Anthropology 499 Independent Study Essay

Facilitating a Community Response to Depleted Uranium in Hawai'i

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Keywords:

Munitions Testing, Depleted Uranium, Risk Perception, Community Empowerment

Introduction:

In 2007, after years of denial, the United States Army confirmed the presence of depleted uranium at the Pohakuloa Training Center on the island of Hawai'i in the Hawaiian Archipelago. The Davey Crockett Missile was tested using ammunition containing depleted uranium from 1961 until 1968, potentially causing long term radioactive environmental contamination. Depleted uranium poses a two-fold risk to public health; it has the chemical properties of a heavy metal while simultaneously exhibiting radioactive behavior. Once depleted uranium has been exploded, the small particles disperse, remaining in the soil for a dangerously long period of time. These small particles become airborne, making internal exposure via inhalation or ingestion possible. The effects of exposure to depleted uranium have been illustrated through in vitro studies, animal research and epidemiological research performed on exposed groups. Depleted uranium has a cumulative affect in the body, leading to cancers, tumors, birth defects and developmental disorders, to name a few. The wind patterns on the Hawai'i Island are consistent, blowing from the eastern side, through the saddle of the mountains, onto the western side referred to collectively as the "Kona side" (Nourigichi, 1984).

This area downwind from the Pohakuloa Training Center, located in the saddle of the mountains, exhibited a pattern of elevated birth defect rates in the years following the period on which depleted uranium was tested (Burch, 1984). This paper is going to propose that there is a potential causal relationship that exists between munitions testing and the adverse health trends that presented themselves on the Kona side of the island during the 1960's and 1970's through the examination of public health records in relationship to available military material concerning the dates that testing occurred.

Figure 1: The State of Hawaii and the location of Pohakuloa Training Area.

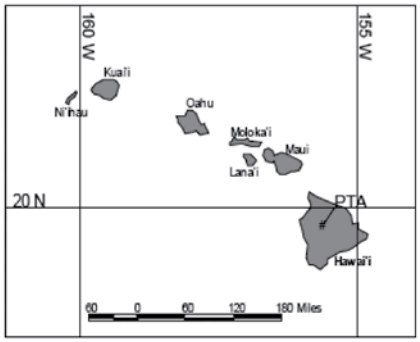
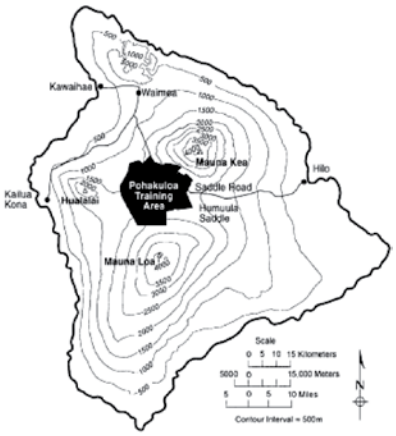


Figure 2: The Island of Hawaii illustrating the location of Pohakuloa Training area in relation to the major topographic features and landmarks.



From Shaw and Castillo 1997.

This paper also hopes to question the current absence of media coverage that critically analyzes the military presence on the island and how this strategic lack of media attention hinders discussion of the dangers that depleted uranium poses. The US military has played, and continues to play, a prevalent role in the colonization, annexation, and statehood of the Hawaiian Islands. Facilitating a discussion regarding the continued militarization that negatively impacts the natural environment of the islands and the health of it's occupants has the potential to function as a bridge issue between supporters of the pro-sovereignty movement, environmental groups, and concerned members of the community.

Rather than imposing a research model onto the potentially affected community, an approach will be developed based off of local surveys, the utilization of trusted avenues of communication and a series of town meetings to ensure that the community's

needs and concerns are being addressed. Ideally, key members of the community will become partners throughout the process, further ensuring that their needs are being addressed appropriately. The results of qualitative and quantitative surveys will be analyzed to provide information regarding the community's perceived exposure risk, the ideal path of action, and the desired end result. The testing that has occurred on the island has the unique potential to strengthen the affected community, providing a platform to perform a long over due critique regarding the omnipresent military presence in Hawai'i that has little accountability to the island's residents.

