid contamination of the evidence (transfer of external materials to an existing evidence).

Furthermore, in different jurisdictions, accredited laboratories are involved in carrying out forensic testing in oil spill cases. For example, the "Marine Safety Laboratory (MSL) provides forensic oil spill identification for the Coast Guard in the United States" (USCG, 2021). The USGC is responsible for all pollution responses occurring in coastal waters, and this responsibility is carried out through the MSL.

In oil pollution cases, the MSL compares a sample of the petroleum oil spilled and the suspected source sample to determine if it is a match. This is done by using different analytical techniques such as gas chromatography (GC), infrared spectroscopy (IR), and gas chromatography-mass spectrometry (GC/MS) in its testing (USCG, 2021). Testing in such instances is conducted in accordance with the ASTM International Standards (USCG, 2021). Being the first of its kind, this research underscores the efforts by forensic laboratories and techniques utilized in oil spill identification and investigations.

In addition to the efforts of the MSL, the Office of Response and Restoration (OR&R) from the National Oceanic and Atmospheric Administration (NOAA) "provide scientific support to the USCG during an oil spill in coastal waters" (NOAA, 2021). OR&R further provides standards and guidelines for cleanup efforts (NOAA, 2021a). This research circles between cleanup efforts employed by the MSL and NOAA.

This dissertation advocates for a strong collaboration between the criminal justice systems and forensic science disciplines because of the correlation found in their operations. Williams (2015, p. 394) alluded to this nexus between the legal system and forensic science by stating that "the law acts a gatekeeper to forensic evidence." The collaboration of these disciplines (found in forensic criminology) is imperative in preserving evidence and ensuring the maintenance of law and order in society, especially in environmental protection cases.

Impact of Forensic Science in Oil Spills

"Forensic science plays a vital role in identifying oil spills" (Wang et al., 2011). For example, researchers have identified the use of different forensic techniques to identify the cause of an oil spill (Wang, Fingas, & Page, 1999; Wang, Stout, & Fingas, 2006; Wang et al., 2011). These researchers obtained samples of chemical components from the studied oil spill sites. They compared them with samples from other affected areas and found similarities in the chemical components. This finding establishes a relationship between the sites (i.e., the original oil spill sites and other sample sites that were affected).

Researchers used various forensic techniques to identify the causes of different oil spills. For example, in the China Bohai oil spill, researchers used GC/MS and gas chromatography-flame ionization detector (GC/FID) in identifying the sources of the spilled oil (Sun et al., 2009).

Using the example of the Deepwater Horizon oil spill of 2010 that occurred in the United States, researchers compared some chemical components from the Alabama shoreline, and the result showed a comparable match with samples from the Deepwater Horizon oil spill (Mulabagal et al., 2013). The researchers achieved this result using forensic techniques such as GC/MS methods for fingerprinting (Mulabagal et al., 2013). This similarity indicated that the pollution on the Alabama beach had a correlation in the form of tar balls from the Deepwater Horizon oil spill site.

For the Sarnia oil spill of 2009 that occurred in Canada, researchers employed GC/MS forensic techniques in identifying the cause of the spill. The researchers used weathering methods through chemical fingerprinting to check and compare for similarities in the spilled chemicals of other nearby incidents (Wang et al., 2011). The result presented a similarity, thus identifying the cause of the 2009 Sarnia oil spill.

In Brazil, following the Guanabara Bay Oil Spill of 2000, samples were collected about five years after the spill's occurrence (Meniconi, Wagener, & Christensen, 2017). The analysis showed the impact of different forensic techniques such as GC/FID and GC/MS that helped clarify the source of the spill.

Furthermore, with the Exxon Valdez oil spill of 1989 that occurred in the United States, existing literature showed that forensic techniques such as fingerprinting were instrumental in identifying the source of the oil spill (Burns, Mankiewicz, Bence, Page, & Parker, 1996).

All of the above studies indicate that different forensic techniques were used by researchers to identify the source of spilled oil in different incidents.

Impact of Forensic Science in Oil Spills: Current Study

In this dissertation, I considered the different forensic analysis using governmental reports that were conducted on our three oil spill case studies. They are outlined below:

Table 1: Forensic Science Application with Case Studies

Location	Spill/Vessel	Year of Spill	Laboratory/Agency	Forensic Technique
Prince William Sound, Alaska, United States	Exxon Valdez Spill	1989	U.S. Geological Survey and Auke Bay Laboratory Alaska Fisheries Science Center NOAA	Gas Chromatography-Mass Spectrometry (GC/MS)

Delaware, United States	M/T Athos I	2004	U.S. Coast Guard Marine Safety Laboratory	Chemical Fingerprinting
Gulf of Mexico, United States	Deepwater Horizon	2010	Det Norske Veritas, U.S. Coast Guard, and Bureau of Ocean Energy Management, Regulation and Enforcement	Forensic Simulations-Finite Element Analysis (FEA)

Analyses of Case Studies

This section addresses the impact of forensic analysis in oil spill cases. In this section, I address the presence of the laboratory where such samples from oil spill sites were taken for analysis. The case studies of this dissertation discuss the environmental labs that analyzed sample from each oil spill.

Furthermore, this dissertation addresses the forensic techniques that were utilized in identifying the causes of the spills in the case studies.

Case Study 1: Exxon Valdez Oil Spill

Laboratory and Forensic Technique Impact

For this spill, the USCG served as the on-scene coordinator between Exxon and other agencies in the investigation and cleanup efforts. The USCG worked alongside the NOAA, the State of Alaska, and other parties for this incident.

The NOAA provided laboratory support for analysis of the oil samples retrieved from the Exxon Valdez spill site. The first scientific action NOAA provided toward recovery was an aerial surveillance to map the extent of the contamination (Skinner & Reilly, 1989). Six officials from NOAA were involved in this task to enhance its operation.

Furthermore, the NOAA Fisheries (2021b) is responsible for controlling U.S. ocean resources and habitats. Because the Exxon Valdez oil spill affected different species and habitats, the NOAA became involved in conducting analysis as to the details of the spill. One of the earliest observations from NOAA was that the spilled oil formed tarballs, which was an indication of weathering, making it difficult for aerial surveillance to analyze (Federal on Scene Coordinators Report, 1993).

Over the years, researchers conducted analysis into the Exxon Valdez oil spill. One such study compared crude oil spilled from the site to oil samples collected from six nearby islands affected by the spill (Hostettler & Kvenvolden, 1994). These researchers found some correlation with the Exxon Valdez spill and some alterations of the hydrocarbons in other chemical samples (Hostettler & Kvenvolden, 1994). This was later followed by a forensic study by these researchers in conjunction with NOAA to determine the source of the oil on the spill site. This latter study identified petroleum sources to the spill because it was discovered that not all the oil or tar on the beaches studied emanated from the Exxon Valdez oil spill because some of the oils were residues from a different incident (Hostettler et al., 1999). The polycyclic aromatic hydrocarbons (PAHs) were measured using GC/MS in this instance (Hostettler et al., 1999).

Furthermore, a later analysis conducted by the NOAA Fisheries Auke Bay Laboratory for oiled mussel beds showed that Exxon Valdez oil was the contaminant for the mussel beds (Carls & Harris, 2005). This analysis was analyzed using GC/MS methods.

The above instances provide some insight into how forensic analysis was utilized in the Exxon Valdez oil spill.

It is worthy of mention that the USCG is currently tasked with investigating oil spills in coastal waters. This is addressed in detail in the next section. However, during the Exxon Valdez spill, the Coast Guard Marine Safety Office (MSO) in Valdez at the time was unable to respond appropriately to the spill. This was due to the "magnitude of the spill which was larger than the contingency plan had anticipated" (North, 1999).

The Exxon Valdez spill led to Congress enacting the OPA of 1990 to hold polluters responsible for their actions and to outline steps the government can take to prevent and prepare for spills.

Case Study 2: M/T Athos I Oil Spill

Laboratory Impact

Chemical components from the M/T Athos I oil spill were analyzed at the MSL. According to the USCG (2006, p. 23, 28), oil portions found on the anchor was sent to the MSL for forensic analysis.

Coast guard investigators also took paint samples to the MSL, where the laboratory program scientist performed the analysis (USCG, 2006, p. 28). One such sample comparison was sent to the MSL, which compared spilled oil samples and a source sample retrieved from the T/V ATHOS I cargo oil tank (USCG, 2006, p. 29).

The chain of custody was maintained as the paint samples were always within sight of the laboratory program scientist for the entire duration (USCG, 2006, p. 28). The laboratory program scientist found conditions favorable for a match (USCG, 2006, p. 28). Further results also indicated a "similarity between the suspected source samples and spill sample to originate from a common source of petroleum oil with differences being caused by weathering and non-petroleum contamination" match (USCG, 2006, p. 30).

Forensic Technique Impact

Trustees for this spill conducted a preassessment by comparing oil samples from the Athos spill to oil in the Delaware River using chemical fingerprinting (NOAA, 2009, p. 19). The result showed that the spill harmed shorelines, birds and wildlife, aquatic resources, and recreational use, for which restoration efforts began (NOAA, 2009, p. 26). Through this analysis, this research highlights the scientific procedure that was adopted in this spill.

Case Study 3: Deepwater Horizon Oil Spill

Laboratory and Forensic Technique Impact

The Deepwater Horizon event led to a joint investigation team (JIT) conducted by the USCG and the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) (USCG, 2010). The investigation covered inquiries, evidence collection, public hearings, and forensic testing (USCG, 2010). These actions further reiterate the observance of evidence management that was discussed in previous sections. The goal was to guarantee the integrity of the evidence.

The seventh and final hearings, conducted in April and August 2011, focused on forensic testing for the blow out preventer (BOP), which was completed by Det Norske Veritas (DNV).

The DOJ alongside BOEMRE officials conducted a screening of forensic experts to determine their qualification and credibility to perform the analysis (U.S. Government Printing Office, 2012, p. 14). This investigation arose because the investigated material, the BOP, was an oilfield equipment, not marine equipment (U.S. Government Printing Office, 2012, p. 14), which necessitated the outsourcing of this task to the necessary professionals—DNV. The purpose of this forensic investigation was to identify factors that prevented the BOP from performing its intended function—sealing the well bore to contain the flow of the oil and avoid a blowout (U.S. Department of the Interior, 2011, p. 136). The scope of the investigation by DNV would extend to proper documentation of chain of custody and evidence preservation (Det Norske Veritas, 2011, p. 6).

The first action relating to environmental forensics includes evidence collection and control. First, DNV documented the forensic investigation digitally (via video and photo) taken from multiple angles (Det Norske Veritas, 2011, p. 11). and also handled all evidence retrieved from the spill site in accordance with ASTM standard procedures (Det Norske Veritas, 2011, p. 9). Samples and evidence retrieved by DNV were tendered to the USCG evidence controller for evidence logging and documentation of chain of custody requirements (Det Norske Veritas, 2011, p. 10). These samples were then transmitted to the designated storage facility, preserved in the secure control of the Coast Guard. Other evidence collection procedures, such as labeling the samples at the scene, assigning unique tracking numbers to the samples, completing a chain of custody form, were also observed by DNV (Det Norske Veritas, 2011, p. 10). This was to ensure that the evidence was preserved to avoid any contamination.

For onsite visits, only authorized personnel were allowed access to restricted areas, and supervised, escorted visits with authorized personnel were enforced where needed. Observers for the forensic testing were also permitted in certain circumstances at an agreed upon distance (Det Norske Veritas, 2011, p. 11). Interested parties (such as technical representatives from BP, Transocean, and Cameron) formed part of the personnel present in the testing area but were limited to observatory roles and technical discussions with DNV personnel (Det Norske Veritas, 2011, p. 12).

The result of the forensic examination indicated that the position of the drill pipe was trapped (Det Norske Veritas, 2011, p. 64; U.S. Department of the Interior, 2011, p. 138), and this interfered with the cutting of the drill pipe and sealing of the wellbore by the BOP (U.S. Department of the Interior, 2011, p. 139; U.S. Government Printing Office, 2012, p. 16). The BOP in this case failed to seal the well during the emergency, leading to the blowout (uncontrolled release of toxic oils into the atmosphere). The investigation revealed that this disaster was "preventable but not inevitable" (U.S. Government Printing Office, 2012, p. 4). By implication, if the necessary machinery in question (BOP) had done what it was supposed to do, which was to seal the wellbore to contain the flow of the oil, the explosion would not have occurred. In the above oil spill, the presence of forensic testing proved useful in revealing one of the causes of the spill, namely the defective BOP.

DNV used forensic simulations and other computer-aided engineering (CAE) techniques such as finite element analysis (FEA) to discover the cause of the defective BOP (Det Norske Veritas, 2011, p. 148, 152, 156, 160).

Theoretical Framework

Understanding social phenomena such as green criminology, environmental justice, environmental racism, and white-collar crime requires proper justification, which can be achieved through theories. The discipline of criminology is not exempt from this as theories have been used to explain the different rationales behind offending or crime commission. Theories serve as the foundational bedrock for explaining connected statements and reality (Curran & Renzetti, 1994; Williams & McShane, 1988).

Environmental issues have a crucial impact on global economies because the 21st century is fraught with different burning issues, and climate change is a huge one. There have been some debates on the applicable theoretical framework to be associated with environmental harms and crimes. Particularly, scholars have alluded to the difficulty in defining or arriving at a theoretical framework of green criminology (Lynch & Stretesky, 2011, p. 293; White, 2008, p. 14). Suffice it to say that theories for explaining environmental crime causation remain a topic of debate in society. Notwithstanding the current concerns, this section uses the rational choice theory to analyze issues of environmental pollution/harms and environmental crimes.

In this section, three case studies (Exxon Valdez oil spill, M/T Athos I oil spill, and Deepwater Horizon oil spill) were analyzed to ascertain the validity or effectiveness of the rational choice model.

Rational Choice Theory

According to the rational choice theory, individuals engage in crimes by weighing the costs, benefits, and opportunities of their activities (Akers, 1990; Cornish & Clarke, 1986, 1987). In doing so, the underlying principle is assessing the costs of their actions, anticipating the benefits to be derived, and highlighting the opportunities available to meet their needs. Although it is argued that some crimes are unplanned, thus bringing up mixed response to the rational choice model (Hagan & Daigle, 2020, p. 124), Williams and McShane (2014, p. 166) advocated that the binding test here is limited rationality because full rationality (having the necessary information or decision-making framework) is not necessary.

Rational choice theory is the brainchild of classical criminology because it assumes that people are rational beings capable of making their own decisions. The early 18th century ushered in the emergence of criminology with two major schools: classical and positive.

The classical school of criminology postulated that humans are rational beings with free will and choice. This viewpoint saw human offenders as being rational to calculate the costs and benefits of committing a crime (Bernard et al., 2016, p. 46). Major proponents of early classical theorists (e.g., Cesare Beccaria and Jeremy Bentham) were instrumental in shaping what today has evolved in the rational choice theory.

The classical theory of punishment was hypothesized through deterrence: "it is better to prevent crimes than to punish them" (Beccaria, ([1764] 1963, p. 92). Deterrence theory is a concept of punishment that serves to restrain individuals (specific deterrence) or groups in a community (general deterrence) from engaging in different criminal conducts. To achieve deterrence, Beccaria believed punishment must be swift, certain, and clear.

Swiftness or celerity entails the prompt dispensation of punishment after the commission of a crime. Thus, "the more promptly and the more closely punishment follows upon the commission of a crime, the more just and useful will it be" (Beccaria, ([1764] 1963, p. 55-56). The celerity standard has been adopted in the Sixth Amendment of the U.S. Constitution in the right to "speedy and public trial" of an accused in a criminal trial (U.S. Const. Amendment VI).

With certainty, Beccaria ([1764] 1963) promoted the notion that crime must be well defined, as well as its punishment. This clear guideline would serve as a good safeguard to deter polluters once they have a reasonable fear of a fixed punishment for their conduct.

In determining the severity or seriousness of a crime, Beccaria ([1764] 1963) encouraged the consideration of the intention of the individual. This standard in modern parlance is known as "*mens rea*" or criminal intent as a standard for adjudging a person's innocence or guilt. The "*mens rea*" ought to be adopted in determining the intention of polluters. That is, it should be determined whether polluters had knowledge that their action or inaction would result in a pollution. This dissertation illustrates that the inaction of corporations like BP in rectifying its defective equipment led to the subsequent pollution that occurred in the Deepwater Horizon oil spill.

Though some scholars have argued on the substantial effect of deterrence (Nagin & Pogarsky, 2001), albeit with certain limitations (Durlauf & Nagin, 2011; Nagin, 1998), as a crime- reduction technique, others have highlighted the minimal impact of deterrence in reducing environmental crimes because of existing economic factors such as tax dividends available in instances of environmental harms (Stretesky et al., 2013).

Bentham, another proponent of the classical school, viewed human behavior as associated with the notion of hedonistic calculus (hedonism) where people maximize pleasure and minimize pain (1789, p. 29). In support of this perspective, Becker (1968) argued for a cost-benefit drive that influences crime through the hedonistic lens. Specifically, he ascertained that criminals weigh the likelihood of getting caught before embarking on that venture.

There is a nexus between the costs and benefits model and how society and corporations relate this to environmental events. Research explores the impact of rational choice theory in explaining how individuals and companies commit environmental crimes because of the cost benefits they bring to them (McKendall & Wagner, 1997). In applying the rational choice theory to oil spill cases, the punishment is often seen in monetary damages and compensation paid by the offending party. This dissertation will highlight this in the analysis of the case studies.

Using the rational choice theory, this research will show that it is easier to commit an environmental tort and pay damages than refrain from it. That is, polluters continue to engage in environmental harm because compensation, which is often the result, is lower than the cost of doing the right thing and avoiding oil pollutions. For example, it is more cost-effective to flare gas and pollute the environment than to use effective methods to store or capture the gas. This will be analyzed using the case studies at hand.

