



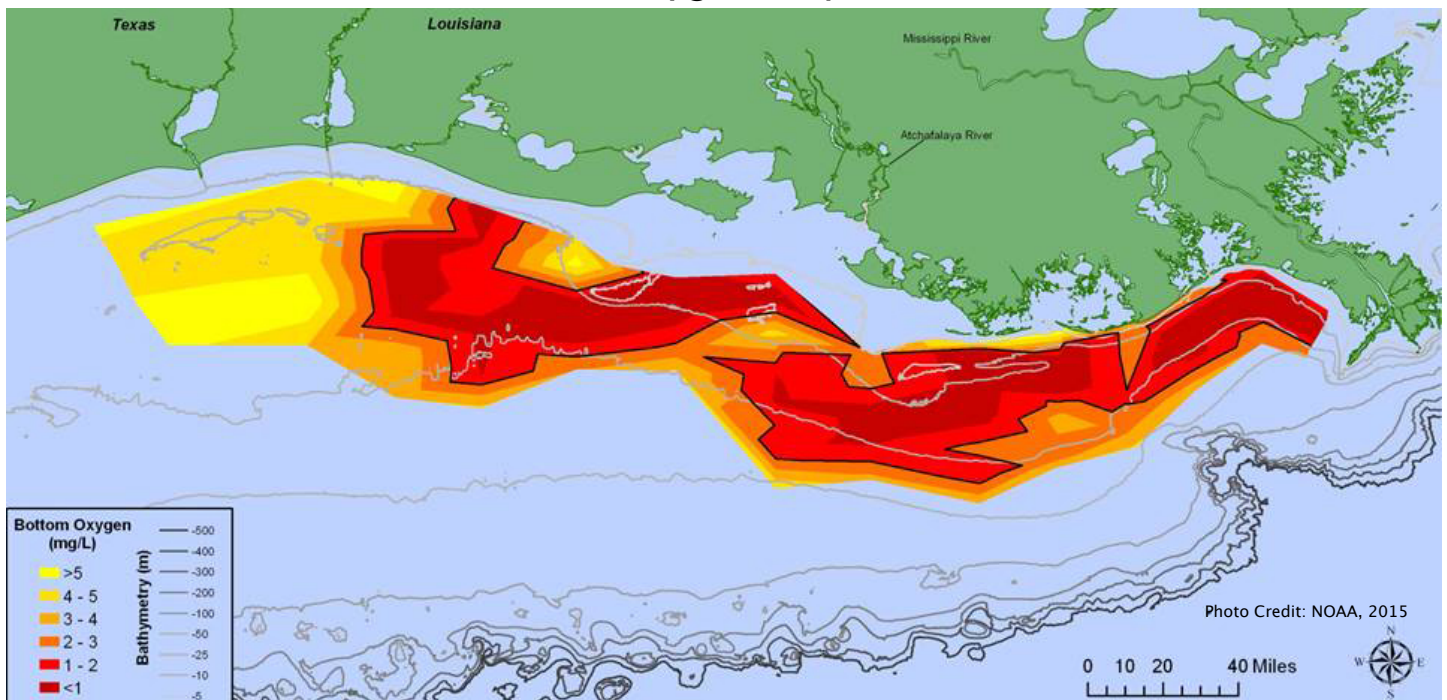
OUTER CAPE ENVIRONMENTAL AWARENESS NEWSLETTER



Difficult problems inspire innovative solutions: “Wind Powered Drinking Water”, the recipient of the **2017 OCEAN Environmental Innovation Award** is not what you may think. In our “can of worms department”, one of our lead Researchers has taken an educational look into recent changes in ocean Oxygen levels. As well as hot news from the Arctic; unraveling some of the mysteries of changing Bird migrations; and a continuing exploration of a new economic engine in our coastal economy: Sugar Kelp. A future issue explores Kelp beds reducing wave energy. **OCEAN** is the environmental education publication of Safe Harbor. This is your Public Domain e-newsletter, to be shared with your friends and fellow students. Thank you, Gordon Peabody, **OCEAN** Editor

June 2017 Issue No. 37

Ocean Oxygen Depletion



As Oceans across the globe warm, many systematic changes are occurring. One of the most ecologically significant is the global drop in dissolved oxygen content. There are several underlying reasons for the reduction in dissolved oxygen content. Primarily, as water warms, its ability to hold dissolved oxygen decreases, meaning that as our planet absorbs more solar radiation, ocean waters inherently lose their ability to maintain dissolved oxygen content.

