VOLUME 1, ISSUE 9 SPRING 2015

VISIONS MAGAZINE is dedicated to the world we live in and the world we hope to create. Visions is a non-partisan, peer-reviewed publication that contains articles from disciplines associated with environmental studies. Just a few of these disciplines include communications, political science, economics, philosophy, religion, art, and English. Visions Magazine is a faculty-student organized and operated publication that features the works of Elon University students and studentfaculty collaborations. The ultimate goal of Visions is to allow students to explore scholarly research, writing, and review in a professional setting. In addition, Visions provides publishing opportunities for students with interests in the environment and sustainable development.

Contributing to Visions Magazine:

Visions Magazine seeks compelling, interesting, well-written, creative contributions on environmentally related topics. Major contributions to the magazine should be grounded in scholarly literature and/or reflect the conventions of research and writing associated with a specific academic field of study. All submissions must receive positive blind peer reviews before consideration for publication.

We wish to thank Elon University's Core Curriculum for its support.

Submissions for the Spring 2016 volume of Visions Magazine are being accepted! Please e-mail visionsmagazine@elon.edu or go to http://www.elon.edu/e-web/bft/ sustainability/ac-visionsMag.xhtml for more information about the criteria for submissions and information about the magazine.

Student Editorial Staff

Emily Cinquemani '15 English/Literature and Crestive Writing

Lauren Franceschini '17 English/Professional Writing and Rhetoric and Creative Writing

Jacqueline Grant '17 English/Creative Writing

Sarah Holdren '18 Public Health and English Language and Literature

Julia Mueller '16 Environmental Studies and Political Science

Production Designers

Kristen DeMaria '16 Strategic Communications

Sydney Fleekop '16 *Marketing*

Katie Kolls '15 Media Arts and Entertainment

Faculty Consultants

Hella Cohen Assistant Professor, English and Elon Core Curriculum

Cassandra Kircher Professor, English

Michele Kleckner Senior Lecturer, Computing Sciences

Contents

Feature

- 2 Yes! It is Your Beeswax *Abby Symes*
- 5 Oil Trade and US-Saudi Relations Julia Mueller
- Dengue Fever Syndrome in **I2** Bangladesh
 - Chloe Donohoe

The Effect of Environmental

16 Destruction on Vulnerable Populations Mary Alice Allnutt and Sarah Clark

- 24 Preferential Food Selection in Elon's Squirrels Sarah Vaughan
- 32 A Comparison of Mammalian Communities Will Hemminger, Susie Masecar, Tim O'Mara, and Alex Saylor

Quick Reads

22 Magic America: Coming of Age in an Altered State *Book review by Jaclyn Pisarski*

30 Power and Water in the Middle East Book review by Matt Snow

39 Bearwallow: A Personal History of a Mountain Homeland Book review by Casey Allen

44 Method's Adam Lowry Comes to Elon University Interview by Lauryl Fischer

Poetry

40 Penance Miranda Romano

42 Arizona Secrets Virginia Kluiters

43 Grow Caroline Guardabassi

Yes! It is Your Beeswax

Written by: Abby Symes

Holes oneybees have been around for millennia, ever since plants evolved the way that they reproduce. Plants originally relied on the wind to be their pollen delivery system, but that was neither energy efficient nor dependable. Once some plants developed into angiosperms (flowering plants), however, they began to use insects as agents for pollination. Due to this evolutionary dependence, honeybees, which are by far the most important pollinating insects, are a keystone species in the environment, which means that other species depend on them and if removed, the community will suffer (Shuster). Hence, bees are a vital part of ecosystems, and without them many of the plants that grow the foods that we love will disappear.

Recently, beekeepers, such as Dave Hackenberg, have encountered a mystery. Hackenberg had been keeping bees and transporting them to farms all over the country for 40 years. In November of 2006, he

dropped off 400 healthy hives in Florida, and when he came back to check on them three weeks later

> Clockwise from top (photos by): Krzystof Szkurlatowski, Lydia Willig '18, Day Donaldson.

only 40 remained. What perplexed him further was that there were no dead worker bees around the hive. The hives and queens were just abandoned (Shuster). Countless beekeepers around the world have encountered this same phenomenon, known as Colony Collapse Disorder, or CCD, which has been wiping out hundreds of thousands of honeybees inexplicably. With bees disappearing in unprecedented proportions, the US Department of Agriculture and the Apiary Inspectors of America conducted surveys which found that in 2007-2008, American beekeepers lost anywhere between 30 to 90 percent of their colonies (Shuster).

With CCD running rampant, beekeepers and citizens alike are asking themselves how they can help save the bees. Before we can ask how to help though, we first need to know what is causing the problem. For this reason, researchers have been called to find CCD's main determinant; however, these researchers have come to the conclusion that no single factor causes CCD. The best theory they have is that CCD is the result of a combination of reasons, including poor farming techniques, pesticides, parasites, pathogens, and disease ("Related Topics"). While modern agricultural methods are currently destroying bee populations around the world, we need to act to save them.

One of the recent issues that bees face is a lack of biodiversity. In today's agricultural system, many farmers have been turning to monoculture, or the planting of one specific crop in mass quantities. This monoculture movement in agriculture threatens our bee populations for two reasons: monoculture forces the bees to feed off of one type of pollen instead of multiple sources, and it restricts bees to one abundant food source during a year. A study by Dr. Alaux of the French National Institute for Agricultural Research showed that bees who are fed from multiple sources of pollen have a healthier immune system than bees fed from a single source of pollen (Black). Bees with a healthier immune system are more able to fight off diseases, which are causes of CCD. Furthermore, having a singular abundant food source threatens bees'



Photo courtesy of freewhd.com

availability of food, because if that one crop dies out to a pest epidemic or disease, the bees would be left with nothing to eat. To combat the threat of mass pest infestations, farmers nowadays use large quantities of pesticides to protect their crops; however, these pesticides have harsh consequences of their own (Glover).

Many pesticides, specifically those containing neonicotinoids, have been shown to be another driving factor in CCD. Neonicotinoids are a class of chemicals that attack the bees' nervous system, altering their navigational and flying abilities (Walsh). What makes neonicotinoids different from other chemicals in pesticides is that they are applied to the seed or the soil, or both, and the chemicals are taken up by the plant, remaining there for years. The pesticides are then in the nectar and pollen that the bee eats ("Save the Bees"). The bees ingest the toxin and while it does not kill them, "[It] may impact some bees' ability to foraging for nectar, learn and remember where flowers are located, and possibly impair their ability to find their way home to the nest or hive" ("Insects in the City"). The bees obviously need their memory and the ability to navigate the vast world around them in order to survive.

Diseases and parasites are not uncommon to the bees, yet they also can be the demise of a colony. Certain parasites like the varroa destructor mite, a tiny arachnid that hops on the backs of worker-bees into the hives, hijack the hives and kill the bees. Once they are inside, the mites suck the blood from both the adults and developing brood, which in turn weakens and shortens the life spans on which they feed. They also bring in their own viruses and bacteria, which damages colonies. The developed brood may have deformities such as missing legs or wings. If the mites are left untreated, they will kill the colony (Besson). Sadly, the destruction of the varroa destructor does not end there. Most adult bees carry harmless viral infections that are asymptomatic, but in conjunction with poor nutrition, stress, and parasites, these infections become symptomatic (Arbia and Babbay). The bees need help to combat these parasites and the diseases that ensue.

The complications associated with CCD are not exclusive to the honeybees, and include the economy and plants that rely on them. The value of honey bee pollination to agriculture worldwide is approximately 153 billion in Euros, which is about 194 billion in US dollars (Gallia). Certain fruits, seed, and nut crops could decrease by more than 90 percent without honeybees (Cayeula). Fruits and vegetables like blueberries, apples, avocados, onions, broccoli, and asparagus are 90 percent directly pollinated by honeybees (Walsh). Not only could some foods be a scarcity without the bees, but some foods could disappear altogether because honeybees are responsible for pollinating many foods that we enjoy. Without them we would not be able to enjoy almonds, because honeybees are solely responsible for pollinating their flowers. Dennis vanEnglesdorp, State Apiarist for Pennsylvania's Department for Agriculture, said that "One in every three bites of food we eat is pollinated directly or indirectly by honeybees" (Shuster). Undoubtedly, bees are of great importance to us economically and personally. But, now knowing the causes of CCD, how can we save them? Fundamentally, all that bees need are diverse, "clean" (free of pesticides), and plentiful food sources, and it is both the responsibility of big companies as well as individuals to provide bees this necessity.

Currently, "there are not enough blooming flowers over the length of the growing season in our agricultural and urban landscapes to support bees" (Spivak). This problem can be fixed by creating habitats for bees, which in turn will give them more pollen sources for a longer period of time. Planting flowers that bees frequent is a solution to this problem. Flower types such as daffodils, sunflowers, wildflowers, and honeysuckle are all good choices for bees. Herbs that we use in cooking, such as oregano, rosemary,

and mint, can also be beneficial to them, and to our food ("Save the Bees"). Even if a beehive is not nearby, bees can travel five miles for food, so creating a habitat for bees is never a bad plan of action (Walsh). Additionally, big corporations could move towards polyculture, which is planting more than one type of crop in any given field. By using polyculture, crop fields would become naturally pest resistant, leading to more guaranteed harvests and food for their pollinators. Furthermore, both planting flowers and moving towards polyculture would help give bees the benefit of a variety of food sources, strengthening their immune systems to combat disease. Polyculture could also cut down the amount of pesticides farmers use because one type of pest would not ruin an entire crop yield (Glover). All of this considered, planting flowers and adapting polyculture would be effective means of saving our bee population.

As far as pesticides, it is impractical to ask corporations to stop using them. Even with a transition to polyculture making farms more pest resistant, pesticides are needed to secure our extreme demand for crops. Even so, there still are measures that can be taken by everyone to minimize their risk. As individuals, the fix for pesticide usage is relatively easy. We just have to follow a few simple guidelines when we use them. First, we just need to follow the directions on the pesticide's label closely. Using too much of a pesticide can have detrimental effects to both a plant and its pollinators. Second, we need to limit the use of pesticides containing neonicotinoids overall, or at least restrict our usage of them in the soil, where their effects are slightly reduced, instead of on the plant or the seed. Lastly, it is vital that we only use neonicotinoids during times when bees are not foraging, such as the evenings ("Insects in the City"). If we follow these few guidelines, then the risks brought by pesticides could decrease substantially.

The last, but most important thing individuals can do is simply give the bees a voice. Writing to local and state governments about planting bee-friendly plants, restricting the use of pesticides in public spaces, and promoting awareness and education to the public about bees can help them tremendously ("Save the Bees"). The government can create laws and provide permanent protection for our bees, but we must take the first few steps. The word must be spread that one of our most important keystone species is threatened, or we will be the ones to pay the price with our quality of life. When all is said and done, the bees are in dire need of our help, and it is our duty as educated citizens to help them.

References

Arbia, A., and B. Babbay. "Management Strategies of Honey Bee Diseases." Management Strategies of Honey Bee Diseases. 17 July 2010. Web. 26 Sept. 2014.

Besson, Ric. "VARROA MITES INFESTING HONEY BEE COLONIES." Varroa Mites in Honey Bee Colonies. Web. 28 Sept. 2014.

Black, Richard. "Bee Decline Linked to Falling Biodiversity." BBC News. BBC, 20 Jan. 2010. Web. 26 Sept. 2014.

Cayuela, Luis, Sarah Ruiz-arriaga, and Christian P. Ozers. "Honeybees Increase Fruit Set in Native Plant Species Important for Wildlife Conservation." Environmental management 48.5 (2011): 910-9. ProQuest. Web. 24 Sep. 2014.

Gallai, Nicola, et al. "Economic Valuation Of The Vulnerability Of World Agriculture Confronted With Pollinator Decline." Ecological Economics 68.3 (2009): 810-821. Academic Search Complete. Web. 26 Sept. 2014.

Glover, Kevin. Personal Interview. 28 September 2014. "Insects in the City." Insects in the City. Web. 28 Sept. 2014. http://citybugs.tamu.edu/factsheets/ipm/what-is-a-neonicoti-noid/>.

"Related Topics." ARS : Honey Bees and Colony Collapse Disorder. Web. 26 Sept. 2014. http://www.ars.usda.gov/News/docs.htm?docid=15572#public.

"Save The Bees." BuzzAboutBees.net. Web. 27 Sept. 2014. Shuster, Miche, and Janet Vigna. Biology for a Changing World. Second ed. New York: W.H. Freeman, 2014. Print. 26 Sept. 2014.

Spivak, Marla. "The Plight of the Bees." Environmental Science & Technology 45, no. 1 (January 2011): 34-38. Academic Search Complete, EBSCOhost. 19 Sept. 2014.

Walsh, Bryan. "The Plight Of The Honeybee." Time 182.8 (2013): 24. Academic Search Complete. Web. 24 Sept. 2014.

Abby Symes '18 is majoring in Exercise Science with the intention of becoming a physical therapist. She owns two horses and rides competitively in the hunter arena. She also loves to play video games.

Oil Trade and US-Saudi Relations

Written by: Julia Mueller

Introduction

The alliance between the United States and Saudi Arabia is often attributed largely to the trade of oil. Saudi Arabia is the world's largest supplier of oil, and the United States is the world's largest oil consumer. When the two countries entered into the alliance in 1945, the intent of the agreement was to prevent communist relations with the United States providing security and technology in exchange for oil (Bronson 2006). Today, political instability and radical Islam—byproducts of colonial land-doling and political instigation in the region—are the primary threats in the Middle East, and the United States is pressing toward energy security. Tensions between the United States and Saudi Arabia are evident, yet the countries remain partners. The purpose of this analysis is to evaluate the significance of oil in the alliance.

Most proponents seek energy independence for national security purposes, but the precise definition of energy independence varies among experts. Some define the phrase as the United States being entirely independent from all foreign energy needs. From an economic viewpoint, the term relates to the stability of price and supply. Others claim that the United States may be classified as energy independent if 75% of the total energy is derived from domestic reserves (Lippman 2008). Today, the United States uses almost 67% of domestic oil (EIA 2014).

Context of Oil Use

It was widely acknowledged that the Persian Gulf contained oil throughout modern history and it is estimated that the region contains approximately 20% of the global oil supply. In 1920, the Standard Oil Company of California (SOCAL) confirmed the presence of oil, and the company signed a deal in the 1930s for exclusive production rights in Saudi Arabia (Simmons 2006). A wholly owned subsidiary, California-Arabian Standard Oil Company, began exploration soon after a drilling agreement was negotiated.

The formal alliance began in 1945 when Franklin D. Roosevelt met King Abdul Aziz, the founding monarch of Saudi Arabia, at the Suez Canal. The alliance was built upon discrediting communism and opposing the Shia theocracy in Iran. Dammam Number 7, among several others, helped solidify the alliance between the United States and Saudi Arabia and produced oil for 44 years until 1982 (Blanchard 2010).

The original shallow wells proved disappointing, but Dammam Number 7 went to a greater depth and was the



Photo courtesy of fotolia.com



Photo courtesy of flickr.com

well that secured commercial Saudi oil production. In 1944, the name of California-Arabian Standard Oil Company was changed to Arabian American Oil Company, referred to as Aramco. Saudi Arabia took full control of Aramco in 1980, and in 1988 the name was changed to Saudi Aramco by royal decree (CNBC 2005). American leaders did not attempt to change the absolute monarchy or conservative Saudi society and was not hostile when forming the alliance. Instead, there was significant respect for the cultural traditions and the government. In fact, the United States acted as a balancing force against the strong British influence in the Arab region (Lippman 2008).

Oil was used in the United States as a lubricant before the 20th century, but America's modern oil industry is tied to a well in southeastern Texas near the town of Beaumont (Almanac 2014). The well was designated as Lucas 1 and initially produced nearly 100,000 barrels per day, exceeding the combined output of all wells across America at that time. The discovery led to the realization that oil was readily available.

Fossil fuels were rapidly adapted to fuel railroads and ships, and later utilized for new inventions such as the airplane and the automobile. Oil provided greater mobility and trade, and American oil proved a valuable resource for allies in the World Wars. With inexpensive oil abroad, the United States shifted to using routine oil. It is now one of the major drivers of globalization (Falola and Genova 2005).

Oil and the Economy

Oil is vital to the Saudi economy. In 2014, oil accounted for approximately 90% of total export revenues, about 80% of budget revenues, and 45% of Saudi Arabia's GDP (Forbes 2014). In 2014, Saudi Arabia's net oil export revenue was \$246 billion (EIA 2014). These funds bring incredible wealth to the ruling family, who in turn establish programs supporting its citizens. In an area where political instability is routine, the Saudi Armed Forces are developed. Funds also provide education of citizens with some being able to participate in programs for study abroad to the United States. For example, the current Minister of Petroleum and Mineral Resources, Ali al-Naimi, studied hydrology and economic geology at Stanford University (CNBC 2005).