This research explores a rational choice framework, where it is proven that it is easier to allow a spill and pollute communities of color and low-income communities than prevent its occurrence. This is because such disadvantaged communities lack the resources and capability to legally fight against such environmental pollution instead of committing such acts in affluent White neighborhoods.

In this dissertation, I created a rational choice model where corporations as offenders chose a profit strategy ("profit over safety") as a way of reducing costs or due to opportunities that availed themselves in different instances. In such instances, human lives or the ecosystems were the victims of such profit strategy. The principle of plausible deniability is seen in top officials denying any knowledge of occurrences leading to oil spill. Nevertheless, the legal system has stepped in to adjudicate such issues.

To properly relate the rational choice theory to the current case studies, the following analysis has been conducted.

Case Study Analysis on Environmental Crimes

In recent times, the justice systems have taken a stricter approach to assigning liability for the adverse consequences of ecological destruction or environmental harms. This liability action is related to the "polluter pay principle," which accounts for responsibility on those who contaminate the environment. Enforcement of the "polluter pay principle" indicates that corporations or corporate personnel are not above the law for harms done to the environment. However, this liability is not usually commensurate to the ecological damage, and loss of lives in some circumstances.

This dissertation considers liability and its relationship to the rational choice model in two ways. The first analyzes the general and specific policies implemented by corporations to mitigate or avoid environmental harms and violations (if any). The second addresses whether such company policies are adhered to and stringent enough to deter criminal or civil actions arising from environmental pollution. This research analyzes this responsibility using the following case studies.

Case Study 1: Exxon Valdez Oil Spill

Personal Liability of Captain Joseph Hazelwood and Nexus to Rational Choice Theory

On March 24, 1989, Joseph Hazelwood (the captain of the Exxon Valdez ship) left the tanker's bridge in the care of another. The ship subsequently ran off the Bligh Reef, discharging some oil while he was gone. In compliance with the Federal Water Pollution Control Act (1948, Section 311), Hazelwood immediately reported the oil spill to the USCG 20 minutes after the ship sank.

In 1990, Captain Hazelwood was charged for negligence and intoxication (consuming alcohol within hours of sailing). The jury convicted him of negligent discharge of oil but rejected the state's charge of intoxication as they were not convinced beyond a reasonable doubt that he was intoxicated. The trial court, per Judge Karl S. Johnstone, sentenced Joseph Hazelwood to 90 days in jail and a $1,000 fine, suspension predicated on one year of probation, performance of 1,000 hours of community work (inclusive of beach cleanup), and $50,000 payment in restitution.

Hazelwood appealed the jury's decision (*Hazelwood v. State*, 1992). He argued an immunity defense. The Appeals Court reversed Hazelwood's conviction because evidence from the trial, acquired from his immunized oil spill report, caused a bar for prosecution. The court held that the trial court erred in denying his motion to dismiss on grounds of immunity for failing to suppress evidence of his intoxication (*Hazelwood v. State*, 1992). The case was remanded.

The Alaska Supreme Court reversed the Appellate Court's decision and remanded the case back to them (*State v. Hazelwood*, 1993).

In *Hazelwood v. State* (1996), the court ruled that Hazelwood's prosecution was permissible, but the trial court erred in instructing the jury that civil instead of criminal negligence was the standard to be used in the conviction of negligent discharge of oil.

The Supreme Court reversed the Appellate Court's decision and held that the trial court did not err in instructing the jury that the ordinary negligence standard was sufficient to convict Hazelwood. The case was remanded (*State v Hazelwood*, 1997). The Court remanded the case back to the Appellate Court.

The Appellate Court "affirmed Hazelwood's conviction for negligent discharge of oil because the erroneous admission of the evidence was harmless beyond a reasonable doubt" (*Hazelwood v. State*, 1998). The court affirmed Hazelwood's sentence (fine and imprisonment).

Using the rational choice model, Captain Hazelwood was aware and understood the consequences of his actions (drinking while on duty). He nevertheless engaged in taking a drink before boarding. Although his intoxication was held not binding in the adjudication of the case, his engagement with alcohol before sailing showed an opportunity under the rational choice model that he embraced.

Hazelwood's violations resulted in criminal liabilities (imprisonment of 90 days), and civil liabilities of $5,000 in punitive damages. Nevertheless, Hazelwood took advantage of Exxon's nonenforcement of rules with regard to his drinking problems because the punishment was not clear. That is, had he received appropriate punishment by Exxon for his alcohol problems in the past, he would have complied with the rules and stayed off alcohol in March 1989 and possibly avoided the oil spill.

Generally, the punishment Hazelwood received from this spill was not commensurate to serve as a specific deterrent in the position of the captain as many livelihoods were lost, seafoods contaminated, and residents displaced due to the oil spill.

Joint Liability of Captain Joseph Hazelwood and Exxon, and Nexus to Rational Choice Theory

On the issue of joint liability between Exxon and Hazelwood, the facts are outlined as follows. At phase I, the jury determined that Hazelwood and Exxon were reckless. It stated that a corporation is vicariously liable for the reckless actions of its employees acting within the scope of their employment and in a managerial capacity (*Exxon Shipping Co. v. Baker, 2008*).

"In Phase II, the jury awarded $287 million in compensatory damages to some plaintiffs and others $22.6 million" (*Exxon Shipping Co. v. Baker, 2008*).

"In phase III, the jury awarded $5 billion in punitive damages against Exxon and $5,000 in punitive damages against Hazelwood" (*Exxon Shipping Co. v. Baker, 2008*). The Ninth Circuit Court upheld phase I and reduced Exxon's punitive damages to $2.5 billion

(*Exxon Shipping Co. v. Baker, 2008*). The Supreme Court held that the punitive damage was excessive and remanded the case to the lower court to be awarded to an amount equal to compensatory damages of $507.5 million (*Exxon Shipping Co. v. Baker, 2008*).

The Supreme Court's decision here established a cap for punitive damages in maritime cases to be equal to compensatory damages. This is a win for corporations because under the rational choice model, the cost for environmental harms with a cap in place sets an open window for more harms to be engaged in, provided the financial burden (price cap) is executed.

Also, the punishment offered by the Supreme Court in the Exxon Valdez case, which was different from that recommended by the jury shows a lack of clarity and certainty of punishment. According to the classical school, punishment must be certain to attain its deterrent effect. The civil punishment (compensatory damages) awarded to Exxon failed to achieve a general deterrent effect to other corporations. That is, corporations see this as a way out to contaminate the environment and make up for the pollution with compensation being paid as damages to injured parties.

Furthermore, Exxon executives had knowledge of Hazelwood's alcohol problems. At the trial of Hazelwood, witnesses testified to Exxon's knowledge of its employee's alcohol addiction and lapsed treatment. Exxon had a policy that employees with alcohol dependency who were receiving rehabilitation would not be terminated (*re the Exxon Valdez,* 2002). This policy also stated that crew members would not operate a vessel within four hours of alcohol consumption (*re the Exxon Valdez,* 2002). Hazelwood operated the vessel within three hours of alcohol consumption (in breach of Exxon's policy).

Exxon claimed that it did not fire Hazelwood over his earlier alcohol addictions because he participated in the company's rehabilitation program. Notwithstanding this account, witnesses testified of his relapse in the treatment program. Exxon, by allowing Hazelwood access to the ships in his capacity as captain, failed to consider the implications of that position as captain. As captain of the ship, his drinking problem altered his ability to efficiently carry out his duty. Exxon could have offered him another position within their employment to be under the supervision of another while observing his conduct before giving him the full responsibility to navigate a ship. These actions by Exxon showed that they acted rationally in allowing Hazelwood access to his ships, thus, putting other lives at risk.

The Exxon Valdez spill of 1989 led to the implementation of the OPA (1990), which defined the powers of the U.S. Congress in prevention and response to oil spills. Prior to this, legislation for environmental pollution was not clearly defined. Although other environmental legislation has arisen in recent times to address different kinds of environmental harms, these laws do not contain a comprehensive list of punishments ascribed to polluters.

Case Study 2: M/T Athos I Oil Spill

On November 26, 2004, the M/T Athos I tanker owned by the Frescati Shipping Company was carrying a shipment of crude oil from Puerto Miranda, Venezuela, to a CITGO refinery at Paulsboro, New Jersey. While it was some feet away from the dock, the M/T Athos I struck an abandoned anchor while trying to dock at CITGO's refinery, causing a spill. The question of who was responsible for this damage arose.

The Supreme Court ordered CITGO and its affiliates, Citgo Asphalt Refining Company, Citgo Petroleum Corporation, and Citgo East Coast Oil Corporation (collectively called "CARCO"), to pay compensation to Frescati under the safe berth warranty for its failure to provide a safety port for the M/T Athos I to dock (*re Petition of Frescati Shipping Co., Ltd*, 2016). Justice Sonia Sotomayor considered the safe berth clause as a "warranty for safety." This implied that CARCO was under a responsibility to provide a safe place for the M/T Athos I vessel in its refinery.

Although CARCO did not intentionally allow the M/T Athos I vessel to strike the abandoned anchor, its failure to ensure that all safety protocols were in place made it responsible to Frescati. Thus, CARCO's failure to provide a safe place demonstrated "limited rationality" (Williams & McShane, 2014, p. 166) in its actions. This establishes that the inaction of corporations through its agents when there is a duty of care has disastrous consequences.

Case Study 3: Deepwater Horizon Oil Spill

Deepwater Horizon was an offshore oil rig belonging to BP America. On April 20, 2010, the Deepwater Horizon exploded off the coast of Louisiana and into the Gulf of Mexico, causing large quantities of oil to spill into the Gulf (U.S. EPA, 2020a).

The Deepwater Horizon oil spill is the largest oil spill in U.S. history and the first spill designated as a "spill of national significance" by the Department of Homeland Security (U.S. EPA, 2020a). It resulted in the death of 11 crew members, 17 injuries, and extreme environmental damage through the release of four million barrels of oil (*re: Oil Spill by the Oil Rig "Deepwater Horizon" in the Gulf of Mexico, on April 20, 2010*, 2015;

U.S. EPA, 2020a). This incident is also recorded as the largest environmental spill in U.S. history.

The effect of the Deepwater Horizon oil spill affected the following states: Alabama, Florida, Louisiana, Mississippi, and Texas (U.S. EPA Office of Inspector General, 2011). These five states are collectively known as the Gulf States of the United States (Gulf States Marine Fisheries Commission, 2015; Tchounwou, 1999; World Population Review, 2021).

In response to the spill, the EPA carried out some assessments to determine locations of landfills where the spill's BP waste would be safely disposed of. Among the selected landfill sites for disposal, it has been argued that five out of the nine landfills are locations inhabited by communities of color and low-income communities (Bullard, 2010a; Bullard, 2010b).

BP was the main operator/leaseholder for the well design, and Transocean was the drilling contractor, owner, and operator of the Deepwater Horizon (U.S. Chemical Safety and Hazard Investigation Board, 2016). Anadarko and MOEX co-owned the Macondo well. Halliburton also maintained a presence in the ship on the eve of the explosion. BP through its entity hired Transocean to drill the Macondo well.

The violations by BP in this spill resulted in consequences that can be categorized into criminal and civil liabilities. That is, BP pled guilty to 11 counts of felony manslaughter, one count of felony obstruction of Congress, and violations of the Clean Migratory Bird Treaty Acts (U.S. DOJ, 2012; U.S. EPA, 2013).

Arising from this disaster, BP was sentenced to $4 billion in criminal fines, $20 billion in civil penalty, and five years' (60 months') probation (*re: Oil Spill by the Oil Rig*

"Deepwater Horizon" in the Gulf of Mexico, on April 20, 2010, 2015; U.S. DOJ, 2012; U.S. EPA, 2013).

The adjudication of justice and liability in the Deepwater Horizon spill is outlined as follows. BP admitted to knowledge of the inaction of two of its highest-ranking supervisors (Robert M. Kaluza and Donald J. Vidrine) on board who negligently caused the deaths of the 11 crew members and the oil spill (U.S. DOJ, 2012; U.S. EPA, 2013). BP Chief Executive Tony Hayward assumed full responsibility on behalf of BP and agreed that BP would clean it up and be responsible for damages.

On the evening of the spill, it was reported that Kaluza and Vidrine had observed that the Macondo well was not secure, and that oil and gas were flowing into the well (U.S. DOJ, 2012; U.S. EPA, 2013). Notwithstanding, these supervisors ignored the apparent hazardous signs and failed to take appropriate steps to prevent the blowout. This oversight led to the eventual catastrophe of the Macondo well blowout and its resultant spill (U.S. DOJ, 2012; U.S. EPA, 2013).

In 2012, Kaluza and Vidrine were indicted on 11 counts of involuntary manslaughter, 11 counts of ship officer's manslaughter charges, and one count alleging a Clean Water Act violation (U.S. DOJ, 2012; U.S. EPA, 2013). The defendants contended that the indictment failed to charge an offense against them, lacked jurisdiction, and thus filed for dismissal. The court granted the motion to dismiss for failure to charge an offense but denied the motion to dismiss for lack of jurisdiction (*United States of America v. Kaluza & Vidrine*, 2013).

Kaluza alleged that upper management from BP was aware of the bad well designs but focused on drilling instead of safety. Their account was that the drilling project at the

Macondo well was running behind schedule and about $58 million over budget. Hence, drilling could not afford to be stopped at this time.

The government appealed the decision (*United States of America v. Kaluza & Vidrine*, 2015). The Appellate Court affirmed the district court's position in dismissing the motion to charge an offense "because neither defendant fell within the meaning of the criminal statute" (*United States of America v. Kaluza & Vidrine*, 2015).

Flowing from the Court's decisions and its inability to meet the legal standard for instituting charges, the State dropped all criminal charges against the defendants. Vidrine accepted a plea deal on a misdemeanor water pollution charge and was sentenced to 10 months' probation. Vidrine passed away in 2018. Kaluza rejected the deal maintaining his innocence.

BP also admitted that the company through its former vice president for exploration for the Gulf of Mexico, David Rainey, obstructed an inquiry by the U.S. Congress into the amount of oil being discharged into the Gulf (U.S. DOJ, 2012; U.S. EPA, 2013). BP admitted to the senior executive withholding documents and providing false and misleading information to the U.S. House of Representatives' requests for information. Nevertheless, David Rainey was acquitted of charges of hindering an investigation (*United States of America v. Rainey*, 2015).

Furthermore, engineer Kurt Mix, one of the BP's engineers on site was responsible for calculating the amount of oil spill from the Macondo well. "He was prosecuted for deleting text messages and emails related to the calculations" (*United States of America v. Mix*, 2013). Due to his actions, he was convicted of obstruction of justice. This conviction was overturned because of jury misconduct where a person had been exposed to extrinsic evidence thereby tainting the evidence (*United States of America v. Mix*, 2015). This setback for the justice department made federal prosecutors drop the obstruction charge in exchange for a guilty plea of a misdemeanor charge of computer fraud and abuse. Mix accepted the deal and served 6 months' probation and 60 hours of community service.

The Macondo well had employees from Transocean and BP. The Transocean rig crew asserted that it followed BP's supervisor's order to proceed despite the reports from the wellhead. BP as the operator of the Macondo well was held grossly negligent in the Deepwater explosion. This did not exonerate Transocean employees who were also implicated in the explosion. Transocean pled guilty to environmental crime (violating the Clean Water Act [CWA]) as well and agreed to pay $1 billion in civil fines and penalties and $400 million in criminal fines and penalties (*re: Oil Spill by the Oil Rig "Deepwater Horizon" in the Gulf of Mexico, on April 20, 2010, 2013*; U.S. DOJ, 2013a). The funds would be directed at benefiting the Gulf Region.

Halliburton received the maximum fine and 3-year probationary period for their destruction of evidence, ordered by its manager Anthony Badalamenti (U.S. DOJ, 2013b). Judge Milazzo noted this as "just punishment and appropriate deterrence" (U.S. DOJ, 2013b). This brings the question of severity into play. That is, was this deterrence severe enough?

Anadarko as a nonoperator also received a civil penalty of $159.5 million for its contribution to the oil spill (*re: Oil Spill by the Oil Rig "Deepwater Horizon" in the Gulf of Mexico, on April 20, 2010*, 2015b).

Using the rational choice model, BP was vicariously aware of the damage to the well headship through its agents (Kaluza and Vidrine). Kaluza and Vidrine were BP's topranking officials on board, and both were industry experts (with Kaluza having a degree in petroleum engineering and 35 years' experience in the oil and gas industry and Vidrine being a well site leader for more than 30 years). The actions of these agents showed that they acted rationally, understanding the consequences of their inaction, to continue operations with the failed state of the Macondo well. On the night of the spill, Kaluza and Vidrine were aware that the Macondo well was not secure, and that oil and gas were flowing into the well. The defendants failed to contact engineers onshore to communicate the state of the Macondo well and failed to adequately account for the abnormal readings during the testing (*United States of America v. Kaluza & Vidrine*, 2013).

The rational choice model indicates that BP's actions were reactive rather than proactive in avoiding environmental damage. Although the incident report to the Macondo catastrophe indicated that BP and Transocean had more rigorous risk-management policies than required by regulation, those policies were not implemented in the Macondo situation (U.S. Chemical Safety and Hazard Investigation Board, 2016). This proved that BP operated a flawed safety culture through noncompliance. It goes without saying that partial compliance is tantamount to noncompliance. It is no wonder Assistant Attorney General Lanny A. Breuer of the DOJ stated that the Deepwater Horizon catastrophe was a result of "BP's culture of privileging profit over prudence" (U.S. DOJ, 2012).

BP's culture of profit over safety was also dominant in its 2005 Texas City Refinery explosion, which killed 15 people and left 180 others injured. An investigatory review conducted for that explosion showed BP has some "organizational and safety deficiencies" (U.S. Chemical Safety and Hazard Investigation Board, 2007, p. 18) in its operations. It was stated that BP had a "cost-cutting culture" of neglecting maintenance and compromising safety, as demonstrated by the explosion (U.S. Chemical Safety and Hazard Investigation Board, 2007).