Furthermore, another problem arises because warm surface water is less dense than cooler water. The implications of this will affect dissolved oxygen content as well. Because much of the oxygen in the ocean comes from mixing with the atmosphere, oxygen content is higher in surface water than it is in deeper waters. This is not a problem when surface water is cool, because cool water is still able to sink down to deeper layers of the ocean. However, when surface water is warmed due to increased solar absorption, that oxygenated surface water loses its ability to sink, and therefore loses its ability to bring dissolved oxygen down lower in the water column. This causes a decline in dissolved oxygen content at depth.

(continued on next page)

An additional problem comes from agricultural nutrients discharged into Oceans at the mouths of large rivers, such as the Mississippi. These nutrients create unsustainable algal blooms that decompose and consume the available oxygen, making it impossible for other organisms to survive. These oxygen-starved areas of the ocean have been coined “dead zones”, and can severely alter the ecosystem where they develop.

More information in the links below:

<https://www.nature.org/ourinitiatives/regions/northamerica/areas/gulfofmexico/explore/gulf-of-mexico-dead-zone.xml>, <https://www.nature.com/nature/journal/v542/n7641/pdf/nature21399.pdf>

Thank you to **OCEAN** Researcher Rae Taylor-Burns

Editor's Choice: Climate Change & Bird Migrations

The issue of climate change causes many scientists to ponder how many species can and will adapt. Often the jarring image associated with global warming is a lone polar bear standing on a tiny piece of ice, but what about other species that might not be so obviously affected by increasing temperatures? Migratory bird species seem to use temperature changes as signals for when to depart, and researchers are studying how this rising trend could influence them.

Birds often migrate to optimize food and resting resources and depart due to subtle temperature cues. An in-depth study that was recently published researched how increases of temperature can affect the timing of migrations and the findings are not favorable. Scientists at the University of Edinburgh have analyzed over 300 years of data concerning hundreds of migratory bird species across five continents. What they discovered is that birds arrive a day earlier on average per increased global degree of temperature. Timing of arrival is important for migratory birds to optimize subjective and objective vital resources and this is true for species that migrate short distances or far and wide. Being too early, or too late, could result in missing out in prime nesting locations or offset the timing of their egg(s) hatching, both of which could impact the survival of offspring.

Though this is the most extensive study looking at how rising temperatures can affect bird migrations it is not the only one. Researchers at University of Wisconsin analyzed how well North American birds have been adapting to climate change. There were two important findings: first they are travelling faster and second their breeding ranges are shifting slightly Northwest.

These studies are important because they demonstrate how global warming and other environmental changes can affect species and help scientists predict what impacts they could have. We should care about these impacts on birds because some species may be more sensitive to climate change than others and may have unexpected consequences. Since much research has proven that anthropogenic greenhouse emissions are the main driver of global warming we need to be aware of the repercussions.

More information in the links below:

<https://www.theguardian.com/environment/2016/dec/28/climate-change-driving-birds-migrate-early-research-reveals-edinburgh-global-warming>, <http://grist.org/article/climate-change-is-already-changing-bird-migration/>

Thank you to **OCEAN** Researcher Brigid McKenna



Photo Credit: Bird Barrier Inc, no date



Photo Credit: ABC News, 2015

CLOSE TO HOME: Climate Change in New England

The Northeast United States, like many other regions across the world, seems to be experiencing a trending increase in temperatures. Scientists from the University of Massachusetts at Amherst have published their findings that the rate of this temperature rise in New England is higher than any other part of the country (excluding Alaska) and that the area might see as much as a 3.6 degree Fahrenheit rise by the year 2025, an inflation occurring about two decades faster than what other regions are predicted to experience.

Scientists used computational modeling to predict how climate change will unfold in different parts in the United States. About 80% of the models for the Northeast estimate that winters will be wetter and therefore the area could possibly face more flooding. The changes in precipitation could affect the snowfall up to 50% and there could be more frequent, intense Nor'easters. An author of the paper went as far to say that the next generations may not witness the same snowfall in Massachusetts as we currently do. The theory behind why New England has and will witness a faster acceleration of temperature is because of its latitude, exposure to western winds, and the increasing temperature of the waters in the Gulf of Maine. Previous studies have also suggested that the winters in the northeast will be shorter and warmer overall.