The oil production by Saudi Aramco spans more than 1.5 million square kilometers. Saudi Aramco is twenty times the size of Exxon Mobil and sits on 260 billion barrels of oil (CNBC 2005). The oil industry continues to play an extremely important role in the country's economy as the private sector contributes a little less than half of revenues to Saudi Arabia's GDP. As a result, there are numerous security measures surrounding the country's oil fields (CNBC 2005).

The United States uses about 19 million barrels of oil per day, and the cost of oil can have a significant impact on the American economy (EIA 2014). Saudi Arabia is a prominent member of the Organization of the Petroleum Exporting Countries (OPEC), and the group maintains substantial power over global oil prices. Individually, Saudi Arabia is now the 19th largest exporter of oil in the world and second largest petroleum exporter to the United States after Canada (Saudi Embassy 2015). Saudi Arabia also holds the fifth largest natural gas reserves (EIA 2014).

If the United States becomes energy secure, it will affect global oil prices. The current price to receive a reasonable profit is approximately \$75 per barrel of oil (BBC 2014). The United States produces more than nine million barrels a day of crude oil (EIA 2014). It is likely that Saudi Arabia and other oil-producing Middle Eastern states will protect their markets before protecting their price of oil. This is an argument against energy independence (Interview 2014).

The Saudi kingdom is aware of decreasing oil prices and according to the current OPEC governor, Mohammed al-Madhi, the kingdom expects prices as low as \$70-\$80 per

barrel. Prices for Brent crude oil are currently trading at slightly less than \$80 per barrel (BBC 2014). There is a sharp divide between policymakers and economists regarding oil trends and prices. Economists claim prices are set regardless of the supplying nation while policymakers are confident that trading partners are central to costs (Clayton and Levi 2012). Because policymakers guide foreign affairs, future relations with Saudi Arabia are less certain according to this debate.

Politics and Oil in the Middle East

Saudi Arabia is viewed as the primary protector of Arab rights and of Mecca and Medina. It is therefore essential that the country maintains credibility and stability (Quandt 1981). In general, Saudi Arabia acts privately both culturally and politically. It is a useful strategy to avoid confrontation with unstable countries like Syria and Iran (Cordesman 2003). Potential destabilizers within the region include Arab-Israeli or inter-Arab conflict, the changing price of oil and inflation in the west. As a result, the United States is central to Saudi foreign policy.

The relationship is beneficial to the United States. Oil companies in America gained incredible profits over the years, and Saudi Arabia is a stable trading partner. The United States imports most of the petroleum from Canada, Mexico, Venezuela, Russia, and Saudi Arabia, but foreign policies of Venezuela and Russia have become increasingly aggressive in recent years. Increased oil production within the United States, combined with other alternatives for petroleum imports, tend to limit the potential impacts of any actions of an individual country.

Saudi Arabia is a reliable supplier of oil, and it is often called the "dove" of the OPEC. However, many observers claim that geopolitics is driving oil prices more than supply and demand (Bromley 2005) (Wehrey et al. 2009). It was reported that the Saudi and American governments are working to decrease the price of oil to impact Russia. This additional pressure on Russia is meant to discourage their support of al-Assad in Syria's civil war. Syria is an ally with Iran, and is a threat to both the United States and Saudi Arabia (Bergen 2014).

China is a potential ally of Saudi Arabia (Klare 2007). China imports a large amount of oil and large-scale investments are motivation for an alliance (Al Arabiya 2014). Like Saudi Arabia, China has an increasing population that will soon require more resources. Great power politics is the primary concern of several foreign policy experts. China and Russia are the closest to becoming great powers, and if the United States is not importing oil from Saudi Arabia, it is extremely likely China will have access to more resources (Al Arabiya 2014) (Klare 2007).

Furthermore, if Canada is producing oil and not exporting it to the United States through the controversial Keystone XL pipeline, it is probable that Canada would send it to China instead (Hoeven 2012). Thomas Friedman argues



Photo courtesy of wikipedia.org

that there is potential of a global oil war with Iran and Russia against Saudi Arabia and the United States (Zhdannikov 2014). Though unlikely, the current opponents rising to power are Russia and China.

Oil Production and Energy Security in the United States

The United States Senate rejected the vote for the Keystone XL pipeline permit on November 18, 2014 (Parker and Davenport 2014). The project is \$7 billion dollars and would extend 1,700 miles from Alberta, Canada to the Gulf Coast. Proponents of the pipeline claim it would create jobs



A reporter recommended using the term energy resilience rather than independence (Clayton 2012). This is arguably more accurate because the United States wants to maintain the technology and supply of oil in the case of a national security emergency. Because oil is a nonrenewable resource, oil supplies in both Saudi Arabia and the United States will eventually be depleted. Even if the United States reaches a level of energy independence, it is unlikely to continue for a



Figure 1. The WOCAP model provides a comprehensive chart of the process for global oil production (Bakhtiari 2004).

in the private sector, stabilize gas prices, and reduce dependence on foreign oil (Clayton and Levi 2012). Keystone XL is now pending. However, a company in Canada is creating a pipeline similar to Keystone XL to send more oil to the United States (Newsweek 2014). This project is also politically charged because of the environmental regulations.

Currently, the oil industry within the United States enjoys a renaissance associated with the wide spread application of hydraulic fracturing. This approach results in large long period of time.

A retired employee of Schlumberger traveled to Saudi Arabia after September 11, 2001 and shared some of his experiences. Schlumberger is an oilfield services company. During the man's business trip, he recognized the significant cultural differences and role of oil between the nations. Oil constitutes about 95% of the country's economy, and Saudi Arabia cannot afford to have the demand for oil disrupted (Interview 2014). Not speaking on behalf of the company, the anonymous source claimed there would not be a continued alliance if it were not for the monarchy. The royal family wants to preserve their power and wealth, and so far, have been successful in keeping citizens satisfied with the government. The kingdom distributes substantial portions of its wealth through money and gov-

ernment services to citizens. Government services include education, electricity, health care, subsidies, and water. This increases the stability of the country (Interview 2014).

The interviewee stated that the United States no longer has cheap oil, but America has better infrastructure and more skilled workers than abroad. He attributed this to capitalism and democracy. Energy independence will depend upon the future price of oil as capitalistic forces will drive advances in renewable energy, if economically feasible. If the United States does in fact achieve independence, it is unlikely that it will last for a long period of time unless a higher percentage of American energy consumption moves from fossil fuels to renewable energy sources (Interview 2014).

Robert Vitalis critiques the Arabian American Oil Company (Aramco), the large American oil company in Saudi Arabia, in America's Kingdom: Mythmaking on the Saudi Oil Frontier. Aramco is revealed to be a historically racist organization with only goals for the United States in mind. This supports the economic forcefulness of American companies for the acquisition of oil. Vitalis, along with other scholars, predict that the United States will act according to fossil fuel interests. The argument is that America is only interested in Saudi Arabia for its oil supply. Though this approach is cynical, there is valid evidence in the statement (Vitalis 2007).

Gawdat Baghat considers the impact of finite resources in the Journal of Social, Political, and Economic Studies. Saudi Arabia will remain stable if diverse energy is developed and renewable sources become as reliable as fossil fuels. Otherwise, less oil from Saudi Arabia will drive prices higher and the global economy will be negatively affected (Bahgat 2012). Similarly, Bahgat encourages interdependence rather than independence. He argues that OPEC will meet the increasing energy demands of the United States and will therefore guard against American energy independence (Bahgat 2006).

If the United States achieves energy independence, this will certainly impact US-Saudi relations. However, even if America ceases to import oil, it is quite possible that security will continue to be offered to Saudi Arabia. As the leading global power, the United States often contributes aid to crises that may relate to either American values or interests (Bacevich 2012). Still, there would be less of an obligation for this defense.

David Painter explains the role of oil in the "American Century." The American Century is the concept of the United States as the global superpower beginning after the Second World War (Bacevich). The idea continues to drive foreign policy. The Truman, Eisenhower, Nixon and Carter Doctrines were relevant to oil in the Middle East (Painter 2012). Today, oil is less sustainable for national security, economic, and environmental conditions (Painter 2012).

The World Oil Production Capacity Model explains the process for the supply possible to produce (Bakhtiari 2004). It reveals that technology and maintenance are integral to continued production by OPEC members. Based on this and the unsustainable practices, perhaps greater emphasis ought to be placed on improving renewable energy sources and diversifying Saudi Arabia's economy. There are several alternative energy options, such as solar, wind, and hydroelectric power. However, renewable energy is currently too expensive to compete with fossil fuels.

Terrorism and Oil Trade

The culture of Saudi Arabia is more conservative than the surrounding Arab nations. It is evident that substantial funding for terrorist organizations is from the interception of oil. Since Saudi Arabia is the largest producer of oil, it is a valid assumption that portions of the funds might be used for the terrorist agenda (Prados 2007). The flow of these funds is a national security threat to both the United States

IT IS EVIDENT THAT SUBSTANTIAL FUNDING FOR TERRORIST ORGANIZATIONS IS FROM THE INTERCEPTION OF OIL.

and Saudi Arabia (Klare 2007).

The United States became concerned about Saudi involvement after the terrorist attacks in 2001 (Bahgat 2003). Fifteen Saudis participated in the attacks though Saudi Arabia agreed to combat terrorism and rejected ties to September 11 (Bergen 2014). Bin Laden, the former Al Qaeda leader, was a Saudi until the government nullified his citizenship in 1994. In the Commission Report released in 2004, the United States National Commission on Terrorist Attacks did not find reliable evidence that Saudi leaders provided funds to Al Qaeda (Gause 2002).

Saudi Arabia took a more combative approach to terrorism in the Arabian Peninsula when terrorists attacked in 2003. The United States encouraged their counterterrorism efforts, though it suggests Saudi Arabia ought to watch fundraising abroad more carefully. Reports claim that funds for Al Qaeda were raised in Saudi Arabia, but Saudi Arabia denied those allegations (Bahgat 2004) (Prados 2007).

Another concern about the alliance with Saudi Arabia is providing weapons to citizens. There is evidence that the weapons can be repossessed by threatening groups and used against the people intended to protect. The United States has provided military training and equipment to Saudis since 1951 as declared in the mutual defense assistance agreement (Bronson 2006). Many American political leaders discouraged the arming of Saudis in fear that the weapons would

be used against Israel, especially during the Gulf Wars. The Saudi kingdom viewed this as their security from the United States withering. However, the United States sent half a million troops to the Gulf when Iraq invaded Kuwait in 1990 (Country Studies 2014).

Major concerns are that America's vast reliance on foreign oil is providing a source of revenue to terrorists who threaten national security (Cronin 2014). One example is the Islamic State in Iraq and Syria (ISIS), diverting funds from oil. Though the Saudi government is fighting against ISIS, it is estimated that ISIS is gaining between \$1 million and \$3 million in revenue each day (Cronin 2014). Saudi Arabia deployed 30,000 soldiers to the Iraqi border in March 2014 with the intent of combating the spread of ISIS movement to the south (Hoppner 2014). The primary concern, in addition to the obvious violence, is the revolt against the monarchs similar to Osama bin Laden's goals in the 1990s.

Current State of the Oil Trade

The population of Saudi Arabia was small and rural before oil production. Between 1970 and 2010, the population quadrupled to 27.3 million. Experts project the Saudi population to reach 40.4 million by 2050 (ESCWA 2014). The population growth will lead to greater domestic energy demands in Saudi Arabia. Clean water will also grow as a concern in the desert country. Water scarcity can lead to political instability, as reflected in other Middle Eastern countries. Additionally, Saudi Arabia faces an increasing debt that must be addressed in the future.

The current relationship between the Saudi King Abdullah and President Obama is tense. The Saudi king rejected the United Nations Security Council seat because of the claimed lack of credibility United States' held when facing Syria and their use of chemical weapons. Saudi Arabia also opposed the American response to the Arab Spring. The monarchy issued public complaints about the Obama administration earlier in 2014. The United States did not comment on Saudi Arabia's vast human rights violations, which may be an example of oil interests interfering with democratic values.

Saudi Arabia maintains control of pumping more oil if necessary in a matter of hours. The "Hubbert Curve" states that geologists are inaccurate in the measurements of gradual oil decline (Falola and Genova 2005). The concept is concerning since Saudi Arabia is the world's largest supplier. On the other hand, a total oil projection reaches 511 billion barrels. Saudi Arabia did not confirm the measurement, but



Photo courtesy of fotolia.com

it is apparent that there are undiscovered oil fields that will continue to provisionally sustain the world.

Summary

Despite different purposes in the Middle East, a senior US official claimed that Saudi Arabia and the United States continue to be united (CNN 2014). In 2014, the United States imported 38.7 million goods while exporting only 13.3 million goods to Saudi Arabia (Trade 2013). The United States is Saudi Arabia's largest trade partner, and the global demand for oil and natural gas continues to increase. Energy security is primarily a political issue, not an economic task.

Both countries want to restrain the rise of Al-Qaeda and similar terrorist organizations in Syria. Saudi Arabia is one of the Arab nations participating in the airstrikes against ISIS. President Obama recognized their contributions on November 19, 2014. Working together to fight Ebola, negotiate with Iran about nuclear weapons, and stabilizing the extremism in Yemen are pending goals of the two countries (Fox 2014).

The current relationship between the United States and Saudi Arabia is tense, but it is unlikely that relations will be severed in the near future. Oil will contribute the most to the decisions within the alliance unless renewable energy becomes a competitor, but politics, economics, and culture will remain discernable factors (Fisher 2013). Most experts concur that the United States will never be entirely independent of global supply and demand patterns, so the ongoing ambivalent alliance with the world's largest producer of oil is necessary (Economist 2012).

References

Andrew J. Bacevich, ed. The Short American Century: A Postmortem. Harvard University Press, 2012.

"Awkward Relations." The Economist. The Economist Newspaper, 29 Mar. 2014. Web. 13 Nov. 2014.

Bahgat, Gawdat. "Oil and Militant Islam: Strains on US–Saudi Relations." World Affairs (2003): 115-122.

Bahgat, Gawdat. "Terrorism and Energy Potential for a Strategic Realignment." World Affairs 167.2 (2004): 51-58.

Bahgat, Gawdat. "The United States and the Middle East:

interdependence not independence." OPEC review 30.3 (2006): 187-201.

Bahgat, Gawdat. "Will Saudi Arabia Face an Energy Crisis?." The Journal of Social, Political, and Economic Studies 37.2 (2012): 181.

Bakhtiari, AM Samsam. "World oil production capacity model

suggests output peak by 2006-07." Oil and Gas Journal 102.16 (2004): 18-19.

Bergen, Peter. "Why the Saudis Unfriended the U.S." CNN. Cable News Network, 28 Mar. 2014. Web. 9 Nov. 2014.

Blanchard, Christopher M. Saudi Arabia: Background and US Relations. DIANE Publishing, 2010.

Bromley, Simon. "The United States and the control of world oil." Government and Opposition 40.2 (2005): 225-255.

Bronson, Rachel. Thicker than oil: America's uneasy partnership with Saudi Arabia. Oxford University Press, 2006.

"China and the Future Alliance with Saudi Arabia." Al Arabiya. Al Arabiya Network, 16 Mar. 2014. Web. 10 Nov. 2014.

Clayton, Blake. "Is U.S. Energy Independence Possible?" Council on Foreign Relations. Council on Foreign Relations, 21 June 2012. Web. 11 Nov. 2014.

Clayton, Blake, and Michael Levi. "The Surprising Sources of Oil's Influence." Survival 54.6 (2012): 107-122.

Cordesman, Anthony H. Saudi Arabia enters the twenty-first century: the political, foreign policy, economic, and energy dimensions. Vol. 2. Greenwood Publishing Group, 2003.

"Country Information." Country Information. Saudi Embassy, 2015. Web. 23 Mar. 2015.

Cronin, Audrey Kurth. "ISIS Is Not a Terrorist Group: Why

Counterterrorism Won't Stop the Latest Jihadist Threat." Foreign Aff. 94 (2015): 87.

"The Demographic Profile of Saudi Arabia." ESCWA. United Nations, 1 Jan. 2011. Web. 17 Feb. 2015.

"Energy to Spare." The Economist. The Economist Newspaper, 17 Nov. 2012. Web. 27 Nov. 2014.

Falola, Toyin, and Ann Genova. The Politics of the Global Oil Industry. Westport: Praeger, 2005.

Fisher, Max. "Six Reasons the U.S. and Saudi Arabia Are Moving Apart." Washington Post. The Washington Post, 22 Oct. 2013. Web. 10 Nov. 2014.

Gause, F. Gregory. "Be careful what you wish for: The future of US-Saudi relations." World Policy Journal (2002): 37-50.

Hoeven, Sen. John, and The Opinions Expressed in This

Commentary Are Solely Those of Sen. John Hoeven. "Why We Need the Keystone Oil Pipeline." CNN. Cable News Network, 24 Feb. 2012. Web. 10 Nov. 2014.

