Climate Change: 2017

Post Reprint: “Trump moves decisively to wipe out Obama’s climate-change record”
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Student Activity: Climate Change — Impact on Ecosystems and Human Communities
Not everyone agrees on the role humans play in climate change. Evidence — changes in reflectivity, weather, oceans, ecosystems — supports the Earth’s climate is changing. Disagreement centers on greenhouse gas emissions and how the activities of humans (driving, deforestation, energy generation and manufacturing practices) contribute beyond natural causes.

President Trump’s March 2017 executive order impacts the coal- and fossil-fuel industry and the Obama administration’s environmental polices. Teachers are provided news articles by veteran science reporters, a guest commentary and discussion questions to focus on this aspect of economic, governmental and environmental intersection.

Climate change is also addressed through observation of changes of migration patterns in this region and around the globe. Tom Toles, The Post’s editorial cartoonist, has drawn on climate change through the years.
President Trump on [March 28] took the most significant step yet in obliterating his predecessor’s environmental record, instructing federal regulators to rewrite key rules curbing U.S. carbon emissions.

The sweeping executive order — which the president signed with great fanfare in the Environmental Protection Agency’s Map Room — also seeks to lift a moratorium on federal coal leasing and remove the requirement that federal officials consider the impact of climate change when making decisions.

The order sends an unmistakable signal that just as President Barack Obama sought to weave climate considerations into every aspect of the federal government, Trump is hoping to rip that approach out by its roots. The president did not utter the words “climate change” once, instead emphasizing that the move would spur job creation in the fossil fuel industry.

“Our administration is putting an end to the war on coal,” he said, accompanied onstage by more than a dozen coal miners, Vice President Pence and three Cabinet members.

“We’re ending the theft of American prosperity, and rebuilding our beloved country.”

Some of the measures could take years to implement and are unlikely to alter broader economic trends that are shifting the nation’s electricity mix from coal-fired generation to natural gas and renewables. The order is silent on whether the United States should withdraw from the 2015 Paris climate agreement, under which it has pledged to cut its greenhouse gas emissions between 26 and 28 percent by 2025 compared to 2005 levels, because the administration remains divided on that question.

The order comes after several moves by Trump to roll back Obama-era restrictions on mining, drilling and coal- and gas-burning operations. In his first two months as president, Trump has nullified a regulation barring surface-mining companies from polluting waterways and set aside a new accounting system that would have compelled coal companies and other energy firms to pay more in federal royalties.

Accelerating fossil-fuel production on federal lands and sidelining climate considerations could lead to higher emissions of the greenhouse gases driving climate change and complicate a global effort to curb the
world’s carbon output. But Trump has repeatedly questioned whether climate change is underway and emphasized that he is determined to deliver for the voters in coal country who helped him win the Oval Office.

The president thanked the miners onstage twice during the ceremony, and as they gathered around him when he signed the executive order, he looked up and remarked, “You know what it says, right? You’re going back to work.”

U.S. coal jobs, which number about 75,000, have been declining for decades. A senior administration official who briefed reporters Monday evening did not predict how many jobs might be spurred by this shift in policy.

Still, Sen. James M. Inhofe (R-Okla.) and other administration supporters said the change in policy would have a tangible impact on the economy. “This order is a clear sign to the country that Trump is serious about unleashing this country’s energy dominance,” Inhofe said in a statement.

Legal fight possible

The centerpiece of the new presidential directive, telling the Environmental Protection Agency to begin rewriting the 2015 regulation that limits greenhouse-gas emissions from existing power plants, will trigger a laborious rulemaking process and a possible legal fight.

The agency must first get permission from the U.S. Court of Appeals for the D.C. Circuit, where the rule is tied up in litigation, to revisit the matter. Then, agency officials will have to justify reaching the opposite conclusion of the Obama EPA, which argued it was technically feasible and legally warranted to reduce carbon pollution by about one-third by 2030, compared with 2005 levels.

“So, for the president, even if he would like to revoke the Clean Power Plan, he doesn’t have legal authority to do that,” said Jeffrey Holmstead, a partner at the Bracewell law firm who opposes the Obama-era rule. Holmstead, who headed the EPA’s air and radiation office under President George W. Bush, said he thinks the agency can justify reversing the regulation. But “they have to justify why they have changed,” he added.