It is even possible that the sea level around the coast could continue to increase, up to 10 feet by the end of the century. The potential sea level rise and worsening winter storms is disconcerting especially because the coastline of the Northeast is susceptible to severe flooding and damage. Of course, this can also affect us in other ways: loss of biodiversity, afflicted food crops, and adverse health issues and disease. The intensity of these events are estimates and not hard facts, and will likely fluctuate depending on variables such as the rate of carbon emissions. Unfortunately, one of the only things to even possibly slow global warming down is to reduce man-made greenhouse gas emissions on a large scale. The Paris Agreement signed by global leaders in 2015 was a great first step to limit the average rise of the world temperature, but countries need to be vigilant about staying on track and we as individuals need be aware of our impact and each do our own part.

More information in the links below:

<http://www.amherstbulletin.com/As-climate-changes-UMass-scientists-predict-a-faster-warming-in-the-Northeast-9244306>, <https://www.bostonglobe.com/metro/2016/09/16/our-winters-will-soon-shorter-warmer-less-snowy-and-that-scary-scientists-say/uMEKGVNfTvdDWXdCxjWL9O/story.html>

Thank you to **OCEAN** Researcher *Brigid McKenna*

Insects Bring a Country to it's Knees

In February of 2017, the South American country of Bolivia endured a locust plague that destroyed 1,000 acres of crops. The locusts targeted the vicinity of Santa Cruz, which is where most of Bolivia's food and meat is produced. Sorghum and corn crops were the most devastated by the locusts.

Bolivian President Evo Morales declared a state of emergency, and committed \$700,000 in funds for fumigation. The goal for fumigation was to spray 17,000 acres, and focus the application in a ring around the area where the locusts swarmed. Furthermore, the producers in the area had to identify the areas where the locusts were laying eggs. After locusts hatch they are known as nymphs, which are juvenile locusts that have not developed wings yet. At this stage, the locust plague is much easier to control because the insects have not yet developed the ability to fly.

The most damaging aspect of the locust plague was that it occurred in the wake of a severe drought. The drought in 2016 was the worst drought Bolivia has faced in 25 years, and as a result the country had to import \$21 million in corn to meet national food demand. The drought also caused the government to pass controversial water rationing regulations, causing social conflict throughout the country.

More information in the links below:

<http://www.bbc.com/news/world-latin-america-38914922>, <http://www.reuters.com/article/us-bolivia-crops-idUSKBN15P2G0>

Thank you to **OCEAN** Researcher *Rae Taylor-Burns*

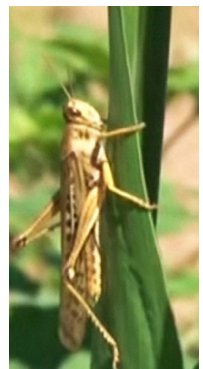


Photo Credit:
Channel News Asia,
2017

SPECIAL INTEREST ARTICLE: Sugar Kelp and Our Coastal Community

Seaweed is a potential power food with numerous beneficial uses and possibilities. The market is currently expanding for seaweed as a food, cosmetic ingredient, energy source, and even fertilizer. The U.S. is only beginning to venture into the \$5.5 billion global commercial seaweed industry (Genter, 2017). *Editor's note: You may want to follow up with these two connected articles. In July, 2016, OCEAN 32 "Kelp Production for Biofuel May Have Local Potential" by Researcher Jessica Hillman, explored the possibility for Cape Cod to commercially expand into growing kelp. In February, 2016 OCEAN 31, Innovative Sea Farming, by Researcher Natalia von Hausen, we looked into the seemingly untapped use of Sugar Kelp in our food industry.*

Recently, Massachusetts awarded its first commercial seaweed growing permits to two Martha's Vineyard brother fishermen, Greg and Dan Martino. Before gaining the permits necessary to grow and sell kelp, the brothers studied the best time, place and methods to grow kelp with local scientists (Genter, 2017). Currently they are growing their seaweed in Vineyard Haven Harbor. They grow their seaweed from ropes, with each line potentially producing 6,000 pounds of kelp in optimal conditions.

Commercially growing seaweed was a perfect complement to the brothers' oyster business because peak growing time for kelp is November to April, the offseason for shellfisheries. Seaweed is also environmentally advantageous to the water because it removes nitrogen, helping to make the ecosystem healthier for everyone. Seaweeds crops could be potentially beneficial to Shell fishermen during their off season.