Hoppner, Stephanie. "Saudi Stance toward ISIS Is Divided" | Middle East | DW.DE | 04.07.2014." DW.DE. Deutsche Welle, 7 Mar. 2014. Web. 13 Nov. 2014.

The Kingdom Built on Oil. Films for the Humanities & Sciences. CNBC, 2005. DVD.

Klare, Michael. Blood and oil: The dangers and consequences of America's growing dependency on imported petroleum. Macmillan, 2007.

Lippman, Thomas W. Inside the mirage: America's fragile partnership with Saudi Arabia. Basic Books, 2008.

Long, David E. "US-Saudi Relations: Evolution, Current Conditions, and Future Prospects." Mediterranean Quarterly 15.3 (2004): 24-37. Personal interview. 11 Nov. 2014.

"Obama Thanks Saudi Arabia for Helping Fight Islamic State." Fox News. FOX News Network, 19 Nov. 2014. Web. 11 Nov. 2014. "Oil Prices Plunge after Opec Meeting." BBC News. BBC, 27 Nov.

2014. Web. 27 Nov. 2014.

Painter, David S. "Oil and the American century." Journal of American History 99.1 (2012): 24-39.

Parker, Ashley, and Coral Davenport. "Senate Defeats Bill on Keystone XL Pipeline in Narrow Vote." The New York Times. The New York Times, 18 Nov. 2014. Web. 10 Nov. 2014.

Prados, Alfred B., and Christopher M. Blanchard. "Saudi Arabia: current issues and US relations." LIBRARY OF CONGRESS WASHINGTON DC CONGRESSIONAL RESEARCH SERVICE, 2007.

Quandt, William B. Saudi Arabia in the 1980s: foreign policy, security, and oil. Brookings Institution Press, 1981.

"Saudi Arabia." Forbes. Forbes Magazine, Dec. 2014. Web. 20 Feb. 2015.

"Saudi Arabia - Relations with the United States." Country Studies. U.S. Library of Congress, 2014. Web. 11 Nov. 2014.

Simmons, Matthew R. Twilight in the desert: The coming Saudi oil shock and the world economy. John Wiley & Sons, 2006.

"Texas Almanac - The Source For All Things Texan Since 1857." Oil and Texas: A Cultural History. Texas State Historical Association, n.d. Web. 12 Nov. 2014.

"Trade." About Saudi Arabia. Royal Embassy of Saudi Arabia, 2013. Web. 14 Nov. 2014.

"U.S. Energy Information Administration - EIA - Independent Statistics and Analysis." How Much Petroleum Does the United States Import and from Where? U.S. Energy Information Administration, n.d. Web. 14 Nov. 2014.

"U.S. Energy Information Administration - EIA - Independent Statistics and Analysis." Saudi Arabia. 10 Sept. 2014. Web. 23 Mar. 2015.

Vitalis, Robert. America's kingdom: mythmaking on the Saudi oil frontier. Stanford University Press, 2007.

Wehrey, Frederic, et al. Saudi-Iranian Relations Since the Fall of Saddam: Rivalry, Cooperation, and Implications for US Policy. Rand Corporation, 2009.

Zhdannikov, Dmitry. "REFILE-Saudi Oil Policy Uncertainty Unleashes the Conspiracy Theorists." Reuters. Thomson Reuters, 18 Nov. 2014. Web. 20 Nov. 2014.

Julia Mueller '16 is a proud member of Omicron Delta Kappa, Kappa Delta, and Phi Alpha Delta's Society of Scholars among other honor societies.

Dengue Fever Syndrome in Bangladesh: A Look at the Impact of Climate Change and Recommendations for Improved Interventions

Written by: Chloe Donohoe

Dengue Fever Syndrome has had immense impacts on the people of Bangladesh, threatening the health of the nation as well as economic stability. This global health problem has been exacerbated by the consequences of climate change, specifically complicating vector control because of the nature of dengue fever as a vector disease. This report will outline the background of Dengue fever and the impacts of climate change on the increasing prevalence of Dengue fever. This report also analyzes the current interventions as well as offers suggestions for prevention approaches.

Dengue fever (DF) is a disease that is characterized by high fever, severe headache and pain behind the eyes (Mahmood & Mahmood, 2011). The incapacitating symptoms of DF, severe muscle and joint pain, can debilitate a person (Mahmood & Mahmood, 2011). DF can intensify into a life-threatening form known as Dengue Hemorrhagic Fever (DHF), which involves hemorrhagic phenomena and, sometimes, circulatory failure. When circulatory failure occurs, the disease has progressed into Dengue shock syndrome, which can last between 12-24 hours, and then the patient may die (Mahmood & Mahmood, 2011). There are four serotypes of the DF virus, each of which causes identical syndromes in humans (Guzman et al, 2010). When someone becomes infected with one serotype and recovers, they contract a lifelong immunity against reinfection by the same serotype, but if they are infected by another serotype they only have temporary, partial protection and increased risk of a more serious disease resulting in DHF (SDNP Bangladesh, n.d.).

The Aedes aegypti mosquitoes and Aedes albopictus mosquitoes serve as vectors of DF in urban and rural settings, respectively. Mosquitoes acquire the virus during the first 2-7 days, known as the fever period during which the virus is circulating the infected person, and after which a bite will result in an infection because of the virus-ridden salivary proteins of the mosquitoes (Mahmood & Mahmood, 2011,). They breed in clean, stagnant water found in water tanks, discarded tins, flowerpots, or anything that holds water. For this reason, there have been found to be close links between DF and human habitation, especially in areas denoted by monsoon rains (Mahmood & Mahmood, 2011). 975 million of the 2.5 billion people at risk of contracting DF in the world inhabit urban areas in tropical and subtropical countries in Southeast Asia, the Pacific and the Americas (Guzman et al, 2010). In Bangladesh, where heavy monsoon rains occur between May and August, there were 5,500 Bangladeshi citizens who were infected with DF in 2011, 98 of which died from the infection (Ahmed et al, 2007, Mahmood & Mahmood, 2011). Increases in DF infections correspond with these rain periods because the heavy rainfall contributes to bodies of water across the country and when the rain becomes too much, floods occur and water is unequally distributed and stagnate, creating the perfect environment for dengue vector mosquitoes (Raheel et al, 2010). In places where water is poorly drained, such as cities located in valleys, the rate of Dengue vectors is three times as much as a well-drained area (Githeko, 2012).

Dhaka City and other cities throughout Bangladesh have shown high ratings on the Breteau Index (BI), a measure of the number of positive containers per 100 houses inspected, indicating an alarming presence of dengue vector mosquitoes (Ahmed et al, 2007). Climate change is playing into this, exacerbating vector presence, infection, and trans-

missibility. Warmer temperatures around the globe allow mosquito vectors to survive in greater geographic ranges, spreading DF to even more populations in combination with globalizing economies and people (McKibben, 2010). Warmer temperatures also impact the growth of mosquito vectors, preventing the larvae from growing to their full size (Banu et al, 2013). Since adult mosquitoes are smaller, they must feed more in order to develop their eggs, increasing the chances of virus contraction and transmission to humans and offspring. Rising temperatures also reduce the incubation time of the virus within the mosquito vector, meaning that the vectors can infect humans sooner than before (McKibben, 2010). In his study of the influence of climate change factors on DF, Banu predicted that dengue incidence will increase by more than 40 times in Dhaka, Bangladesh's capital, by year 2100 if the temperatures continue to increase steadily (Banu et al, 2013).

Dengue fever presents a significant economic and health toll for Bangladesh, the burden of which is approximately 1,300 disability adjusted life years per million population in Bangladesh. This number is similar to other tropical and childhood disease like tuberculosis in this region (Guzman, 2013). Although there was no specific data for Bangladesh, the cost per dengue case for Southeast Asia is estimated at \$12.39, exceeding the cost per case for malaria treatment (Lam, 2013). A study of similarly afflicted Southeast Asian countries found that dengue fever treatment and vector control was costing their country \$1.8 billion annually, a cost

THE POVERTY-STRICKEN URBAN POPULATIONS ARE THE MOST VULNERABLE POPULATION FOR CONTRACTING DF

that inhibits the ability for countries like Bangladesh to fix the structural issues causing dengue incidences (McKibben, 2010).

Many changing structural factors also predispose Bangladesh, along with many other Southeast Asian countries, to dengue transmission, specifically its large population, rapid urbanization, and developmental projects (Mahmood & Mahmood, 2011). An increasing number of people moving to urban areas serve to distribute the four different dengue viruses and their vectors, putting a greater number of people in contact and at risk of infection (SDNP Bangla-



Photo by Muhammed Muheisen/AP

desh, n.d.). The poverty-stricken urban populations are the most vulnerable population for contracting DF because of the urban conditions to which they have less flexibility and resources to cope with, the lack of sewage disposal, vectorprone water collection methods and poor nutritional and health status (Banu et al, 2013, Mahmood & Mahmood, 2011). DF incidence tends to be conditioned by age and immunological response, making children under fifteen and individuals with asthma, diabetes, and other chronic diseases the most susceptible (Mahmood & Mahmood, 2011, Guzman et al, 2010). DF infection has shown to be negatively correlated with under nutrition, an immunological and developmental deficiency that affects 38.6% of Bangladeshi children under age 5 (Mahmood & Mahmood, 2011, CIA, 2014). When one's health is compromised and their body is undernourished and less able to fight viruses, DF has more ability to affect the impoverished urban populations whom have fewer resources to deal with disease if they are infected. Water collection in urban areas also contributes to DF transmission because water is primarily collected using rooftop, exposed water collection containers (Mahmood & Mahmood, 2011). This provides ideal breeding areas for mosquito vectors directly from the water consumed and used by families (SDNP Bangladesh, n.d.). A survey of Dhaka City found that these rooftop concrete water col-

lection containers commonly found in urban independent households were most likely to have high densities of *Aedes* mosquitoes carrying the Dengue virus (Mahmood & Mahmood, 2011). The impoverished urban population are least likely to be able to afford purchasing fresh water as opposed to collecting rain water and therefore are put at more of a risk of being infected and least likely to be able to afford to be sick with the feverous symptoms that are debilitating and prevent infected individuals from working.

Dengue fever prevalence needs to be addressed through the advancement of vector control strategies already put in place and the further development of a vaccine to prevent dengue fever for mass populations. The current primary interventions in urban regions to combat DF focus on vector control by targeting the *Aedes* mosquitoes. This is typically done through the application of larvicides and adulticide space sprays on water collection containers, or chemical controls are added to water for domestic use (Guzman et al, 2010). These larvicidal agents, such as organphosphate temephos, have low biological toxicity and are largely used by households (Mahmood & Mahmood, 2011). However, there is increasing resistance to their use from households due to fears of contamination. For this reason, it is difficult to achieve high and regular larvicidal coverage of water collection containers that are prone to dengue vectors (Guzman et al, 2010). Another primary intervention is the use of covers for water collection containers, an intervention which is limited by its reach to different socio-economic levels (Raheel et al, 2010). Another primary intervention is the targeting of container sanitation habits, campaigns about which have been started in order to promote cleanup of water storage containers (Guzman et al, 2010). The current secondary interventions are the use of mosquito nets in areas with high vector density as well as surveillance testing using the MAC Elisa and HIT tests (Raheel et al, 2010, Mahmood & Mahmood, 2011). These tests are used to detect dengue antibodies in a sample of blood. Although

FOR THE TERTIARY INTERVENTIONS, DENGUE FEVER HAS NO DRUG TREATMENTS AVAILABLE.

the HIT test is considered the "gold standard" test, it has a more expensive and involved process and so the MAC Elisa test tends to have better results and coverage because it is sensitive and easy to perform (Mahmood & Mahmood, 2011). For the tertiary interventions, DF has no drug treatments available. Therefore, DF is managed through monitoring of warning signs and initiation of intravenous rehydration therapy. If the patient progresses into a more serious condition, then fluid replacement crystalloids are given (Guzman et al, 2010). The WHO guidelines suggest that patients undergoing treatment are assessed hourly to see if fluid change or blood transfusions are necessary (Mahmood & Mahmood, 2011). However, it is important to note that the populations in the urban areas are very large and there are only 0.6 beds per every 1,000 population. For this reason, the urban impoverished populations are less likely to be seen in a timely and comprehensive manner considering the people primarily pay for the majority of their health care costs. This makes those who do not have enough money to pay for hospital fees more susceptible to fatal outcomes (CIA, 2011).

The vector control interventions need to be improved to become more efficient and effective. To do so, infrastructure projects need to be planned and overseen by the Ministers of Public Health and municipal health departments for Bangladeshi regions in order to make sure that the economic and public health burdens of disease linked to water distribution are being acknowledged and solutions being created (Guzman et al, 2010). Doing so allows for a more horizontal approach to vector control by gaining multiple perspectives about the impacts that each infrastructure project will have. In order to make the most progress, interventions need to be community based by aiming for behavior change as a means of vector control. To do so, communication is needed about the threat and prevention of DF, preferably at the local level through locally trusted doctors and public health organization. Approaching prevention at the local level will hopefully increase perceptibility and adherence, allowing for widespread acceptance and change of behavior. Another recommendation is the alteration of consumer products that are already being purchased so that they can target vector larvae, specifically through sprayed container covers with control-released larvicides (Guzman et al, 2010). This will allow consumers to purchase products together rather than separately and hopefully will allow for more coverage of the populations at risk of dengue infection. In order to bring down the price so that impoverished urban populations would have access to these products, there should be

initiatives to use recycled materials and all natural, localized larvicides so that less needs to be manufactured and import from other places. Another recommendation is the push for sewage disposal systems throughout urban areas. The government could hopefully fund this project using money profiting from oil reserves that are currently being utilized. These sewage disposal systems will address many health issues along with aiding in vector control as well as serve as a buffer for monsoon seasons so that sewage can be properly allocated and not impact households further during heavy storms and flooding. Finally, vaccine development needs to become as priority in the research sector globally. Vaccine development has been difficult to advance because there are four virus strands, each of which needs to be addressed in the vaccine because protection against only one could increase the risk of a more serious disease if another serotype is contracted. However, considering the global reach of DF and the threat it poses for two-fifths of the world's population, this vaccine should be looked a by multiple research and vaccine organization as a means of advancing our intervention strategies and preventing the spread of DF globally (Mahmood & Mahmood, 2011).

Chloe Donohoe '17 is an Environmental Studies and Public Health major from Warminster, PA. She is an Elon College Fellow who will be completing an undergraduate research project on community gardens in North Carolina. She was in intern in the Office of Sustainability for 2014-2015 and will be an Eco Rep in 2015-2016.

References

Ahmed, T.U., Rahman, G.M., Bashar, K., Shamsuzzaman, M., Samajpati, S., Sultana, S., et al. (2007). Seasonal Prevalence of Dengue Vector Mosquitoes in Dhaka City, Bangladesh. Bangladesh Journal of Zoology, 35:205–12.

Banu, Shahera, Hu, Wenbiao, Guo, Yuming, Hurst, Cameron and Shilu Tong. (2014). Projecting The Impact Of Climate Change On Dengue Transmission In Dhaka, Bangladesh. Environment International. 63: 137-142.

CIA. (2014). The World Factbook: Bangladesh. Retrieved October 8, 2014 from: https://www.cia.gov/library/publications/theworld-factbook/geos/bg.html

Githeko, A.K. (2012). Advances In Developing A Climate Based Dengue Outbreak Models In Dhaka, Bangladesh: Challenges & Opportunities. Indian J Med Res, 136: 7–9.

Guha-Sapir, D. & Schimmer, B. (2005). Dengue Fever: New Paradigms for a Changing Epidemiology. Emerging Themes Epidemiology, 2(1): 1-10.

Guzman, M.G., S.B. Halstead, H. Artsob, P. Buchy, J. Farrar, D.J. Gubler, E. Hunsperger, A. Kroeger, H.S. Margolis, E. Martínez, et al. (2010). Dengue: A Continuing Global Threat. National Review of Microbiology, 8 (12): S7–S16.

Lam, S. K. (2013).Challenges in Reducing Dengue Burden. Expert Rev Vaccines, 12(9): 995- 1010.

Mahmood, B. A. I. & Mahmood, S. A. I. (2011). Emergence Of Dengue In Bangladesh: A Major International Public Health Concern In Recent Years. Journal of Environmental Research and Management, 2(3): 035-041.

McKibben, Bill. (2010). Eaarth: Making a Life on a Tough New Planet. New York, NY: St. Martin's Press.

Raheel, U., Faheem, M., Riaz, M., Kanwal, N., Javed, F., Zaidi, N., & Qadri, I. (2010). Dengue fever in the Indian subcontinent: an overview. The Journal Of Infection In Developing Countries, 5(04), 239-247.