Colonization, Neo-Colonialism and Military Testing

From a military perspective, the Pacific Islands are situated in a strategically significant region between the United States, Asia, and Russia (Barker, 2004) The first US military ship, the USS Dolphin, came to Hawai'i in 1826 with the expressed purpose of pressuring the Hawaiian ruling class, the ali'i, into repaying their debts to American merchants (Ireland, 2004). Less than seventy years later, in 1893, 162 US Marine Corps and two companies of US Navy sailors would intervene to ensure that the economic well being of American business men was being protected, this time illegally overthrowing the Hawaiian kingdom to ensure that profits from sugar cultivation were not threatened (Russ, 1992). Changes in US economic policy favored domestic sugar production through monetary incentives, providing a push for Hawaiian plantation owners in 1898 to force the official annexation of Hawai'i, which could already be considered an "economic colony" of the United States (Russ, 1992). President Cleveland found that the military had acted inappropriately by participating in the illegal overthrow of the kingdom. However, the wheels of colonization were already spinning, with the large newspapers taking a stance of being "ardent advocate for annexation" (Chapin, 1996). The US government, certainly considering the strategic military position of the Hawai'i Islands, along with the sense of manifest destiny that was rampant at the time, chose to keep its latest acquisition. The Hawaiian Kingdom was not restored and the precedence for a seemingly unquestioned military presence with the apparent license to act without threat of the typical consequences was set. Currently, activists and sympathizers of the pro-sovereignty movement would consider Hawai'i an internal colony of the United States hidden under the guise of statehood and kept in check through an illegal military occupation (Trask, 1999).

The bombing of Pearl Harbor on Oahu not only brought the United States into WWII but it also has been exploited for decades as a source of military propaganda to justify the US occupation of the Pacific (Ireland, 2004). This self-ordained responsibility to "protect" a vulnerable population, in this instance Hawai'i, is a hallmark of the paternalistic ideology that colonialism is notorious for. The Pohakuloa Training Center was established during years after WWII, a time period riddled with media representations showing the necessity of the US military to protect Hawai'i, historical texts that made connections between Hawaiian and US history in order to foster a pseudo sense of historical association, and a slew of Hollywood movies that glorified the "Americanization" of Hawai'i (Ireland, 2004). The United States education system serves to foster a sense of nationalism that revolves around military prowess and the necessity of global militarization. In many regards, US history as it is taught in public schools is not defined by eras or even presidents, but rather by war. The military markets itself largely to males, and in the instance of Hawai'i, a group of males that have been emasculated through colonization. This strategic marketing extends beyond the classroom through the Boy Scout program and the junior ROTC programs (Tengan, 2002). The military presents itself as a socially sanctioned path to strength and masculinity in a community that has experienced the loss of their "traditional beliefs, [a] separation from the land, [and a] breakdown of traditional structures of leadership and community…" (Tengan, 2002). This functions to solidify the military's position within a community. Furthermore, ensuring that unsavory behavior on their part, that may be harmful to both military personnel and civilians, is less likely to be questioned due to the pretense that their continual presence protects, masculinizes, and defines the community.

The main newspapers in Hawai'i have traditionally had strong economic ties to the continental United States and thus promote a "pro-America" and "pro-military" stance (Chaplin, 1996). Currently, one particular media group based out of Las Vegas, Nevada owns every daily newspaper in circulation on the Big Island, suggesting that the news may be suffering from a monopolization that directly impacts, not only what is being reported, but also, how it is being reported. Capitalism has created a unique web of interrelated social institutions that elevate healthy profits over the intellectual, economic, and physical health of the people that social institutions, such as the press, should be catering to. In essence, "freedom of the press," and a

local community's ability to access a traditional forum of communication is severely compromised by the interdependence of the media, large businesses, and what has been called our nation's largest business: the military.