Cape Cod Bay is unlikely to fill with seaweed farmers anytime soon, particularly due to the risk that sea turtles and whales could become entangled in the seaweed lines. However, areas such as the Vineyard, Falmouth and the North Shore have been marked as experimental locations due to the low risk of sea life entanglement in the area. Another challenge facing potential seaweed farmers is the need to sell to wholesale dealers due to stricter regulations. However, many believe it is only a matter of time until Cape Cod begins to serve seaweed on the menu and the crop takes off commercially.

Although the brothers are still experimenting with seaweed growing and have yet to officially release their crop, visit their website for more information about their oysters and seaweed: <https://cottagecityoysters.com> This product has the ability to revitalize the shell fishing industry on Cape Cod through the advancement into not only the local, but also the global seaweed industry.

More information in the links below:

<http://www.capecodtimes.com/news/20170114/seaweed-growers-look-to-turn-tide>,

<http://www.seaveg.com/blog/page/3/>

Thank you to **OCEAN** Researcher Jessica Hillman



Photo Credit: Seaveg.com, 2016

Pesticide Awareness

Pesticides have become widespread in modern agriculture and can easily end up on your plate if you're not cautious. Produce with the highest pesticide residue includes, strawberries, spinach, nectarines, apples, peaches, celery, grapes, pears, cherries, tomatoes, sweet bell peppers and potatoes, as listed in the 2017 Environmental Working Group's Dirty Dozen list (<https://www.ewg.org/foodnews/summary.php>)

For those concerned about unintentionally consuming pesticides there are many tips to remove them from your food. One holistic blog outlines how to use a homemade vegetable cleaner. The recipe is user friendly and simple; just soak the fruit in 90% water and 10% white vinegar. For more information view the blog here: <http://www.healthy-holistic-living.com/remove-pesticide-produce.html?t=HHL>

Thank you to **OCEAN** Researcher Jessica Hillman



Photo Credit: Healthy-Holistic-Living.com, 2016



Photo Credit: TedXAmsterdam, 2017

We Are What We Eat: Microplastics

Consumers are becoming increasingly wary of fish and shellfish. Fish are accumulating some of the worst side effects of human pollution, through the net gain of bioaccumulation and biomagnification through the food chain. Recently, Ghent University scientists released research calculating that shellfish eaters are consuming up to 11,000 plastic fragments yearly (Cauwenberghe and Janssen, 2014). Microplastics are rapidly being absorbed into the underwater food chain as they are easily dumped in the ocean or even spilled during shipping. While the human body only absorbs less than 1% of these plastic fragments, these levels remain and accumulate over time.

The film “A Plastic Ocean,” was released January 20, 2017 and served to expose the reality about the amount of plastic in the water and its impact on our Ocean’s ecosystems. This film has raised awareness for the repercussions this is having on fisheries worldwide (watch here: <https://www.plasticoceans.org/film/>). The film shows how, in some parts of the ocean, scientists have found more plastic than plankton, an alarming phenomenon. It also explains how they are stored in the fatty tissue of fish and shellfish that we are consuming.

A campaign group, “A Plastic Planet” is now urging UK supermarkets to create plastic free isles where environmentally conscientious shoppers can choose to buy their food from. This would enable shoppers to put their money where their mouth is and support products that will not contaminate our oceans and fisheries. Visit: <http://aplasticplanet.com> for more information.

Although consuming small amounts of plastic with shellfish may not have a significant impact yet, we should modify our diet as these amounts continue to grow.

More information in the links below:

<http://www.ecotox.ugent.be/microplastics-bivalves-cultured-human-consumption>, <http://tedx.amsterdam/2015/10/plastic-planet/>

Thank you to **OCEAN** Researcher Jessica Hillman

Bicycle Powered Homes?

The idea of the pedal powered generator has recently re-entered the news stream, thanks to Manoj Bhargava, the founder of the free electric bike. This invention aims to bring electricity to poverty stricken areas and could be used to support education. Bhargava claims that this bicycle could power a small village if one member of each household spent 1 hour a day bicycling (Gulland, 2008). Though this innovation is perfect for rural areas the applications in the United States seem somewhat limited. 1 hour on this bike will generate about 0.11 kWh, which is a good amount of energy, however the average American household uses about 30 kWh per day. Even individuals who are trying to live off the grid use 3-5 kWh per day. This means that while using an electric powered bicycle may save you a small amount of money and generate some electricity, you won’t be able to power your home with 1 hour of pedaling (West, 2016).