SDNP Bangladesh. (n.d.). Dengue the Deadly Killer. Sustainable Development Networking Programme. Retrieved from http:// www.sdnbd.org/sdi/issues/health/dengue/FAQ/index.htm



Photo courtesy of WaterAid/GMB Akash/Panos

The Effect of Environmental Destruction on Vulnerable Populations

Written by: Mary Alice Allnutt and Sarah Clark

The comprehension gap between scientific specialists and the general population means that people do not see through complicated scientific research to its true impact on human lives. Lawmakers with no specialization in environmental science are allowed to make legislation that does not address the problems demonstrated by extensive scientific research. In the few instances where dramatic changes have garnered media attention, governments and organizations have taken action to regulate industrial contribution to these problems. A wide variety of ecosystems have been dramatically altered due to human activity, and while some problems have been addressed effectively, there are others where industry may have still more damaging effects.

The exploitation of resources can take many forms, but it usually follows a general pattern. A large business or corporation will travel to find resources, and begin to operate from that location. From there, the new industry could boost the local economy by providing jobs or prevent the local populace from doing the jobs that they have always done. The industry's operation can either be sustainable in the long term or it can dramatically alter the ecosystem. When the arrival of a new industry takes away the local populace's traditional way of life and/or dramatically alters the ecosystem, the exploitation of resources has lead to an exploitation or mistreatment of people. The activities of many different industries have created this state of exploitation. Businesses and governments often profit substantially through the exploitation of natural resources, but the methods used are not sustainable. The groups most vulnerable to this ecosystem damage are native peoples, such as the Māori in New Zealand, and the Alaskan Inuit. The plight of these two native populations can be used to demonstrate the abilities of business to appropriate local resources and the lack of protection provided by law makers.

The exploitation of the oceans around New Zealand has destroyed a traditional way of life, making not only its cultural practices but its main occupation virtually impossible to maintain.¹ Overfishing has greatly damaged the marine ecosystem, and by extent, the culture of the Māori, New Zealand's indigenous peoples. Seafood is by tradition their largest source of food, and one fish in particular is central to their cultural identity. The depletion of the pāua



Photo courtesy of wikipedia.org



Photo courtesy of wikipedia.org

fish population detracts from the Māori's ability to continue their traditions. Yet as companies have overfished the waters around New Zealand, the changing ecosystem has made the indigenous people's connection to their environment weak. The traditional ecological knowledge of the people no longer applies to their new environment, and as a result their cultural traditions are vanishing. Not only is the culture of the Māori people being extinguished, but the change in their diets- from seafood caught themselves to store-bought goodshas caused health issues.¹ In the case of the Māori, commercial overfishing means that fishing is no longer a viable lifestyle, as there is restricted access to valuable commercial species to those without the expensive equipment that has become necessary.¹

Certain industrial processes can result in contamination in ecosystems worldwide. Waste burning and pesticide use has resulted in widespread contamination of ocean habitats, in the form of Persistent Organic Pollutants, or POPs. These POPs become concentrated in the fatty tissues of organisms that consume them and are easily transferred up the food chain. POPs accumulate in the Arctic because the climate results in slow decomposition, evaporation, and metabolism, meaning that they are not recycled quickly through the environment. Instead, POPs in the Arctic concentrate in marine

species. One particular type of POP, Polychlorinated biphenyls (PCBs), is particularly harmful. It can act as an endocrine disruptor, disrupting normal hormonal activity and causing reproductive issues, immune system problems, stomach problems, and various other physical problems. Even more seriously, POPs are easily transferred through breast milk, thus the children of women exposed to PCB showed slowed physical and intellectual development.² The marine ecosystem in the Arctic has been inundated with these contaminants, and because of the dependence of the indigenous people on the ecosystem for food, Inuit mothers' breast milk can be harmful to their children.^{2,3} "Although forbidden from using them on American soil, U.S. companies are allowed to manufacture more than 4 million tons of chlordane and other pesticides. The majority go to developing countries."² This is an excellent example of industrial products having negative effects concentrated on a certain environment, resulting in severe damage to a particular group of people. In this case, the health risks posed by POPs concentrated in the Arctic, posing a major threat to the health of the Inuit peoples, who rely heavily on marine wildlife for food. However, POPs in the Arctic also prompted one of the most cohesive and organized international responses to any environmental problem.

In order to rectify the dangerous situation in the Arctic, the Stockholm Convention was created, which first met in 2001 to coordinate the UN response to Persistent Organic Pollutants and their effect on human health. The Convention agreed that the parties involved would eliminate or restrict "the production and use of the intentionally produced POPs, [prohibit] and [eliminate] production and use or import of POPs, [conduct] research, [identify] areas contaminated with POPs, and [provide] financial support and incentives for the Convention."⁴ 179 countries have agreed to the terms of the Convention to some degree, and 152 countries have ratified it. The terms of the Convention regulate the monitoring, intentional or unintentional production, trade, and definition of POPs.

The Convention has several responsibilities that, when combined, are a well organized and effective response to the dangers presented. The Convention meets to deliberate adding new chemicals to the list of regulated POPs and to monitor the progress of the participating countries. So far

the levels of harmful POPs in the environment have not been dramatically decreased. However, the Stockholm Convention has been largely successful in preventing further contamination, and its goal is to discover methods of biodegradation that will re-

move the harmful chemicals without causing any additional damage. In the meantime, the Convention runs workshops in developing countries to encourage the use of alternatives to harmful chemical products. An example workshop from June 2010 was held in Kenya, and its goal was to help strengthen the country's capacity to integrate different sectors in order to reduce the cost of DDT alternatives.⁵

The cooperation of a large number of countries with these environmental regulations of hazardous chemicals demonstrates the factors necessary to organize a global effort towards reducing the harmful output of human industry. First, there must be definitive and extensive proof of damage. The presence of POPs concentrated in Alaskan Inuits, and the studies that illustrated the negative health effects of these chemicals, forced governments to take action. Next, there must be a singular group that oversees and organizes the cooperative efforts of many countries. The UNEP's Conventions allows for people with different political, economic, and environmental specialities to work together to create an effective plan that can be presented worldwide and implemented. Lastly, there must be efforts toward mediating the cost of implementation. The 2010 workshop in Kenya aimed to help the government coordinate efforts in different sectors of the country's industries to reduce the cost of DDT alternatives.⁵ If many countries can be convinced that an industry's actions or a product's usage is harmful to people, they can organize themselves and appoint a committee to oversee their efforts. That committee, composed of a variety of people with different specialties, can give the participating countries a method of implementing changes without crippling costs. The Stockholm Convention is an excellent example of this method and its success.

While actions have already been taken by governments to control the emission of POPs, there has been another issue facing the Arctic recently which has governments aligned on the side of industry. As global temperature has increased over the past 60 years, the change has been most dramatic in

SO FAR THE LEVELS OF HARMFUL POPS IN THE ENVIRONMENT HAVE NOT BEEN DRAMATICALLY DECREASED. the Arctic. Whereas Antarctica is a land mass covered by glaciers, the Arctic is largely just ocean covered in ice. The steady decline of ice caps in the Arctic has had both positive and negative effects on its native people. While the melting ice has disrupted the

marine ecosystem, hurting indigenous hunters, it has also made for increased access to oil, gas, and minerals.3 Warmer weather plus the acquisition of valuable natural resources has made agriculture more prominent than traditional hunting. However, many Inuit fear that the Arctic's resources will not be used in a sustainable manner, and this race for the Arctic's resources could damage the region's economic potential irreparably.³ The shrinking ice caps allow for more shipping to pass through, and as warmer-water fish species move North, commercial fishing is likely to expand northward as well. The problem with this changing climate is that there is not, as yet, an international agreement in place over how to use resources, address environmental concerns, and uphold the rights of the Inuit peoples. Additionally, governments are reluctant to create such an agreement, because it would limit profits to those countries with land in the Arctic region. As global warming opens the Arctic up for drilling and exploitation, a whole host of potential harmful effects crop up for not



Photo courtesy of staticflickr.com

only the environment but the indigenous population.

The case of the "Race for the Arctic" shows the variety of perspectives regarding the management of natural resources, and the role that indigenous populations play in these decisions. A major debate in this case involves the risk of oil spills. Many environmental organizations, including Oceana, the World Wildlife Fund, and the European Environmental Agency³, describe the risks of drilling for oil in an environment with significant ice coverage. The more ice coverage, the more difficult it becomes to clean up oil spills, posing a serious threat to the ecosystem.³ Environmental conditions in the Arctic, not only the ice coverage but the lack of daylight in winter and the extreme cold, would make drilling for oil very risky, not only for the environment but for those operating the facility.³ In order to determine if the exploitation of Arctic resources "should" occur, the factors to be considered are: How many jobs will be created for the local populace? Is there high risk of environmental destruction and is there a way to prevent this while still making a profit? In other words, do the benefits outweigh the risks, and are the benefits and risks evenly distributed between the local populace and businesses? From the perspective of the various governments with territory in the Arctic, the economic benefits appear to outweigh both the environmental risks and the risk to the indigenous population. According to the Routledge Handbook of Environmental Law, the current legislation regarding the management of Arctic resources, the United Nations Convention on the Law of the Sea (1994), does not even address the rights of the Inuit peoples.⁹ Additionally, the indigenous communities in the Arctic largely do not have jurisdiction over land or resources,⁹ and are thus in a position to be exploited by corporations and their respective governments.

Opinion on resources in the Arctic is split between those that want legislation to change and those who are happy with the regulations currently in place. On the one hand, there are those that say that the existing regulations are enough to ensure responsible, effective, and profitable operations. Governments are universally enthusiastic about the economic gain that is possible from exploitation of the Arctic's resources, and they cite previous legal regulations to support the position that there is no need to treat the Arctic's steadily more accessible resources any differently.⁶ While governments and businesses which stand to profit are squarely on this side, there are many others who support the idea of a new industry bringing economic gain to Arctic communities. On the other side, there are many who fear that oil drilling is too risky in the Arctic without making adjustments to the legislation to provide for it.³ Additionally, they fear that the encroaching industry will not only damage the environment, but cause exploitation and economic harm to the local populations.

The Stockholm Convention's success in the matter of Persistent Organic Pollutants demonstrates that, when there is sufficient evidence of severe health threats to a large enough population, governments will take action. However, in the cases of overfishing off the coast on New Zealand and oil drilling in the Arctic, the potential for profits appears to have outweighed the risks to both indigenous populations and the environment, at least as far as the law is concerned. It is vital, then, that actions are taken at the individual, community, and national level to address this issue.

No single method and no single group of people can solve the problem of environmental exploitation and degradation. The best method going forward will be a combination of the successful elements of past ones. One successful method, the UNEP Conventions, demonstrates that a vital part of successful programs are cooperation between many different groups of people, and in this case, countries. It will take the combined efforts of individuals, organizations, and nations



Photo courtesy of flickr.com

to stop environmental degradation. Actions can be taken at many different levels, from the international/ national level, to business administration, to the individual citizen.

The UN and EU have taken action to stop environmental degradation, but countries need to pass and enforce stricter laws on environmental impacts. Even laws that do get passed have extensive, harmful "riders" on the end that were added as a compromise, which make the legislation so watered down that it has little actual impact. It is up to the leaders of every country to pass laws that actually help the environment, and in return help the people suffering from the destruction of it. Laws that reduce pollution/emission allowances, protect endangered animals from extinction, preserve or restore habitats, or in any way help the environment, help the people as well, and may provide long-term economic benefits which outweigh the initial investment. For example, a study published in Environmental Science & Policy conducted a cost analysis on the implementation of EU environmental policies, and found not only a decrease in harmful emissions, but that the cost of implementation was overtaken by savings in fuel consumption.¹³ If the government could use data from studies such as this, perhaps the idea of financial savings for the public can outweigh the losses of big business, and help to overpower these industries in the legislation.

While companies can lessen their environmental impact, they tend not to because industry has the most to gain from the destruction of the environment. If these companies had an incentive, they would be able to enact enormous change. That is why emissions trading systems work so well; companies can make money by reducing the amount of emissions they produce, so they make a gain and help the environment. Outside of the ETS, companies can take responsibility for their actions and be more considerate of both the environment and the native people. Industries in the past have pushed natives out and claimed their land because of the value of the resources. If, instead, the industries could work with the indigenous people to find out more about the land and the nature, then they would be less likely to unknowingly destroy it, making the area more profitable in the long term for the company. This would have made a difference in the case of the Maori. Had the industrial fishing companies in New Zealand attempted to adopt a sustainable method that did not damage the existing ecosystem, the industry would have a more stable long-term source of fish, and the Māori would not have lost so many of their traditions.

Citizens are responsible for taking the initiative in reducing environmental destruction by being knowledgeable about the subject. Taking the initiative means that citizens have a responsibility to be informed about what is going in the world around them. The first and most important action to take is to educate oneself. Each individual is capable of finding information about the current state of the environment, educating others, and influencing government policy. The average person knows very little about what is going on in our world environmentally. There are plenty of resources available, however, including many of the sources that have been cited in this very paper. One educated individual can have a huge positive impact on society. Students could start an organization that aims to educate that school's population, not only on recycling and personal waste management, but on current environmental legislation. During election years, a few small organizations could educate the populace on the candidates' respective positions on environmental law. If enough people were educated about environmental issues and the urgent need to address them, perhaps James "Jim" Inhofe would not be primed to set environmental legislation back 10 years. Once people are educated and have their feet on the first rung of the ladder, the rest is easy. People who have an above average understanding of what is going on will be more inclined to act. This means recycling more, wasting less, composting, cutting down on electricity, cutting down on car use, carpooling, and buying local products in food. People who are more educated on these topics are more likely to be more to be more conscious of the consequences of their actions.

People can have a positive effect on the environment in their everyday life by being an environmentally conscious buyer. People who are more environmentally conscious are less likely to buy goods that come from far away or require the destruction of the environment to obtain or produce. Support for environmentally friendly products would force corporations to change their practices to less environmentally destructive in order to please the conscientious consumer. Those people who are moved by what they learn may also be inclined to elect leaders who will pass laws to protect the global environment. Some may even become environmental activists and demand that change be made. The impact that an educated consumer can have is astounding. Once citizens are educated, they will be more environmentally conscious, and they can put pressure on governments and companies to help the environment as well. Once the environmental destruction has been slowed or stopped, the ruin of indigenous cultures can be dealt with, having cut off the problem at the source. After the destruction has stopped, restoration can begin. Though many people believe that they can do nothing to help the situation, they can do everything. Revolutions of any kind, political, industrial, scientific, and now the green revolution, all start small. Once enough citizens are educated about these topics, the little changes they make in their own daily lives will be enough to help turn things around, for both us and our world.

Individuals can educate themselves, then use that knowledge to create change in the community around them. Organizations such as the EPA are easily accessible, informative resources. Get involved in environmental organizations such as Elon's Sierra Club or the Office of Sustainability, at a collegiate or national level. Volunteer with these groups, donate money, promote them. Organizations already exist that are trying to influence national environmental policy, and make industrial practices safer and more sustainablebenefitting everyone over the long term. All that the individual need do is get involved, get information, and spread the knowledge. The more people that are informed and actively involved in environmental activism, the more power these groups will have to resist the financial might of industry in government.

Mary Alice Allnutt is a first-year student from Glenwood, MD majoring in Biochemistry.

Sarah Clark is also a first-year student, and is majoring in Environmental Studies.

References

1. Mccarthy, A., Hepburn, C., Scott, N., Schweikert, K., Turner, R. and Moller, H. (2014), Local people see and care most? Severe depletion of inshore fisheries and its consequences for Māori communities in New Zealand. Aquatic Conserv: Mar. Freshw. Ecosyst., 24: 369–390. doi: 10.1002/aqc.2378

2. Abramovitz, J. N., Brown, L. R., Bright, C., Dunn, S., Flavin, C., French, H., . . . Renner, M. (2000). A Worldwatch Institute Report on Progress Toward a Sustainable Society. In L. Starke (Ed.), State of the World. New York, London: W.W. Norton & Company. Woodard, C. (2007, October 1). Oceans in crisis. CQ Global Researcher, 1, 237-264. Retrieved from http://library.cqpress.com/globalresearcher/

3. Persistent Organic Pollutants: A Global Issue, A Global Response. (2002). Retrieved from United States Environmental Protection Agency website: http://www2.epa.gov/international-cooperation/ persistent-organic-pollutants-global-issue-global-response#stockholm Stockholm Convention. (2008). Retrieved from UNEP website: http://chm.pops.int/Home/tabid/2121/mctl/ ViewDetails/EventModID/1007/EventID/528/xmid/6921/Default.aspx

4. Beary, B. (2008, August 1). Race for the Arctic. CQ Global Researcher, 2, 213-242. Retrieved from http://library.cqpress.com/globalresearcher/

5. Martínez-Estévez, L., Balvanera, P., Pacheco, J., & Ceballos, G. (2013). Prairie Dog Decline Reduces the Supply of Ecosystem Services and Leads to Desertification of Semiarid Grasslands. PLOS One. http://dx.doi.org/10.1371/journal.pone.0075229

6. "The EU Emissions Trading System." (2014, October 28). Retrieved from European Commission website: http://ec.europa.eu/ clima/policies/ets/index_en.htm

7. Alam, S., Bhuiyan, J. H., Chowdhury, T. M.R., & Techera, E. J. (2012). Routledge Handbook of International Environmental Law. Routledge.