Summary

In this research, I describe pollution as it relates to oil spills which could be accidental, or negligently encouraged by human action, not the conventional type of pollution we are familiar with in hazardous wastes where waste is dumped in landfills or other sites. This pollution (from oil spills) nevertheless affects disadvantaged communities; thus, I will refer to it as "unintentional environmental racism" in this dissertation—that is, racism arising from pollution caused negligently or in which its effects place a disproportionate burden on disadvantaged communities. The rationale for this is that the spill itself was not intentionally created or done by the corporations in the case studies analyzed. Nevertheless, the pollution happened out of negligence of certain personnel from the corporations, thereby placing a disproportionate health burden on disadvantaged communities. Flowing from this, this research introduces the term "unintentional environmental racism" to cover pollution that was caused negligently or in which its effects place a disproportionate burden on disadvantaged communities.

CHAPTER 3

METHODOLOGY

Research Philosophy

This research will embark on a secondary research inquiry using a case study approach. This method was selected because it provides the best platform to analyze whether environmental pollution disproportionately affects minority and low-income communities. This method was also preferred because of the vast array of available resources to the researcher in the different public websites on the selected topic.

The case study method offers numerous advantages and disadvantages to research. Case studies are best used in understanding social occurrences and real-life situations (Flyvbjerg, 2006; Yin, 2009). Case studies provide detailed information that can be tailored to current events and create new knowledge. This serves to advance future research and knowledge in a given field (Merriam, 2009).

However, case studies do not provide strong reliability and validity for the research hypothesis (Flyvbjerg, 2006). This is because of the secondary nature of its data. Importantly, case studies are subject to the researcher's bias, which may be projected on the general nature of the work.

In answering the research questions on whether disadvantaged communities are disproportionately affected by the effect or response of an oil spill, this research will analyze three oil spills in North America and examine their differential effects on the impacted communities categorized as communities (minority versus nonminority).

Data Collection

Data will be retrieved from published works online and government databases. The information will be focused on the surrounding communities where oil spills occurred. The databases to be assessed are the U.S. EPA, U.S. Census Bureau, the health registries of counties being studied, and Google Scholar. This case study will rely on peer-reviewed articles, government reports, and technical reports that address the minimization of oil spill disasters in marginalized and disadvantaged communities.

The principal investigator will not require permission to access the data required because it is public information. The data sought by the principal investigator is not confidential because it is available for public viewing.

Data Analysis

The purpose of this research is to determine how environmental pollution (oil spills) disproportionately affects disadvantaged communities. The research questions and hypotheses are given below:

Research Questions and Hypotheses

1. **Are the effects of environmental disasters (oil spills) on health different between minority and nonminority communities?**

Hypotheses:

H_0: The health effects of environmental disasters are the same on minority and nonminority communities.

H_1: The health effects of environmental disasters are not the same on minority and nonminority communities.

2. **Are minority communities treated any differently than nonminority communities in terms of response time for cleanup of oil spills?**

Hypotheses:

H_0: There is no difference in response times for cleanup between minority and nonminority communities.

H_1: There is a difference in response times for cleanup between minority and nonminority communities.

3. **Are minority communities treated any differently than nonminority communities in terms of resource allocation?**

Hypotheses:

H_0: There is no difference in the amount of resources allocated to minority and nonminority communities.

H_1: There is a difference in the amount of resources allocated to minority and nonminority communities.

Independent Variable

1. **Communities: (minority and nonminority communities)**

Disadvantaged communities (comprising minority and low-income communities) have been at the forefront of environmental racism. Studies show that environmental inequalities arising from pollution disproportionately affect communities of color and low-income communities (Bryant & Mohai, 1992; Bullard, 1990; Bullard, 2010b; Bullard & Wright, 2012). This dissertation seeks to address the aftermath of environmental pollution to establish the prevalence or absence of environmental racism in disadvantaged communities.

This research will operationalize minority populations as Black American, Hispanic, Asian American or Pacific Islander, and American Indian or Alaskan Native as defined by the U.S. EPA (2004).

Dependent Variables

1. **Health Impact or Health Disparities**

Researchers have stated that air pollution affects the health of minority and poor communities (Mikati et al., 2018). These researchers found that Blacks exhibited a 1.5 times higher burden of being exposed to air pollution than Whites, and Hispanics were 1.2 times higher than non-Hispanic Whites (Mikati et al., 2018). The ripple effect of this pollution in disadvantaged communities has resulted in different health and economic challenges. This research will examine the adverse impact of environmental pollution response on the health (using lung and bronchus cancer cases) of members in disadvantaged communities. That is, whether residents of disadvantaged communities are more likely to experience underlying health issues or deterioration after instances of pollution.

2. **Loss of Income**

Research shows that the Deepwater Horizon oil spill significantly affected Black communities' coastal neighborhoods, which led to job losses as coastal regions like Florida experienced employment decline because of a drop in tourism via air travel. In contrast, Louisiana coastal parishes experienced an employment increase (Aldy, 2014). The economic impact in terms of oil spill response will be considered in this research. That is, this research will examine the loss of income and allocation of recovery funds that were distributed in comparison to the composition of disadvantaged communities living in the study's selected oil spill regions. This will determine whether specific communities were allocated more cleanup funds than others based on their racial composition to establish environmental racism. This will be achieved by comparing the community racial demographics with the recovery funds allocated per community.

This research will also evaluate the compensation paid to different communities affected by oil spills to determine the compensation's equitable structure, that is, whether disadvantaged communities affected by oil spills are paid less than their counterpart communities. This will be obtained from settlement reports paid to communities that are affected by oil spills.

Statistical Analysis

This research will perform an independent samples t-test to determine the effects of, and response to, environmental disasters (oil spills) on minority and nonminority communities. Communities (minority and nonminority communities) will be used as the independent variables, and the effects of spills will be used as the dependent variables.

Research Questions

1. **Are the effects of environmental disasters (oil spills) on health different between minority and nonminority communities?**

There are severe consequences of oil pollution on human health. Aguilera et al. (2010) identified that exposure to spilled oil negatively impacted the health of exposed individuals both physically and psychologically. This research analyzes three case studies of oil spill cases and addresses whether the spill affected the health of residents (with regard to cancer specifically) in the affected areas. The case studies under consideration are the Exxon Valdez oil spill, M/T Athos I oil spill, and the Deepwater Horizon spill.

To empirically test these hypotheses, this dissertation used data sets from relevant government databases and government reports (such as the U.S. Census Bureau and county-level data on cancer cases) to generate demographic statistics. These demographic statistics were useful in determining whether affected communities of the case study spills were comprised of minority or nonminority populations.

This research also used county-level health and cancer estimates to understand the health of residents in affected oil spill locations.

Health/Cancer Information

Racial inequalities in health care are a major concern for most U.S. citizens. Research shows that environmental exposure causes cancer (Aguilera et al., 2010). This research made an inclusion criterion on cancer cases because of its high prevalence in society. Using a ten-year period (the year of the affected oil spills inclusive), this research analyzes cancer rates and mortality rates in affected counties where the case study spills occurred.

According to the Centers for Disease Control and Prevention (CDC), cancer has been identified as the second major cause of death for Americans in 2020 (CDC, 2020). That is, an estimation of more than 1.6 million cancer diagnosis and over 600,000 deaths were predicted (Centers for Disease Control and Prevention, 2020; National Cancer Institute, 2020a). Notably, Blacks are adjudged to have the highest cancer death rates and shortest cancer survival rates of any racial group in the United States. (American Cancer Society, 2019, p. 1, 15).

Congress enacted the Cancer Registries Amendment Act (1992), which encouraged the maintenance of a database and state-level population registries for cancer information.

This Act is managed by the CDC and administered by the National Program of Cancer Registries (Cancer Registries Amendment Act, 1992). This research utilized data from the cancer registries of affected states and counties where oil spills happened.

This dissertation will review the three cases of oil spills in the United States in order to establish whether or not disadvantaged communities are disproportionately victims of health disorders such as cancer, with an emphasis on lung cancer. Emphasis has been placed on lung cancer because of its demonstrated nexus to air pollution (Air Pollution Control District, 2021). The Word Health Organization, through its International Agency for Research on Cancer (2013), identified particulate matter, a proxy of air pollution, as a cause of lung cancer (American Cancer Society, 2020; American Lung Association, 2020). Likewise, lung cancer amounted to the largest number of cancer deaths of 45% in Black men and women in the United States. (American Cancer Society, 2019, p. 4).

Census Information

Article 1, Section 2 of the U.S. Constitution (also known as the census clause or enumeration clause) empowers Congress to conduct census. The census clause in the U.S. Constitution has a political undertone because the data help to determine the number of seats allotted to each state in Congress. This research therefore relies on census data during the year of various recorded spills to determine the number of residents in a given location.

The census in the United States began in 1790 and occurs every 10 years (also known as the decennial census) to count all residents in the United States (U.S. Census Bureau, 2020a; U.S. Const. art. 1, S. 2, clause 3). However, the American Community Survey (ACS) conducts ongoing surveys on a yearly, three-year, and five-year basis (U.S.

Census Bureau, 2020b). ACS was fully implemented in 2005 as prior to this period, census data was conducted on a decennial basis.

ACS conducts “period of time estimates” evidenced in single year and multiyear estimates, and also “point in time” estimates evidenced on a specific date (U.S. Census Bureau, 2020c, p. 13). The single year/1-year estimates are collected over a 12-month period (January-December), and multiyear estimates/5-year estimates are collected over a 60-month period (January-December) (U.S. Census Bureau, 2020c, p. 13).

The difference between the decennial census and ACS lies in the fact that the decennial census is collected to aid “congressional apportionment” whereas the ACS is collected to “measure changing social and economic characteristics of the population” (U.S. Census Bureau, 2020c, p. 68).

This research relies on the 5-year estimate dataset because of its statistical reliability, precision, large sample size, and extended scope for including information from all areas (U.S. Census Bureau, 2020c, p. 16). It is worthy of mention that ACS data is based on sampling estimates, making it susceptible to sampling errors (U.S. Census Bureau, 2020c, p. 1). To address this sampling error, the U.S. Census Bureau provides a margin of error with a 90% confidence interval for each ACS estimate (U.S. Census Bureau, 2020c, p. 1, 53).

The oil spill case studies under consideration are outlined below:

- Case Study 1: Exxon Valdez oil spill
- Case Study 2: M/T Athos I oil spill
- Case Study 3: Deepwater Horizon oil spill

The above case studies are analyzed further in the upcoming sections of this dissertation.

Case Study 1: Exxon Valdez Oil Spill

The Exxon Valdez spill occurred on March 24, 1989, when the Exxon Valdez tanker spilled in Alaska (United States Environmental Protection Agency, 2017b). The aftermath of the spill affected Alaskan residents as reported by different studies. In their study, Palinkas et al (1993) found that there was a decline in the health of affected Alaskan residents as a result of the spill, leading to certain medical conditions such as depression and post-traumatic stress disorder (PTSD).

According to the United States Environmental Protection Agency (2004), Alaskan Natives are classified as a minority group.

Prince William Sound, Alaska

Prince William Sound, Alaska, was affected by the Exxon Valdez oil spill of 1989. It is located near the Kenai Peninsula Borough. This research utilized the census status of 1980 in its analysis of Kenai Peninsula Borough. This data is skewed, and caution must be exercised in its interpretation. This is because the Census Bureau revealed that there were instances of population undercounting by 1.2% and 3.7% in African Americans, which was higher than for other races (U.S. Census Bureau, 2020d).

The 1980 demographics of the Kenai Peninsula Borough is given below (U.S. Census Bureau, 1982, p. 15).

Kenai Peninsula Borough: Population (25, 282)

White	23,099
Black	41
American Indian	812
Eskimo	337

Aleut	589
Japanese	54
Chinese	10
Filipino	81
Korean	32
Asian Indian	2
Vietnamese	9
Hawaiian	9
Guamanian	1
Samoan	2
Other	204

Health Statistics of Kenai Peninsula Borough

Table 2: Kenai Peninsula Borough Cancer Data: Lung and Bronchus Cancer

Race	Year	Count	Rate
White	1996-2018	774	70.2
	1989		
	1990		
	1991		
	1992		
	1993		
	1994		

	1995		
	1996	30	113.6
	1997	21	60.2
	1998	38	122
	1999	36	102.9

Race	**Year**	**Count**	**Rate**
Black	1996-2018	^	^
	1989		
	1990		
	1991		
	1992		
	1993		
	1994		
	1995		
	1996	^	^
	1997	^	^
	1998	^	^
	1999	^	^

Race	**Year**	**Count**	**Rate**
Alaska Native/American Indian	1996-2018	133	81
	1989		
	1990		
	1991		
	1992		
	1993		
	1994		
	1995		
	1996	^	^
	1997	^	^
	1998	^	^
	1999	^	^

Race	**Year**	**Count**	**Rate**
Asian or Pacific Islander	1996-2018	^	^

	1989		
	1990		
	1991		
	1992		
	1993		
	1994		
	1995		
	1996	^	^
	1997	^	^
	1998	^	^
	1999	^	^

Data Information Notes

- Rates are per 100,000 and age-adjusted to the 2000 U.S. standard population.
- ^ Statistics not displayed due to fewer than six cases. Data was suppressed for cases that fall below six due to patient confidentiality. Specifically, as the populations of Blacks and Asian/Pacific Islanders in Alaska are small, most of the data for these races have been suppressed.
- Number of cases that fall below 20 are considered unstable and should be interpreted with caution.

Limitation

The Alaska cancer registry only records cancer incidence data starting with diagnosis year 1996.

Asian and Pacific Islanders were classified as a single race category. Cancer incidence report for Some Other Race or Two or More Races was unavailable at the Alaska cancer registry.

Case Study 2: M/T Athos I Oil Spill

The M/T Athos I oil spill occurred on November 26, 2004, in Delaware, causing grave injury to the environment. The spill affected shorelines in Delaware, New Jersey, and Pennsylvania (NOAA, 2020d).

Restoration efforts were focused on the following areas: New Castle and Kent counties, Delaware; Salem and Cumberland counties, New Jersey; Delaware River in Philadelphia; and Delaware county, Pennsylvania (National Oceanic and Atmospheric Administration, 2009).

Census Notes and Limitation

The U.S. Census Bureau indicated that the ACS was not fully implemented until 2005. Thus, this research relied on racial demographics and income statistics from the 2000 decennial census.

Delaware

New Castle County. New Castle County, located in Delaware, was one of the affected counties of the M/T Athos I oil spill. New Castle County is the largest county in Delaware (Delaware Health and Social Sciences, 2014, p. 11).

In 2000, New Castle County had a total population of 500,265 (U.S. Census Bureau, 2021a). The demographic data is outlined below:

New Castle County: 2000 Population (500,265)	
White Alone	365,689
Black or African American Alone	99,778
American Indian and Alaska Native Alone	973
Asian Alone	13,182
Native Hawaiian and Other Pacific Islander Alone or in combination with one or more other races	442
Some Other Race Alone	11,270
Two or More Races	9,154

Health Statistics of New Castle County: Cancer

The Delaware Cancer Registry serves as the State's authority which mandates that medical or treatment centers in the state report all cancer cases to the Department of Health and Social Services (Delaware Cancer Control Act, 1980, S. 3202).

Between 2005 and 2009, New Castle County had 13,718 cancer cases (Delaware Health and Social Sciences, 2013, p. 17). Out of this number, New Castle County had 1,911 lung cancer cases (Delaware Health and Social Sciences, 2013, p. 113).

Cancer Mortality in New Castle County

This research obtained cancer mortality rates (incidence data) from the Delaware Health and Social Sciences, an extension of the Delaware Cancer Registry. Cancer mortality rates in Delaware was obtained by "dividing the number of cancer cases or deaths by the total population and expressed per 100,000 of the population" (Delaware Health and Social Sciences, 2014, p. 116).

Between 2005 and 2009, New Castle County recorded the majority of cancer deaths amounting to 54.9%—4,991 deaths (Delaware Health and Social Sciences, 2013, p. 16, 20). Out of this number, New Castle County recorded 1,442 lung cancer deaths for 2005 to 2009 (Delaware Health and Social Sciences, 2013, p. 117).

Table 3: New Castle County Cancer Data: Lung and Bronchus Cancer

Race	**Year**	**Count**	**Rate**
White	2004-2014		
	2004		78.3
	2005		76.7
	2006		83.2
	2007		72.6
	2008		71.9
	2009		67.2
	2010		75.5
	2011		72.3
	2012		65.1
	2013		68.7
	2014		65.9

Race	Year	Count	Rate
Black	2004-2014		
	2004		99.8
	2005		62.9
	2006		82.7
	2007		67.5
	2008		76.1
	2009		72.1
	2010		63.1
	2011		65.1
	2012		60.7
	2013		73
	2014		61.6

Race	Year	Count	Rate
American Indian and Alaska Native	2004-2014		
	2004		^
	2005		^

	2006		^
	2007		^
	2008		^
	2009		^
	2010		^
	2011		^
	2012		^
	2013		^
	2014		^

Race	Year	Count	Rate
Asian or Pacific Islander	2004-2014		
	2004		^
	2005		^
	2006		^
	2007		^
	2008		^
	2009		^

	2010		^
	2011		^
	2012		^
	2013		^
	2014		^

Race	**Year**	**Count**	**Rate**
Unknown (including other unspecified 1991+)	2004-2014		
	2004		^
	2005		^
	2006		^
	2007		^
	2008		^
	2009		^
	2010		^
	2011		^
	2012		^

	2013		^
	2014		^

Kent County. Kent County, located in Delaware, was also one of the affected counties of the M/T Athos I oil spill.