Depleted Uranium Uses and Implications

Depleted uranium is a radioactive waste product (Briner, 2006). The unique physical properties of this material, paired with expense storage costs, and the rising costs of steel during the 1960's, led to its use in military applications (Middleton. 1975). Roughly ten years after this practice began, the Stockhom International Peace Research Institute issued a report asserting that using depleted uranium in weapons would "…open the way to more radioactive or toxic substances" (1975). Regardless of these early concerns, depleted uranium still holds a pivotal place in military applications such as projectile points on munitions and armor for tanks. As a dense, hard metal, it has the ability to sharpen upon impact, piercing armor rather than collapsing, resulting in deeper penetration (Department of Defense, 2003). It is also pyrophoric, erupting into flames nearly spontaneously, producing an oxidized dust that is also referred to as an aerosol. This aerosol contains particles that have been heated up to 5,000 degrees Celsius, converting then into an insoluble material (Bertell, 2006). Up to 70% of depleted uranium converts into nano-particles less than two microns in size, which are small enough to be easily inhaled and enter into red blood cells (Briner, 2006). According to a 1943 Department of Defense memo, a gas mask would not be able to limit exposure, ensuring that particles would become lodged in the pulmonary system (US Dept Defense, 1943). The pulmonary half-life of depleted uranium is four years, during which, it can travel throughout the body creating oxidative stress and exposure to free radicals seemingly indefinitely (Bertell, 2006). Very little depleted uranium would initially be excreted through the urinary system (Durakovic, 2005). Depleted uranium becomes lodged in the lungs for a period of approximately four years, after which it would begin to solubilize directly into the blood stream and lymphatic systems, making a conventional urine detection test difficult (Hindin, 2005).

Depleted Uranium as a Heavy Metal

Evaluating the potential dangers of depleted uranium exposure requires an adequate analysis of both the potential threat it poses as a heavy metal in addition to a critique of it's radioactive behaviors (Miller, 2004). Depleted uranium (DU) is the byproduct of the uranium enrichment process and largely retains the chemical characteristics of natural uranium (Hindin, 2005). It differs from the natural uranium found in mining situations because it is used largely in situations that make it easily inhaled and directly exposes the internal organs to potential heavy metal toxicology.

The US government has taken the stance that depleted uranium poses no more danger than lead, thus examining the dangers of heavy metal poisoning is essential. Lead is considered to present the most significant toxicity risk of the heavy metals, thus depleted uranium can be considered to be similarly dangerous (Briner, 2006). It is well documented that lead exposure affects both the central and peripheral nervous system in addition to causing damage to reproductive and cardiovascular systems (Schwartz, 2007).

Recent research has shown a link between depleted uranium exposure and behavioral changes, cognitive capabilities and cancer. For example, studies performed on animals illustrate that depleted uranium accumulates in the brain inhibiting memory formation, reactive ability and increase lipid oxidation in the brain; this decreases cognitive ability, and changes behavioral patterns (Briner, 2006). The carcinogenic affects of DU on the reproductive, the urinary, and the immune system have been documented in Yugoslavia, Bosnia, and Gulf War veterans. Depleted uranium has the ability to pass through the placental barrier adversely affecting birth weight, producing skeletal abnormalities and causing delays in both physical and mental development (Bertell, 2006). Animal studies also illustrate that post-gestation brain and behavioral development are impaired while weight gain is accelerated, yielding animals with higher body weight and a lower brain weight (Briner, 2006).

Studies performed by the Department of Defense in 1998 found a correlation between exposures to depleted uranium fragments to cells in vitro and elevated cancer rates (Miller, 2004). Further tests performed on rats involved the implantation of DU shards suggested that the nature of the chemical as a heavy metal presented major health risks; the researchers concluded that "our studies demonstrate for the first time that the malignant transformation of immortalized human cells can be achieved by exposure to the depleted uranium" (Miller,2004). Research performed in 2006 concluded that depleted uranium exposure has a detrimental affect on the immune system; effectively killing or changing the signaling pattern of the macrophages that ingest the particles (Wan, 2006). By compromising this "first line of defense", the immuno-defense system becomes

severely compromised, making the body more vulnerable to the carcinogenic properties of depleted uranium in addition to any other pathogens (Wan, 2006).

Radioactive Aspects and Health

Though the chemical dangers that uranium poses have been widely accepted for over two hundred years, the radioactive dangers of depleted uranium is still shrouded in controversy (Durakovic, 1999). The term "depleted uranium" implies that the radioactive aspects of uranium are no longer present, though this implication is a misnomer at best, and deliberate propaganda at worst (Dickstein, 1974). Natural uranium and all of its isotopes have unstable nuclei and are therefore radioactive (Oeh, 2007). Though this metal is only 75% as radioactive as natural uranium, it is still a dangerous form of ionizing radiation (Hindin, 2005). According to NATO, depleted uranium emits Alpha and Beta particles in addition to Gamma radiation (2000). One milligram of depleted uranium is "about the same as a milligram of uranium and shoots about 1,251,000 powerful little "bullets" of Alpha particles a day for 4.5 billion years." (Bertell, 2007). As electrons split apart they release protons, electrons and neutrons that cause significant physical and chromosomal damage to nearby cells (Dickstein, 1974). Cellular damage increases rates of skin cancer, cancer of the bones and thyroid, as well as leukemia, birth defects and genetic mutations. Even a very small exposure to radiation during pregnancy can result the child's risk of developing leukemia to increase by fifty percent (Dickstein, 1974).