8. Polar Bear. (n.d.). Retrieved from National Wildlife Federation website: http://www.nwf.org/wildlife/wildlife-library/mammals/polar-bear.aspx

9. Goldenberg, S. (2014, November 6). Climate change denier Jim Inholfe in line for Senate's top environmental job. The Guardian.

10. Goldenberg, S. (2010, March 1). US Senate's top climate skeptic accused of waging 'McCarthyite witch-hunt'. The Guardian.

11. Chiesa M, Perrone M, Ballarin Denti A, et al. An environmental, economical and socio-political analysis of a variety of urban air-pollution reduction policies for primary PM10 and NOx: The case study of the Province of Milan (Northern Italy). Environmental Science & Policy [serial online]. December 2014;44:39-50. Available from: GreenFILE, Ipswich, MA. Accessed October 26, 2014.

QUICK READS

Magic America: Coming of Age in an Altered State

Written by: C.E. Medford Reviewed by: Jaclyn Pisarski

Some of today's most talked about issues involve the environment and how to preserve it for future generations, from technology to advocating for the little things. Companies today pride themselves on using "green technology," and they advertise it everywhere, hoping to attract the people in society who are environmentally conscious. Even for those people not actively taking a major role in promoting environmental wellness, it would be incredibly difficult to find someone who does not at least recycle. With society's relatively newfound awareness of the destruction caused to the environment since industrialization and constant improvements on science and technology, degradation is not as severe or commonplace today as it had been in the past. C.E. Medford's Magic America: Coming of Age in an Altered State illustrates perfectly how severe these past transgressions were.

Magic America was published on July 1, 2014 by CreateSpace Independent Publishing Platform. The intended audience for this book was young adults, especially those with an interest in the environment or in underdog stories. It has been classified as a Magical Realist Novel. Medford loves to write magical realism and the likes. For her, in a story there must be "breathless moments; colour and fire." Her goal in writing these stories is to provide a separate world the reader can step into and experience, and not simply read about.

The book is set in the 1980s in Trenton, New Jersey. When reading the jacket for this book, one may be tempted to believe that it is a fantastical story. This is due to the jacket's advertisement of the book with phrases such as "radioactive cats, congenital tattoos, biker angels, [and] cocky fairy godmothers." While there are plenty of moments of innocence and child-like fascination and curiosity, heavier subjects are breached. The story is told through the eyes of Hope, a young girl growing up near Trenton, whose life is thrown upside down by many troubles. Almost always, these accounts, such as domestic abuse, sexual assault, public ridicule, corporate greed, and poor living conditions are connected directly back to the resident destructive corporation, LoboChem.

LoboChem is portrayed as ignorant to the destruction

their factory causes to the environment and the deteriorating health of workers in their factories. Hope's home for a good portion of her childhood is right down the road from LoboChem's factory. Her father works there, and her mother stays home with her. The local park where Hope goes to

play is home to a canal that leads to from LoboChem's dump yard to the Delaware River. Drainage pipes with innumerable biohazard bins leaking toxic chemicals take up the entire dump yard, and the chemicals constantly seep into the water. Living in and around the canal are five-legged frogs, bloated catfish "shrimpy leg rats," "no eye ducks," "turtles with orange patches on they shells," and blue trees. Hope experiences migraines due to her extensive time spent near the canal. During a time when her migraine pain is not as excruciating and she is lucid, Hope thinks about all of these unusual phenomena along with the purple smoke coming from the factory. She concludes that none of this is natural.

Apart from the obvious physical abnormalities in wildlife, the company's workers are suffering from unusual health related illnesses as well. Hope refers to the factory workers as "werewolves." Their hands and feet are abnormally large; they have unruly hair and beards; they are loud, obnoxious, angry,

vicious, and violent; and some even have fluorescent green eyes. Unsurprisingly, Hope's father began to display some of these traits, but according to Hope's mother, he was not



QUICK READS

always like this. "Once he was charming. He was fun. He was handsome"..."Then he started working in a chemical factory"..."And then he disappeared." When Hope hit high school, she started babysitting. Once, a so-called "werewolf" tried to break into the motel in which the kids that she was looking after lived. Hope and the kids felt cornered and terrified. He was relentless, and it was evident that he was intent on doing serious harm to someone. Clearly this factory and the chemicals being manufactured within are messing with the psychology and physiology of previously healthy people.

While Medford does a great job of detailing how detrimental these chemicals are to the environment and the life nearby, she certainly takes a few liberties and almost goes overboard for the sake of fiction. Of course some things are much more likely than others, like the deformed frogs, the



dead wildlife, the cancers, and the change in water quality. However other effects seem to be a stretch, like the fluorescent green eyes, the enormous housecats, the neon purple smoke, and the congenital tattoos. The book requires a little suspension of disbelief in order to fully enjoy it and extract the message regarding the negative impact of corporate greed on the ecosystem.

A group of unlikely heroes emerges early on: the local biker gang led by a man nicknamed Rooster. He used to own the business that was once on the land now owned by LoboChem. His business was all about moving forward while preserving the environment, and manufacturing "good products for a good price and without cheating his employees." So when LoboChem forced them off the land and proceeded to dump chemicals, Rooster and his fellow bikers banded together to get rid of the company. These guys were not always the most peaceful of protestors since many had been

personally victimized by LoboChem in the past. As soon as Hope was old enough to understand what was going on, she joined a few protests, much to her mother's disappointment. The 1980s was a time when businesses were more concerned with making money than how their actions could affect the surrounding areas. Unbeknownst to the public, companies often cut corners during the production of goods for the sake of turning a profit. Through the eyes of Hope, C.E. Medford depicts many health and environmental issues due to this corporate mindset.

Throughout the book, Hope learns more and more about what LoboChem has been doing, the effects it has, and the resulting corruption: the cover-ups, the lies to the public, and the blackmail. Eventually she asks the one question that always comes up in situations like this: "Everyone knows LoboChem is poisoning us. Why won't anyone listen?" That is a common question that people never talk about when it concerns the environment. This is because the answer to the lack of change usually has something to do with not wanting to lose money or power. In most situations the companies have both, while most of the people directly affected have neither. This is another point addressed in the book. Most of the people that Hope deals with, whether they are family, friends, or one of the heroic bikers, have barely enough money to scrape by. So when LoboChem comes looking for employees, they tempt all of the lower class individuals with a decent paycheck, and the offer is difficult to turn down. For LoboChem, nothing is more important than making money. They lie about business practices, trying to seem reasonably safe on paper, but what happens behind closed doors is different. They disregard policy, the health of their workers, and the health of the environment for no other reason than to make a profit.

Like many good stories, Magic America praises the underdog fighting for what is right. The reader is taken on a journey from Hope's childhood into college, and the characters she meets along the way give life and excitement to a story that could easily have been a bland narrative about a dangerous company. LoboChem is not willing to give up their money to ensure safety, and many companies that also have such a negative impact are unwilling to give up the money either. Ultimately what Magic America is trying to illustrate is that corporate greed has become a danger to the environment, and when not closely monitored and controlled, can lead to mutations as crazy blue trees and five-legged frogs.

Jaclyn Pisarski '18, from Frederick, MD, is a Biology major with aspirations to become a veterinarian. Some of her hobbies include reading, country music, hiking, and playing sports, especially soccer.

Preferential Food Selection in Elon's Squirrels

Written by Sarah Vaughan

Introduction

Squirrels have been shown to preferentially select "higher quality" acorns, nuts, and seeds over those that are not as beneficial in their ability to provide energy. Their selection is based off of several influential factors including seed size, lipid and tannin content, and acorn perishability (Smith and Follmer 1972; Lewis 1980; Wang et al. 2012; Smallwood and Peters 1986). While some argue that certain factors are more important than others, it becomes evident that there is not one single factor that has the most influence over squirrel food preference because different environments and habitats cause certain factors to override others. Choosing certain nuts and acorns has important implications for caching behavior because squirrels need to be able to have access to valuable food resources to get the necessary energy intake each day, especially in periods of low food supply (MacArthur and Pianka 1966).

A mixture of factors influences squirrel foraging and caching behavior. These factors, though seemingly subtle, affect the decisions that squirrels make when they forage and cache different types of acorns or other nuts. In general, squirrels have been known to prefer foods that are easily accessible and those that provide the highest amount of energy for the squirrel's body to absorb (Smith and Follmer 1972; Lewis 1980). The Optimal Foraging Theory explains this idea; it states that animals (such as squirrels) specifically forage for their food in order to get the maximum amount of energy intake (Lewis 1980). While it is most beneficial for squirrels to eat energyrich foods, environmental circumstances may prevent them from consuming those foods. According to MacArthur and Pianka (1966), some food (which may have a lower energy output) is easier to find than other foods that may have a higher energy output. This would cause animals to eat and store higher quantities of the accessible food instead of expending their own energy to search for the most effective food sources (MacArthur and Pianka 1966).

According to Wang et al. (2012), squirrels forage and cache their food in order to maintain a constant food source throughout the year. They point out the fact that many factors including seed size and mass, nutrient content, and tannin content (tannins are water-soluble compounds that bind to proteins, prevent a squirrel from absorbing proteins, and affect a squirrel's ability to digest foods properly) all influence a squirrel's foraging and caching behavior, but they note that

1. Squirrels either disregard or handle seeds/acorns when they find them;

2. Seeds/acorns are either eaten at the site or removed to a farther location;

3. Seeds/acorns are carried away at various distances at the squirrel's discretion;

4. If carried away, squirrels have to decide whether to eat or cache the seed/acorn.

This model helps explain the process through which squirrels go in order to maintain a steady food and nutrient supply throughout the year.

a specific paradigm for the process of selection has not been explored. They described a decision-making model:

Scavenger-hoarders, like squirrels, forage for food as well as cache it in different locations from the site at which they discovered the food. Caching behavior allows squirrels to keep a storage supply of food that is useful when resources may be low, such as in the winter, or when predation or other risk factors are high that may prevent a squirrel from foraging for food. It is important for the squirrels to consider the value of the food that they select to store. If the food does



Photo by Al Drago '15

not have any potential nourishing value in the future, then a squirrel expends energy for no benefit. Thus, it is important for squirrels to have an ability to determine which foods are the best candidates for storage. Several factors, as noted by Wang et al. (2012), influence these decisions, and different combinations of these factors affect what type of food a squirrel may keep in its cache.

Smallwood and Peters (1986) found that squirrels prefer to eat foods with higher lipid content and do not prefer to eat foods with high tannin content (Smallwood and Peters 1986). Several other researchers have found preference toward high-lipid foods (Smith and Follmer 1972; Wang and Chen 2012) due to their high calorie content. Smallwood and Peters (1986) determined that the higher lipid concentration a certain foodstuff has, the longer a squirrel spends eating that foodstuff. While they acknowledge that others (Lewis 1980; Smith and Follmer 1972) argue that squirrels prefer high lipid content to maximize energy intake, Smallwood and Peters argue that squirrels do not aim to maximize their daily energy intake but rather for an entire season, especially the fall/winter season (Smallwood and Peters 1986).

While several researchers have aimed to discover the effects that multiple factors have on squirrel food preference, not many have tried to figure out the direct effect that lipid content alone has on squirrel preference. Lipid content has been measured relative to other factors, but this study will measure nutrient content alone. There is also little to no literature about the effect that sugar content has on squirrel food selection. This study aims to determine whether squirrels prefer high-lipid foods or high-sugar foods. Asking this question is especially important in October and November because food supply is very high in the fall, causing squirrels to want to search for the best quality food to store in the

winter months. By examining these factors individually, the results will show how nutrient content influences a squirrel's selectivity without being mixed with other factors that have the potential to influence a squirrel differently.

Because the high-sugar food is a new, unexplored variable, we were unsure of how the squirrels would respond to this experimental supplement. Based on previous research, we expected to find that squirrels would eat and cache more high-lipid food instead of high-sugar food or unsupplemented corn kernels. Our reasoning behind this hypothesis is that squirrels use high-lipid foods to obtain the most energy possible for long-term use (to continue foraging for more food or to be able to have an energy-rich diet in the winter). We also hypothesized that when given the choice between natural food and supplemented food, squirrels would eat or cache more natural food because acorns are already part of their diet and because acorns are abundant at this time in the year.

It is important to answer these questions about squirrel food preference, especially on a college campus, because supplemental feeding could become an important part of maintaining squirrel populations. If squirrels prefer a certain type of acorn, it may be important to preserve the tree population that produces that nut. To give squirrels the optimal diet, college campuses or national or state parks could set up feeders to entice squirrels to the area. It is also important to keep squirrels healthy, so maintaining a tree population or providing nutritional supplements may help in that regard.

Methods

The methodology for this study has been adapted from several previous researchers (Lewis 1980; Smallwood and Peters 1986; Smith and Follmer 1972; Wang and Chen 2012). We

provided Eastern Gray Squirrels (Sciurus carolinensis) on Elon University's campus with corn kernels supplemented with different nutrients in order to determine if they prefer high-fat foods or high-sugar foods. Squirrels were provided with food in the field because constraints of the study did not allow for squirrels from Elon's campus to be captured and kept in captivity for observation. Previous exposure to types of food and previously established inclination to choose certain foods could not be controlled in this study because we observed squirrels that have been living on Elon's campus and that have been maintaining their own diet without much human intervention. Because they are on a college campus, it is possible that they have been exposed to foods outside of their acorn-rich diet, but these foods were not able to be determined. Therefore, it is possible that squirrels have a predisposition to prefer certain supplemented foods.

To initiate our study, we cut four cardboard pallets on which to place the supplemented corn kernels and natural acorns in the field. Dry corn kernels were purchased online. The study took place behind the Alpha Chi Omega house in the Greek Courts on Elon University's campus because there is low human traffic and a high number of squirrels in this area. Accounting for low human interaction is important because student presence may prevent squirrels from foraging as much as when they are undisturbed.

To prepare the corn kernels, four groups of kernels were separated. One group was left dry, one group was soaked in water, another soaked in liquid sugar, and the last soaked in corn oil. We left the corn kernels to soak for 4 days to allow the corn kernels to absorb the fats and sugars. The water-soaked corn was only soaked a day before each trial because further soaking caused the corn to become moldy and unusable.

A control group of corn kernels (which was dry and unsupplemented) was placed at the observation site two days before the experimental corn kernels were provided to the squirrels. The purpose of the control was to acclimate the squirrels to supplemental feeding and to help them recognize the presence of the corn kernels. This gave the squirrels a chance to find the kernels and eat them before they took part in the study.

After the squirrels had eaten the control corn, the four cardboard pallets were placed under a tree at the observation site. Three separate pallets held the different experimental kernels while the fourth pallet held acorns collected from Academic Village. We recorded an initial mass of each of the different kernels and the acorns. We left the cardboard pallets with the kernels and acorns overnight because squirrel foraging activity is highest in the early morning hours. We returned to the observation site once a day to collect the remaining kernels and measure the mass that had been lost from each pallet. When necessary, we soaked more corn to replace the corn that the squirrels took. The study ran for 12 days.

To ensure that squirrels, instead of nocturnal animals such as mice or possums, were visiting the observation site, we sprinkled flour on the cardboard pallets during the last three days of the study. The days after we sprinkled the flour, we took pictures of footprints that we saw on the pallets and compared them to images of squirrel, mouse, rat, and possum footprints found online to determine which animal(s) was/were visiting the observation site.

After the data was collected, we calculated the average mass lost during each day of the study. We found the standard error of the mass differences of each type of corn kernel and the acorns. We graphed these differences in a bar graph showing the standard error bars. We also ran an ANOVA test, using a 95% confidence interval, to calculate p-values and to determine the difference in the mean kernel mass lost between the different types of kernels. This data showed us which feeder was most popular among the squirrels. The independent variable in this study was the type of food (supplemented corn kernels or natural acorns) provided and the dependent variable was the amount (in grams) of food that the squirrels ate. A significantly greater amount of mass lost in a particular type of kernel suggests kernel preference.

Results

Pictures of the footprints found at the observation site were compared to images of squirrel, rat, mouse, and possum footprints found online. The footprints found at the site closely matched images of gray squirrel footprints. Figures 1, 2, and 3 show the squirrel footprints both at the observation site as well as the image to which we compared the footprints.

Figure 3 shows both a forepaw print (left) and a hind paw print (right). Figure 1 resembles a forepaw print and Figure 2 resembles a hind paw print.



The average food mass lost over the twelve days of the study was found to compare each type of food. These averages are shown in Table 1.

Food Type	Average Mass Loss (g)
Sugar	3.8
Water	17.2
Oil	42.2
Natural	30.4

Table 1: Average mass of corn kernels and acorns lost and standard error of the means. It shows the average amount of food, in grams, that the squirrels took over the course of 12 days. The standard errors of the means demonstrate the accuracy of recorded means.