In 2000, Kent County had a total population of 126,697 (U.S. Census Bureau, 2021c). The demographics is outlined below:

Kent County: 2000 Population (126,697)

White Alone	93,244
Black or African American Alone	25,626
American Indian and Alaska Native Alone	1,079
Asian Alone	2,083
Native Hawaiian and Other Pacific Islander Alone	N/A
Some Other Race Alone	1,688
Two or More Races	2,950

Health Statistics of Kent County- Cancer

Between 2005 and 2009, Kent County had 4,391 cancer cases (Delaware Health and Social Sciences, 2013, p. 17). Out of this number, Kent County had 695 lung cancer cases (Delaware Health and Social Sciences, 2013, p. 113).

Cancer Mortality in Kent County

Between 2005 and 2009, Kent County recorded 1,587 cancer deaths (Delaware Health and Social Sciences, 2013, p. 16, 20). Out of this number, Kent County recorded

476 lung cancer deaths for 2005 to 2009 (Delaware Health and Social Sciences, 2013, p. 117).

Table 4: Kent County Cancer Data: Lung and Bronchus Cancer

Race	**Year**	**Count**	**Rate**
White	2004-2014		
	2004		86.7
	2005		93.2
	2006		85.8
	2007		103.6
	2008		92.6
	2009		81.9
	2010		80.1
	2011		91.7
	2012		83
	2013		82.8
	2014		79.1

Race	**Year**	**Count**	**Rate**
Black	2004-2014		

	2004		^
	2005		^
	2006		^
	2007		^
	2008		^
	2009		^
	2010		^
	2011		^
	2012		90.4
	2013		^
	2014		^

Race	**Year**	**Count**	**Rate**
American Indian and Alaska Native	2004-2014		
	2004		^
	2005		^
	2006		^
	2007		^

	2008		^
	2009		^
	2010		^
	2011		^
	2012		^
	2013		^
	2014		^

Race	Year	Count	Rate
Asian or Pacific Islander	2004-2014		
	2004		^
	2005		^
	2006		^
	2007		^
	2008		^
	2009		^
	2010		^
	2011		^

	2012		^
	2013		^
	2014		^

Race	**Year**	**Count**	**Rate**
Unknown (including other unspecified 1991+)	2004-2014		
	2004		^
	2005		^
	2006		^
	2007		^
	2008		^
	2009		^
	2010		^
	2011		^
	2012		^
	2013		^
	2014		^

Data Information Notes

- Rates are per 100,000 and age adjusted to the 2000 U.S. Standard population (19 age groups—Census P25-1130) standard.
- Confidence intervals are 95% for rates.
- ^ Statistic not displayed due to fewer than 25 cases.
- ~ Statistic not displayed due to fewer than 25 cases.

Limitation

Asian and Pacific Islander are merged into a single racial group.

New Jersey

Salem County. Salem County, located in New Jersey, was also one of the affected counties of the M/T Athos I oil spill.

In 2000, Salem County had a total population of 64,285 (U.S. Census Bureau, 2021e). The demographics is outlined below:

Salem County: 2000 Population (64,285)

White Alone	52,042
Black or African American Alone	9,471
American Indian and Alaska Native Alone	265
Asian Alone	370
Native Hawaiian and Other Pacific Islander Alone	N/A
Some Other Race Alone	1,090
Two or More Races	1,031

Health Statistics of Salem County: Cancer

The New Jersey State Cancer Registry (2020) was established by legislation for maintaining a database on all cancer cases for the state and has done so since October 1, 1978.

Between 2004 and 2008, New Jersey residents had a total of 233,522 cancer cases (New Jersey Department of Health, 2011, p. 55), of which 118,029 were male and 115,493 were female cancer cases (New Jersey Department of Health, 2011, p. 16, 18).

Between 2004 and 2008, lung and bronchus cancer cases amounted to a total of 30,015 (New Jersey Department of Health, 2011, p. 55) with male cases being 15,117 and female 14,898 (New Jersey Department of Health, 2011, p. 16, 18).

Cancer Mortality in Salem County

Between 2004 and 2007, there were 68,653 cancer deaths in New Jersey (New Jersey Department of Health, 2011, p. 3).

Table 5: Salem County Cancer Data: Lung and Bronchus Cancer

Race	Year	Count	Rate
All Races	2004-2014	653	73.2
	2004	50	67.6
	2005	60	79.3
	2006	51	64.3
	2007	58	74.0
	2008	60	76.1

	2009	53	65.2
	2010	68	82.1
	2011	62	75.4
	2012	59	65.6
	2013	70	80.2
	2014	62	74.1

Race	**Year**	**Count**	**Rate**
White	2004-2014	565	73.3
	2004	45	70.7
	2005	55	84.2
	2006	44	63.2
	2007	52	77.1
	2008	53	79.2
	2009	42	60.2
	2010	58	81.1
	2011	54	76.2
	2012	53	67.4
	2013	60	78.2

	2014	49	67.2

Race	Year	Count	Rate
Black	2004-2014	80	71.7
	2004	^	^
	2005	5	49.6
	2006	7	73.6
	2007	6	57.1
	2008	7	62.4
	2009	9	86.4
	2010	10	94.7
	2011	7	71.4
	2012	^	^
	2013	10	102.3
	2014	11	105.8

Race	**Year**	**Count**	**Rate**
American Indian/Alaska Native	2004-2014	6	181.7
	2004	^	^
	2005	^	^
	2006	^	^
	2007	^	^
	2008	^	^
	2009	^	^
	2010	^	^
	2011	^	^
	2012	^	^
	2013	^	^
	2014	^	^

Race	**Year**	**Count**	**Rate**
Asian or Pacific Islander	2004-2014	^	^

	2004	^	^
	2005	^	^
	2006	^	^
	2007	^	^
	2008	^	^
	2009	^	^
	2010	^	^
	2011	^	^
	2012	^	^
	2013	^	^
	2014	^	^

Race	**Year**	**Count**	**Rate**
Unknown (including other unspecified 1991+)	2004-2014	^	^
	2004	^	^
	2005	^	^
	2006	^	^

	2007	^	^
	2008	^	^
	2009	^	^
	2010	^	^
	2011	^	^
	2012	^	^
	2013	^	^
	2014	^	^

Data Source: New Jersey State Cancer Registry SEER*Stat Database: November 16, 2020 analytic file. Created February 1, 2021.

Data Information Notes

- Rates are per 100,000 and are age adjusted to the 2000 U.S. Standard population (19 age groups—Census P25-1130) standard.
- Incidence rates and counts are suppressed for fewer than 5 to ensure statistically reliability and patient confidentiality.
- Rates generated from small numbers should be interpreted with caution.
- Annual rates for relatively uncommon cancers tend to fluctuate substantially from year to year because of small number of cases, particularly in minority populations or smaller geographic areas such as counties.
- ^ (Statistic not displayed due to fewer than five cases).
- ~ (Statistic could not be calculated).

Limitation

Salem County has one of New Jersey's smaller populations and thus does not contain many residents with less common racial groups.

Cancer data collected for Asian, Native Hawaiian, and Other Pacific Islander are classified as one group called (API).

Cancer data is not collected for Other Race or Two or More Races.

Pennsylvania

Delaware River. The Delaware River was one of the affected locations of the M/T Athos I oil spill. It is located around the borders of Delaware, New Jersey, New York, and Pennsylvania. Pennsylvania was highlighted as one of the affected locations arising from the M/T Athos I oil spill. Commodore Barry Bridge (located in Delaware County) is one of the closest to the Delaware river 12 miles away (Pennsylvania State Department, 2021). This dissertation uses Delaware County, which is close to the Delaware river, for its analysis.

In 2000, Delaware County had a total population of 550,864 (U.S. Census Bureau, 2021g). The demographics is outlined below:

Delaware County: 2000 Population (550,864)

White Alone	442,216
Black or African American Alone	79,260
American Indian and Alaska Native Alone	671
Asian Alone	18,290
Native Hawaiian and Other Pacific Islander Alone	N/A
Some Other Race Alone	2,917

Two or More Races	7,413

Health Statistics of Delaware County: Cancer

The Pennsylvania Cancer Registry collects statewide cancer incidence data since 1985 (Pennsylvania Department of Health, 2021a). Health data (cancer statistics) can be accessed through the Enterprise Data Dissemination Informatics Exchange (EDDIE), which is Pennsylvania's primary tool for disseminating data (Pennsylvania Department of Health, 2021b).

The cancer data was obtained from the Pennsylvania Department of Health (2021c), and it is given below:

Table 6: Delaware County Cancer Data: Lung and Bronchus Cancer

Race	Year	Count	Rate
All Races	2004	472	74.2
	2005	512	78.5
	2006	499	78.2
	2007	474	74.6
	2008	474	74.4
	2009	526	82.0
	2010	477	73.7
	2011	473	72.1
	2012	410	60.6
	2013	433	63.4

	2014	455	65.8

Race	**Year**	**Count**	**Rate**
White	2004	401	72.5
	2005	446	77.5
	2006	435	78.8
	2007	404	74.1
	2008	411	75.1
	2009	460	83.4
	2010	405	74.5
	2011	392	70.8
	2012	331	58.9
	2013	365	63.7
	2014	383	67.3

Race	**Year**	**Count**	**Rate**
Black	2004	64	99.9
	2005	54	82.5
	2006	56	79.5

	2007	60	85.8
	2008	55	75.9
	2009	56	80.7
	2010	60	80.5
	2011	71	88.7
	2012	47	53.7
	2013	62	74.9
	2014	66	71.0

Race	**Year**	**Count**	**Rate**
Asian/Pacific Islander	2004	2	ND
	2005	7	ND
	2006	4	ND
	2007	6	ND
	2008	3	ND
	2009	6	ND
	2010	10	ND
	2011	9	ND

	2012	9	ND
	2013	4	ND
	2014	6	ND

Data Information Notes

- Incidence counts for groups with few Pennsylvania residents (such as Native Americans) are not published for confidentiality purposes and patient safety reasons.
- ND = Not displayed.
- Age-adjusted rates were not shown for counts below 20 due to the unreliability of such calculations based on small numbers.
- Frequency count and rate was suppressed for population less than 300.
- Disclaimer: "These data were provided by the Pennsylvania Department of Health. The Department specifically disclaims responsibility for any analyses, interpretations, or conclusions."

Limitation

Native Americans in Delaware county have a small population, thus do not have publishable data for cancer incidence counts.

Asian and Pacific Islander are merged into a single racial group.

Case Study 3: Deepwater Horizon Oil Spill

Deepwater Horizon was an offshore oil rig belonging to BP America. On April 20, 2010, the Deepwater Horizon exploded off the coast of Louisiana and into the Gulf of Mexico, causing large quantities of oil to spill into the Gulf (U.S. EPA, 2020a). The

Deepwater Horizon oil spill is the largest oil spill in U.S. history and the first spill designated as a "spill of national significance" by the Department of Homeland Security (U.S. EPA, 2020). It resulted in the deaths of 11 men and 17 injuries (United States Environmental Protection Agency, 2020a).

The effect of the Deepwater Horizon oil spill affected the following states: Alabama, Florida, Louisiana, Mississippi, and Texas (U.S. EPA Office of Inspector General, 2011). Collectively, these five states are known as the Gulf States of the United States (Gulf States Marine Fisheries Commission, 2015; Tchounwou, 1999; World Population Review, 2021).

In response to the spill, the EPA carried out some assessments to determine locations for landfills where the BP waste from the spill would be safely disposed of. Among the selected landfill sites for disposal, it has been argued that five out of the nine landfills are locations inhabited by communities of color and low-income communities (Bullard, 2010a; 2010b). This dissertation analyzes the impact of the designated EPA's landfill sites on disadvantaged communities. The selected landfills in question are the following:

Alabama (AL)

- Magnolia Landfill, Summerdale, AL
- Chestang Landfill, Mount Vernon, AL

Florida (FL)

- Springhill Regional Landfill, Campbellton, FL

Louisiana (LA)

- Jefferson Davis Parish Landfill, Welsh, LA

- Jefferson Parish Landfill, Avondale, LA
- River Birch Landfill, Avondale, LA
- Tidewater Landfill, Venice, LA
- Colonial Landfill, Ascension Parish, LA

Mississippi (MS)

- Pecan Grove Landfill, Harrison, MS

Alabama

The selected landfills sites in Alabama to receive the Deepwater Horizon oil spill waste include Magnolia Landfill in Summerdale and Chestang Landfill in Mount Vernon (Bullard, 2010a).

Baldwin County

Magnolia Landfill in Summerdale is located in Baldwin County. In 2010, Baldwin County had a total population of 175,791 based on a 5-year estimate (U.S. Census Bureau, 2020j). The demographic data is outlined below:

Baldwin County: Population (175,791)

White Alone	151,453	86.2%
Black or African American Alone	16,613	9.5%
American Indian and Alaska Native Alone	1,090	0.6%
Asian Alone	1,149	0.7%
Native Hawaiian and Other Pacific Islander Alone	6	0.0%
Some Other Race Alone	3,084	1.8%
Two or More Races	2,396	1.4%

Health Statistics of Baldwin County: Cancer

In line with federal directives, the Alabama Board of Health mandated cancer reporting in the Alabama Statewide Cancer Registry (ASCR) in 1995 (Alabama Public Health, 2019; Alabama Statewide Cancer Registry, 2016, p. 2).

In 2010 (the year of the Deepwater Horizon oil spill), Baldwin County had 1,213 cancer cases.

Table 7: Baldwin County Cancer Data: Lung and Bronchus Cancer

Race	Year	Count	Rate
All Races	2009-2018	1,887	67.2
	2009	156	65.5
	2010	177	70.3
	2011	132	52.7
	2012	188	72.6
	2013	209	77.7
	2014	203	71.2
	2015	195	66.2
	2016	205	66.3
	2017	222	69.5
	2018	200	60.0

Race	Year	Count	Rate
White	2009-2018	1,766	67.9
	2009	148	66.9
	2010	164	70.2
	2011	122	52.6
	2012	174	72.2
	2013	198	79.7
	2014	190	72.4
	2015	188	68.9
	2016	190	66.4
	2017	207	70.1
	2018	185	60.0

Race	Year	Count	Rate
Black	2009-2018	105	62.5
	2009	^	^
	2010	^	^
	2011	^	^
	2012	^	^

	2013	^	^
	2014	^	^
	2015	^	^
	2016	^	^
	2017	^	^
	2018	^	^

Mobile County

Chestang Landfill in Mount Vernon is located in Mobile County. In 2010, Mobile County had a total population of 408,620 based on a 5-year estimate (U.S. Census Bureau, 2020k). The demographic data is outlined below:

Mobile County: Population (408,620)

White Alone	250,336	61.3%
Black or African American Alone	140,847	34.5%
American Indian and Alaska Native Alone	3,033	0.7%
Asian Alone	7,393	1.8%
Native Hawaiian and Other Pacific Islander Alone	99	0.0%
Some Other Race Alone	2,071	0.5%
Two or More Races	4,841	1.2%

Health Statistics of Mobile County: Cancer

Table 8: Mobile County Cancer Data: Lung and Bronchus Cancer

Race	Year	Count	Rate
All Races	2009-2018	3,387	69.5
	2009	350	78.2
	2010	364	81.1
	2011	334	72.5
	2012	338	72.1
	2013	363	76.6
	2014	302	61.1
	2015	316	61.9
	2016	346	66.3
	2017	343	66.2
	2018	331	61.9

Race	Year	Count	Rate
White	2009-2018	2,440	38.9
	2009	263	34.1
	2010	259	44.6

	2011	226	40.6
	2012	251	41.3
	2013	270	44.7
	2014	223	37.8
	2015	228	40.4
	2016	236	37.8
	2017	251	35.4
	2018	233	34.3

Race	**Year**	**Count**	**Rate**
Black	2009-2018	906	63.4
	2009	85	67.1
	2010	99	76.6
	2011	102	77.2
	2012	84	61.6
	2013	89	62.8
	2014	79	54.7
	2015	84	53.3
	2016	101	66.5

	2017	88	55.6
	2018	95	59.1

Data Information Notes

- Rates are per 100,000 and age-adjusted to the 2000 U.S. (19 age groups) standard.
- Rates are for malignant tumors only.
- ^ Rate and count not displayed due to fewer than fifteen cases.

Limitations

In Alabama, county-level cancer data was only available for Whites and Blacks at the time of this research. This was because data for other racial groups are not generated on the county-level because of their small numbers.

Furthermore, cancer data for 2019 and 2020 were not available at the time this research was conducted. As per the county directives, 2019 cancer data will be available November 2021 and 2020 cancer data will be available November 2022.

Florida

Florida was one of the listed states affected by the Deepwater Horizon oil spill of 2010. One of such facilities where the BP clean up waste were to be received was Springhill Regional Landfill, Campbellton, Florida (Bullard, 2010a).

Jackson County

Springhill Regional Landfill, Campbellton, Florida is located in Jackson County. In 2010, Jackson County had a total population of 49,334 based on a 5-year estimate (U.S. Census Bureau, 2020l). The demographic data is outlined below:

Jackson County: Population (49,334)

White Alone	34,134	69.2%
Black or African American Alone	12,928	26.2%
American Indian and Alaska Native Alone	275	0.6%
Asian Alone	221	0.4%
Native Hawaiian and Other Pacific Islander Alone	34	0.1%
Some Other Race Alone	640	1.3%
Two or More Races	1,102	2.2%

Health Statistics of Jackson County: Cancer

The state of Florida had the second highest cancer burden in the nation, and cancer became the leading cause of death in 2011 (Florida Health, 2019).

In 2010 (the year of the Deepwater Horizon oil spill), Florida recorded 103,855 cancer cases, Jackson County recorded 209 cancer cases and 34 lung and bronchus cases (Florida Cancer Data System, 2010a).

A major limitation of this data is its exclusion scope to county of residence at the time of diagnosis. Specifically, this record does not show if a person had a cancer diagnosis before he or she became a Florida resident (Florida Cancer Data System, 2020).

Cancer Mortality in Jackson County

In 2010, Florida recorded a total of 41,394 cancer death, Jackson county recorded 126 cancer deaths and 43 lung and bronchus cancer deaths (Florida Cancer Data System, 2010b).