In terms of money, the 1 hour of pedaling produces roughly 100 watts of energy which equates to about 1 cent worth of power. There is some money that is saved, but not all that much (West, 2016). If you were interested in purchasing a pedal powered generator they can be reasonably cheap. The ones created by Bhargava are not currently for sale, but he plans to distribute 10,000 bicycles in India this year. Other bicycle powered generators range in price from a few hundred dollars to a few thousand, and can be found almost anywhere, ranging from amazon, craigslist (if you were looking to save a few bucks), and even pedal generator specific sites.

More information in the links below:

<http://www.motherearthnews.com/renewable-energy/pedal-powered-generators-zmaz08onzgoe>,
<http://www.instructables.com/id/How-To-Build-A-Bicycle-Generator/>

Thank you to **OCEAN** Researcher Lindsey Stanton

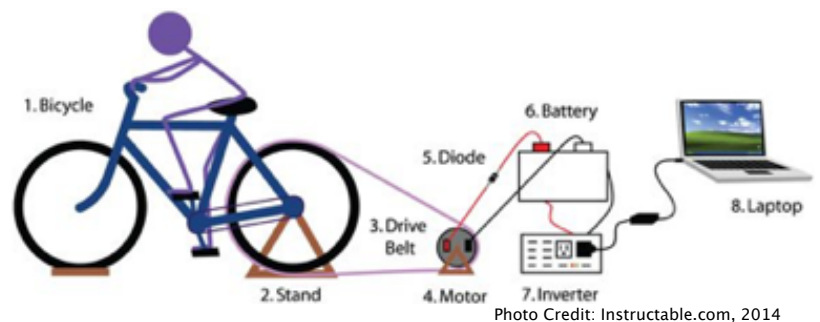


Photo Credit: Instructable.com, 2014

OCEAN 2017 Environmental Innovation Award: Wind Powered Drinking Water

In an era of climate change and shifts in precipitation regimes, large-scale regional droughts are a concern for many semi-arid regions of the world. According to the United Nations, nearly 3 million people will struggle with water shortages over the next 10 years, creating potential for massive social instability and migrations. Currently, an estimated 750 million people lack access to safe water, and water-related disease kills about 840,000 people annually. Furthermore, scientists estimate that by 2030, the global water supply will be 40% short of what is needed. In this context, it is clear that solutions are needed to ensure safe water is available to at risk communities.

VICI-Labs in partnership with UC Berkeley and the National Peace Corps Association has developed a device that can play a role in solving the issue of water shortage. The WaterSeer is a device that collects moisture from the atmosphere and condenses the vapor into liquid using the temperature gradient between the above-ground turbine and the collection tank, which is stored underground. The turbine blows cool air into the condensation tank, where vapor is cooled, causing it to become liquid water.

These devices operate without any external energy source, and can produce up to 11 gallons of water a day. They are able to function properly even in the most arid conditions. However, as the device does rely on a temperature gradient between warm air and cool earth, it is unclear whether the WaterSeer will be able to operate in temperate or cooler climates. The temperature in the ground is typically around 55 degrees Fahrenheit, and if the air temperature is close to that or colder, water vapor may not condense into liquid. With cooler air temperatures, the device would likely require much higher humidity in the air to function.

The product is still in development. WaterSeer is in a crowdsourced funding stage, and hopes to have product available for sale later in 2017.

More information in the links below:

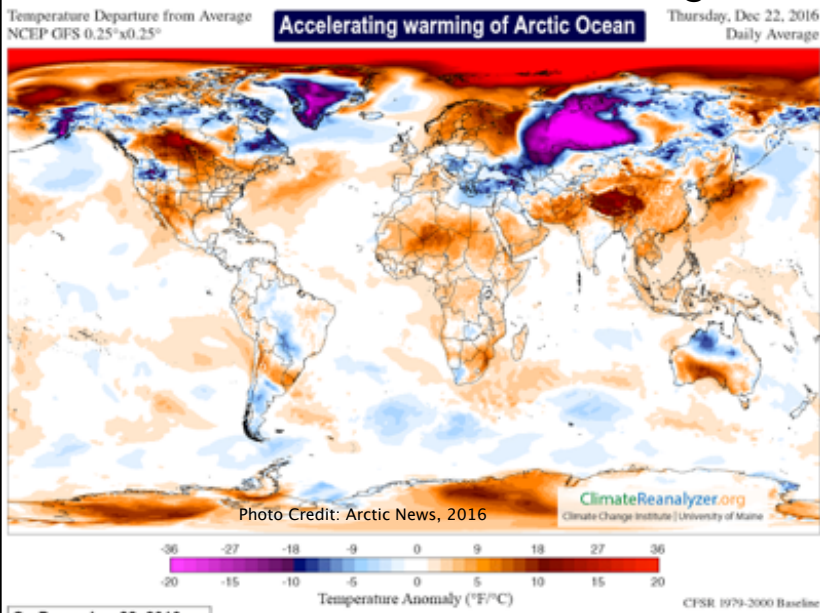
<https://www.minds.com/blog/view/631153990247133200>, <http://anonhq.com/cheap-wind-powered-device-can-produce-11-gallons-clean-drinking-water-per-day-air/>, <https://www.waterseer.org/>