The symptoms of radiation can also be subtler. Studies performed in 1986 in the Ukraine after the Chernobyl meltdown have concluded that memory deficiencies, fatigue, pallor, chronic pain and impaired sensory-motor skills developed after exposure. The term currently being used for this collection of degenerative symptoms is "vegetative dystonia" (Landauer, 2002). Additionally, recent studies of exposure to depleted uranium in Gulf War veterans resulted in a cluster of symptoms including incapacitating fatigue, skeletal and joint pains, headaches, neuro-psychiatric disorders, affect changes, confusion, visual problems, changes of gait, loss of memory, lymphadenopathies (enlargement of the lymph nodes), respiratory impairment, and impotence (Durakovic, 2003). The psychological stress of being exposed to an "invisible threat" that is often treated with ambiguity or stigma leads to anxiety and elevated levels of fear (Landauer, 2002). Whether DU is studied as a radioactive danger or a heavy metal, the detrimental affects are going to be most marked in children due to their vulnerable developmental state. Even a low exposure to alpha omitting radiation can lead to genetic changes and chromosomal mutations resulting in multi-generational genetic abnormalities (Miller, 2004).

Military studies performed in 1998 to examine both the chemical and radioactive activity of depleted uranium in conjunction to each other yielded what the researchers described as "startling results" (Miller, 2004). The researchers established that depleted uranium had the potential to transform or mutate cells. They concluded that it's the unique combination of DU heavy metal properties, in conjunction with it's radioactive activity, that results in it's carcinogenicity (Miller, 2004). Furthermore, all cells exposed to even a small amount of depleted uranium experienced genetic alterations that may be due directly to depleted uranium causing damage to DNA or the mechanisms that repair damaged DNA (Miller, 2004).

Establishing a Causal Relationship (A Case Study)

A tremendous increase in cancers, specifically leukemia in Iraqi children after the first Gulf War, led researchers in Basrah to begin attempting to determine if causal relationships existed (Yaccoub, 1999). Using the guidelines established by the British research teams that argued for an association between smoking and lung cancer, the researchers sought to determine if a relationship existed between exposure to depleted uranium and childhood cancers (Hill, 1965). The body of data was gathered from the main hospital in Basrah which had maintained a cancer registry system stretching back to the 1980's. The registry chronicled the number of new cases each year, the age of onset, specific variety of malignancy, and the area of Basrah the patient resided in.

A remarkable rise in childhood cancers began in 1995, approximately four years after the invasion. This four-year period is consistent with the expected latency period of ionizing radiation, supporting the criteria for an appropriate time sequencing model (Briner, 2006; Hill, 1965). Additionally, from the period of 1990 until 2000 the rates of malignancies increased every year (Yaccoub, 1999). In 2000, childhood cancers were occurring at a rate close to 400 times greater than in 1990. The consistent pattern of increasing incidents over time supports the cumulating affect of radiation exposure, strengthening the case for a causal relationship. A survey of the statistics shows that younger and younger children are developing cancers; close to 60% of the new leukemia cases are

in children under five years old, again correlating with other research compared to 1990 statistics when this figure was closer to ten percent. This shift correlates with the substantial body of research that supports the relationship between childhood exposures to radiation and the development of cancers at younger ages; this is due to the more vulnerable developmental stages the body is going through (Briner, 2006). Geographically, areas that had high levels of measurable radiation also had higher incidents of cancers. This correlation also serves to support the biological plausibility of the relationship between depleted uranium exposure and childhood cancer rates (Yaccoub, 1999). This case study, paired with the recent findings of Miller, Briner, and Wan provide the impetus to examine the effects of depleted uranium in Hawai'i.