Table 9: Jackson County Cancer Data: Lung Cancer

Race	Year	Count	Rate
All Races	2009	22	35.5
	2010	34	53.3
	2011	39	59.0
	2012	30	43.8
	2013	35	53.7
	2014	53	78.2
	2015	45	65.8
	2016	31	42.4
	2017	30	41.1
	2018	45	59.4

Race	Year	Count	Rate
White	2009	20	42.1
	2010	28	56.1
	2011	33	64.5
	2012	22	42.7
	2013	27	53.2

	2014	42	78.0
	2015	36	70.2
	2016	23	41.0
	2017	24	42.6
	2018	38	64.6

Race	Year	Count	Rate
Black	2009	1	7.2
	2010	6	50.2
	2011	6	46.2
	2012	8	55.7
	2013	8	57.4
	2014	9	61.7
	2015	9	53.9
	2016	8	52.9
	2017	6	40.3
	2018	7	45.5

Data Information Notes

- Age-adjusted cancer incidence.
- Rate per 100,000 population.
- Data are suppressed when there are 1—9 cases in a year.

Louisiana (LA)

Louisiana was one of the listed states affected by the Deepwater Horizon oil spill of 2010. The Louisiana Department of Health (2020) is tasked with maintaining and disseminating public health data for the State of Louisiana.

The following locations were identified to receive the BP clean up waste (Bullard, 2010a):

- Jefferson Davis Parish Landfill, Welsh, LA
- Jefferson Parish Landfill, Avondale, LA
- River Birch Landfill, Avondale, LA
- Tidewater Landfill, Venice, LA
- Colonial Landfill, Ascension Parish, LA

Jefferson Davis Parish

Jefferson Davis Parish Landfill, Welsh, Louisiana is located in Jefferson Davis Parish. In 2010, Jefferson Davis Parish had a total population of 31,500 based on a 5-year estimate (U.S. Census Bureau, 2020m). The demographic data is outlined below:

Jefferson Davis Parish: Population (31,500)

White Alone	25,033	79.5%
Black or African American Alone	5,129	16.3%
American Indian and Alaska Native Alone	56	0.2%

Asian Alone	107	0.3%
Native Hawaiian and Other Pacific Islander Alone	0	0.0%
Some Other Race Alone	279	0.9%
Two or More Races	896	2.8%

Health Statistics of Jefferson Davis Parish: Cancer

The Louisiana Tumor Registry is a statewide legislation that mandates cancer reporting from health care facilities (Louisiana Tumor Registry, 2017, S. 1105.2).

Hsieh et al. (2014, p. 21) completed a compilation of cancer incidence and mortality information from January 1, 2007 to December 31, 2011. In their report, it was gathered that Louisiana had 22, 831 invasive cancer cases between 2007 and 2011.

Between 2007 and 2011, Louisiana had a total number of 3,456 lung and bronchus cancer cases (Hsieh et al., 2014, p. 31).

Table 10: Jefferson Davis Parish Cancer Data: Lung and Bronchus Cancer

Race	Year	Count	Rate
All Races	2010-2017		
	2010	29	78.9
	2011	25	65.7
	2012	34	89.1
	2013	32	83.2
	2014	39	100.4
	2015	30	78.9
	2016	29	72.2
	2017	27	68.5

Race	Year	Count	Rate
White	2010-2017		
	2010	26	83.3
	2011	16	49.2
	2012	26	83.5
	2013	29	87.6
	2014	34	103.1

	2015	25	77.7
	2016	24	71.8
	2017	25	75.7

Race	**Year**	**Count**	**Rate**
Black	2010-2017		
	2010	^	^
	2011	^	9
	2012	^	8
	2013	^	^
	2014	^	^
	2015	^	^
	2016	^	^
	2017	^	^

Race	**Year**	**Count**	**Rate**
American Indian/Alaska Native	2010-2017		

	2010	^	^
	2011	^	^
	2012	^	^
	2013	^	^
	2014	^	^
	2015	^	^
	2016	^	^
	2017	^	^

Race	Year	Count	Rate
Asian or Pacific Islander	2010-2017		
	2010	^	^
	2011	^	^
	2012	^	^
	2013	^	^
	2014	^	^
	2015	^	^
	2016	^	^

Race	Year	Count	Rate
	2017	^	^
Race	**Year**	**Count**	**Rate**
Unknown	2010-2017		
	2010	^	^
	2011	^	^
	2012	^	^
	2013	^	^
	2014	^	^
	2015	^	^
	2016	^	^
	2017	^	^

Jefferson Parish

Jefferson Parish Landfill, Avondale, Louisiana, and River Birch Landfill, Avondale, Louisiana are located in Jefferson Parish.

In 2010, Jefferson Parish had a total population of 431,019 based on a 5-year estimate (U.S. Census Bureau, 2020n). The demographic data is outlined below:

Jefferson Parish: Population (431,019)

White Alone	276,992	64.3%
Black or African American Alone	112,803	26.2%

American Indian and Alaska Native Alone	2,171	0.5%
Asian Alone	16,525	3.8%
Native Hawaiian and Other Pacific Islander Alone	85	0.0%
Some Other Race Alone	16,183	3.8%
Two or More Races	6,260	1.5%

Health Statistics of Jefferson Parish: Cancer

Table 11: Jefferson Parish Cancer Data: Lung and Bronchus Cancer

Race	Year	Count	Rate
All Races	2010-2017		
	2010	349	71.3
	2011	378	75.8
	2012	308	59.8
	2013	344	65.2
	2014	351	66.3
	2015	342	62.4
	2016	376	68.2
	2017	301	54.5

Race	Year	Count	Rate
White	2010-2017		

	2010	272	69.5
	2011	306	76.6
	2012	244	60.4
	2013	284	68.2
	2014	261	62.6
	2015	278	64.9
	2016	281	65.4
	2017	230	53.9

Race	**Year**	**Count**	**Rate**
Black	2010-2017		
	2010	73	88.1
	2011	68	85.6
	2012	56	61.1
	2013	59	65.2
	2014	86	91.0
	2015	58	54.5
	2016	82	79.2
	2017	62	62.7

Race	**Year**	**Count**	**Rate**
American Indian/Alaska Native	2010-2017		
	2010	^	^
	2011	^	^
	2012	^	^
	2013	^	^
	2014	^	^
	2015	^	^
	2016	^	^
	2017	^	^

Race	**Year**	**Count**	**Rate**
Asian or Pacific Islander	2010-2017		
	2010	^	^
	2011	^	^

	2012	6	^
	2013	^	^
	2014	^	^
	2015	^	^
	2016	10	^
	2017	8	^

Race	**Year**	**Count**	**Rate**
Unknown	2010-2017		
	2010	^	^
	2011	^	^
	2012	^	^
	2013	^	^
	2014	^	^
	2015	^	^
	2016	^	^
	2017	^	^

Plaquemines Parish

Tidewater Landfill, Venice, Louisiana, is located in Plaquemines Parish. In 2010, Plaquemines Parish had a total population of 22,710 based on a 5-year estimate (U.S. Census Bureau, 2020o). The demographic data is outlined below:

Plaquemines Parish: Population (22,710)

White Alone	16,406	72.2%
Black or African American Alone	4,917	21.7%
American Indian and Alaska Native Alone	505	2.2%
Asian Alone	738	3.2%
Native Hawaiian and Other Pacific Islander Alone	0	0.0%
Some Other Race Alone	77	0.3%
Two or More Races	67	0.3%

Health Statistics of Plaquemines Parish: Cancer

Table 12: Plaquemines Parish Cancer Data: Lung and Bronchus Cancer

Race	Year	Count	Rate
All Races	2010-2017		
	2010	16	75.3
	2011	21	84.5
	2012	26	100.8
	2013	10	^
	2014	15	^

	2015	15	^
	2016	11	^
	2017	23	89.3

Race	**Year**	**Count**	**Rate**
White	2010-2017		
	2010	12	^
	2011	16	84.8
	2012	19	97.2
	2013	9	^
	2014	11	^
	2015	11	^
	2016	7	^
	2017	17	84.9

Race	**Year**	**Count**	**Rate**
Black	2010-2017		
	2010	^	^
	2011	^	^

	2012	7	^
	2013	^	^
	2014	^	^
	2015	^	^
	2016	^	^
	2017	6	^

Race	**Year**	**Count**	**Rate**
American Indian/Alaska Native	2010-2017		
	2010	^	^
	2011	^	^
	2012	^	^
	2013	^	^
	2014	^	^
	2015	^	^
	2016	^	^
	2017	^	^

Race	**Year**	**Count**	**Rate**
Asian or Pacific Islander	2010-2017		
	2010	^	^
	2011	^	^
	2012	^	^
	2013	^	^
	2014	^	^
	2015	^	^
	2016	^	^
	2017	^	^

Race	**Year**	**Count**	**Rate**
Unknown	2010-2017		
	2010	^	^
	2011	^	^
	2012	^	^
	2013	^	^
	2014	^	^

	2015	^	^
	2016	^	^
	2017	^	^

Ascension Parish

Colonial Landfill is located in Ascension Parish, Louisiana. In 2010, Ascension Parish had a total population of 102,501 based on a 5-year estimate (U.S. Census Bureau, 2020p). The demographic data is outlined below:

Ascension Parish: Population (102,501)

White Alone	76,344	74.5%
Black or African American Alone	22,772	22.2%
American Indian and Alaska Native Alone	237	0.2%
Asian Alone	914	0.9%
Native Hawaiian and Other Pacific Islander Alone	15	0.0%
Some Other Race Alone	1,425	1.4%
Two or More Races	794	0.8%

Health Statistics of Ascension Parish: Cancer

Table 13: Ascension Parish Cancer Data: Lung and Bronchus Cancer

Race	Year	Count	Rate
All Races	2010-2017		
	2010	59	67.2
	2011	72	77.8
	2012	59	61.0
	2013	59	57.8
	2014	73	69.2
	2015	65	55.7
	2016	75	71.3
	2017	67	57.5

Race	Year	Count	Rate
White	2010-2017		
	2010	51	71.6
	2011	56	71.8
	2012	50	63.0
	2013	48	57.7

	2014	61	71.2
	2015	57	61.3
	2016	67	79.6
	2017	60	65.2

Race	**Year**	**Count**	**Rate**
Black	2010-2017		
	2010	7	^
	2011	16	113.3
	2012	9	^
	2013	11	^
	2014	12	^
	2015	7	^
	2016	6	^
	2017	6	^

Race	**Year**	**Count**	**Rate**
American Indian/Alaska Native	2010-2017		
	2010	^	^
	2011	^	^
	2012	^	^
	2013	^	^
	2014	^	^
	2015	^	^
	2016	^	^
	2017	^	^

Race	**Year**	**Count**	**Rate**
Asian or Pacific Islander	2010-2017		
	2010	^	^
	2011	^	^
	2012	^	^

	2013	^	^
	2014	^	^
	2015	^	^
	2016	^	^
	2017	^	^

Race	Year	Count	Rate
Unknown	2010-2017		
	2010	^	^
	2011	^	^
	2012	^	^
	2013	^	^
	2014	^	^
	2015	^	^
	2016	^	^
	2017	^	^

Data Information Notes- (Louisiana Tumor Registry, 2019)

- Rates are per 100,000 and age-adjusted to the 2000 U.S. Standard population (19 age groups—Census P25-1130) standard.

- Counts are the total number of cases during the year for the selected parish.
- Counts are suppressed for fewer than 6 cases.
- Rates are suppressed when based on less than 16 cases or deaths and/or underlying population consists of fewer than 20,000 people.
- ^ Case counts are not displayed for totals less than six.
- ~ Statistic could not be calculated.

Disclaimer

The Louisiana Tumor Registry is supported by the SEER Program (NCI), the National Program of Cancer Registries (CDC), the State of Louisiana, the Louisiana State University (LSU) Health Sciences Center New Orleans, and host institutions.

Mississippi

Mississippi was one of the listed states affected by the Deepwater Horizon oil spill of 2010. One facility where the BP clean up waste was to be received was Pecan Grove Landfill, Harrison, Mississippi (Bullard, 2010a).

Harrison County

Pecan Grove Landfill is located in Harrison County, Mississippi. In 2010, Harrison County had a total population of 181,791 based on a 5-year estimate (U.S. Census Bureau, 2020q). The demographic data is outlined below:

Harrison County: Population (181,791)

White Alone	129,156	71.0%
Black or African American Alone	39,612	21.8%
American Indian and Alaska Native Alone	1,047	0.6%
Asian Alone	5,162	2.8%

Native Hawaiian and Other Pacific Islander Alone	81	0.0%
Some Other Race Alone	2,210	1.2%
Two or More Races	4,523	2.5%

Health Statistics of Harrison County: Cancer

Table 14: Harrison County Cancer Data: Lung and Bronchus Cancer

Race	Year	Count	Rate
White	2010	156	113.9
	2011	122	88.2
	2012	151	108.3
	2013	178	127.0
	2014	149	105.7
	2015	144	101.7
	2016	161	113.3
	2017	160	111.9
	2018	164	114.1

Race	Year	Count	Rate
Black or African American	2010	34	78.0

	2011	28	61.9
	2012	30	64.4
	2013	30	62.2
	2014	31	62.4
	2015	36	70.3
	2016	35	66.6
	2017	22	40.8
	2018	40	72.8

Race	Year	Count	Rate
Asian/Pacific Islanders	2010	5	81.10^
	2011	5	79.1^
	2012	7	108.7^
	2013	5	75.8^
	2014	5	75.4^
	2015	*	**
	2016	*	**
	2017	6	87.8^

	2018	5	73.4^

Data Information Notes

- Rates are age-adjusted to the 2000 US standard million population and expressed per 100,000 population.
- ^ Rates based on less than 16 cases are unstable and should be interpreted with caution.
- *Fewer than 5 cases observed.
- **Rates based on fewer than 5 cases are suppressed.

Limitations

In Harrison County, county-level cancer data was only available for Whites, Blacks, and Asians/Pacific Islanders at the time of this research. In this case, Asians and Native Hawaiian and Other Pacific Islanders have been classified into one category as opposed to separate categories designated to these groups by the U.S. Census Bureau. Population data for American Indians and Alaska Natives was too small to generate any data for at the county level.

Furthermore, county-level cancer data for 2019 and 2020 in Harrison county was unavailable at the time this research was conducted.

Additionally, at the time of this research, it was garnered that rates based on fewer than five cases are suppressed by the county for confidentiality purposes. For the purpose of this research, rates based on less than 16 cases are considered unstable as provided by the county and thus advised to be interpreted with caution.

The cancer data does not also include information from the Veterans Affairs (VA) hospital and the Air Force hospital. As federal entities, these organizations are exempt from reporting to the state cancer registry.

Research Question 2

Are minority communities treated any differently than nonminority communities in terms of response time for cleanup of oil spills?

The factors that affect clean up differs from one spill to another. These include weather conditions, geographic isolation, spill size (United States Environmental Protection Agency, 1999, p. 27), location, oil type, timing of spill, regulatory framework (Etkin, 1999), and so on.

Proving environmental racism through the occurrence of an environmental contamination such as oil spills is a herculean task because some oil spills are not intentional. However, racism can be inferred from the actions of the polluter post-spill occurrence if it adversely affects disadvantaged communities. This has resulted in the introduction of the term of "unintentional environmental racism" by this dissertation.

The major focus of a post-spill occurrence should be intentionality after the contamination or oil spill has occurred. That is, it should determine whether polluters deliberately choose to clean up certain areas faster than others when an oil spill occurs because this could prove a bias leading to inferences on environmental racism.

This dissertation used government reports and recorded settlement information from governmental agencies to identify clean up timelines for different oil spills.

In the United States, the CERCLA (1980), also known as the Superfund, makes provision for contaminators to be involved in the cleanup process of uncontrolled or abandoned pollutants in the environment.

The NOAA manages cleanup efforts and environmental restoration of natural resources after the occurrence of a spill. The NOAA's Office of Response and Restoration

(OR&R) is tasked with responding to oil spills and other emergencies occurring in coastal waters (NOAA, 2020a). The OR&R provided scientific support to the U.S. Coast Guard personnel during a spill (NOAA, 2020a). The NOAA's Office of Response and Restoration in collaboration with the NOAA's General Counsel for Natural Resources and Office of Habitat Conservation created the Damage Assessment, Remediation, and Restoration Program (DARRP) in 1992 (NOAA, 2020b). Specifically, DARRP helps in assessment and restoration plans for the environments arising from oil spills or hazardous waste resources (NOAA, 2020b, 2020c). DARRP works in conjunction with teams of state, tribal, federal trustee agencies, industry experts, and the public in ensuring the protection and restoration of natural resources contaminated by spills or hazardous waste (NOAA, 2020c).

Cleanup timeline for the understudied spills are given below:

Table 15: Oil Spill Timeline

Location	Spill/Vessel	Year of Spill	Year Awarded	Clean Up Timeline	Estimated End Date
Prince William Sound, Alaska, United States	Exxon Valdez	March 24, 1989	1991	**25 years**	
Delaware, United States	M/T Athos I	November 26, 2004		**5 months**	April 22, 2005
United States	Deepwater Horizon	April 20, 2010	2016	**15 years**	2031

This dissertation analyzes the above table in the following section:

Case Study 1: Exxon Valdez Oil Spill

The Exxon Valdez Oil Spill Trustee Council was set up in 1991 to handle restoration of the environment and manage the funds directed at cleanup (Exxon Valdez Oil Spill Trustee Council, 2020b). Cleanup efforts commenced in 1991 with the establishment of the Exxon Valdez Oil Spill Trustee Council, which was set up 2 years after the spill of 1989.

Recovery timeline for species in the environment differed from one breed to another. There are four categories of recovery types listed for the species and these include: recovered species and habitats, recovering species and habitats, species and habitats not recovering, and status unknown (National Oceanic and Atmospheric Administration, 2019).

