



The Environmental Synopsis

A Monthly Update from the Joint Legislative Air and Water Pollution Control and Conservation Committee

JANUARY 2018



The Chairman's Corner Senator Scott E. Hutchinson

This year marks the 50th anniversary of the Joint Legislative Conservation Committee, an important milestone in our history.

Although one of the smallest legislative service agencies, the Committee serves an important role for General Assembly, providing bipartisan information on the environment, energy and conservation. Its work is often removed from political headlines, but past and present members understand the significant contributions such a unique, nonpartisan committee brings to the legislative process.

The Committee was established in the late-1960s, a time when the public sought basic protections for the Commonwealth's diverse natural resources. Act 448 of 1967, signed by Governor Raymond P. Shafer, created a new agency to provide legislative oversight for a conservation bond referendum known as Project 500. The Committee was also tasked with studying pollution across the Commonwealth and recommending laws to the General Assembly.

This spring, the Committee will publish a retrospective of the last 50 years. It will highlight the origins of the Committee, its activities over the decades and the legislators and staff who have been integral to its success. I hope that you will take some time to read about the

Committee's influence on Pennsylvania's conservation legacy.

In its early history, the Committee's role was pivotal in enacting many of the state's first environmental laws, perhaps most famously the Environmental Rights Amendment to the Pennsylvania Constitution. Written by Committee member Representative Franklin Kurry, voters approved the ballot measure by a four-to-one margin in May of 1971. Since then, the Committee has diligently worked to navigate the complex relationship between our society and the environment.

Over the years, the Committee has had a significant influence on the development of environmental legislation and policy in Pennsylvania. For example, Committee public forums, roundtables, investigative hearings, reports and studies have assisted

in the development of the following laws: the "Pennsylvania Infrastructure and Investment Authority Act", the "Municipal Waste Planning Recycling and Waste Reduction Act", the "Small Water Systems Assistance Act", the "Oil and Gas Act", the "Keystone Recreation, Park, and Conservation Fund Act", the "Waste Tire Recycling Act" and the "Covered Device Recycling Act." Not to mention the iconic Pennsylvania Wild Resource Conservation Fund specialty license plates.

In 1990, the Committee conducted a comprehensive review of the issues confronting how the WRCF financed its vibrant and sought-after grant program which supports research and conservation of Pennsylvania's non-game wildlife. At that time, the WRCF relied on a state income tax checkoff for its funding. The Committee determined that a special revenue-generating license plate program would be a better solution, performing

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Notes from the Director

Tony M. Guerrieri, Executive Director

It's a good time to be a craft brewer, as full-flavored and local beers are in high demand. Craft breweries are small, independent operations that produce less than 6 million barrels a year and focus on all-malt beers. They are also experimental, often producing unique recipes and varieties, seasonal beers and limited release editions. D.G. Yuengling and Son Inc. located in Pottsville, Pennsylvania, for example, is considered a craft beer, and a staple of the Keystone State.

Since 2011, the number of breweries in the U.S. has skyrocketed from just over 2,000 to more than 5,300 in 2016. There are over 130 of these craft breweries in Pennsylvania, producing more than 4 million barrels of beer annually, according to the U.S. Brewers Association. The craft/microbrew market serves a customer base that enjoys the culture and taste of unique beers, the ambiance of smaller, local brewers and pubs and learning how the establishment contributes to positive environmental and community efforts.

In addition to the market potential, there are many economic benefits of improving the energy, water and waste efficiencies of these producers.

Energy use in breweries varies depending on size, location and types of products. As more craft breweries come on the market, owners and operators are beginning to realize some of the obsta-



cles associated with beer production. For instance, breweries are extremely energy-intensive operations. Between refrigeration, space heating, packaging and the actual brew house, breweries require a large amount of either electricity, natural gas, or both.

There are many ways to curb energy consumption in a brewery. An energy study at an Oregon brewery found that just insulating steam pipes throughout the facility can reduce heat loss by 87 percent, and decrease steam purchase or generation costs.