Depleted Uranium Use in Hawai'i

Pohakuloa training center, established in 1955, is the largest US military training center in the Pacific, and covers over 100,000 acres including an impact-testing area that covers 51,000 acres (Beavers, 2002). It has been used for the firing long-range guided missiles and artillery of live ammunition containing depleted uranium for the past sixty years. The principle weapon of concern is the Davey Crockett recoilless gun that was tested from 1960-1968 (US Army, 2007). The gun was originally developed to be a short-range nuclear delivery system of one to three miles that could be deployed by a single person. The US Secretary of Defense Robert S. McNamara stated in 1964 that "the smallest nuclear weapons kill, primarily, not by blast but by radiation" (Finney, 1964). The testing process in Hawai'i did not include the conventional, "live" nuclear missiles, but rather the use of over seven hundred XM-101 spotter rounds loaded with depleted uranium as a means of simulating the behavior of a nuclear missile (Army, 2007). These rounds were highly explosive and weighed approximately one pound, of which nearly half of that weight was derived from depleted uranium, a form of ionizing radiation (Hickey, 1997). The explosive nature and long half-life of depleted uranium is a particular source of concern. As the 1943 internal memo from the US War Department states, long-term terrain contamination from depleted uranium occurs because the small particles can be "stirred up as a fine dust for a long time" making areas uninhabitable (US Dept Defense, 1943). This memo also stated that DU broke down into "beta and gamma emitting fission products that may be absorbed from the lungs or G-I tract into the blood and so distributed throughout the body" (ibid). Additionally, in 1984 the army issued an internal safety report that concluded that depleted uranium posed an internal radioactive danger, especially if the exposure was caused from inhalation of the aerosol (Memo, 1984). Research performed in Kosovo after the Gulf War confirms that dust containing depleted uranium can remain dangerous for many years (Briner, 2006).

Strong persistent trade winds in Hawai'i flow from the Northeast, possibly pushing contaminated dust west of the training center to the areas of Kailua and North Kona (Noguchi, 1979). Additionally, according to the records kept by the training center, "tens of hundreds of fires have occurred" from the period of 1987 until 1999: this due to the continued testing of munitions (Beavers, 2000). This causes additional soil disruptions in the very area that weapons containing depleted uranium would have been tested, possibly resulting in the military personnel and the communities downwind of the area to suffer from continual re-exposure to the depleted uranium. An army commander in 1979 asserted, "… people at distances downwind from the fire are faced with potential over exposure to air borne uranium dust" (Military Medicine). When depleted uranium is burned, it produces an oxide that is particularly difficult to solublize causing long-term site contamination and a means for particles to travel through the air (NATO, 2000). Documentation illustrates incidents of depleted uranium traveling up to 26 miles from the initial impact site and that it tends to remain in the soil longer in arid environments, the very conditions that are found at the Pohukaloa training center (Hindin, 2005).

From a demographic standpoint, the Big Island during the 1960's reflected the racial trends present at the nuclear testing sites in New Mexico and other Pacific Islands (Barker, 2004). According to the Department of Research and Development for the County of Hawai'i, in 1980, Caucasians comprised less then 18 percent of the population; they resided almost entirely on the Hilo side of the island, away from the prevalent wind patterns that could result in exposure. Japanese accounted for 44% of the population, native Hawaiians comprised 20.4%, while Filipinos and Portuguese making up the remainder. Effectively, radioactive weapons testing on the Big Island of Hawai'i was being performed with an underlying ideology that it was justified because it was on a island inhabited by "the other,"a group of darker-skinned people that represented a potentially "expendable population" (Barker, 2004). It is also imperative to consider that the people testing the weapons are potential victims of exposure as well.

Ground level soldiers are not directly involved in the implication of policy and are often also perceived as expendable. The military's denial of performing any testing with weapons containing depleted uranium, followed by their admission in 2007 that they had performed testing, but that depleted uranium isn't dangerous, mirrors the policy of denial and downplaying, that are hallmarks of the U.S. nuclear testing program (Barker, 2004).