Thank you to **OCEAN** Researcher Rae Taylor-Burns



Photo Credit: WaterSeer Inc, 2017

Record Breaking Heat Wave in the Arctic



This past winter, in the high latitudes of the northern hemisphere, the North Pole saw record high temperatures. Temperatures in November of 2016 were 27 degrees Celsius above normal. After a summer with the second thinnest sea ice ever recorded by satellites (which first collected this data in 1979), this extreme winter heat wave could be devastating for the arctic ecosystem. The heat wave resulted from a mass of warm air from the North Atlantic that flowed continuously up to the North Pole, resulting in cloud condensation that prevented the heat from leaving the area.

One of the biggest problems with arctic heat waves is the resulting change in the albedo of the earth. Albedo is the reflectivity of a surface, and surfaces with high albedo absorb less radiation from the sun. Snow is one of the most reflective land covers, and it is so bright that it can reflect as much as 90% of the incoming solar radiation. The issue arises when snow and ice melt, because they turn to water, which has a much lower albedo. The ocean is dark, and only reflects about 6% of the incoming solar radiation. This means that when rising temperatures cause snow and ice melt, they transform into a substance that absorbs even more radiation and warms even more quickly, creating a positive feedback.

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Heat Wave in the Arctic (cont.)

Though this is an anomaly today, as scientists say this type of heatwave is a 50-year event, using preindustrial climate data, scientists say a heatwave like this could only have occurred once every thousand years. Scientists say the heatwave confirms that anthropogenic climate change is a real threat. Without the anthropogenic signals, they are unable to model a heatwave of this magnitude.

More information in the links below:

<https://www.scientificamerican.com/article/north-pole-temperatures-may-soar-to-50-degrees-above-normal/>, <http://www.climatecentral.org/news/2016-low-arctic-sea-ice-20702>

Thank you to **OCEAN** Researcher Rae Taylor-Burns

Thousands of Fracking Spills

In recent years fracking has become a hot topic in the United States. Debates are surging, arguing whether fracking truly causes the negative consequences associated with it. One of the most notable outcomes of this is earthquakes. More information on the process of fracking and the tremors associated with it can be found in **OCEAN** 31, "WHAT'S SHAKING IN OKLAHOMA?" by Jessica Hillman. However, one of the lesser known side effects of fracking is the inevitable spillage of oil.

New research from US scientists suggests that there have been 6,600 spills from fracking wells in just four states over a 10 year period (McGrath). According to this study the state with the highest level of incidents was North Dakota, with 4,453 reported in the state. This is in part because the laws for North Dakota require any spill over 42 gallons to be reported. Other states in this study like Colorado and New Mexico only require spills over 210 gallons to be reported, meaning the actual number of spills may be much larger or open to interpretation (McGrath). Though this seems like a high number of spills it doesn't necessarily mean that there are negative implications to the process, right?

According to a recent study from Duke some streams in North Dakota were found carrying radioactive and toxic materials that were higher than the federal drinking water standards as a result of wastewater spills from fracking. This studying also showed that, at the oldest spill site tested (about 4 years) there were still large amounts of contamination. The problem with this type of fuel retrieval is that due to the nature of fracking large amounts of brine often spill over and contaminate water sources. This consists of inorganic chemical, metals and salts that are resistant to biodegradation making the spills even more troublesome (Kelly). With fracking growing every day it is important to know what is happening and any potential ramifications there may be for the environment or for us as humans.