Quality craft beer production also requires clean water. The connection between good beer and clean water is obvious; water composes anywhere from 90 to 95 percent of many beers. The brewing process uses water in nearly every step. Hops, barley and malt are key to the brewing process, but the chemistry of the water can influence the taste and aroma of beer. Beers run the spectrum from malty or light, to dark and bitter, or hoppy and bright. Yet, it's the minerals in the water that are integral in creating a beer's unique flavor. A common measure in the brewing sector is how many barrels of water it takes to make one barrel of beer. Until recently, the brewing process needed up to 7 barrels of water to produce one barrel of beer (7:1). That number is decreasing across the spectrum of beer manufacturers. The world's largest beer producers (Molson, Coors and Anheuser-Busch, for example), have decreased that ratio of water to beer to 3:1.

In addition to use in the actual beer itself, water is also used for cleaning brewing equipment, pasteurization, and in the packaging process. For instance, cold water is used to cool down the wort – the extracted liquid that contains the sugar that will be fermented during the beer-making process. Hot water is used to clean and sanitize equipment used

to make beer. Breweries can also reduce water consumption by recovering water throughout the brewing process for use in cleaning processes that do not require high quality water.

Non-product water reuse can be seen at one Minnesota brewery, where they capture rinse water for the inside of their bottles, filter it, then reuse it to rinse the outside of their bottles, has reduced their water consumption by about 2.7 million gallons annually. While craft breweries only account for a small percentage of water usage, the proliferation of craft breweries means this percentage is only likely to increase in the future.

Breweries generally produce two types of solid waste: brewing process wastes and packaging wastes. Spent grains, by-products of the brewing process and the largest source of waste for most brewery operations, can be utilized by businesses and individuals in various ways. Breweries today sell or donate spent grain to local farmers and livestock owners for animal feed or compost, which results in less waste sent to a landfill. Beer cans and bottles can be recycled an infinite number of times. Ten states (not including Pennsylvania) have beverage container deposit laws, commonly known as bottle bills, which are a deposit-refund system for beverage containers and are designed to reduce litter and promote recycling. However, bottle bills are not universally popular throughout the beverage or distributor industries.

These days it's easy to buy beer and wine in Pennsylvania. New craft breweries can be found in almost every major city or town. Supermarkets and convenience stores now have a wide selection on their shelves. Considering Pennsylvania's history with the temperance movement, it's a fascinating development. Much has changed since then, of course, and that's worth toasting.

Research Briefs

Each month, the committee's staff researches and prepares a number of "briefs" on several topics relevant to the committee's mission. Very often these briefs include references to reports and further research on the topics so that readers may pursue issues on their own. Please note that the information and opinions expressed in the Research Brief articles do not necessarily represent the opinions or positions of the Joint Legislative Air and Water Pollution Control and Conservation Committee, nor those of the Pennsylvania General Assembly.

Study Suggests Tree Ranges Are Shifting West as Climate Changes

Tony M. Guerrieri, Executive Director

Many climate change studies have shown a strong correlation between changes in temperature and a naturally occurring phenomenon known as "tree migration." Trees, of course, do not move themselves, but their populations can shift over time, and saplings can expand into a new region while older growth dies in another.

Scientists predicted forest cover would shift as temperatures and weather patterns changed. What they didn't expect is that forests have not only moved north, but west as well.

With warming temperatures, locations that were previously unsuitable for a particular species may become suitable, and thus that species' range will have moved. For example, cold-adapted plants will survive if they move "up" – that is, as they move further north (away from the tropics) and higher in elevation (away from the warm ground) in search of familiar temperatures.

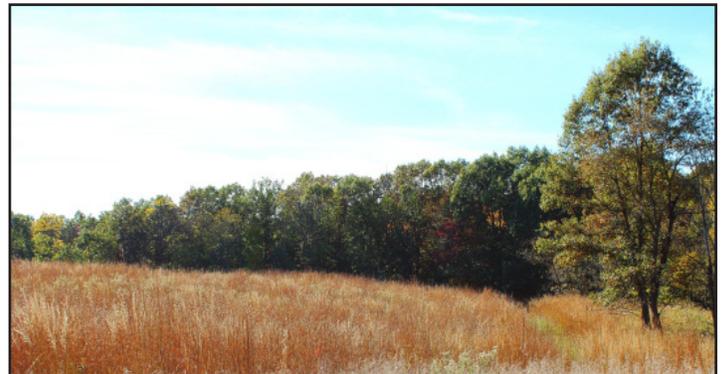
In a study published in the journal *Science Advances*, researchers at Purdue University examined how tree

populations have shifted over the past three decades, finding that this effect is already in action. But there is a twist: Even more than moving northward, trees are moving west.