Determining if a Significant Exposure Risk Exists

Briner proposes a six point model to determine if a population is at exposure risk for an environmental hazard, including: a knowledge of the group's exposure level, the possible dose absorbed, the route and duration of exposure, the accepted benchmark that must be met to produce affects, and a knowledge of the affects a researcher would expect to see (2006). The Army has released limited information to the press regarding the quantity of depleted uranium containing rounds that were used. The most recent information available puts that number at approximately seven hundred rounds, with each round containing approximately 454 grams of depleted or roughly half of the total weight of the spotter round (Nuclear Registry Commission, 1997). Based off of these numbers, it is possible to conservatively estimate that 317,800 grams of depleted uranium were utilized during the testing period. The amount of depleted uranium that becomes aerosol upon impact ranges from 50 to 96 percent (Bourdulenko, 2003; Fahey, 1999; Hindin, 2005). Of this total, if approximately 70% of the total 317,800 grams became aerosolized at initial impact, up to 222,460 grams of depleted uranium would have been converted into micron particles that had the potential to be respirable during that seven-year period. According to Briners model, this would mean the average potential exposure rate through respiration per year was over 30,000 grams, or thirty million milligrams, in the immediate vicinity downwind of the testing area. Thus, if as little as one tenth of one percent of the total number of aerosolized particle traveled roughly 40 miles northwest on the prevalent trade winds, the communities in Kohala and Kona, and all homes along the trajectory would have potentially been exposed to air containing over 30,000mg of respirable particles per year. The accepted benchmark for exposure to ionizing radiation exposure put forth by the World Health Organization is 1 mSv (microsievert) per year for civilians and 10 mSv/year, or 100 mg, for military personnel (Bordujenko, 2003). Furthermore, these 30,000 grams would omit 10,000 Ci (Curie) of radiation per year (Durakovic, 1999. Hansen, 1974). The monthly average exposure rate of 850Ci exceeds the safety standards that New York State has put forth at 150Ci per month by a factor of almost six (Briner, 2006).

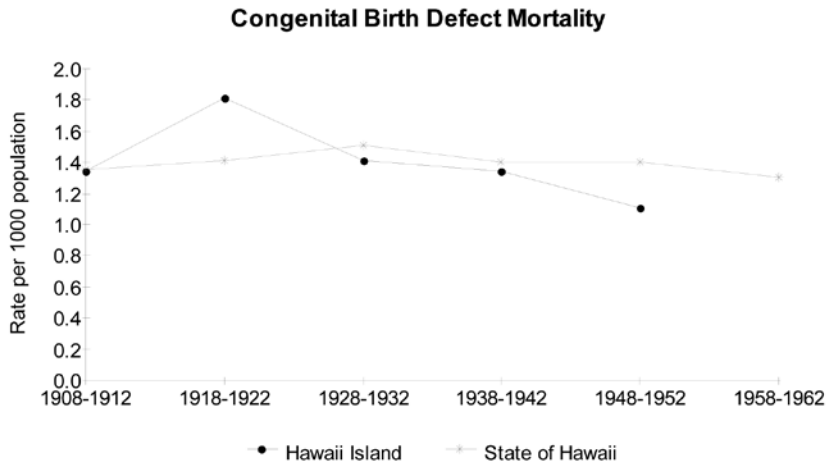
Based on the knowledge that depleted uranium exposure through respiration did surpass the recommended safe levels put forth by the World Health Organization and New York State for a minimal period of seven years, the next step in determining if these communities were adversely affected by these elevated exposures, through the examination of archived health records, determining if the health affects, specifically birth defects, that accompany this type of environmental hazard are present.

A Causal Relationship in Hawai'i

Application of the acceptable criteria for establishing a causal relationship to the public health records in Hawai'i from the turn of the century through the present yields startling results. The years with the highest rates of potential depleted uranium exposure occurred between 1961 and 1968. Thus, considering that the accepted pulmonary life of depleted uranium before it is absorbed into the body is four years, the data should illustrate a rise in birth defects beginning in 1965 and continuing conservatively through about 1972 (Briner. 2006, Yaccoub. 1999, Bertell. 2006). Available data was drawn from the Hawai'i Department of Health's Research and Statistics archived reports.

According to Schmitt, death from congenital birth defects across the state of Hawai'i declined from 1908 until 1962 and the Island of Hawai'i exhibited rates that where declining even more rapidly (See graph 1). The spike in infant mortality found on the Hawaiian Island between 1918 and 1922 may have been due to the Spanish Flu epidemic or differences in collection methods by island (Fujimura, 2003).

Graph 1:



From 1968 through 1982, the districts of North and South Hilo consistently exhibited lower rates of birth defects and infant mortality than almost any other district on any of the Hawaiian Islands (Burch, 1984). Conversely, the Kona side of the island experienced the opposite trend (See Table 1). Birth defects increased along a time-line that mirrors the trajectory put forth by Yaccoub; within four years after initial testing began the prevalence of birth defects increase in the areas downwind from the testing sites.

Table 1: Birth Defects by District per 1000 Live Births

County	1968-1972	1973-1977
North Hilo	6.3	5.9
South Hilo	14.7	10.1
North Kohala	17.5	41
South Kohala	11.6	14.3
North Kona	22.9	7.1

The birth defect rates in North Kohala spiked dramatically within the four to nine years after the testing period ended, resulting in a fourteen-year average that tripled Hilo's North district (See Table 2).