While environmental groups decried Trump’s move, mining officials welcomed it as an important course correction in federal energy policy.

“This rule was an unlawful attempt to radically transform the nation’s power grid, destroying valuable energy assets and leaving our economy more vulnerable to rising power prices — all for an insignificant environmental benefit,” said Hal Quinn, president and chief executive of the National Mining Association.

Environmentalists vowed to fight the executive order in court and press ahead with their goals on the state level.

David Doniger, director of the Natural Resources Defense Council’s climate and clean-air program, said unwinding the Clean Power Plan will not happen quickly, no matter what
Christopher Field, a professor at Stanford University’s Wood Institute for the Environment, said in an email that the directive carries long-term risks, rather than immediate ones. “Some are risks from eroding the position of U.S. companies in the clean energy sector,” Field said. “Others are from the loss of irreplaceable natural heritage that is put in jeopardy by ill-conceived policies.”

The president will also instruct the Interior Department to rewrite a 2015 rule, currently stayed in court, that imposes restrictions on hydraulic fracturing on federal and tribal lands. The directive will also make it easier to flare methane in oil and gas operations on federal land, by triggering the review of a rule the Interior Department finalized in November.

**More immediate actions**

Other aspects of the executive order can take effect immediately, though it is unclear how quickly they will translate into greater coal extraction. One section overturns a 2016 White House directive to consider climate change when agencies conduct reviews under the National Environmental Policy Act, a sweeping law that informed any federal decisions that have a significant environmental impact.

Another provision instructs Interior’s Bureau of Land Management to lift a freeze on federal coal leasing. That moratorium has been in effect since December 2015.

Tom Sanzillo, director of finance for the Institute for Energy Economics and Financial Analysis, said in an interview that the move “becomes a largely politically symbolic measure for right now” because other, lower-carbon sources of energy are out-competing coal. He noted that U.S. coal consumption has declined 27 percent since 2005, from 1.02 billion tons to 739 million tons in 2016, its lowest level in nearly four decades.

“They’re not going to reverse the fundamental economic law here,” Sanzillo said. “There’s no market signal that’s telling them they should be mining more coal.”

Still, regulatory relief could make some coal firms, nearly 50 of which have filed for bankruptcy since 2012, somewhat more economically viable. Some of the sector’s biggest companies — including Arch Coal, Peabody Energy and Alpha Natural Resources — are just now emerging from bankruptcy protection.

Ethan Zindler, head of U.S. research at Bloomberg New Energy Finance, said in an email that solar and wind are competitive with coal in some parts of the country and that natural gas ranks as the lowest-cost source of electricity generation overall. The sector that could suffer
the greatest hit from the elimination of the Clean Power Plan is nuclear energy, which provides about a fifth of U.S. businesses’ and households’ power.

“Many of the 100 or so U.S. plants are aging, and approximately a third are economically uncompetitive today,” Zindler said. Without stricter federal emissions limits, he added, “there may be little to stop the retirement of these plants in coming years and their replacement with a combination of gas/wind/solar.”

National Rural Electric Cooperative Association CEO Jim Matheson, whose group challenged the Clean Power Plan in federal court, said in an interview that he does not anticipate many of his members will start building new coal-fired plants. But for those who have already invested heavily in keeping their coal plants operating, he said, “It has given them much greater flexibility to maintain more reasonably-priced and affordable power for our consumers.”

Separately, Trump has instructed federal officials to abandon the practice of factoring in the impact of climate change — what is dubbed “the social cost of carbon” — in their policymaking decisions. That calculus, which is currently set at $36 per ton of carbon dioxide, aims to capture the negative consequences of allowing greenhouse-gas emissions to continue to rise. But some conservatives have criticized it as too sweeping.

Federal officials will return to the traditional cost-benefit analysis outlined in a 2003 Office of Management and Budget guidance, which appears to put the cost associated with carbon emissions at zero.

As Trump seeks to scale back federal limits on greenhouse gas emissions, states and cities are likely to take on a larger role in charting the course forward.

An analysis by the Rhodium Group, an economic consulting firm, found that Trump’s forthcoming executive order would slow the country’s shift away from carbon-emitting sources of energy. It found after Trump’s action, the United States would be 14 percent below its 2005 emissions levels by 2025, compared to 21 percent below that mark had current Obama-era policies remained in place.