The study tracks the shifting distributions of 86 types of trees using existing data collected by the U.S. Forest Service's Forest Inventory and Analysis Program spanning the last three decades. The USFS program surveys the health, density and species mix of forested areas across the country.

Researchers expected the northward shift towards cooler weather, but they were surprised by the move west, which was larger and in a majority of the species. About three quarters (73 percent) of tree species common to eastern American forests – including white oaks, sugar maples, and American hollies – have shifted their population centers west since 1980. More than half (62 percent) of the species studied also moved northward during the same period. Hardly any types of tree moved south or east.

Overall, the changing climate has pushed trees an average of 20 miles north and 25 miles west over the past 30 years. During that same period, the mean annual temperature in the eastern United States increased by about 0.16 degrees Celsius on average. The northern areas of that region had among the highest temperature increases.



Climate change has elevated temperatures across the eastern U.S. and significantly altered precipitation patterns. The Northeast has gotten a little more rain since 1980 than it did during the preceding century, while the southeast has gotten much less rain. The Great Plains, especially in Oklahoma and Kansas, see much more rain than in decades past.

The study suggests that, in the near-term, trees are responding to changes in water availability more than to temperature changes. Most of the trees that shifted west were angiosperms, or flowering trees (oaks and maples). The evergreen trees – the needle species (pines and spruce) – are primarily moving northward.

However, there are a patchwork of other forces which could cause tree populations to shift west. Changes in land use, wildfire frequency, conservation efforts and the arrival of invasive pests and diseases can also contribute.

Because forest management is long-term, it is important that the effects of climate change on species distribution be factored into forest planning. There are concerns that as deciduous trees

are moving westward while conifers move northward, important ecological communities of forests could fracture.

The mix of species, and the interactions between them determine the attributes of a forest more than the simple presence of a lot of trees. Divergent responses to climate change by specific species could lead to changes in the composition of forest ecosystems, compromising the resilience and sustainability of forest ecosystems.

The study, *Divergence of Species Responses to Climate Change*, is available at: <http://advances.sciencemag.org/content/advances/3/5/e1603055.full.pdf>.

Physical Evidence of Ozone Recovery

Coleen P. Engvall, Research Analyst

Scientists had long considered that man made chemicals were disrupting the ozone layer. Without this high-altitude shield, damaging ultraviolet radiation from the sun would penetrate the atmosphere. In 1985, new research showed that the damage was much worse than many considered possible when scientists discovered the size and magnitude of ozone depletion over the Antarctic.

Two years later, 43 countries from across the globe agreed to reduce production and sale of chlorofluorocarbons, with a total ban following not long after. This progression cannot be attributed to



governments and policy alone; many private citizens voluntarily discontinued their use of ozone depleting chemicals before it was mandatory.

This monumental global achievement of cooperation and action saw an eventual decrease in ozone loss, but the cause was unclear and recovery was slow. Unfortunately, CFCs often persist in the atmosphere for 50 to 100 years after emission. Due to this, research released this year was the first direct proof that the concentration of man made CFCs has decreased. The researchers assert that this proves the recovery of the ozone seen in later years is connected to the ban on CFCs.

For the first time since the Montreal Protocol was signed in 1987, scientists have shown that the chemical ban is responsible for the improvement of the ozone layer.

Susan Strahan and Anne Douglass of NASA's Goddard Space Flight Center published their results in *Geophysical Research Letters*. The letter, *Decline in Antarctic Ozone Depletion and Lower Stratospheric Chlorine Determined From Aura Microwave Limb Sounder*

Observations, detailed their findings and the implications.