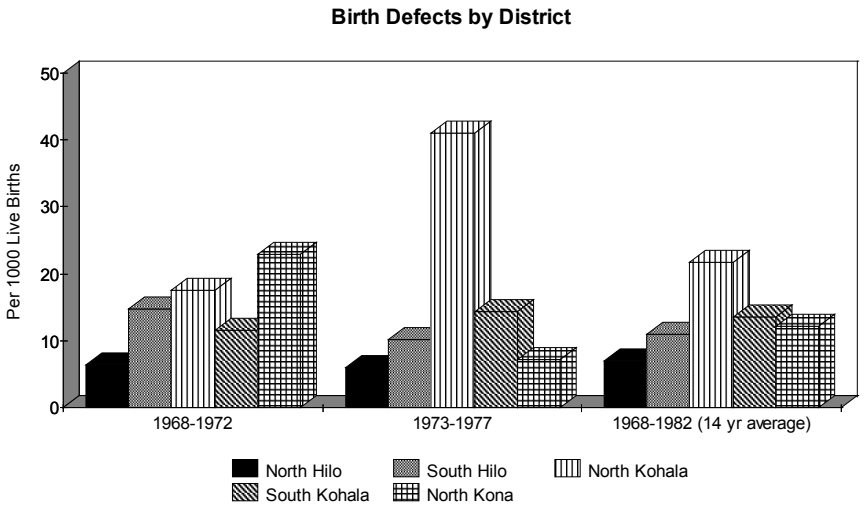
Table 2:Average Birth Defects by District per 1000 Live Births

County	1968-1982 Average
North Hilo	7
South Hilo	11
North Kohala	21.8
South Kohala	13.6
North Kona	12.1

The Hawai'i State Birth Defect Registry was established in 1988 partially due to this spike. The surveying is no longer performed by district in order to protect the confidentiality of the families, physicians, and hospitals. Though these steps to protect personal privacy are essential, it makes the tracking of any long-term genetic mutations that may have arisen in specific geographic regions from depleted uranium exposure difficult. However, the presence of this cluster of statistics merits a community discussion. Additionally, according to the Hawai'i Birth Defect Registry, from 1988 until 2002, Hawai'i Islands exhibited high rates of chromosomal abnormalities such as Patau Syndrome, Edwards Syndrome and Ammiotic Band Syndrome comparative to other states.

Recommendations for DU Assessment in Hawai'i

Traditionally, minority groups exposed to environmental pollutants are disenchanted with how the issue is addressed, the policy that dictates governmental response and an overall lack of involvement throughout the process (Greene, 2006). The research model formulated by Howard University seeks to overcome the power dynamic between the researcher, as a perceived "outsider," and the affected community that is often a reflection



of the larger disproportion of power between the majority's voice and the minority's silence (ibid).

The initial stage of the research would involve establishing a pathway of communication with activists already involved with the movement to end weapons testing on the island until the presence of depleted uranium has been thoroughly and independently tested for. Activists for the multiple Hawaiian State sovereignty movements also may be interested in getting involved with this issue due to the larger implications of neo-colonizing that the military presence symbolizes.

After the initial period of networking, a series of community forums would ideally be performed around the entire island to enable maximum community involvement. The advertisement of these meetings would mirror similar grass-roots campaigns that have occurred throughout the Pacific Islands, through the utilization of fliers, the networking with concerned groups, and newspaper editorials. These meetings would be used to gather data regarding issues that groups feel are significant and gauge the group's degree of knowledge on the subject in addition to building a certain degree of trust between the researcher and the population.

Quantitative surveys would be distributed and filled out after the meeting as a means of further synthesizing the qualitative information brought up during the meeting (Byrman. 1988). The qualitative surveys would deal with the risk perception and the degree of trust the community feels toward different sources of information (Drottz-Sjōberg, 2000). Determining the information sources the group trusts will help increase coordination within the concerned group and perhaps also serve as a medium for attracting more concerned citizens. For example, determining if editorials or articles in an independent paper, versus handing out fliers, or publishing in the local corporate newspaper would make a difference in community involvement and their perceived degree of trust in the information. Determining if we need to utilize a "local" voice rather than an outsider to fully engage the public also merits consideration. Surveying to determine the perceived exposure risks from different radiation sources, such as the sun, cellular phones, nuclear bombs, and depleted uranium, will also help gauge the degree of threat that depleted uranium poses and whether the issue should be pursued from a public health angle or as a potential issue to build community action around. For example, if the community asserts that they are concerned about the test's affects on the previous generation, but do not feel that depleted uranium currently poses a threat, then issues surrounding government accountability, responsibility and monetary compensation for the previously affected group will drive the community's further action.