All three West Coast governors and a handful of mayors issued a statement within minutes of the order’s signing, vowing to press ahead with their own policies to cut carbon emissions. In an interview, California Gov. Jerry Brown (D), said his state would fight to maintain strict carbon standards in court, and would participate in U.N. climate talks to help foster further action overseas.

“Gutting the Clean Power Plan is a colossal mistake, and defies science
An Integrated Curriculum For The Washington Post Newspaper In Education Program

Have you seen signs of climate change in your local community?

We may use your submission in related Washington Post stories online, in print or on social media. And as part of our continuing coverage, a Post staffer may contact you to talk further.


Tim Profeta, who directs Duke University’s Nicholas Institute for Environmental Policy Solutions, said regulators from more than half-dozen states in the Southeast are now talking about how to chart their own path forward. Having met for nearly three years, the group stopped discussing how to comply with the Clean Power Plan after November’s election, but it is still talking.

“We are now talking about the evolution of the power sector in an environment of uncertainty,” Profeta said in an interview. “We’re seeing the beginning of states taking control of their destiny.”
President Trump’s latest executive order on energy policy seeks to fulfill what he repeatedly promised during his campaign rallies: “A lot of people are going to be put back to work, a lot of coal miners are going back to work. The miners are coming back.” Understandably, laid-off and underemployed miners in Appalachian hollows like to hear this message — but few of them will actually be hired. Robert Murray, chief executive of the country’s largest privately held coal-mining company, put it bluntly: “He can’t bring them back.”

This reality has almost nothing to do with government’s preferences or orders: The retreat from American coal mining was not caused by President Barack Obama’s environmental regulations or by any ideological dislike of the fuel that provided the energy foundations of modern civilization. The history of energy use is a sequence of transitions to sources that are cheaper, cleaner and more flexible.

Size of the markets and technical imperatives make these transitions relatively slow, but the process is inexorable. That is why coal displaced wood and charcoal and why, in turn, its many former uses (railroads, shipping, household heating, industrial production) were displaced by fuels refined from crude oil and by natural gas. At the beginning of the 21st century, global coal use was largely limited to two big remaining markets: generating electricity and using high-quality coal to produce metallurgical coke to produce iron (which is then turned into steel).

In 2000, the United States derived half of its electricity from coal — a substantial share of it produced in aging plants built during the 1950s and 1960s (the decades of rising electricity demand). At this point, natural gas generated only 16 percent of electricity, and its stagnating domestic production seemed to make future large-scale imports of natural gas inevitable. Then came the rapid advances of hydraulic fracturing (shale gas and oil), and by 2009, the United States once again became the world’s largest producer of natural gas.

The economics became irresistible. Burning clean natural gas in highly efficient gas turbines (which can convert 60 percent of fuel’s energy, compared with 40 percent in the best coal-fired stations) became the most
certain aspects of mainstream climate science, such as the relative influence of human activity versus natural climate variations. The third majority witness, University of Colorado professor Roger Pielke, Jr. has generally acknowledged the human influence on climate change, but has been known to question the severity of global warming’s impact on events like hurricanes or flooding.

Although research suggests that such viewpoints are outliers within the general scientific community, Christy suggests that the idea of a consensus is a “political notion.” And therefore, he argues, policy should be informed by a more diverse set of viewpoints than the conclusions presented by bodies like the IPCC — hence the red team idea, which he says he’s proposed at other congressional hearings in the past as well.

“What’s happened in the IPCC is they’ve just stopped selecting people who disagree with the consensus,” Christy told The Washington Post. “So you have a consensus of those who agree with the consensus.”

Curry, in her testimony, said the IPCC’s authority “marginalizes skeptical perspectives and is operating to the substantial detriment of climate science, as well as biasing policies that are informed by climate science.”

But climate scientist Michael Mann of Pennsylvania State University, called as a witness at Wednesday’s hearing by the committee’s Democratic minority, said such bias claims are “hogwash.” Policymakers who suggest a need for alternative views on climate change are cherry-picking the science they choose to trust, Mann said.

“These folks start out with their ideology and then work backwards to decide which science they like and which they don’t,” he said in an emailed comment to The Washington Post. “But that’s not how scientific research works. It’s not a buffet where you get to selectively pick and choose what to believe. It’s not about belief. It’s about evidence.”