The ozone layer is formed when oxygen gas in the stratosphere is bombarded with solar radiation, splitting apart into two oxygen atoms before rejoining as ozone. These particles accumulate in the stratosphere and protect the planet from much of the ultraviolet radiation

that can cause skin cancer, cataracts and burns. Alongside the danger this poses to humans and animals, this radiation can damage most forms of life, including plants.

When CFCs, which were used in refrigerant and many aerosols, are released, some accumulate in the stratosphere. As the ultraviolet radiation splits these compounds, they release chlorine: the primary chemical responsible for the actual process of ozone depletion.

Detecting this element was key to determining the impact of the Montreal protocol's ban on CFC concentrations.

Interestingly, once the chlorine in the stratosphere has depleted all the available ozone, it will react instead with methane, creating hydrochloric acid. With this understanding, the Aura satellite was able to detect the presence of hydrochloric acid using microwaves, and therefore detect the amount of excess chlorine in the Antarctic's atmosphere. The researchers collected and examined this data, along with other atmospheric analyses, from 2005-2016.

Overall, the rate of depletion slowed by 20 percent during the span of the study. Again, this has been observed previously, but the cause was not certain. Now, the NASA researchers were able to show that the concentration of CFCs has been decreasing in comparison to other naturally-occurring depleting chemicals, and vitally, compared to the concentration of CFCs at surface levels.

At sea level, CFCs have decreased since the ban, but the long life of the compound allowed them to persist in the stratosphere and continue to deplete the ozone. By measuring hydrochloric acid, particularly in colder months when weather patterns in the Antarctic are more stable, and by using these comparisons, the researchers provided a direct, causal link between the ban of CFCs and the reduced rate of depletion.

This measurable progress was a long time in the making, with the ban having come into effect over 30 years ago, and with research spanning all the way back through the seventies and earlier. Unfortunately, while the ozone's situation continues to improve, it will take decades before it stabilizes completely.

To read the researcher's findings in full, go to: <http://onlinelibrary.wiley.com/doi/10.1002/2017GL074830/full>.

Living in Close Proximity to Active Oil and Gas Wells

Tony M. Guerrieri, Executive Director

More than 17 million people in the U.S. live within a mile radius of an active oil or gas well, according to a study in the journal *Environmental Health Perspectives*. Co-authored by researchers at the non-profit research institute PSE Healthy Energy; the University of California, Berkeley; and Harvey Mudd College, the study is the first peer-reviewed nationwide measurement of the number of people living in close proximity to actively producing oil and gas wells.

Oil and gas development operations are a heavy industrial activity. They release pollutants including particulate matter, benzene, nitrogen oxides, ozone, volatile organic carbons and carbon monoxide to nearby air and water.



Opponents of oil and gas development have speculated that living near active well site could have adverse health impacts, such as heart, lung and neurological problems, some cancers, and certain birth defects such as lower birth weights and pre-term births.

But only a few studies quantifying populations in proximity to these operations have been published, and those studies do not tie pollution emissions to specific types of oil and gas development operations.

Researchers estimated that 17.6 million Americans, or about 6 percent of the population of the contiguous 48 states, live within a mile radius of an active oil or gas well site.

In addition to calculating a national population total, researchers produced a state-by-state comparison that revealed several states with especially high percentages of their populations living near an active oil or gas well.

For example, in West Virginia, about half (50 percent) of the state's roughly 1.8 million people live within a mile of an active oil or gas well. Oklahoma was a close second, at 47 percent of residents living near active wells. About a quarter of Ohioans – 24 percent – reside near active wells.

The study found that Texas, Ohio, California, Oklahoma and Pennsylvania all have more than one million of their residents living within a mile of wells. Texas had the highest number



of residents – 4.5 million – living near active wells.

One striking statistic in the study notes that approximately 1.4 million children under the age of 5, a notable subgroup in the study because of their vulnerability to environmental exposures, live within a mile of active wells.

The researchers looked at hydraulic fracturing (fracking) wells, which typically use sand, water and chemicals to release oil or gas from rock formations – a process generally referred to as “unconventional drilling” – as well as active conventional oil and gas wells.