Recovery timeline for the following species were Rocky Intertidal (1992); Bald Eagle (1996); River Otter (1999); Common Murre, Sockeye Salmon, and Pink Salmon (2002); Cormorant, Harbor Seal, Dolly Varden, and Common Loon (2006); Subtidal Communities, Rockfish, and Cutthroat Trout (2010); and Sea Otter and Harlequin Duck (2013) (NOAA, 2019).

Species and Habitats still covering are Clams, Black Oystercatcher, Mussels, Killer Whale Pod AB, Barrow's Goldeneye, Intertidal Communities, Designated Wilderness, and Sediments (NOAA, 2019).

Species and Habitats not recovering are Herring, Killer Whale Pod AT1, and Pigeon Guillemots (NOAA, 2019).

Species whose status are unknown are Kittlitz's Murrelet and Marbled Murrelet (NOAA, 2019).

The recovery information for species from the Exxon Valdez oil spill is tabulated below.

Table 16: Recovery Data for Species and Habitats

Recovery Year	Recovered Species and Habitats	Species and Habitats Recovering	Species and Habitats not Recovering	Species whose status are unknown
1992	Rocky Intertidal	Clams	Herring	Kittlitz's Murrelet
1996	Bald Eagle	Black Oystercatcher	Killer Whale Pod AT1	Marbled Murrelet
1999	River Otter	Mussels	Pigeon Guillemots	
2002	Common Murre	Killer Whale Pod AB		
2002	Sockeye Salmon	Barrow's Goldeneye		
2002	Pink Salmon	Intertidal Communities		
2006	Cormorant	Designated Wilderness		
2006	Harbor Seal	Sediments		
2006	Dolly Varden			
2006	Common Loon			
2010	Subtidal Communities			
2010	Rockfish			
2010	Cutthroat Trout			
2013	Sea Otter			
2013	Harlequin Duck			

Source: National Oceanic and Atmospheric Administration, 2019

Case Study 2: M/T Athos I Oil Spill

The NOAA and natural resource agencies conducted a natural resource damage assessment (NRDA) to analyze the effect of the spill and implement projects to restore the natural resources and environment affected by the spill (NOAA, 2009).

The agencies included U.S Fish and Wildlife Service; New Jersey Department of Environmental Protection; Delaware Department of Natural Resources and Environmental Control; and Pennsylvania Department of Conservation and Natural Resources, Department of Environmental Protection, Fish and Boat Commission, and Game Commission (NOAA, 2009). This assessment resulted in the creation of a restoration plan and environmental assessment (NOAA, 2009).

Trustees received $27.5 million for restoration projects in 2010 devised to repair the environment, coastal communities, and the economy (NOAA, 2020d). These projects include: freshwater tidal wetlands restorations at John Heinz National Wildlife Refuge (Pennsylvania), Create oyster reefs (New Jersey and Delaware), Darby Creek dam removal and habitat restoration (Pennsylvania), habitat restoration at Mad Horse Creek (New Jersey), shoreline restoration at Lardner's Point (Pennsylvania), Blackbird Reserve Wildlife Area Pond and Pasture Enhancement (Delaware), and improve recreational opportunities (Pennsylvania, New Jersey, and Delaware) (NOAA, 2020d).

In line with the OPA, the restoration project was funded by the Oil Spill Liability Trust Fund administered by the USCG because the responsible party exceeded its limit of liability (National Oceanic and Atmospheric Administration, 2009, p. ix; Oil Pollution Act, 1990). This provision is invoked as long as the responsible party is not grossly negligent for the incident, the responsible party is not in failure to comply with federal and state regulations, the responsible party is not in breach of reporting or cooperating with government officials in removal activities and costs (Oil Pollution Act, 1990, S. 2704).

Preassessment actions on the oil spill began on November 27, 2004 resulting in a cleanup timeline of 5 months (National Oceanic and Atmospheric Administration, 2009, p. 4). Although cleanup activities for the M/T Athos I spill ended on April 22, 2005, it has been reported that environmental restoration following the spill was still ongoing as of 2009 (National Oceanic and Atmospheric Administration, 2009, p. 4).

Case Study 3: Deepwater Horizon Oil Spill

President Barrack Obama created the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (2011, p. vi) to provide an impartial analysis on the Deepwater Horizon spill.

The U.S. Government entered into a consent decree with BP for resolution of a civil claims of $20 billion (*re: Oil Spill by the Oil Rig "Deepwater Horizon" in the Gulf of Mexico, on April 20, 2010*, 2015). This decree required BP to pay the civil penalty over a 15-year period.

Research Question 3

Are minority communities treated any differently than nonminority communities in terms of resource allocation?

The amount of compensation or resource allocation post spill offered to different communities becomes the litmus test on whether or not minority communities are treated unfairly to nonminority communities. This section will compare the compensation awarded in different environmental pollution cases.

This research outlined the following compensation disbursed on the oil spill case studies.

Table 17: Oil Spill Compensation/Cleanup Costs

Location	Spill/Vessel	Year of Spill	Cleanup/Compensation Costs	Year Awarded
Prince William Sound, Alaska, United States	Exxon Valdez Spill	March 24, 1989	$1,150,000,000	1991
Delaware, United States	M/T Athos I	November 26, 2004	$143,000,000	
United States	Deepwater Horizon	April 20, 2010	$20 billion (civil penalty)	2015
United States	Deepwater Horizon	April 20, 2010	$4 billion (criminal penalty)	2012

Case Study 1: Exxon Valdez Oil Spill

In *United States. v. Exxon Corporation et al*. (1991), the Court entered a consent decree against Exxon for criminal and civil payment. The Exxon Valdez Oil Spill Trustee Council was set up in 1991, 2 years after the spill of 1989 (Exxon Valdez Oil Spill Trustee

Council, 2020b). Its purpose was to ensure the restoration of the environment caused by the spill and monitoring of funds disbursed toward cleanup efforts. Restoration is intended to place the environment back in the state it would have been had the spill not occurred.

"Between the period of the spill through August 1991, Exxon paid an excess of $2.1 billion for clean-up activities and reimbursements to federal, state, and local governments" (*United States. v. Exxon Corporation et al.*, 1991, p. 3).

In addition to the $2.1 billion expended by Exxon for cleanup activities, Exxon paid some additional payments via the consent decree entered. These payments are outlined in the preceding paragraph.

On the criminal plea agreement, Exxon was fined $150 million but paid $25 million ($12 million to the North American Wetlands Conservation Fund and $13 million to the National Victims of Crime Fund) after being exonerated of $125 million in recognition of their cooperation in the cleanup efforts (Exxon Valdez Oil Spill Trustee Council, 2020a; *United States. v. Exxon Corporation et al.*, 1991).

On criminal restitution, Exxon paid $100 million, which was divided equally between the federal and state governments as restitution for injuries caused to the wildlife and lands of the spill (Exxon Valdez Oil Spill Trustee Council, 2020a).

On its civil claim, Exxon paid $900 million over a 10-year period to be used for restoration of lost resources or losses caused by the spill (Exxon Valdez Oil Spill Trustee Council, 2020a; *United States. v. Exxon Corporation et al.*, 1991, p. 7). This amount was divided into $213.1 million, used as reimbursement to federal and state governments for damage assessment and spill response, and $686.9 million was to be disbursed by the Exxon Valdez Oil Spill Trustee Council (Exxon Valdez Oil Spill Trustee Council, 2020a).

Similarly, the consent agreement created a reopener clause, allowing the state and federal governments to seek up to $100 million in the future for restoration projects to address unforeseen environmental damages (*United States. v. Exxon Corporation et al.*, 1991, p. 18). The government invoked the reopener clause on August 31, 2006 by requesting for $92 million for additional restoration costs but decided not to pursue this further because potential affected species had recovered (United States Department of Justice, 2015c).

In 1994, a federal jury awarded punitive damages of $5 billion against Exxon. This amount was reduced to $4.5 billion by a federal judge (*re Exxon Valdez*), and upon appeal, the Appeals Court cut it to $2.5 billion. The Supreme Court found that $2.5 billion was excessive and reduced it to the amount of actual harm (that is, equal to compensatory damages) incurred, which was $507.5 million (*Exxon Shipping Co. v. Baker, 2008*).

Table 18: Case Study 1: Exxon Valdez Oil Spill: Settlement Fund Allocation

Criminal Plea Agreement $150 million			**Criminal Restitution $100 million**		**Civil Settlement $900 million**	
$125 million	**$13 million**	**$12 million**	**$50 million**	**$50 million**	**$213.1 million**	**$686.9 million**
Exxon exonerated for its cooperation in cleanup efforts	National Victims of Crime Fund	North American Wetlands Conservation Fund	Federal governments	State governments	Federal and state reimbursements for damage assessment	Exxon Valdez Oil Spill Trustee Council

Source: Exxon Valdez Oil Spill Trustee Council (2020c)

Case Study 2: M/T Athos I Oil Spill

The M/T Athos I tanker was owned by Frescati Shipping Company carrying a shipment of crude oil from Puerto Miranda, Venezuela to a CITGO refinery at Paulsboro, New Jersey. While it was some feet away from the dock, the M/T Athos I struck an abandoned anchor, which pierced it causing the release of over 200,000 barrels of oil being spilled to the Delaware River.

The District Court ordered CARCO to pay a total judgment of $71,508,149.70 to Frescati (a breach of contract claim and negligence of $55,497,375.95 plus prejudgment interest of $16,010,773.75). The court also ordered CARCO to pay $48,614,738.64 to the United States (*re Petition of Frescati Shipping Co., Ltd.*, 2016).

The Court also awarded the United States a total sum of $48,614,738.64 (*re Petition of Frescati Shipping Co., Ltd.*, 2016). This amount included $43,994,578.66 on the breach of contract claim after a 50% reduction of its claim for failing to discover the anchor, and a prejudgment interest of $4,620,159.98.

In light of the spill, Frescati Shipping Company and the U.S. Oil Spill Liability Trust Fund paid a total compensation of $143 million in cleanup costs as the responsible party under the OPA (1990, S. 2701). The $143 million for cleanup costs involved decontaminating the polluted waters and paying claims of third parties. Subsequently, the United States reimbursed Frescati $88 million in accordance with the OPA (1990, S. 2701), which caps the liability of shipowners.

Frescati Shipping Company and the United States sought to recover this compensation from CARCO because the safe berth warranty contained in the agreement was a guarantee by CARCO that its port would provide a safe passage for Frescati's vessel to dock. The Supreme Court ruled on a majority that Frescati was a beneficiary of the safe berth warranty and the assurance that CARCO's port would be a safe place for Frescati's vessel (*CITGO Asphalt Refining Co. v. Frescati Shipping Co*., *Ltd.,* 2020).

Case Study 3: Deepwater Horizon Oil Spill

According to the Oil Pollution Liability and Compensation Act (1990, S. 2702), BP is mandated to reimburse all state and local governments for their efforts to clean up any spill caused by its vessel.

In line with the OPA, trustees comprising of state and federal agencies acted on behalf of the public's interest to execute a restoration plan to the areas affected by the spill (Gulf Spill Restoration, 2020c; U.S. EPA, 2020a, p. 13). The Deepwater Horizon trustees consisted of representatives from federal and state agencies. The federal agencies included the U.S. Department of Commerce, NOAA, the U.S. Department of the Interior (DOI), the U.S. Environmental Protection Agency (EPA), the U.S. Department of Agriculture (USDA), and designated state agencies representing the five Gulf States: Alabama, Florida, Louisiana, Mississippi, and Texas (Gulf Spill Restoration, 2020c; U.S. EPA, 2020a, p. 13).

A consent decree awarding BP a penalty of $20 billion was entered by the judge in a suit brought by the United States and Gulf States against BP and its entities (*re: Oil Spill by the Oil Rig "Deepwater Horizon" in the Gulf of Mexico, on April 20, 2010*, 2015). In order to comply with this order, BP established the Gulf Coast Claims Facility (GCCF). Payments from the fund would be adjudicated by an Independent Claims Facility (ICF), or by a court, or as agreed by BP (BP, 2010). Neutrality was not achieved via the GCCF resulting in its replacement with a court- supervised settlement.

The consent decree according to *re: Oil Spill by the Oil Rig "Deepwater Horizon" in the Gulf of Mexico, on April 20, 2010* (2015) awarded a civil penalty of $5.5 billion (p. 21), Natural Resource Damages of $7.1 billion (p. 23), Early Restoration distribution of $1 billion (p. 94), Natural Resource Damages Assessment costs for federal and state of $350 million (p. 27), Unknown Conditions and Adaptive Management not exceeding $700 million (p. 26), Schedule for Payment of Other Amounts of $250 million (p. 30), and a separate agreement of $5.9 billion to resolve economic damages claims from state and local authorities.

According to the United States Department of Justice (2021), the consent decree summary of payment is outlined as follows:

CWA Civil Penalty	$5.5 billion
Natural Resource Damages	$7.1 billion
Early Restoration BP previously committed (partially paid)	$1 billion
NRD Assessment Costs (States and U.S.)	$350 million
Unknown Injury and Adaptive Management	Up to $700 million
False Claims Act; Royalties on oil; Response and other costs	$250 million
State and Local Economic Claims (Separate Agreement)	Up to $5.9 billion
Total	$20.8 billion

As part of the consent decree, the Court approved an $8.8 billion settlement against BP as restoration cost for the affected Gulf States on April 4, 2016 (Gulf Spill Restoration, 2020a; U.S. EPA, 2020, p. 13). BP is expected to pay the said amount ($8.8 billion) to trustees who will administer the fund over a space of 15 years (Gulf Spill Restoration, 2020b).

To execute the payment plan, the trustees designated restoration areas which comprised of the five Gulf state affected by the spill, region wide and the open ocean (Gulf Spill Restoration, 2020a). Restoration areas received the following funding in the categories listed below.

Alabama. Alabama received a total restoration settlement of $296 million from BP. The funds were allocated on the following basis: Restore and Conserve Habitat ($96 million), Restore Water Quality ($5 million), Replenish and Protect Living Coastal and Marine Resources ($54 million), Provide and Enhance Recreational Opportunities ($111 million), and Monitoring Adaptive Management, Administrative Oversight ($30 million) (Gulf Spill Restoration, 2020d).

Florida. Florida received a total restoration settlement of $680 million from BP. The funds were allocated on the following basis: Restore and Conserve Habitat ($38 million), Restore Water Quality ($335 million), Replenish and Protect Living Coastal and Marine Resources ($93 million), Provide and Enhance Recreational Opportunities ($184 million), and Monitoring Adaptive Management, Administrative Oversight ($30 million) (Gulf Spill Restoration, 2020e).

Louisiana. Louisiana received a total restoration settlement of $4.981 billion from BP. The funds were allocated on the following basis: Restore and Conserve Habitat ($4.3 billion), Restore Water Quality ($20 million), Replenish and Protect Living Coastal and Marine Resources ($343 million), Provide and Enhance Recreational Opportunities ($60 million), and Monitoring Adaptive Management, Administrative Oversight ($258 million) (Gulf Spill Restoration, 2020f).

Mississippi. Mississippi received a total restoration settlement of $297 million from BP. The funds were allocated on the following basis: Restore and Conserve Habitat ($141 million), Restore Water Quality ($28 million), Replenish and Protect Living Coastal and Marine Resources ($74 million), Provide and Enhance Recreational Opportunities ($24 million), and Monitoring Adaptive Management, Administrative Oversight ($30 million) (Gulf Spill Restoration, 2020g).

Texas. Texas received a total restoration settlement of $240 million from BP. The funds were allocated on the following basis: Restore and Conserve Habitat ($100 million), Restore Water Quality ($23 million), Replenish and Protect Living Coastal and Marine Resources ($91 million), Provide and Enhance Recreational Opportunities ($19 million), and Monitoring Adaptive Management, Administrative Oversight ($7 million) (Gulf Spill Restoration, 2020h).

Regionwide Restoration Area

This involved restoration of natural resources in affected oil spill regions, the services they rendered, replenishing and protecting wildlife (Gulf Spill Restoration, 2020i). Restoration for all regionwide activities received a total restoration settlement of $350 million from BP. The funds were allocated on the following basis: Replenish and Protect Living Coastal and Marine Resources ($245 million) and Monitoring Adaptive Management, Administrative Oversight ($105 million) (Gulf Spill Restoration, 2020i).

Open Ocean Restoration Area

This involved restoration for “wide-ranging and migratory species” (Gulf Spill Restoration, 2020j). Restoration for the open ocean received a total settlement of $1.24 billion from BP. The funds were allocated on the following basis: Replenish and Protect

Living Coastal and Marine Resources ($868 million), Provide and Enhance Recreational Opportunities ($22 million), and Monitoring Adaptive Management, Administrative Oversight ($350 million) (Gulf Spill Restoration, 2020j).

Table 19: Case Study 3: Deepwater Horizon Oil Spill: Restoration Fund Allocation

Location	Restoration Funds Allocated	Restore and Conserve Habitat	Restore Water Quality	Replenish and Protect Living Coastal and Marine Resources	Provide and Enhance Recreational Opportunities	Monitoring Adaptive Management, Administrative Oversight
Alabama	$296 million	$96 million	$5 million	$54 million	$111 million	$30 million
Florida	$680 million	$38 million	$335 million	$93 million	$184 million	$30 million
Louisiana	$4.981 billion	$4.3 billion	$20 million	$343 million	$60 million	$258 million
Mississippi	$297 million	$141 million	$28 million	$74 million	$24 million	$30 million
Texas	$240 million	$100 million	$23 million	$91 million	$19 million	$7 million
Regionwide Restoration Area	$350 million	$0	$0	$245 million	$0	$105 million
Open Ocean Restoration Area	$1.24 billion	$0	$0	$868 million	$22 million	$350 million

In November 2012, BP was also fined $4 billion in criminal fines and penalties after pleading guilty to 11 counts of felony manslaughter charges, environmental crimes, and obstruction of Congress (U.S. DOJ, 2012). This was the largest criminal resolution in U.S history (United States Environmental Protection Agency, 2017c).