Looking at the table, it is evident that the oil-soaked corn kernels and natural acorns experienced a higher mass loss than the other types of food, with averages of 42.2 g/day and 30.4 g/day, respectively. The sugar experienced the least mass loss with an average loss of 3.8 g/day. These averages, along with standard errors, were graphed in a bar graph to determine if there was any significance in the differences that we found in the mass lost. Table 1 also shows the standard errors of the means, and Graph 1 shows the standard error bars with the average mass lost from each of the food piles.

Some of the standard error bars overlap and others do not. The standard error bars of sugar and water, water and acorns, and oil and acorns overlap and the bars of sugar and acorns, oil and sugar, and oil and water do not overlap. Like Table 1, Graph 1 shows that oil-soaked corn kernels had the highest average mass loss over the 12 days of the study and that sugarsoaked corn kernels had the lowest average mass loss.



Graph 1: This bar graph shows the average mass of each type of food lost per day along with standard error bars. This gives a visual interpretation of statistical significance of the difference in means.

Food Type	Standard Error
Sugar	1.072
Water	5.583
Oil	5.951
Natural	4.457

Table 2: Standard errors of the means. This table shows the standard errors of the means, which demonstrates the accuracy of the recorded means.

Like Table 1, Graph 1 shows that oil-soaked corn kernels had the highest average mass loss over the 12 days of the study and that sugar-soaked corn kernels had the lowest average mass loss.

We ran a one-way ANOVA test on Sigma Plot to determine the p-values between each of the variables. We used a 95% confidence interval for the ANOVA test; the level of significance was 0.05. The p-values found from the ANOVA test are shown in Table 3.

Variables Compared	p-value	
Water and Oil	0.02	
Water and Sugar	0.569	
Water and Acorns	0.114	
Oil and Sugar	0.003	
Oil and Acorns	0.377	
Sugar and Acorns	0.022	

Table 3: p-values comparing the variables. This table shows the p-values comparing each of the different food types. Three are below 0.05, while three are above 0.05

Table 3 shows that three of the p-values, those between water and oil, oil and sugar, and sugar and acorns, were below the level of significance (0.02, 0.003, and 0.022, respectively). The other three p-values between water and sugar, water and acorns, and oil and acorns were above the level of significance.

It should be noted that the F-value from the one-way ANOVA test was excluded and is recognized as a shortcoming of this study. A future study will provide a more detailed and accurate statistical analysis of the data.

The trend found in these results is that acorns and oilsoaked corn kernels experienced a high mass loss and sugarsoaked corn kernels experienced a low mass loss. The watersoaked corn kernels experienced an intermediate amount of mass loss.

Discussion

We were able to conclude that squirrels were contributing to the mass loss at the observation site because the footprints we collected compared to images of gray squirrel footprints. This is important for our study because this means that we can attribute our results to squirrels and not to other small mammals that had the potential to affect the mass of kernels and acorns being taken from the observation site. We can age mass loss, we concluded that squirrels prefer high-fat supplemented foods to high-sugar supplemented foods. There was a significant difference in the amount of oil-soaked kernels the squirrels ate or cached compared to the sugar-soaked corn kernels as indicated by the p-value, 0.003. This p-value is much lower than the level of significance, 0.05, so we can conclude that the squirrels significantly preferred the oilsoaked corn. Our first hypothesis as well as our prediction that squirrels would prefer high-fat foods to high-sugar foods



Photo courtesy of wordpress.com

also say that our data indicates squirrel food preference as opposed to small mammal food preference.

By studying the background literature and engaging in trial-and-error throughout the experimental process, we learned that squirrels forage in the early morning hours. This was an important discovery because it allowed us to gather significant results that we were not able to find in the beginning stages of our project, when we were trying to gather data in the afternoon.

Because the oil-soaked corn kernels had the highest aver-

is supported by this result. We believe that because squirrels are foraging for the winter, their primary goal is to gather foods with high-fat content that will provide them with longterm energy rather than the short-term energy that highsugar foods would provide. This also relates to the Optimal Foraging Theory—our results show that squirrels were taking the food that would provide them with the maximum energy profit.

There was a statistically insignificant difference between the amount of food taken from the pile of acorns and the pile

of oil-soaked corn kernels (p-value=0.377, which is above the confidence level of 0.05). Therefore, we could not conclude whether or not squirrels prefer natural food to supplemented corn kernels. This result could come from the fact that we provided a smaller mass of acorns compared to oil-soaked kernels. However, it is also possible that even if an equivalent mass of acorns and oil-soaked corn kernels were provided that we would still find a statistically insignificant difference in the amount of food taken from the site. While we expected to find that squirrels would prefer natural food to supplemented food, it is likely that they prefer both oil-soaked corn and acorns because each of these foods provides a beneficial energy profit. However, because we did not provide equivalent masses of the two foods, we cannot determine that squirrels prefer one to the other or that they prefer both.

In order to improve this experiment and engage in further testing, we would like to carry out this experiment over a longer period of time. The squirrels took several days to get used to the supplemented food that we were providing, which may have skewed our data due to the fact that squirrels were taking smaller amounts of corn at the beginning of the study. The limited time period also prevented us from repeating the trials for more than twelve days. Our results may have been more conclusive had we exposed the squirrels to supplemented food over a few months rather than a few weeks. It would also be interesting to place cameras at the site in order to determine how many squirrels and other animals visited the observation site. With cameras, we would be able to more conclusively say that squirrels were contributing to the recorded mass loss as opposed to nocturnal animals that also live on Elon's campus.

Another variable to be tested in future experiments is the difference between immediate consumption and caching behavior. Because we left the food overnight, we were not able to determine whether squirrels were eating the food immediately or carrying it away to store in a cache. Determining caching preference is important because this would reveal whether squirrels prefer to store foods that would provide an energy profit during the winter months (the oil-soaked corn) or foods that were not supplemented (acorns and watersoaked corn kernels). Finding these results would provide insight into how squirrels choose their food for the winter and what they prefer to eat immediately during the fall while foraging and preparing a cache.

Studying squirrel preference for certain nutrients is important for maintaining squirrel populations both on Elon's campus and in other gray squirrel habitats around the country. Because food supply is low in the winter, it is important

that squirrels gather enough nutrient-rich food to sustain themselves for the colder months. By providing supplemented food to squirrels, they may be able to cache food that would not otherwise be available to them in the fall. However, it is also necessary to determine how beneficial supplements actually are for squirrel health. For example, if we provided large amounts of high-sugar foods to squirrels, we would need to observe how added sugar affected squirrel health. Providing supplemented food may be beneficial, but providing healthy supplements as well as energy-rich supplements is a balance that needs to be maintained. Because squirrels have been shown to prefer high-fat foods both in past research and in our research, it can be concluded that lipids are beneficial to squirrel health and that this is a good supplement to provide in the fall when squirrels are preparing for a time of low nutrient supply.

Overall, our study supports the Optimal Foraging Theory as explained by Lewis (1980). As stated, animals will forage in a way that will provide them with the maximum energy profit while expending as little energy as possible. Lipids have been shown to have a high calorie content that provides long-term energy for animals, and research has shown that foraging animals (such as squirrels) prefer to eat and cache high-lipid foods (Smith and Follmer 1972). As our research shows, squirrels have a high preference for a lipid supplement as opposed to a sugar supplement or no supplementation. We expect this is because the squirrels were foraging in accordance with the Optimal Foraging Theory to obtain the best energy-rich cache for the winter.

References

Lewis AR. 1980. Patch by Gray Squirrels and Optimal Foraging. Ecology. 61(6):1371-1379.

MacArthur RH and Pianka ER. 1966. On Optimal Use of a Patchy Environment. The American Naturalist. 100(916):603-609.

Smallwood PD and Peters WD. 1986. Grey Squirrel Preferences: The Effects of Tannin and Fat Concentration. Ecology. 67(1):168-174.

Smith CC and Follmer D. 1972. Food Preferences of Squirrels. Ecology. 53(1):82-91.

Wang B and Chen J. 2012. Effects of Fat and Protein Levels on Foraging Preferences of Tannin in Scatter-Hoarding Rodents. PLoS ONE. 7(7).

Sarah Vaughan '16 is a Biology major who believes research is an important component of an academic career. In her free time, Sarah loves to travel and experience nature through hiking.

QUICK READS

Power and Water in the Middle East: The Hidden Politics of the Palestinian-Israeli Conflict

Written by: Mark Zeitoun Reviewed by: Matt Snow '18

The field of hydro-politics is a specialized field, often researched and written about by professors for other professors, in language that the average reader may not follow. However, in Power and Water in the Middle East: The Hidden Politics of the Palestinian-Israeli Conflict, author Mark Zeitoun offers a solid geopolitical analysis of the water conflict between Israel and Palestine that is both understandable and interesting for the layman. With an academic background in civil engineering, environmental engineering, and human geography, Zeitoun is able to draw upon an immense body of knowledge that effectively describes the inter-disciplinary nature of hydro-political conflict.

The central argument in this book is that backdoor politics, hidden from the mass media, academic literature, and donor reports, "is [a] determining [factor] in both the outcome and perceptions of the Israeli-Palestinian water conflict," and that power specifically "is the primary determinant" (2). Though power is often interpreted in terms of military might and war, Zeitoun stresses that the absence of war does not mean an absence of water conflict (7). Following the Oslo II agreement between Israel and Palestine in 1995, Israel agreed to a "pervasive and hegemonic deal" which has established Israel as a hydrohegemony to this day (4). Overall, the inequality of power

POWER AND WATER IN THE MIDDLE EAST

The Hidden Politics of the Palestinian–Israeli Water Conflict



between these two States explains the unequal outcome in the water conflicts and the main discourse on the topic according to the book.

Consider these startling facts about the water disparity found by Zeitoun. In 2003, the allocation of consumptions for water was 1,600 million meters cubed per year for Israel but just a meager 275 million meters cubed per year for Palestine, a ratio of 6:1 for Israeli vs. Palestin-

QUICK READS

ian water consumption (14). Of these amounts, Israeli's consume nearly 100% of the massive supply in their own nation in addition to 27% of the water in the West Bank, while Palestinians consume none of Israel's water and only 73% of the moderate water supply they have access to (55).

While statistics backed up by academic research, visual displays of data, and geographical descriptions are vital to describing an accurate picture of the water disparity, the vast majority of the book is focused on applying political science to understanding the water conflict in the Middle East. The central theme of power as the determinant of access to water and hegemony as the defining nature of Israeli rule is backed up through multiple applications of political theory. Though at times written in a complicated manner, for the most part Zeitoun breaks down his political arguments into understandable theories. The notion of power is broken down into three main categories, each

ZEITOUN'S WRITING WILL PROVE TO KEEP THIS MULTI-FACETED ISSUE INTERESTING AND ENGAGING.

with their own chapter: hard power, bargaining power, and ideational power.

The chapter on hard power references a famous Noam Chomsky quote, stating that the "outcome of co-operation between an elephant and a fly is not hard to predict." Chomsky is describing Israel as the elephant, agitated by and able to crush Palestine, the little fly. Two case studies are used to prove the use of coercion on Israel's part: the first is the failure of the Joint Water Committee to keep water infrastructure out of the way during the 2002 military excursions into Jenin, Palestine and the second is the Separation Wall built along the West Bank. The \$2.1 million damage to Jenin's water infrastructure and \$7.6 million damage to water and wastewater systems showed a disregard for Palestinian civilians right to water and "subordinated [water issues] to military interest" (91-94). The Separation Wall has physically imposed problems by "wining around Palestinian wells" and isolated Palestinian land form the Western Aquifer, but also represents the failure of the Joint Water Committee to prevent unilateral and asymmetrical action on water issues (98). Hear, Zietoun's keen political analyses along with strong data evidence create a compelling exposure of the hidden politics of hard power.

The chapter on bargaining power outlines the inherent flaws in the Joint Water Committee that allow for Israeli dominance of water. Coercion, compliance producing mechanisms (Israeli licensing control), incentives for Palestinian submission, and overall skewed bargaining power brings about a failure of the "Joint" Water Committee. Zeitoun affectively shows these factors to be the underlying support of a "hegemonic apparatus" in Middle Eastern water policy.

The chapter on ideational power focuses on the narratives of this conflict, mainly those put forward by Israel and their effect on how the water conflict is perceived and understand by different stakeholders. Israeli "sanctioning of the discourse" over water, such as the "Needs Not Rights" campaign has couched Israeli master planning/control over water resources in terms of "solutions" and compliance (115). Zeitoun shows these ideas to be reinforced by "a mechanism for manufacturing consent, propagating the system, and maintaining the power asymmetry" (123). This is a deep argument, challenging the lenses through which we view international issues and exposing the incentives for those in power to maintain the status quo.

As a whole, Zeitoun has a strong argument, with wellresearched supporting evidence and a solid geopolitical analysis of the issue. In addition, he effectively merges scientific and political writing in a style that engages the reader and breaks concepts down to simple terms for the average reader. Perhaps the only major fault in Zeitoun's book is the assumption made in the book that all neo-liberal advocates inherently support hegemony in a "dominant set of ideas and method[s] for dealing with international relations and trade" (11). This broad assumption steps far outside the water conflict between Israel and Palestine and makes too great a claim to be justified.

Asides from this minor misstep, Zeitoun's book is great. I would definitely recommend this book to anyone interested in Israel and Palestine, conflicts over natural resources, and the general theory of hegemony. Zeitoun's writing will prove to keep this multi-faceted issue interesting and engaging. This read is thought provoking and definitely worth the time.

A Comparison of Mammalian Communities Across Three Microhabitats in Central North Carolina

Written by: Will Hemminger, Susie Masecar, Tim O'Mara, and Alex Saylor



Photo courtesy of pixabay.com

Abstract

Understanding how mammalian communities vary across microhabitat type is crucial for making effective conservation and management decisions for mammalian species. Small mammal populations have not been researched as extensively as large mammals, and therefore studies investigating small mammal communities are currently of additional importance. To facilitate effective species conservation and investigate current gaps in the literature, large and small mammal communities were sampled across three microhabitats (field, agricultural, and forest) in Elon, North Carolina, during the fall of 2014. The field microhabitat was hypothesized to support the largest and most diverse mammalian community due to increased ground-level cover and abundant food availability, Large mammals were sampled with camera traps and small mammals were sampled with Sherman traps. Eight species were sampled across these microhabitats (Sigmodon hispidus, Blarina carolinensis, Mus musculus, Peromyscus leucopus Odocoileus virginianus, Sciurus carolinensis, Urocyon cineroargenteus, Procyon lotor), and 22 individuals from 4 species (Sigmodon hispidus, Blarina carolinensis, Mus musculus, Peromyscus leucopus) were captured with Sherman traps. Species richness was determined for large mammals, small mammals, as well as for vegetation, while Shannon diversity and abundance was also determined for small mammals. The hypothesis was supported, as the field microhabitat had the greatest mammalian abundance, species richness, and Shannon diversity. Thus, conservationists are encouraged to focus efforts on field microhabitats in order to protect the greatest and most diverse mammalian species.

Introduction

Demographic studies on both small and large mammals have been performed extensively in recent years as climate change and urbanization increasingly affect habitats. Evidence strongly suggests that vertebrate communities have been in decline due to land use changes, including habitat loss and fragmentation, as a result of increased human activity (Andrén 1994). Large mammals, however, have been

studied much more thoroughly than other mammalian species in terms of population dynamics and ecology, indicating that greater attention is given to large mammal conservation status (Gonzalez-Suarez et al. 2012). Small mammals' higher diversity and abundance, in addition to larger geographic ranges, allow for greater analysis of their populations as well as the effects of anthropogenic activity on their dynamics. It is important to survey across multiple microhabitats due to high variability in small mammal communities and habitat selection (Stephens and Anderson 2014). Sampling mammals from multiple microhabitats, as done in our study, would give more predictive trends of species assemblages and their habitat uses.

Mammals in temperate climates have been studied in multiple dimensions, including habitat preference and distribution within various microhabitats. As one study showed on small mammals, habitat preference varies by species with vertical foliage being the main determinant of habitat selection (Stancampiano and Schnell 2004). Vegetation abundance and richness can also affect small mammals' spatial ecology and habitat use. Common disturbances where complete loss of vegetation is possible, resulting in habitat fragmentation, can lower the colonization rate of small mammals into a particular habitat, altering the distribution of these species (Kirchner et al. 2011, Francl and Small 2013, Hemminger 2014). Other abiotic factors such as the amount of woody debris within each microhabitat are also important in determining the spatial distribution of small mammals. Some studies have found a positive correlation between the amount of woody debris and population densities within a habitat (Naxara et al. 2009) while others have found no significant relationship or that habitat use varies by forest type and location (Jones and Lindquist 2012). In addition, the percentage of woody cover in a habitat has shown to be reflective of small mammal abundance; the highest densities of most species are found when woody cover is no greater than 17% of the habitat (Matlack et al. 2008).