There are no federal regulations for buffer distances between active wells and people's homes. Many states have their own setback requirements. The setbacks range from 100-1,000 feet. The findings could be used by local and state government officials to better assess the costs and benefits of allowing oil and gas drilling near populated areas.

The study concludes that given the number of individuals and large percentages of populations potentially exposed to pollutants emitted from oil and gas development, protective regulations and policies should be considered. Health-protective policies could include minimum wide deployment of the best available air pollution-reduction technologies.

The 11-page study titled *Toward Consistent Methodology to Quantify Populations in Proximity to Oil and Gas*

Development: A National Spatial Analysis and Review is available for download at: https://ehp.niehs.nih.gov/wp-content/uploads/2017/08/EHP1535.alt_.pdf.

Washing Silver Down the Drain

Coleen P. Engvall, Research Analyst

Advances in modern clothing manufacturing have changed how we sell and buy clothes in many ways, though most people are unaware of how. For example, did you know that synthetic clothing sheds microplastics in the wash, which have been shown to make their way into the environment? While these advances provide as many benefits as challenges, new technologies and techniques require innovative ways to mitigate negative consequences.

One such technique is the addition of silver nanoparticles to some fabrics. These particles have some antibacterial properties that can reduce odor uptake, an attractive trait for both producers and consumers.

Researchers from the University of Massachusetts at Dartmouth conducted a study to determine the potential impacts of this rising trend. They published their findings in *The American Chemical Society's Sustainable Chemistry and Engineering Journal* earlier this month. The article is entitled, *Silver Recovery from Laundry Wastewater: The Role of Detergent Chemistry*.



Laundry water runs into sewers and through wastewater treatment facilities before reentering the environment. These facilities run the water through a gauntlet of chemical and physical stages to remove pollutants and neutralize dangerous compounds. A major part of this process involves live bacteria which digest targeted nutrients into safe byproducts, or into forms that are easier to remove.

One function bacteria can perform is called nitrification, a vital component of nitrogen removal which uses ammonia to react with the nitrogen. This allows further processing to eventually remove it from the waste stream. Nitrogen can be extremely harmful to waterbodies in large concentrations, fueling toxic algal blooms and contributing to hypoxic conditions.

Wastewater facilities have made huge strides in recent decades, cutting back their nitrogen effluent. However, as mentioned, silver has antibacterial properties, and the beneficial bacteria used in these facilities are not exempt. Previous studies have shown small concentrations of silver nanoparticles disrupting the nitrification process by more than 11 percent. They concluded that the nitrifying bacteria would begin to show impacts at a concentration of 10 milligrams of silver per liter.

Aside from the damage it does within infrastructure, silver can cause more problems once it enters the environment. Ionic silver is extremely toxic to aquatic organisms, from fish, to insects, to naturally-occurring bacteria, to plants and algae. In fact, some species of trout can be harmed, even killed, by concentrations as small as 10 micrograms per liter.

These significant impacts to treatment facilities and wildlife demonstrate the importance of understanding the use of silver and ways to mitigate the impacts. Three main problems

have confounded researchers in past studies: silver nanoparticles exist in extremely small concentrations, scientists were unaware of the form that the silver was traveling in and the presence of other chemicals made isolating the silver difficult.

The researchers began by testing ion-exchange resin, which showed to be remarkably effective at targeting silver. After all, in most laundry loads, there are many other competing ions, such as sodium, that can interfere with the collection of a specific metal. This also demonstrated that the silver was present in positive ionic form.

Silver protects textiles from odor-causing bacteria, however, when the micro particles are washed away, they can cause a host of problems in both wastewater treatment facilities and in the environment.

They then tested the resin in the presence of common laundering chemicals. Detergent, luckily, did not seem to impede the filtration, regardless of the basicity. However, bleaching agents and water-softeners did negatively impact the efficacy.

With this new understanding, the researchers encourage further study into ways to trap more of the silver in our laundry water, either by investigating alternative laundering chemicals, or by exploring other techniques for recovery. Aside from protecting wastewater facilities and ecosystems, the efficient and reusable methods they tested in their experiment could create a more sustainable product cycle.