Analysis of Research Questions 2 and 3

Data regarding cleanup time and compensation for specific racial or income categories could not be obtained from the public information available on this subject. Thus, this research relied on general cleanup guidelines found in its case studies. Given this limitation, this research will be relying on mathematical normalization to standardize and analyze the cleanup effects and compensation per case studies.

The cleanup time and compensation per case studies will be normalized by oil and gas spill volume (measured in million gallons). This standardization allows a direct comparison from case study to case study.

Using a normalization procedure, this will be calculated as the cleanup time divided by the volume of barrels of oil spilled in order to make some empirical assumptions on the available data.

Regarding compensation amount to determine equality, the normalization procedure will be analyzed using the amount of compensation divided by the volume of barrels of oil spilled in order to make some empirical assumptions on the available data.

This research outlines the amount of oil spilled for each case studies to address the assumptions from the normalization procedure. The Exxon Valdez oil spill released 10.8 million gallons of crude oil (Exxon Valdez Oil Spill Trustee Council, 1990), the M/T Athos I oil spill released 265,000 gallons of crude oil (National Oceanic and Atmospheric Administration, 2020d), and the Deepwater Horizon oil spill released 134 million gallons of oil (National Oceanic and Atmospheric Administration, 2020f). This is tabulated as follows:

Table 20: Amount of Oil Spilled

Location	Spill/Vessel	Year of Spill	Amount Spilled in Gallons of Crude Oil
Prince William Sound, Alaska, United States	Exxon Valdez Spill	March 24, 1989	10.8 million gallons of crude oil
Delaware, United States	M/T Athos I	November 26, 2004	265,000 gallons of crude oil
United States	Deepwater Horizon	April 20, 2010	134 million gallons of crude oil

CHAPTER 4

FINDINGS/RESULTS

This chapter describes the results from the analysis conducted on the designated oil spills case studies.

This research relied on nonprobability sampling where the chance of selecting a case study was not known (Maxfield & Babbie, 2015, p. 222) and because of its appropriateness for this exploratory study (Bachman & Schutt, 2014, p. 116). Particularly, this research employed purposive sampling which is a sample based on the purpose and knowledge of the nature of the selected case studies spills (Bachman & Schutt, 2014, p. 119; Maxfield & Babbie, 2015, p. 222). That is, the Exxon Valdez spill was one of the most publicized and iconic spills, leading to the enactment of major legislation in U.S. history (the OPA), MT/Athos I oil spill affected the Delaware river, "the largest North American port for paper, meat imports, generates about $19 billion in annual revenue, home to five of the largest East Coast refineries and six nuclear power plants" (U.S. EPA, 2006), and Deepwater Horizon was the deadliest and most punitive spill recorded in the history of the United States. Bias was estimated to be negligible, and the impact of the selected case studies spills covered an inclusive criterion of significant oil spills in U.S history.

Given the small sample size of the oil spill case studies ($n = 3$), this research uses the *t* statistic and the sampling distribution of the *t* to perform the hypothesis test. The level of significance (alpha level) selected for this test is .05.

RESEARCH QUESTION 1

Are the effects of environmental disasters (oil spills) on health different between minority and nonminority communities?

Research question 1 compares lung and bronchus cancer rates in affected counties of the case study under investigation to determine the health impact on minority (Black) and nonminority (White) communities.

Yearly aggregated cancer data (lung/bronchus caner) were provided from the Department of Health for the counties being investigated by the case study. The yearly data was matched for a 10-year period including the year of the specific spill in the case study.

This research adopts a nondirectional (two-tailed) hypothesis test because the correlation between the effects of oil spills on disadvantaged communities is unknown. Specifically, it is hard to predict in advance the effects of oil spills on disadvantaged communities to establish environmental racism because studies on environmental racism are centered on wastes and landfills.

The individual results for each oil spill case studies per county is addressed as follows:

Case Study 1: Exxon Valdez Oil Spill

Table 21: Kenai Peninsula Borough: Independent Samples T- Test Results

Warnings

The Independent Samples table is not produced.
The Independent Samples Effect Sizes table is not produced.

Group Statistics

	Race	N	Mean	Std. Deviation	Std. Error Mean
Healthimpact	White	4	99.6750	27.45291	13.72646
	Black	0[a]	.	.	.

a. t cannot be computed because at least one of the groups is empty.

In Kenai Peninsula Borough, the independent samples *t*-test was not able to be used because the data for the Black population was suppressed for patient confidentiality and protection due to the small-sized population. According to county's requirements, cancer data and rates are suppressed for cases that fall below 6 due to patient confidentiality.

Furthermore, cancer data was not able to be generated for the year of the spill leading to the following 6 cases. This is because the Alaska cancer registry only recorded cancer incidence data starting with diagnosis year 1996 causing a creation of (*n*=4) years for only the White population.

Case Study 2: M/T Athos I Oil Spill

Delaware

Table 22: New Castle County: Independent Samples T- Test Results

Group Statistics

	Race	N	Mean	Std. Deviation	Std. Error Mean
Healthimpact	White	11	72.4909	5.62165	1.69499
	Black	11	71.3273	11.68718	3.52382

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Healthimpact	Equal variances assumed	2.927	.103	.298	20	.769	1.16364	3.91028	-6.99306	9.32034
	Equal variances not assumed			.298	14.392	.770	1.16364	3.91028	-7.20168	9.52896

An independent samples *t*-test was conducted to compare the health impact on minority (Black) and nonminority (White) communities in New Castle County. There was no significant difference with health impact on minority (M = 71.33, SD = 11.69) and nonminority (M = 72.49, SD = 5.62), df (20), t (.29), p = .769 > .05, we fail to reject the null hypothesis. The magnitude of the differences in the means (mean difference = 1.16, 95% CI: -6.99 to 9.32 was not significant.

Table 23: Kent County: Independent Samples T- Test Results

Group Statistics

	Race	N	Mean	Std. Deviation	Std. Error Mean
Healthimpacts	White	11	87.3182	7.33169	2.21059
	Black	1	90.4000	.	.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Healthimpacts	Equal variances assumed	.	.	-.402	10	.696	-3.08182	7.65770	-20.14423	13.98060
	Equal variances not assumed			.	.	.	-3.08182	.	.	.

In Kent County, the independent samples *t*-test was not able to be used because the data for the Black population was suppressed for patient confidentiality and protection due to the small sized population. According to county's requirements, the statistics for the Black population could not be displayed because it is fewer than 25 cases.

New Jersey

Table 24: Salem County: Independent Samples T- Test Results

Group Statistics

	Race	N	Mean	Std. Deviation	Std. Error Mean
Healthimpact	White	11	73.1545	7.83254	2.36160
	Black	9	78.1444	20.19357	6.73119

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Healthimpact	Equal variances assumed	12.298	.003	-.757	18	.459	-4.98990	6.59535	-18.84622	8.86642
	Equal variances not assumed			-.700	9.970	.500	-4.98990	7.13345	-20.89073	10.91093

An independent samples *t*-test was conducted to compare the health impact on minority (Black) and nonminority (White) communities in Salem County. There was no significant difference with health impact on minority (M = 78.14, SD = 20.19) and nonminority (M = 73.15, SD = 7.83), df (9.97), t (-.70), p = .500 > .05, we fail to reject the null hypothesis. The magnitude of the differences in the means (mean difference = -4.98, 95% CI: -20.89 to 10.91) was not significant.

Pennsylvania

Table 25: Delaware County: Independent Samples T- Test Results

Group Statistics

	Race	N	Mean	Std. Deviation	Std. Error Mean
Healthimpact	White	11	72.4182	6.99340	2.10859
	Black	11	79.3727	11.50548	3.46903

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Healthimpact	Equal variances assumed	.711	.409	-1.713	20	.102	-6.95455	4.05960	-15.42272	1.51363
	Equal variances not assumed			-1.713	16.502	.105	-6.95455	4.05960	-15.53930	1.63020

An independent samples *t*-test was conducted to compare the health impact on minority (Black) and nonminority (White) communities in Delaware County. There was no significant difference with health impact on minority (M = 79.37, SD = 11.51) and nonminority (M = 72.42, SD = 6.99), df (20), t (-1.71), $p = .102 > .05$, we fail to reject the null hypothesis. The magnitude of the differences in the means (mean difference = -6.95455, 95% CI: -15.42 to 1.51) was not significant.

Case Study 3: Deepwater Horizon Oil Spill

Alabama

Table 26: Baldwin County: Independent Samples T- Test Results

Warnings

The Independent Samples table is not produced.
The Independent Samples Effect Sizes table is not produced.

Group Statistics

	Race	N	Mean	Std. Deviation	Std. Error Mean
Healthimpact	White	10	67.9400	7.36994	2.33058
	Black	0[a]	.	.	.

a. t cannot be computed because at least one of the groups is empty.

In Baldwin County, the independent samples *t*-test was not able to be used because the data for the Black population was suppressed for patient confidentiality and protection due to the small-sized population. According to county's requirements, the statistics for the Black population could not be displayed because it has fewer than 15 cases.

A limitation for the number of cases was that cancer data for 2019 and 2020 were not available at the time this research was conducted. As per the county directives, 2019 cancer data will be available November 2021, and 2020 cancer data will be available November 2022.

Table 27: Mobile County: Independent Samples T- Test Results

Group Statistics

	Race	N	Mean	Std. Deviation	Std. Error Mean
Healthimpact	White	10	39.1000	3.88015	1.22701
	Black	10	63.4500	8.48911	2.68449

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Healthimpact	Equal variances assumed	4.818	.042	-8.250	18	<.001	-24.35000	2.95162	-30.55112	-18.14888
	Equal variances not assumed			-8.250	12.603	<.001	-24.35000	2.95162	-30.74705	-17.95295

An independent samples *t*-test was conducted to compare the health impact on minority (Black) and nonminority (White) communities in Mobile County. There was a significant difference with health impact on minority (*M* = 63.45, *SD* = 8.49) and nonminority (*M* = 39.10, *SD* = 3.88), df (12.60), *t* (-8.25), *p* = .001 < .05, we reject the null hypothesis. The magnitude of the differences in the means (mean difference = -24.35, 95% CI: -30.75 to -17.95) was significant.

A limitation for the number of cases was that cancer data for 2019 and 2020 were not available at the time this research was conducted. As per the county directives, 2019 cancer data will be available November 2021, and 2020 cancer data will be available November 2022.

Florida

Table 28: Jackson County: Independent Samples T- Test Results

Group Statistics

	Race	N	Mean	Std. Deviation	Std. Error Mean
Healthimpact	White	10	55.5000	13.38266	4.23197
	Black	10	47.1000	15.36345	4.85835

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Healthimpact	Equal variances assumed	.106	.748	1.304	18	.209	8.40000	6.44307	-5.13638	21.93638
	Equal variances not assumed			1.304	17.668	.209	8.40000	6.44307	-5.15466	21.95466

An independent samples *t*-test was conducted to compare the health impact on minority (Black) and non-minority (White) communities in Jackson County. There was no significant difference with health impact on minority (*M* = 47.10, *SD* = 15.36) and nonminority (*M* = 55.50, *SD* = 13.38), df (18), *t* (1.30), *p* = .209 > .05, we fail to reject the null hypothesis. The magnitude of the differences in the means (mean difference = 8.40, 95% CI: -5.14 to 21.94) was not significant.

Louisiana

Table 29: Jefferson Davis Parish: Independent Samples T- Test Results

Group Statistics

	Race	N	Mean	Std. Deviation	Std. Error Mean
Healthimpact	White	8	78.9875	15.33422	5.42147
	Black	2	8.5000	.70711	.50000

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Healthimpact	Equal variances assumed	1.599	.242	6.215	8	<.001	70.48750	11.34153	44.33388	96.64112
	Equal variances not assumed			12.947	7.116	<.001	70.48750	5.44447	57.65578	83.31922

An independent samples *t*-test was conducted to compare the health impact on minority (Black) and nonminority (White) communities in Jefferson Davis Parish. There was a significant difference with health impact on minority (M = 8.50, SD = .707) and nonminority (M = 78.99, SD = 15.33), df (7.11), t (12.95), $p = .001 < .05$, we reject the null hypothesis. The magnitude of the differences in the means (mean difference = 70.49, 95% CI: 57.66 to 83.32) was significant.

A major limitation of this test was that the sample size analyzed was uneven between minority and nonminority group. This is due to the small size of the Black population that led to the suppression of counts for fewer than 6 cases and rates less than 16 cases.

Table 30: Jefferson Parish: Independent Samples T- Test Results

Group Statistics

	Race	N	Mean	Std. Deviation	Std. Error Mean
Healthimpact	White	8	65.1875	6.70894	2.37197
	Black	8	73.4250	14.13484	4.99742

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Healthimpact	Equal variances assumed	12.472	.003	-1.489	14	.159	-8.23750	5.53177	-20.10196	3.62696
	Equal variances not assumed			-1.489	10.002	.167	-8.23750	5.53177	-20.56277	4.08777

An independent samples *t*-test was conducted to compare the health impact on minority (Black) and nonminority (White) communities in Jefferson Parish. There was no significant difference with health impact on minority (M = 73.43, SD = 14.13) and nonminority (M = 65.19, SD = 6.71), df (14), t (-1.49), $p = .159 > .05$, we fail to reject the null hypothesis. The magnitude of the differences in the means (mean difference = -8.24, 95% CI: -20.10 to 3.63) was not significant.

Table 31: Plaquemines Parish: Independent Samples T- Test Results

Warnings

The Independent Samples table is not produced.
The Independent Samples Effect Sizes table is not produced.

Group Statistics

	Race	N	Mean	Std. Deviation	Std. Error Mean
Healthimpact	White	3	88.9667	7.13045	4.11677
	Black	0[a]	.	.	.

a. t cannot be computed because at least one of the groups is empty.

In Plaquemines Parish, the independent samples *t*-test was not able to be used because the data for the White and Black population was suppressed for patient confidentiality and protection due to the small-sized population. According to the county's requirements, the statistics for majority of the White and all the Black population were suppressed for counts fewer than 6 cases and rates less than 16 cases.

Table 32: Ascension Parish: Independent Samples T- Test Results

Group Statistics

	Race	N	Mean	Std. Deviation	Std. Error Mean
Healthimpact	White	8	67.6750	7.12315	2.51841
	Black	1	113.3000	.	.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Healthimpact	Equal variances assumed	.	.	-6.039	7	<.001	-45.62500	7.55524	-63.49031	-27.75969
	Equal variances not assumed			.	.	.	-45.62500	.	.	.

An independent samples *t*-test was conducted to compare the health impact on minority (Black) and nonminority (White) communities in Ascension Parish. There was a significant difference with health impact on minority (M = 113.3, SD = n/a) and nonminority (M = 66.68, SD = 7.12), df (7), t (-6.04), p =.001 < .05, we reject the null hypothesis. The magnitude of the differences in the means (mean difference = -45.63, 95% CI: -63.49 to -27.76) was significant.

The result of Ascension Parish should be interpreted with caution because there was a lot of missing cases in the data for the Black population due to its small size. According to the county's requirements, the statistics for the Black population were suppressed due to counts fewer than 6 cases and rates less than 16 cases.

Mississippi

Table 33: Harrison County: Independent Samples T- Test Results

Group Statistics

	Race	N	Mean	Std. Deviation	Std. Error Mean
Healthimpact	White	9	109.3444	10.58987	3.52996
	Black or African American	9	64.3778	10.41163	3.47054

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Healthimpact	Equal variances assumed	.044	.836	9.084	16	<.001	44.96667	4.95028	34.47255	55.46079
	Equal variances not assumed			9.084	15.995	<.001	44.96667	4.95028	34.47230	55.46103

An independent samples *t*-test was conducted to compare the health impact on minority (Black) and nonminority (White) communities in Harrison County. There was a significant difference with health impact on minority (*M* = 64.38, *SD* = 10.41) and nonminority (*M* = 109.34, *SD* = 10.59), df (15.99), *t* (9.08), $p = .001 < .05$, we reject the null hypothesis. The magnitude of the differences in the means (mean difference = 44.97, 95% CI: 34.47 to 55.46) was significant.

A limitation of this was that county level cancer data for 2019 and 2020 in Harrison County was unavailable at the time this research was conducted.

A further limitation was that cancer data does not also include information from the Veterans Affairs (VA) hospital and the Air Force hospital. As federal entities, these organizations are exempt from reporting to the State cancer registry.

Summary of Results

This research analyzed health effect (lung and bronchus cancer) on minority (Black) and nonminority (White) communities in 13 counties selected from its three oil spill case studies.

In terms of environmental racism on health cases, this research showed significant evidence of health disparity between White and Black populations in four counties, no significant evidence in five counties, and unknown result for the remaining four counties. This is tabulated as follows:

Table 34: Summary of Independent Samples T- Test

Case Study/Oil Spill	Significant Evidence	No Significant Evidence	Unknown Result
Case Study 1: Exxon Valdez Spill			Kenai Peninsula Borough
Case Study 2: M/T Athos I Spill		New Castle County	
			Kent County
		Salem County	
		Delaware County	
Case Study 3:			Baldwin County

Deepwater Horizon Spill			
	Mobile County		
		Jackson County	
	Jefferson Davis Parish		
		Jefferson Parish	
			Plaquemines Parish
	Ascension Parish		
	Harrison County		

The significant difference found in health disparities between White and Black populations is seen in the Deepwater Horizon oil spill case in Mobile County, Alabama; Jefferson Davis Parish and Ascension Parish, Louisiana; and Harrison County, Mississippi.

The significant correlation between lung and bronchus cancer cases seen in the demographics indicates the presence of "unintentional" environmental racism.

This research did not find significant difference between health disparities in White and Black populations in New Castle County, Delaware; Salem County, New Jersey; Delaware County Pennsylvania; Jackson County, Florida; and Jefferson Parish, Louisiana.

The study's analysis found unknown results in Kenai Peninsula Borough, Alaska; Kent County, Delaware; Baldwin County, Alabama; and Plaquemines Parish, Louisiana. This is because there were no or few cases of lung and bronchus cancer for the Black population due to the small size of the population, leading to the information being suppressed by the county for patient confidentiality reasons.