If the community did feel that a danger still exists, a third survey would utilize aspects of the survey developed by Asaf Durakoiv, the former Chief of the Nuclear Sciences Division at the Armed Forces Radiobiology Research Institute and advisor to the National Science Foundation. This survey listed a variety of symptoms associated with low-level radiation exposure, which the individuals can fill out for themselves, but also provide anecdotal statistics regarding the health of neighbors, parents, children, or pets. The fourth aspect of the survey will involve surveying to determine the desirable potential paths of further action. Questions would involve determining what group should be in charge of testing for nuclear contamination and if certain forms of oversight are necessary to ensure the results of the tests are accurate. Monetary considerations concerning the funding of testing and clean up efforts will also be presented. An open section will provide a space for further writing if they feel that certain concerns haven't been addressed or they want to expand on a certain concept or concern.

The results of these surveys will be synthesized into a body of data that will dictate the next step of

the research project. A series of workshops will be developed to address these concerns while simultaneously building trust and increasing community involvement. For example, if the community feels that depleted uranium is a danger and wants further education regarding the dangers of exposure, the next forum would include distributing published data from credible sources, as well as coordinating with local experts and health-care providers to increase community awareness. If the group feels certain that a danger exists that merits further research, the next meeting would also focus on determining what areas of land need to have soil samples taken, and if the water in specific areas needs to be surveyed. Here again, care in selecting the parties that will perform and oversee the testing will be dictated by the community.

Conclusion

I conducted a random survey of fifteen Hilo residences ranging from age 19 to 61 to determine of a cursory concern regarding weapon's testing and/or depleted uranium exposure existed within the community. The survey was in written form, but nearly all the participants also wanted to share their opinions after the survey was completed. These tentative results illustrated that everyone was aware of a military base being present on the island and the vast majority expressed concerns about weapons testing on the island. They also unanimously felt that depleted uranium was a dangerous material. Many responders expressed leeriness towards the military, lamenting that "they can't be trusted" or that they "are still hiding weapons up there." The impact on the natural environment, in addition to the potential danger that depleted uranium presents to humans, were common themes throughout the course of the interviews and provide cursory evidence that the citizens of Hilo are very concerned about the military testing that has, and continues, to occur.

Further research is necessary to determine if health trends that existed on the west side of Hawai'i Island are tied to exposure to environmental hazards and if any of these issues are still occurring. The rather limited amount of data that is currently available suggests that the population living down-wind from the training center has been exposed to depleted uranium at least during the years directly following the testing period. Changes in how the Hawai'i health department surveys for birth defects occurred in the early 1980's making the tracking of long-term genetic changes by district virtually impossible. However, networking and engaging the community may provide the means of overcoming that obstacle.

Given the long half-life of depleted uranium, the continual military testing of munitions on the site, and frequent fires that stem from those tests, there is a strong likelihood that questionable levels of radiation exposure are still occurring. Further research needs to focus on the rates of chromosomal abnormalities on both sides of the island along with leukemia rates and thyroid disorders to determine if a causal relationship exists between depleted uranium exposure and these occurrences. It is imperative that the potentially affected community not only has a forum for voicing concerns, but also steers the direction of further research. This can be achieved through community meetings, educational workshops, and frequent quantitative surveying to ensure that the needs of the community are being addressed. The absence of mainstream media coverage also needs to be addressed. I challenge that the proven implications of depleted uranium use in Hawai'i are ignored for the same reasons that correlations between prostitution and a military presence, as well as nuclear testing in the South Pacific, and anti-war efforts, do not earn media coverage; namely that the media's financial well-being is intrinsically tied to a continual military presence. The military's presence is supposed to convey a sense of security and safety to the Island residents, but I would challenge that decades of lies and the misuse of force has seriously undermined their credibility. Every member of the Big Island's community has been adversely affected by the testing that has occurred. The media's reluctance to discuss this particular issue, and its larger implications, suggests a self-serving support of the colonial heir to Hawai'i: the United States' military.

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