More information in the links below:

<https://www.scientificamerican.com/article/fracking-can-contaminate-drinking-water/>, <http://www.bbc.com/news/science-environment-39032748>, <http://howiekahn.com/resources/WRITING/DebFinal.pdf>

Thank you to **OCEAN** Researcher Jessica Hillman

"OCEAN 36 also had a connecting article by Researcher Rae Taylor-Burns. During the California drought, desperate orange growers were allowed use of oil production wastewater. The ensuing revelations of contamination generated a boycott of oranges." Editor, Gordon Peabody

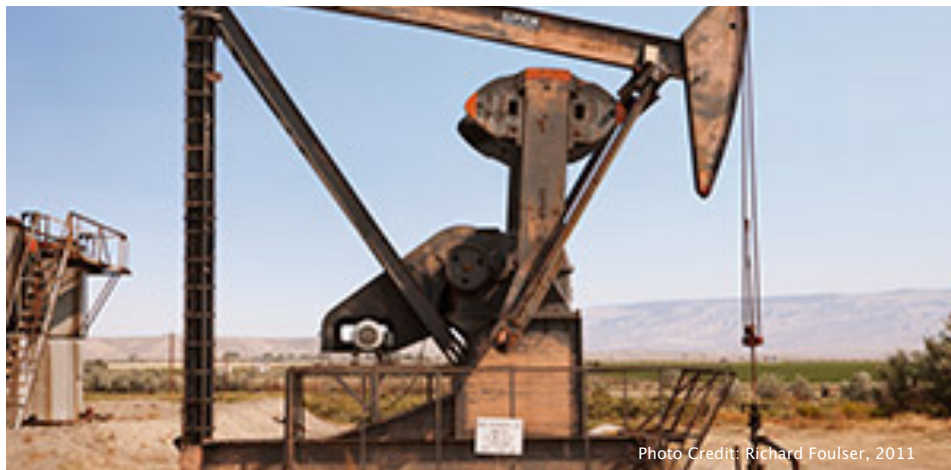


Photo Credit: Richard Foulser, 2011

Local Intern Program Now Open to Graduate Students

Caitlin Higgins

Safe Harbor Environmental has a long history with their Intern Program. The intern program evolves and grows by bringing together various backgrounds and levels of experience to work with Mentors, performing environmental work on Cape Cod. Through a cooperative educational partnership developed with Cape Cod Community College, Interns may qualify for College Credit. The intern program has previously been open to high school students, college students, and as of 2017, is now open to Master's Program students.

Caitlin Higgins, Safe Harbor's Winter Intern and first Master's student, is pursuing her Master of Science in Environmental Management and Sustainability at St. Edwards's University in Austin, Texas. She joined Safe Harbor as a Coastal Restoration Intern from January to May 2017. Caitlin conducted research on the resiliency of several types of native vegetation in Provincetown for her degree work. Caitlin also worked with Safe Harbor on projects including planting beach grass; steep slope stabilization; storm water management and participated in Conservation Commission Public Hearings to review Safe Harbor Projects.



Safe Harbor considers every application for participation in our Intern Program. More detailed information is available at <https://www.safeharborenv.com/who-we-are-2/intern-program/>.



Photo Credit: Jen Turrell of Huffington Post, 2016

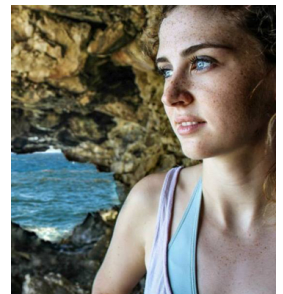
Advocacy statement, "Voting with our dollars": Climate Change concerns should never distract us from how we can make a difference in our communities. Between the unknowns of Climate Change Stress and the unknowns of how we can adapt, our Natural Resource Systems provide the only buffer we have. Are we voting with our dollars to support local businesses and organizations that believe in protecting and restoring our Natural Resources? For more information check out the link below:

<http://www.necn.com/news/new-england/Cape-Cod-Salt-Marshes-to-Be-Restored-427126103.html>



Thank you to Associate Editor Samantha Thywissen for creating this issue of **OCEAN**, which we suspect dovetailed nicely with final exams at Massachusetts Maritime Academy. This summer Samantha will be interning at Wood Hole Oceanographic Institute, in their Environmental Health and Safety Office.

Thank you Jessica Hillman, our Research Coordinator at **OCEAN**. We are proud to share the news that Jess has just been accepted into a special, accelerated graduate school program at Brandeis University for Global Public Health Policy and Management!



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Thank you for your support!