Microhabitat selection among large mammals is often dependent on the species composition of the biotic communities. For example, one review discussed how several ungulates species prefer microhabitats with adequate amounts of cover because it lowered the risk of predation (Mysterud and Ostbye 1999). The composition of vegetation, therefore, is an equally important factor in determining habitat use of large mammals as it is for small mammals. Among apex carnivores, prey biomass and composition regulate population size; many species select habitats that are composed of solitary ungulates, which makes predation advantageous (Laundré 2010, Logan and Sweanor 2010). Many ungulate species, therefore, face a trade-off between cover and food availability



Photo by Matt Pieper '16

when selecting habitats, since high food availability would outweigh the costs of predation risks (Mysterud and Ims 1998). One study showed that red deer frequently choose agricultural plots that have high food availability at nighttime when predation risks are lower, easing the effects of the trade-off (Godvik et al. 2009). Studying mammalian habitat selection is crucial to understanding how habitat alterations affect their population dynamics.

The rise of urbanization and human development in the past century has led to habitat loss and declining resource availability for species (Saunders et al. 1991). The effects of land use conversion, causing habitat fragmentation, vary across the Mammalia class. Habitat fragmentation studies have found different results in terms of the abundance of small mammal species within different patches (Gaines et al. 1992, Anderson et al. 2006). Some studies have found that density is greater in some mammal species when area is greater (Bowers and Matter 1997), whereas others have found no significant relationship between density and size of a fragmented area (Bowers and Matter 1997, Connor et al. 2000). Island biogeographic theory suggests that as the degree of patch isolation increases and patch size decreases, population size and density of a species will decrease (MacArthur and Wilson 1967, Andrén 1994). Although, smaller patches may not always be a random sample of larger areas, meaning that habitat fragments can essentially be new habitats for species and colonization rates may lead to increased density (Andrén 1994). However, when habitat fragmentation results in the loss of suitable habitat, mammal species abundance generally declines.

The main purpose of this study was to perform an observe how the species composition of mammals varies between microhabitat types. We hypothesized that long grass field habitat will host a greater abundance of mammals because most mammals are ground-dwelling, and the abundant ground level vegetation provides adequate protection from predators as well as abundant food resources. This study is important in better understanding how events such as deforestation and land conversion affect biodiversity in microhabitats, In addition, it will assess how small mammals are adapting to these changes, which will facilitate more effective species management and conservation methods.

Methods

This field study was undertaken in the mature forest and field areas of Loy Farm in Elon, North Carolina, that lies half a mile east-southeast of the main campus of Elon University at 36.099°N and -79.493°W.

Small mammals were sampled with 3 x 3.5×9 " Sherman live traps in September - October, 2014. Fifty traps were placed in both the field and forest microhabitat, while 20 were placed in the agricultural area, in a grid where traps were ~10 meters apart (Fig. 1). The forest and field were sampled for 350 trap nights each, and the agricultural area for 140 trap nights. Traps were opened at ~7:00 pm, and checked the following morning at ~8:30 am. One tsp of peanut butter in wax paper or whole oats in a Kimwipe was used to bait the traps, with bait type alternating per trap. Bait was replaced when mold appeared, the oats rooted, or the bait was consumed or otherwise disturbed. Following a capture, the trap was sprayed with parvasol and wiped with a paper towel.

For each captured small mammal, total length, mass, species, reproductive status, age, and sex were recorded. Each animal was ear tagged with a steel, stamped, self-piercing ear tag. Data collection and ear tagging was performed in the field, and the captures were released at the site of capture. Weather, time, trap number, and tag number (for recaptured individuals) were also recorded for each individual. Any captures that were found dead on arrival were sent to the North Carolina Museum of Natural History.

Large mammals were surveyed with Bushnell and Moultrie camera traps for 16 days in November, 2014. Three cameras were placed in the forest, two in the field, and one in the ecotone between forest and field, and were placed near signs of recent animal activity, such as footprints, scat, etc., to maximize the chance of large mammal capture. Species capture in the forest-field ecotone were counted as belong to both the forest and field microhabitats.

Vegetative communities within the forest were sampled using point-quarter sampling, while communities in the field were sampled using plot sampling. Sampling was excluded from the agricultural plot as it was assumed to be a homogenous microhabitat with little vegetation diversity or

Habitat	Small Mammal Abundance	Small Mammal Shannon Diversity	Mammalian Species Richness	Vegetative Species Richness
Field	16	0.99	6	15
Agricultural	5	0	4	n/a
Forest	1	0	3	5

Table 1. Mammalian and vegetative community metrics across field, agricultural, and forest microhabitats. Small mammals were sampled with Sherman traps, large mammals with camera traps, and vegetation with plot or point-quarter sampling.

richness.

Mammalian species richness was determined for each microhabitat and sampling type. Abundance and Shannon diversity was also determined for small mammals, as was vegetative species richness. Home range for small mammals was determined with the greatest distance method. Bait preference, mean mass, mean length, and sex ratio were calculated for each small mammal species. To compare mammalian communities between the three microhabitats, these metrics and other observed data were analyzed qualitatively.

Results

Eight species were sampled in total, with four species sampled with Sherman traps (Sigmodon hispidus, Blarina carolinensis, Mus musculus, Peromyscus leucopus) and four with camera traps (Odocoileus virginianus, Sciurus carolinensis, Urocyon cineroargenteus, Procyon lotor). Of these eight species, three were found in the forest microhabitat (P. leucopus, O. virginianus, S. carolinensis), four in the agricultural microhabitat (M. musculus, O. virginianus, U. cineroargenteus, P. lotor), and six in the field microhabitat (S. hispidus, B. carolinensis, M. musculus, O. virginianus, U. cineroargenteus, P. lotor).

Small mammal abundance, Shannon diversity, as well as overall mammalian species richness was greatest in the field microhabitat at 16, 0.99, and 6, respectively (Table 1). The agricultural microhabitat had a median small mammal abun-

Habitat	bait preference	mean mass (g)	mean length (mm)	sex ratio (M:F)
Richness	(PB:O)			
Sigmodon hispidus	1 : 2.63	84.5	199	1 : 2.33
Blarina carolinensis	1 : 0.20	9.0	80	n/a
Mus musculus	1 : 0.25	14.0	138	4 : 0.00
Peromyscus leucopus	0 : 1.00	28.0	160	1:0.00

Table 2.Physiological patterns in Sherman trap sampling by species. Traps were baited with either peanut butter (PB) or whole oats (O), mass was measured with a 300g pesola, length was measured with a metric ruler, and sex was determined visually. Ratios were manipulated to lead with "1" except where no data points were collected for one component of the ratio.

dance and species richness at 5 and 4, respectively. Because only one species of small mammal was captured in both the agricultural and forest microhabitat, Shannon diversity for both of these areas was 0. The forest microhabitat had the least small mammal abundance and mammalian species richness at 1 and 3, respectively. The field microhabitat also had the greatest vegetative species richness at 15, as opposed to the forest's 5 species. Vegetative density at ground-level was visibly greatest in the field and least in the forest.

Twenty-two individuals were captured by Sherman traps, of which 9 were S. hispidus, 6 were B. carolinensis, 6 were M. musculus, and 1 was P. leucopus. All but one of the B. carolinensis individuals were found dead in the trap. Only two individuals, both S. hispidus, were recaptured. Small mammal species richness was greater than 1 in only the field; P. leucopus was found in the forest, M. musculus were found in the agricultural area, but M. musculus as well as S. hispidus and B. Carolinensis were found in the field. The only M. musculus was caught on the edge of the field adjacent to the agricultural area, while S. hispidus and B. Carolinensis individuals were found throughout the field. Mean home range for S. hispidus was 197 square meters. While this collective sample of small mammals did not display a preference for bait type with 11 oat captures and 12 peanut butter captures, individual species did display bait preferences (Table 2). Similar trends appeared in sex ratios, with 8 males and 7 females overall but multiple species for which only males were captured. Individual species also ranged widely in terms of mass and length, from 85g and 199mm for S. hispidus to 9g and 80 mm for B. carolinensis.

Discussion

Results suggest that mammalian abundance, diversity and species richness is greater in field microhabitats than agricultural or forest microhabitats. Thus, our hypothesis that field microhabitats support a larger, more diverse mammalian community was supported. This trend is likely attributed to one or a combination of factors: 1) increased food availability, 2) increased protection from predators through dense, ground-level vegetation and adequate protection from predators, or 3) habitat specialization.

Mammals eat a wide range of food types, from grains to other mammals. Most of these food items, particularly for the mammals sampled in the study, live on the ground (as opposed to within the canopy or underground). The canopy of the forest blocks sunlight from reaching the ground, thus reducing the amount of energy available to primary producers on the ground. As a result, ground-level biomass on the forest floor is drastically reduced when compared to a field, where sunlight is abundant. Because primary producers are the foundation for other trophic levels, and because many mammals consume primary producers themselves, the field

microhabitat likely provided more abundant and diversified food resources on the ground level when compared to the forest. In comparison, the highly-controlled and homogenous food resources in the agricultural plot provided less consistent and diverse food resources.

The abundant ground-level vegetation that results from unobstructed sunlight may also provide additional protection from predators such as *Strix varia* or *Lynx rufus*, particularly for small mammals that are small enough to hide within herbaceous material. Because the woody plants found in the forest are spaced so far apart, they do not provide cover for small mammals that dwell on the ground. Similarly, the highly-organized and spaced out nature of herbaceous plants found in the agricultural plot provide reduced cover. Thus, mammals in the field microhabitat may have a higher survivorship due to decreased predation.

The trend in mammalian diversity across microhabitats may, however, simply be due to each individual species' specialization to a particular habitat. For example, B. carolinesis is known to be found in dense field habitats (Layne 1992), and S. hispidus is known to stay away from places where the tree canopy shades ground cover (Geortz 1964). Species specialization is apparent in two areas of the presented results: 1) certain species were only found in one microhabitat, such as P. leucopus only being found in the forest and S. hispidus and B. carolinensis only being found in the field, even though these microhabitats bordered each other to an extent where even small mammals could easily move back and forth between the two. 2) Bait preferences varied between species, with B. carolinensis strongly favoring peanut butter and S. hispidus strongly favoring whole oats. These demonstrated differences indicate that individual species have evolved specific adaptations that may only be fulfilled by one type of microhabitat.

Competition may be one of the reasons why only one species was found in the agricultural and forest habitat. Due to decreased food availability, it is possible that multiple species of small mammals cannot be supported within these microhabitats. Interestingly, *S. hispidus* as well as *B. carolinensis* tend to be aggressive towards other rodent species in their habitat area (Cameron and Spencer 1981), but these two species were the only small mammals found to overlap in distribution. Because these species were both abundant within the field microhabitat, it is likely that the two species fulfill different niches and thus do not compete with each other. The physiological differences in size, with *S. hispidus* being much larger than *B. carolinensis*, supports this suggestion. On another note, *O. virginianus* may have little to no competitors their fundamental niche does not overlap with another other present



Photo courtesy of flickr.com

species'. This may allow them the ability to have a greater home range and be limited only by predation, in contrast the smaller and ground dwelling mammals.

The small size of each microhabitat fragment may have been a significant contributor to the observed mammalian diversity trends. Forest edges are generally lower quality habitats than the forest interior because of increased predation (Wolf and Batzli 2004), although *O. virginianus* is commonly found in edge habitats (Bryant and Demarius 1991). In addition, coexistence of species is found to decrease as fragment size decreases, indicating that specialist species tend to dominate fragmented habitats (Palmer 1992). The forest fragment sampled here was thin enough at ~70 meters wide that the entire area could be considered an edge habitat. Fragment size likely affected the abundance of each species found within the various microhabitats as well as the species richness, and the effect was an overall decrease in abundance and diversity, although the final effect is uncertain.

It is important to note the positive relationship between vegetative species diversity and mammalian diversity due to the classic concept that "niches beget niches." For example, *O. virginianus*, which was captured in all three microhabitats, is capable of increasing the herbaceous plant diversity, especially in areas that are disturbed, such as the habitats here, by decreasing the diversity of competitive plant species. The

high diversity of mammals found in the field may be attributed to higher diversity of all organisms. It is likely that if the forest or agricultural plot had demonstrated an equally diverse vegetative community, mammalian diversity would have also been higher. However, if forest or agricultural microhabitats generally demonstrate low vegetative diversity, whether or not mammalian diversity would be affected is irrelevant.

The results of this experiment contributes to the current knowledge of mammalian communities and how they vary across microhabitats, and is particularly useful for small mammals since they are underrepresented in the literature. The contributions made here to basic ecological knowledge are important, but this information can also be used to better focus species conservation and management methods. Because the field microhabitat hosted the largest and most diverse community of mammals, this microhabitat should receive preference when the goal of the conservation program is to protect the healthiest mammal community per unit area.

Sampling efforts were met with several challenges. On occasion, traps were discovered to have been closed when they did not record a capture, meaning that it was a false positive. These errors were most likely due to either faulty traps or some abiotic factor that triggered the traps to close. When collecting demographic data on small mammal captures, many individuals escaped before data collection was completed, which resulted in untagged individuals and missing mass, length, and sex data. Additionally, because different sampling methodologies were used to sample the field and forest microhabitat, diversity metrics such as evenness or Shannon diversity were not comparable, which reduced the power of our vegetative diversity-related analyses. Moreover, n=1 for each microhabitat type, which is an extremely small sample size off which to base conclusions. Finally, data collection occurred over a short time frame within one season. Because populations vary widely between weeks, seasons, and years, the samples collected may not be truly indicative of the present communities.

Future studies should look into the broad understandings of how microhabitats function ecologically as a part of a fragmented environment and how the mammals within these microhabitats are affected. Effects of fragmented habitats on trophic level dynamics should be further explored to fully determine how habitat destruction and urbanization are affecting biotic relationships. In addition, studies need to examine the methodologies of how microhabitats are classified and how they are compared. This includes research on comparable vegetation diversity metrics as it is currently difficult to compare vegetation communities between microhabitats. By further investigating the dynamics between fragmented habitats and how species utilize those habitats, we can better understand the effects of human activity on the surrounding ecosystem and thus work towards mitigating its typically adverse effects.

Acknowledgements

We would like to thank Jenny Archis, Josh Chory, Cat Hollister, Tyler Lehmann, Cassidy Levy, Lindsay Luhn, Clare Maher, Warren Michell, Julia Scully, and Dana Willson for their assistance in the collection of small mammals and their collection of data. We would also like to thank the Elon University Department of Environmental Studies for allowing us to use their equipment.

Author contributions

All authors contributed equally to this work. Will Hemminger, Susie Masecar, Tim O'Mara, and Alex Saylor sampled mammalian and vegetative communities, analyzed data, and wrote the manuscript. Professor Patricia Thomas-Laemont designed the study.

Will Hemminger '16 is an Environmental/Ecological Science and Biology Education double major. He is an inspiring secondary biology and environmental science teacher.

Susie Masecar '15 is graduating with a B.S. in Biology and Environmental/Ecological Science, and will continue onto NC State University's College of Veterinary Medicine to pursue a career in wildlife conservation and research.

Alex Saylor '15 is a Strategic Communications Major and Environmental Studies minor. He intends to blend Communications and Environmental Studies to advocate for sustainability in organizations and business practices.

Tim O'Mara '16 is an Environmental Studies major. Tim enjoys the outdoors, animals, and farming.

Patricia Thomas-Laemont received her Master's Degree from Villanova University in 1988, and has been working at Elon University as an Adjunct Instructor in the Biology and Environmental Studies Depts. since 2007.

References

Anderson, C. S., D. B. Meikle, A. B. Cady, R. L. Schaefer. 2006. Annual variation in habitat use by white-footed mice, Peromyscus leucopus: the effects of forest patch size, edge and surrounding vegetation type. Canadian Field-Naturalist 120(2): 192-198.

Anderson, R. B., and E. M. Anderson. 2014. Habitat associations and assemblages of small mammals in natural plant communities of Wisconsin. Journal of Mammology 95: 404-420.

Andrén, H. 1994. Effects of habitat fragmentation on birds and mammals in landscapes with different proportions of suitable habitat: a review. Oikos 71: 355-366.

Bowers, M. A., and S. F. Matter. 1997. Landscape ecology of mammals: relationship between density and patch size. Journal of Mammology 78: 999-1013.

Bryant, Fred C.; Demarais, Steve. 1991. Habitat management guidelines for white-tailed deer in south and west Texas. In: Lutz, R. Scott; Wester, David B., eds. Research highlights--1991: Noxious brush and weed control; range and wildlife management. Volume 22. Lubbock, TX: Texas Tech University, College of Agricultural Sciences: 9-13. Cameron, G.N., and Spencer, S.R. 1981. Sigmodon hispidus. Mammalian Species 158: 1–9.