RESEARCH QUESTION 2

Are minority communities treated any differently than nonminority communities in terms of response time for cleanup of oil spills?

Table 35: Cleanup Timeline Per Unit Crude Oil Spilled

Location	Spill/Vessel	Year of Spill	Cleanup Timeline (Years)	Cleanup Timeline Converted to (Months)	Amount of Crude Oil Spilled Converted to (Million Gallons)	Cleanup Time Per Unit Crude Oil Spilled (Months/Million Gallon)
Prince William Sound, Alaska, United States	Exxon Valdez Spill	March 24, 1989	25 years	300	10.800	**27.778**
Delaware, United States	M/T Athos I	November 26, 2004	5 months	5	0.265	**18.868**
United States	Deepwater Horizon	April 20, 2010	15 years	180	134.000	**1.343**

From the analysis above, the Exxon Valdez oil spill took 28 months to clean one million gallons of oil, M/T Athos I spill took 19 months to clean one million gallons of oil, and Deepwater Horizon took 1 month to clean one million gallons of oil. The cleanup time per case studies was normalized by oil and gas spill volume (measured in million gallons) to arrive at this result.

This research used a county level demographics as a baseline for the affected counties in the case study analyzed because cleanup and compensation for oil spills are allocated per county, not zip code. Based on this broad characteristics (county level data), the majority of the spill occurred in counties predominantly inhabited by nonminorities. The result of the cleanup timeline above does not tell us whether nonminority communities were cleaned faster than minority communities because the county-level data indicated that they were majorly nonminority communities analyzed.

Accordingly, although the cleanup timeline for each spill was widely different, the result was unable to make a case of environmental racism based on this.

RESEARCH QUESTION 3

Are minority communities treated any differently than nonminority communities in terms of resource allocation?

Table 36: Oil Spill Compensation/Cleanup Costs

Location	Spill/Vessel	Year of Spill	Year Awarded	Cleanup/ Compensation Costs	Amount of Crude Oil Spilled (Million Gallons)	Compensation Costs Per Unit Crude Oil Spilled (Dollars/Million Gallon)
Prince William Sound, Alaska, United States	Exxon Valdez Spill	March 24, 1989	1991	$1,150,000,000	10.800	**106,481,481.48**
Delaware, United States	M/T Athos I	November 26, 2004		$143,000,000	0.265	**539,622,641.51**
United States	Deepwater Horizon	April 20, 2010	2015/ 2012	$20 billion + $4 billion (civil and criminal penalty)	134.000	**179,104,477.61**

From the analysis above, the Exxon Valdez oil spill spent $106,481,481.48 per one million gallons of oil spilled in compensation, the M/T Athos I oil spill spent $539,622,641.51 per one million gallons of oil spilled in compensation, and the Deepwater Horizon oil spill spent $179,104,477.61 per one million gallons of oil spilled in compensation. The compensation allocated per case studies was normalized by oil and gas spill volume (measured in million gallons) to arrive at this result.

Accordingly, although the amount of compensation for each spill was widely different, the result was unable to make a case of environmental racism based on this.

Nevertheless, based on the result of compensation per spill above, this research recommends the adoption of a best practice model that will allow for uniformity in compensation costs per volume of the spill. A caveat here should be that the compensation per volume adopted would serve as a minimum base with a maximum amount to be determined on a case-by-case basis per spill. This will help avoid a situation where compensation amount addresses questions of equality but may be inequitable, depending on certain factors that may be needed in one spill versus another. These factors include the type of product spilled, machinery and strategy needed for cleanup (which varies from one spill to another), location of the spill, legislation of the spilled location, and so on.

Limitations

Although the study found significant differences in lung and bronchus cancer cases between White and Black populations arising after an oil spill, there were still some cases that turned out to not be significant in the context of health disparities between White and Black populations. A possible reason for the non-significant results found in these counties could be a result of the study's focus. This research focused on county-level data in oil spill cases instead of zip code mapping of hazardous landfill sites like other studies did in establishing environmental racism. This dissertation's focus on county-level data stems from availability of health data, which is provided per county instead of zip codes for patient confidentiality. Also, existing best practices indicate that cleanup and compensation for oil spills are allocated by the awarding organization or the government on a generic scale (statewide level or county basis). The closest data to getting the cleanup and compensation values were analyzing counties that the spill affected due to availability of the information. Future studies should compare both county-level data and zip code data of oil spill cases for a more comprehensive understanding and reading of the results.

As this is a secondary research, there were restrictions in obtaining the comprehensive data needed to properly make a comparison of environmental racism between the study's demographics. Government databases, county health departments, and agency records provided information relied upon by this dissertation but generally did not deliver the level of detail necessary to identify the specific attributes of disparity at different oil spill incidents. For example, although data were available for cleanup and compensation allocated per county, there was no breakdown by racial demographics on compensation amount or conduct of cleanup activities in specific locations. This has highlighted the need to conduct a follow-up study by engaging in primary research that will make additional information more available to the researcher.

Finally, there is a huge gap in data that focuses on oil spill pollution itself to support hypotheses of environmental racism in disadvantaged communities. This dissertation calls for more (and specific) tailored studies of green criminology that focuses on oil spills and their impact on disadvantaged communities. This gap can be bridged by having more scholarly research conducted that focuses on the impact of oil spills on disadvantaged communities. I hope this research can help create the necessary awareness on this issue and serve as a nudge for further studies in the area of green criminology.

CHAPTER 5

CONCLUSIONS

Mother Earth, our only home, is threatened by pollution and climate change as highlighted by this dissertation. Dickens ([1859] 2012) succinctly captured this as, "*it was the best of times*" (this is evident in current technological advancement and access to resources globally), "*it was the worst of times*" (plagued with pollution, extreme heats, flooding, earthquakes, wildfires, and human and non-human induced climate changes). To address this predicament and create a balance in the ecosystem, sustainable efforts such as environmental protection efforts must be undertaken by all (especially green criminologists). In this dissertation, I consider environmental racisms and environmental justice from the lens of green criminology. This research contributes to the effort of green criminologists in analyzing environmental harms and crimes. Additionally, this section proposes sustainable solutions to help in environmental protection efforts.

This research addressed pollution arising from oil spills using three case study spills: the Exxon Valdez oil spill, the M/T Athos I oil spill, and the Deepwater Horizon oil spill. The health impact, cleanup timeline, and compensation structure of these spills were analyzed to determine their influence (presence or absence of environmental racism) on disadvantaged communities (communities of color and low-income communities).

Regarding health impact, this research discovered the presence of "unintentional environmental racism" seen in lung cancer cases arising from a 10-year analysis after the occurrence of a spill. The principle behind "unintentional environmental racism" is explained using a disparate health effect arising from oil spill pollution that was caused negligently or in which its effects place a disproportionate burden on disadvantaged communities. Although the spill itself was not intentionally created, the unintentional occurrence of pollution arising out of negligence of certain personnel from the corporations leading to a disproportionate health burden on disadvantaged communities results in "unintentional environmental racism."

This dissertation showed that the cleanup timeline and compensation structure varied from one spill to another. Although, this dissertation was unable to establish any bias from this because of the unavailability of information on the racial division on cleanup and compensation structure, it recommends some best practice models to be adopted. This is further addressed below.

This dissertation also highlights the relationship between environmental forensics and green criminology. In analyzing elements of environmental forensics in this dissertation's case study, this dissertation showcased the impact of forensic science in oil spill identification. By doing so, it underlines the extensive collaboration of the forensic science and criminology disciplines in the course of environmental protection.

An extension of environmental protection mechanisms has been emphasized in this dissertation through environmental justice efforts. These efforts must continue to address all forms of environmental racism and bring protection to society, especially disadvantaged communities. Flowing from this, the dissertation proposes the following solutions for environmental protection efforts in society.

Policy Implications and Direction For Future Studies

Environmental Accountability. Environmental accountability means the implementation of regulatory programs and responsible actions towards the environment, irrespective of the environmental state. Environmental accountability involves employing responsible actions, and it is divided into two phases: pre-environmental accountability and post-environmental accountability.

Pre-environmental accountability involves proactive actions implemented to avoid instances of environmental harms. This research brought to light a different form of environmental racism known as "unintentional environmental racism." Although some forms of environmental pollution are unplanned, their occurrence nonetheless remains a menace to society, especially in disadvantaged communities through "unintentional environmental racism." Pre-environmental accountability can address situations of environmental racism (whether intentional or not) that have not yet occurred. In this research, it is gleaned that there is no unified compensation benchmark to deter companies from polluting. This research suggests a pre-environmental accountability mechanism in the adoption of a best practice model that will allow for uniformity in compensation costs per volume of the spill. This will serve as a starting guide on how much polluters would be liable for in the event of a disaster. A caveat must be added here that the compensation per volume adopted by the industry would serve as a minimum amount, with a maximum amount to be determined on a case-by-case basis per spill. The distribution scale in terms of resource allocation should be fair and equitable in all communities. This will help avoid a situation where compensation amount addresses questions of equality but may be inequitable, depending on certain factors that may be needed in one spill versus another. These factors include the type of product spilled, machinery and strategy needed for cleanup (which varies from one spill to another), location of the spill, legislation of the spilled location, and so forth. To buttress this point, Biden's executive order on environmental justice efforts requires a portion of federal settlements to be allocated to disadvantaged communities. The distribution of these resources should be subject to audits to ensure that the distribution of resources is done in an equitable manner according to each disadvantaged community's requirements and not based on a generic scale that may be equal but not equitable.

A further pre-environmental accountability measure would involve mandatory public reporting of compensation payment to ensure transparency.

Post-environmental accountability involves reactive actions such as market-based strategy (emissions trading systems) like carbon pricing and carbon tax aimed at emissions reduction. This research earlier emphasized the importance of environmental justice actions seen in accountability measures such as carbon pricing or carbon tax. These market-based mechanisms place a tariff or tax on greenhouse gas emitters, holding these groups responsible for their pollution in line with the "polluter pays principle." These mechanisms will spur polluters to explore cost-effective ways to reduce emissions because of the financial burden they bear for emitting emissions and should be greatly encouraged. The United States currently has a bill called the Energy Innovation and Carbon Dividend Act—H.R. 2307. The enactment of this bill into law would serve as one of the checklists towards post environmental harm accountability. It is the responsibility of everyone to encourage their senators or representatives to vote to ensure that the bill is passed into law. A bill is only as effective as its name unless it is passed into a formal and binding mechanism seen in laws. Future studies should pay attention to pilot programs that test the effectiveness of any existing emissions trading systems and recommend more effective solutions toward their success. These studies should also focus on creating more awareness to ensure that more market-based mechanisms are enacted into law.

Additionally, a post-environmental accountability measure should be the enforcement of stricter "post-oil spill impact assessment plan." Post-oil spill impact assessment plans involve actions undertaken to mitigate situations when environmental contamination has arisen. This research revealed that compensation structure is not allocated according to racial demographics but given to states for cleanup. As disadvantaged communities are the ones directly impacted, the compensation ought to be allocated according to the communities/counties/zip codes affected. Future studies should focus on areas that elucidate how compensation is allocated in disadvantaged communities and whether or not disadvantaged communities are compensated less. A further focus should also be on the speed at which communities are cleaned up. That is, whether or not minorities communities are cleaned up faster than nonminorities communities.

Furthermore, environmental accountability strategies must be subject to consistent reviews and audits handled by an independent agency. A different paradigm that handles the responsibility of environmental accountability must be outsourced to an independent agency to ensure transparency. According to the Latin maxim, "*nemo judex in causa sua,*" no one can be a judge in their own case. The effectiveness of environmental accountability strategies lies in the transparency of such strategies. Thus, environmental accountability mechanisms mentioned in this research must be subject to regular independent reviews/audits.

Another post-environmental accountability measure is the punishment of environmental crimes and white-collar crimes found in pollution with severe punishments to deter polluters. Environment crimes are usually treated under administrative violations.

These types of crimes should carry similar punishments on corporation by piercing the corporate veil to hold responsible parties liable.

Punishments for environmental crimes must be clearly defined by law just like regular crimes. This will serve as a good deterrent to polluters once the punishment is appropriately defined. According to classical theorists, punishment must be swift, certain, and clear to have a deterring effect (Beccaria, ([1764] 1963).

The purpose of environmental accountability is not just to engage in the blaming of corporations or individuals whose actions harm the ecosystem. The dissertation findings and proposed solutions are given to serve as a benchmark that society implements toward environmental protection and environmental justice. Importantly, the solutions suggest possible actions that would enhance ecological sustainability and thrust the earth further ahead toward carbon neutrality and a cleaner ecosystem for all.

Environmental Protection Collaborations. This dissertation highlighted the relationship and roles that different professionals and advocates play toward environmental protection and environmental justice. These professionals or advocates involve green criminologists, epidemiologists, public health officials, forensic chemists, forensic scientists, and forensic toxicologists. Predominantly, the efforts of green criminologists to serve as environmental justice watchdogs in addressing climate change and environmental harms remain a priority in society. Criminologists have extensive experience working with marginalized communities. This knowledge is transferable and will be productive in helping to bring environmental justice to disadvantaged and frontline communities (who are most vulnerable to environmental injustice due to their location or exposure).

This research calls for the expansion of collaborative efforts between green criminologists and public health officials, as illustrated in the principle of "criminal epidemiology or epidemiological criminology/EpiCrim" (Akers & Lanier, 2009; Lanier, 2010). These efforts should explore research, extensive risk communication to disadvantaged communities, and involvement with key personnel of disadvantaged communities who have firsthand knowledge about these groups through "community based participatory research." More progress can be achieved when the true intentions and needs of disadvantaged communities drive such changes. This can be achieved by engaging these communities and improving their communities. Green criminologists should also collaborate with other justice agencies such as environmental activists, environmental grassroots organizations and agencies, and the prosecution office needed to bring to justice culprits of environmental destruction.

Exploration of Effective Energy Transition Policies. Energy transition is a shift from the use of conventional sources of energy to renewable energy sources. As the world transitions to renewables and low emission carbon society, this must be done strategically because current production in the world presently relies heavily on fossil fuels. It is therefore imperative that energy transition occur progressively to avoid a collapse in global production. Also, industries (such as the oil and gas industry) that are the major drivers of fossil fuels should not be left out in this discussion because of the industry's heavy reliance on using conventional sources of energy to advance societal usage.

Conventional sources of energy such as oil and petroleum sources play a key role in contaminating the environment. This research analyzed pollution through various oil spills (a conventional source of energy), and their impact on the environment and disadvantaged communities. To fight the menace of environmental racism, the source (pollution) must be properly managed and eventually eradicated. The less pollution experienced by disadvantaged communities, the better the quality of life these communities will enjoy. Suffice it to say that conventional sources of energy need to be efficiently replaced with nonconventional sources of energy (renewable energy or renewables).

Although there is no quick fix to energy transition, progressive energy transition measures such as decarbonization must be explored. Just like a child learns to crawl before they walk, the existing conventional source of energy must follow a gradual course through practical energy transition policies to ensure long-term sustainability. Examples of such energy transition policies involve cutting emissions in conventional usage as much as possible with an ultimate goal of achieving carbon neutrality. Companies should explore more carbon offset programs toward emission reduction..

Collaborative efforts among states, utility companies, energy agencies and organizations, and community-based organizations are highly encouraged in disadvantaged communities through rebates and subsidies programs to transition the use of conventional source of energy to RHC technologies in such communities and households. RHC technologies are cost-effective, provide great health benefits by reducing emissions and air pollutants for their users, provide an avenue for job creation and energy security, and so on (Langniss, 2007; Nada & Alrikabi, 2014; U.S. EPA, 2017d). Different pathways of transition to renewable sources such as electrification and direct use of solar and geothermal heat have been recommended (IEA, 2020b). These are pathways to pursue to help disadvantaged communities mitigate the negative effects of climate change.

Other energy transition policies are effective collaborations among entities to drive scalable solutions in the distribution and usage of renewable energy. The government should partner with organizations to provide better electrification policies to help consumers to successfully transition into using renewable sources. This involves implementing policies such as making affordable zero-emissions vehicles, developing more affordable charging stations, and fueling infrastructure for consumers. The government should create policies that encourage businesses to get on board with reducing their carbon footprint by providing rebates and incentives for establishments to adopt net-renewable electricity. These establishments can, in turn, offer a diverse complimentary charging stations for patrons to use when they shop or visit their businesses. Policies act as a 21st-century environmental justice tool that can provide a shield for all U.S. families, especially disadvantaged communities. The government must take full advantage of energy policies that provide beneficial impact for both organizations and consumers.

An effective energy transition would provide immense benefits to society especially disadvantaged communities. A fully transitioned economy to renewable energy sources would create a level playing field for all as there are benefits to be derived for the individual, and the ecosystem.

For disadvantaged communities, these benefits expand to more job availabilities and creation of green jobs. Researchers also alluded to this fact that transition to clean energy would result in more green jobs in disadvantaged communities (Hoerner & Robinson, 2008). These jobs should utilize talents from disadvantaged communities. Employment opportunities can be made through different workforce development programs and training options in disadvantaged communities, supporting minority-owned businesses and corporations in disadvantaged communities, collaborations with schools in disadvantaged communities (particularly MSIs such as HBCUs, etc.) by providing feeder programs or internships to recruit talent on how best to use and install clean technologies.

Energy transition policies must be prudently implemented to win in the fight of sustainability because its success would greatly help to usher in a clean economy for all. The ecosystem would be much cleaner, and resources would be used sustainably. Creating a balance in how we achieve carbon neutrality is the core of energy transition. This is important to avoid a collapse in current human production and activities for the ecosystem. Simply stated, an effective energy transition is the scaling strategy needed for a sustainable economy.

The switch to renewable energy sources must be done in a progressive manner for the world to reach its climate goals. Mother Earth requires a unified action from all to make this happen and also protect the environment and people, especially disadvantaged and frontline communities.

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