To read the full report, go to: <https://www.sciencedaily.com/releases/2017/12/171220121706.htm>.

On the Horizon

A look at upcoming events

Monday, February 5, 9 a.m.

Public Hearing - Nutrient Credit Trading in PA

Room 8E-A, Capitol East Wing, Capitol Complex, Harrisburg

The February hearing will cover Pennsylvania's nutrient credit trading program, featuring testimony by DEP, the Chesapeake Bay Commission and other stakeholders. They will discuss the current status of the program, which allows for facilities that discharge nutrients into the Chesapeake Bay Watershed to offset their output by purchasing credits from other sources that have reduced their nutrient pollution by more than is required. The hearing testifiers will provide input from their respective sectors on how the program can be improved.



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You can find us on Facebook at www.facebook.com/jointconservationcommittee, or on Twitter at www.twitter.com/PA_JLCC. Take a moment and follow us today for the latest on issues related to Pennsylvania's diverse natural resources.

This Month in Conservation History

A look back at the evolution of environmental stewardship

50 Years Ago

On January 8, 1968 the Undersea World of Jacques Cousteau made its debut on the ABC television network. Jacques Cousteau led the public on a voyage of discovery through the world's oceans at the helm of his ship, the Calypso. Every Sunday night he shared his undersea adventures with generations of television viewers worldwide, revealing the fascinating, hidden world that lay beneath the waves. He was also an environmentalist and an inventor who co-developed the aqualung, better known as the self-contained underwater breathing apparatus or SCUBA. Cousteau introduced the sights and sounds of marine life that would have gone unseen by most of us, delivering the experience of the ocean into living rooms for all to enjoy. Much of our understanding of the ocean and its ecosystems can be attributed to Jacques Cousteau, who passed away in 1997.



President Kennedy awarding Cousteau the National Geographic Society's Gold Medal.

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The Chairman's Corner

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the double duty of helping to fund the program bringing awareness to a popular cause. The WRCF plate, introduced in November 1993, was the first specialty plate issued by Pennsylvania. Now they are found on the back of cars and trucks throughout the Commonwealth.

The Prescribed Burning Practices Act, a byproduct of the Committee's legislative forestry task force, is integral to the stewardship of our forest resources and the communities they support. The prescribed fires law was a collaboration between academics, state conservation officials and the forest products industry.

Without giving away too much of the upcoming retrospective, I thought I would share a few interesting facts about the Committee's membership and activities over the years:

- The Committee is one of the oldest state legislative agencies of its kind in the U.S.
- Almost every county in the Commonwealth, or parts of it, has been represented by a legislative member serving on the Committee.
- From 1968-2018, there have been 119 legislative members that have served on the Committee. In addition, there have been seven different Committee chairmen and nine executive directors.
- Beginning in 2000, the Committee has held 83 Environmental Issues Forums that were attended by over 1,600 individuals including legislators, state agency representatives, stakeholders and others.
- The longest serving member is Rep. Camille "Bud" George, a Democrat from Clearfield County, who sadly passed away in September. Bud was an active member of the Committee for nearly 30 years (1983-2012).



The Committee's staff often refers to the "environmental umbrella" which covers nearly all sectors of our society and economy. Since becoming Chairman in 2001, I've been amazed at the sheer scope of issues and programs we have examined. I've found myself in the Pennsylvania Wilds learning about forest management, on a mountain in Berks County observing migratory raptors and in Columbia County surrounded by over 6 million tires in Pennsylvania's largest waste tire pile. There are still many topics left for the Committee to explore.

The Joint Legislative Conservation Committee is celebrating its 50th Anniversary this year. It may surprise you just how intertwined the Committee is with Pennsylvania's conservation legacy.

As the Committee reflects on 50 years of service, it is natural to consider what is next for the agency. How will its work continue to evolve to meet the needs of the Pennsylvania General Assembly? What legislation and policies will help shape the next 50 years? The answer to those questions is history in the making. Thank you to all of our supporters, past, present and future!