Cameron, G., and S. Spencer. 2008. Mechanisms of habitat selection by the hispid cotton rat (Sigmodon hispidus). Journal Of Mammalogy 89: 126-131.

Connor, E. F., A. C. Courtney, and J. M. Yoder. 2000. Individualsarea relationships: the relationship between animal population density and area. Ecology 81: 734-748.

Francl, K. E., and C. J. Small. 2013. Temporal changes and prescribed-fire effects on vegetation and small-mammal communities in central Appalachian forest, creek, and field habitats. Southeastern Naturalist 12: 11-26.

Gaines, M. S., G. R. Robinson, J. E. Diffendorfer, R. D. Holt, and M. L. Johnson. 1992. The effects of habitat fragmentation on small mammal populations. Wildlife 2001 Population 8: 875-885.

Godvik, I. M. R., L. E. Loe, J. O. Vik, V. Veiberg, R. Langvatn, and A. Mysterud. 2009. Temporal scales, trade-offs, and functional responses in red deer habitat selection. Ecology 90: 699-710.

Geortz, J.W. 1964. Influence of habitat quality upon density of cotton rat populations. Ecological Monographs 34: 359–381.

Gonzalez-Suarez, M., P. M. Lucas, and E. Revilla. 2012. Biases in comparative analyses of extinction risk: mind the gap. Journal of Animal Ecology 81: 1211-1222.

Hemminger, W. 2014. Population dynamics of small-mammals across various habitats. Visions Magazine 8: 14-17.

Jones, C. G., and E. S. Lindquist. 2012. Utilization of woody debris by Peromyscus leucopus in a fragmented urban forest. Southeastern Naturalist 11:689-698.

Kirchner, B. N., N. S. Green, D. A. Sergeant, and J. N. Mink. 2011. Responses of small mammals and vegetation to a prescribed fire burn in a tallgrass blackland prairie. American Midland Naturalist 166: 112-125.

Laundré, J. W. 2010. Behavioral response races, predator-prey shell games, ecology of fear, and patch use of pumas and their ungulate prey. Ecology 91: 2995–3007.

Layne, J. N. 1992. Sherman's short-tailed shrew Blarina carolinensis shermani. Pages 328-334 in S.R. Humphrey, editor, Rare and endangered biota of Florida. Vol. I.M mammals. University Press of Florida. Gainesville.

Logan, K. A., and L. L. Sweanor. 2010. Behavior and social organization of a solitary carnivore. In: Hornocker, M., Negri, S. (Eds.), Cougar: Ecology and Conservation. University of Chicago Press, Chicago, pp. 105-117.

MacArthur R. H., and E. O.Wilson. 1967. The theory of island biogeography. Princeton Univ. Press, Princeton, NJ.

Matlack, R. S., D. W. Kaufman, and G. A. Kaufman. 2008. Influence of woody vegetation on small mammals in tallgrass prairie. American Midland Naturalist 160: 7-19.

Mysterud, A., and A. Ims. 1998. Functional responses in habitat use: availability influences relative use in trade-off situations. Ecology 79: 1435-1441.

Mysterud, A., and E. Ostbye. 1999. Cover as a habitat element for temperate ungulates: effects of habitat selection and demography. Wildlife Society Bulletin 27: 385-394.

Naxara, L., B. T. Pinotti., and R. Pardini. 2009. Seasonal microhabitat selection by terrestrial rodent in an old-growth atlantic forest. Journal of Mammology 90: 404-415.

Palmer, M. W. 1992. The coexistence of species in fractal landscapes. The American Naturalist 139: 375-397.

Saunders, D. A., R. J. Hobbs, and C. R. Margules. 1991. Biological consequences of ecosystem fragmentation: a review. Conservation Biology 5:18–32.

Stancampiano, A. J., and G. D. Schnell. 2004. Microhabitat affinities of small mammals in southwestern Oklahoma. Journal of Mammalogy 85(5): 948-958.

Stephens, R. B., and E. M. Anderson. 2014. Habitat associations and assemblages of small mammals in natural plant communities of Wisconsin. Journal of Mammology 95: 404-420.

Wolf, M., and G. Batzli. 2004. Forest edge—high or low quality habitat for white-footed mice (Peromyscus leucopus)?. Ecology 85: 756-769.

QUICK READS

Bearwallow: A Personal History of a Mountain Homeland

Written by: Jeremy B. Jones Reviewed by: Casey Allen

In his memoir Bearwallow, author Jeremy B. Jones explores his own confused identity through the people, history, and land surrounding him in his native slice of the Blue Ridge Mountains. The result of his journey is a book that combines poetic language with southern slang, history with modern-day life, and personal narrative with environmental commentary. The blending of various storylines, writing styles, and ideas within the book mirrors the blended community within the Appalachian Mountains, which contains a multitude of familial lines from varying racial and economic backgrounds.

When Jones returns from his time teaching in Honduras to his hometown near Bearwallow Mountain, he is confronted with shifts in his own life and in the small town around him. He accepts a position teaching Spanishspeaking students English, which mirrors his time spent abroad. These two experiences push against one another in Jones's mind as he begins to contemplate what it means to be a stranger in someone else's hometown, and what it means to finally return home. He tries to create a new life in this old place that feels comfortable, the way he feels on the level peak of Bearwallow mountain during one of his many bike rides, in the "moments when I would sit balanced exactly on top, when gravity was not pulling me the way I'd come or drawing me ahead." He retreats back into the past in order to assess his future, discovering the ways in which his familial history and attachment to this particular part of North Carolina shaped him.

In doing so, Jones wrote a remarkably satisfying book about the complexities of a people and a region that is so often simplified. He takes a group that is normally stereotyped as hillbillies and hicks and shows the nuances within that idea, and the people who break it altogether. His portrayal of the mountains and the folks who live in them



is both honest and original, depicting the distinct culture that

embodies both his hometown and himself. His book is ultimately about change and how what we know influences what we cannot yet see. He meditates on experiences within his own life that have pushed him miles away from Bearwallow and then pulled him back, coupling this with the mountain's own history and the changes it may face, as the peak suddenly becomes the site of a new housing development.

This unique mix of genealogy, language, landscape, and banjo tunes allows readers to burrow into one man's home while contemplating the impact of their own. This sense of search and discovery resonates with all of us, and it is ultimately what led me, a girl from Eastern North Carolina, to drive three hours west and finish the last few chapters of the book from a rock near the top of the mountain that defined so much of Jones's life. Bearwallow is an insightful and genuine glimpse into the meaning of coming home.

Jeremy B. Jones '04 majored in English and Religious Studies. His essays have been named Notable in Best American Essays and appear or are forthcoming in Oxford American, The Iowa Review, and Brevity, among others. He received his MFA in nonfiction writing from the University of Iowa, and he teaches creative writing at Western Carolina University.

Casey Allen'15 is a English Literature and Creative Writing major from Winston-Salem, North Carolina. Upon graduation, Casey has accepted a position with Teach For America and will join the corps in Tulsa, Oklahoma teaching elementary school.



Photo by Matthew Piper '16



Photo by Matthew Piper '16

PENA Written by: Miranda Romano

Build me a garden, in the space where the swing set is hanging in the backyard. Pull apart the rotting wood, turn to dirt the bars our children used to climb. Their own children have never seen them; can never miss them.

I know that in the night, strangers will slip in beneath the fence to touch each other between the garden leaves. Children will pull the oranges from the trees and smash them against the ground; peels ripped and leaking orange flesh. These human sounds are life to me after years of silence hanging like curtains against our windows.

In the summer

when the sprouting trees are baking in the sun and the wisteria has already begun to choke and curl, when the air is hot and thick to breathe, we'll bathe in the fountain just to feel the heaviness lift from our bones. I can imagine your veined skin shining in the glinting light. The fish will taste your toes if they survived the winter below the ice.

You'll plant roses and gardenias and they will smell the way my skin used to all those years ago. But I won't care. I want the smell of your hands with dirt beneath the fingernails, I want the taste of starting over.



Photo by Lydia Willig '18

N C E

In the mornings before you wake I will walk along the gravel paths among the birds pulling breakfast from the raspberry bushes. I will have the pictures of our children in my hands your son with skin dark from working for hours beside you in the blazing sun and his arm around our pouting girl, the dolls held against her ribs now discarded somewhere deep inside the house.

I wish I knew if they still smile the same, quick and rare, with all their teeth, if they still imagine you the way you were, hunched shoulders and angry. I wonder how long they planned their escape from the closed doors, our rules, our worried hands.

Out beneath the waking sun, a younger me would have chased the pigeons to see how much fright would make them take to the sky. I wonder now if it's fear too that makes those we hold too close take flight.



Photo by Matthew Piper '16



Photo by Lydia Willig '18

Miranda Romano '16 is majoring in Professional Writing & Rhetoric and Creative Writing and, after graduating, plans on finding a job that will support her and her diva of a cat. A professor once said that her poetry is very rich, playful, passionate, sensory, emotional and powerful, and she likes to think that this describes her personality as well.

Arizona Secrets

Written by: Virginia Kluiters

I.

The desert is a nursery with rock formations blanketed in warm, red sand. They are wrinkled, swaddled in purple light. Sprawling across crusted orange sandcastles, their fat fists are mesas facing the sky.

II.

The canyon exhales birds, breathing them into the open. In the light, their sleek skins are blue-black. They fly from inside the canyon's pocked walls, a shriveled womb, emptied.

III.

Inside canyons the earth is cool; shafts of light illuminate layers of rock—mirrored and deep like the inside of a woman. The sweet walls are damp and smooth with winding canals through which I crawl. Outside my skin feels red, raw, like an infant's. And to me, everything is bright, tender, new.

Virginia Kluiters '16 is a rising senior with a major in Creative Writing and a minor in Photography. In her free time, she can be found binge watching crime shows or happily consuming large amounts of coffee.



Photo courtesy of fotalia.com

42 | VISIONS MAGAZINE

Grow

Written by: Caroline Guardabassi

Sunshine filters through my tomato-colored dress as I stand before the cracked bay window, brushing my fingertips against the fluid fabric. The dappled light makes my dress pulsate yellow and red like when I put a flashlight behind my finger. My pregnant stomach pulls the threads taut over my waist.

I look through the glass and metal grid at the glimmering party, its bright bustle of patterns and people christening the house with splashes of champagne spilled on bricks. Under my skin, the baby's head presses toward the sun.

Suddenly I want to eat every plant in this garden, make it part of my baby, each cell that begins her life growing from the nutrients of those trees, that flower, or this soil. The thick branches that hold delicate paper lanterns look like they would have the same salty-rich taste of meat. I'd take the tree marrow as a main course then lick the dew off leaves for tea.

I pass the trays lining the hallway and walk out onto the patio. Sweet wines fill glasses of various shapes. I breathe the perfume of several guests but keep moving toward the green of the yard that stretches back into woods. My baby and this assembly of nature are the only things on my mind as I step into the mossy grass beneath the forest canopy.

I think of hiding back in these woods with the baby. I can picture her in front of me, a small child like a forest sprite, skin stained light green from her tree tinged genes. Dark blue eyes streaked through with gold like pansies. Twigs snap beneath me. I keep going further into my new home. Except, these tall grasses do not seem foreign, I have always lived here, this is the only place to live.

Caroline Guardabassi '16 is a junior from Fort Lauderdale, FL majoring in Creative Writing and Literature with Anthropology and Sociology minors. She's also a member of Sigma Tau Delta.

QUICK READS

Method's Adam Lowry Comes to Elon University

Interviewed by: Lauryl Fischer

It wasn't just about soap.

When Adam Lowry and his business partner Eric Ryan decided to go into business together back in 2000, they weren't just looking to make money, but to make a difference. They imagined the perfect product: safe to use, safe for the environment and pleasant to look at. From this dream sprang Method, a line of cleaning products that would go on to revolutionize what was considered a stagnant industry.

Since its humble beginnings on local grocery store shelves up and down the West Coast, Method has gone national, then international. *Inc.* magazine named it the 7th fastest-growing company in the USA in 2006, and in 2013, the green European manufacturer, Ecover, purchased Method. Despite its success, the company never lost sight of its emphasis on sustainability when designing and launching new products. For Method, sustainability is more than one of its business tenets. Sustainability actually drives its business.

Lowry, a chemist, environmentalist and a businessman, visited Elon March 3 to share with students what he calls the Method Method—one that pairs his environmentalism with his business acumen—and to encourage students to "embrace weird" in their own entrepreneurial efforts.

Fischer: As a chemist, your background is more environmental than your partner's. How has this background informed your career as a businessman?

Lowry: I view business as a vehicle for creating positive social and environmental outcomes. Unfortunately, the link between sound science and policy is broken in America, and therefore I believe that business, as the largest and most powerful institution on the planet, has not just the opportunity, but the onus to create change for good. More specifically, my scientific understanding of environmental issues allows me to design business models, products, etc., so that they produce environmental and social outcomes that are better.

Fischer: During your visit to Elon, you worked with young entrepreneurs. As a businessman and



an environmentalist, what pieces of wisdom do you hope to instill in the students?

Lowry: First of all, that with an enlightened perspective business really can be a powerful force for good. Second [of all], that in order to do that, the business has to be a strong business as well as a 'green' business. Too many green businesses focus on the green and end up playing to a market niche rather than really scaling. Sustainability needs to be built into the quality of the product, not used as a way to market it. And finally, that we have to focus sustainable business on the mainstream if we want to see the change we seek.

Fischer: In both your presentation and book you mention a difficult decision regarding wrap packaging-switching from a resin container that was recyclable to wrapping that isn't, but which uses less plastic. You justified this choice by saying that you were reducing your carbon footprint in the "now," though I know you later went on to develop a film wrap that was 80% recyclable (almost a best of both

QUICK READS

worlds!) How do you reconcile your commitment to sustainable practices in the future with reducing your carbon footprint in the present? I guess I'm asking about the past vs. the future—how do you reach a compromise between the two?

Lowry: There is no truly sustainable product today – every product has an impact of some kind as measured through carbon footprint, waste produced, water consumed. What is important is that we reach truly sustainable product designs as fast as possible. In order to achieve that goal, we have to get consumers to adopt each of our sustainable innovations; otherwise, they are irrelevant. That means the sustainable innovation process must incorporate adoption at scale. Paradoxically, often the best way to reach a more sustainable endpoint is through multiple smaller steps than one giant leap, because the giant leap often requires a stretch too far in the consumer's mind or in the consumer behavior change that it requires.

The key with every product design is stretching the consumer toward sustainability as much as possible while still achieving mass adoption, and then immediately innovating again!

Fischer: Why should most businesses be sustainable, besides the obvious 'save the world' mantra? In other words, what can businesses gain from being environmentally conscious?

Lowry: Regardless of your motivations, sustainability is good for business. Plain and simple, less waste, less water, less carbon means lower cost. That's a hard business benefit. There are also myriad less tangible, but ultimately more valuable benefits like consumer loyalty, employee retention, etc.

Fischer: Corporate Social Responsibility is trendy in marketing andadvertising these days, and it makes some people jaded, seeing businesses use social movements such as feminism or body positivity to grab customers. How does Method, which has long touted sustainability and environmentalism as its causes, avoid sounding insincere?

Lowry: We believe that our marketing should just be a reflection of ourselves and what we do. Ultimately, in a social media saturated marketplace, if you're inauthentic, you'll be discredited. So you might as well be good, and just tell people what you're actually doing. One other key element is corporate humility. I believe that we at Method have to be the first ones to point out where we aren't sustainable. That of course requires having a plan to address it. But as long as you do, it's a powerful way to show people that you really mean it.

Fischer: In *The Method Method*, you've talked about Method being 'inspiration-based' in how it treats its environmental message as opposed to 'educationbased.' Why does Method choose this route?

Lowry: Educating consumers about the hazards of cleaning products for the last 40 years has produced a 4% market share. It doesn't work. I want ALL cleaning products to be green. If we're going to achieve that, we're going to have to move from showing people what's wrong to showing them how their lives can benefit from a more sustainable approach. Every great movement in human history (think civil rights, information revolution, etc.) created scale by showing people a more positive and inspiring vision of the future. The sustainability movement has yet to do that.

Fischer: You talk a little in your book about making the pursuit of a clean environment personal, by bringing it back into the home. How can this mindset be applied to other green movements to encourage the kind of engagement and inspiration that Method inspires?

Lowry: I believe green products need to be great products first. In other words, the product has to be a winner for all the "normal" reasons, taking sustainability out of it. That's what we mean when we say "make it selfish." If you remove the conundrum...[of] choosing between [a] green product and good product, then you can really scale, and you inspire consumers with the idea that sustainability not only doesn't need to be a sacrifice, but can bring fantastic incremental benefits.

Lauryl Fischer '16 is a Strategic Communications and Creative Writing major, passionate for writing in all its forms. She is the Features Editor for *The Edge* magazine, a writing consultant, and account supervisor for Live Oak Communications.

THE WORLD WE LIVE IN THE WORLD WE WANT TO LIVE IN