In an era when funding for scientific research of any sort may soon become more scarce than ever, the idea of a red team approach for climate science may never be more than a proposal.

But if it did come into being, it could be used to justify the actions of an administration that has vowed — and, in fact, already begun — to undo numerous climate-related regulations and goals established under the Obama administration. Members of the new administration, including President Trump, have expressed doubt about the accepted science of climate change, and suggested that climate action is therefore unwarranted and wasteful.

However, funding panels aimed at presenting alternative viewpoints would essentially be amplifying a set of contrarian opinions that are vastly discredited by most other experts. According to Frumhoff of the Union of Concerned Scientists, assessing scientific evidence is already the responsibility of bodies like the National Academy of Sciences, which have weighed the existing research and concluded — over and over — that the overwhelming burden of evidence supports the idea that human greenhouse gas emissions are the primary driver of climate change.

“That’s exactly why you have independent scientists on a scientific panel,” he said. “To provide that independent scientific — not political, but scientific — evaluation of the science that’s relevant to policy-making. That’s why science advisory boards are established for various federal agencies. That science needs to be independent of politics.”

Chelsea Harvey is a freelance journalist covering science. She specializes in environmental health and policy.
These scientists want to create ‘red teams’ to challenge climate research. Congress is listening.

By Chelsea Harvey

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Prominent scientists operating outside the scientific consensus on climate change urged Congress on Wednesday to fund “red teams” to investigate “natural” causes of global warming and challenge the findings of the United Nations’ climate science panel.

The suggestion for a counter-investigative science force — or red team approach — was presented in prepared testimony by scientists known for questioning the influence of human activity on global warming. It comes at a time when President Trump and other members of the administration have expressed doubt about the accepted science of climate change, and are considering drastic cuts to federal funding for scientific research.

A main mission of red teams would be to challenge the scientific consensus on climate change, including the work of the United Nations’ Intergovernmental Panel on Climate Change, whose reports are widely considered the authority on climate science.

“The one way to aid Congress in understanding more of the climate issue than what is produced by biased ‘official’ panels of the climate establishment is to organize and fund credible ‘red teams’ that look at issues such as natural variability, the failure of climate models and the huge benefits to society from affordable energy, carbon-based and otherwise,” said witness John Christy, an atmospheric scientist at the University of Alabama in Huntsville, in his prepared testimony.

“I would expect such a team would offer to Congress some very different conclusions regarding the human impacts on climate.”

Wednesday’s hearing, which focused on “the scientific method and process as it relates to climate change” is the latest in a series of recent House science committee hearings to challenge the existence or seriousness of climate change. In their prepared testimonies Wednesday, witnesses called by the committee’s Republican majority suggested that organizations like the IPCC present a biased view of climate change,
and do not represent the views of the entire scientific community.

They argued that policymakers would benefit from assembling groups of experts to conduct assessments that challenge the accepted climate narrative.

“A scientist’s job is to continually challenge his/her own biases and ask ‘How could I be wrong?’” Judith Curry, professor emeritus at Georgia Tech’s School of Earth and Atmospheric Sciences and president of the Climate Forecast Applications Network, said in her own testimony. “Playing ‘devil’s advocate’ helps a scientist examine how their conclusions might be misguided and how they might be wrong. Overcoming one’s own biases is difficult; an external devil’s advocate can play a useful role in questioning and criticizing the logic of the argument.”

Curry also suggested that red teams or similar panels presenting diverse opinions on climate change could take on this role.

Red teams are special groups designed to improve an organization’s performance by assuming the role of a rival, challenger or devil’s advocate. They have sometimes been used by agencies like the CIA and the Defense Department to help test out security operations or military tactics by assuming the role of enemies, hackers or foreign governments.

But using them to challenge accepted climate science is “a completely ridiculous proposition,” said Peter Frumhoff, director of science and policy for the Union of Concerned Scientists.

The National Academy of Sciences already provides independent scientific advice to the government, he said, and it has consistently supported the scientific consensus that climate change is largely driven by human activity.

“The scientific community, in its various forms and in professional journals, has a very well-established, time-tested and by-and-large quite effective process for evaluating alternative hypotheses about any body of science — and that’s called independent peer review,” he told The Washington Post.

“The notion that we would need to create an entirely different new approach, in particular for the specific question around global warming is unfounded and ridiculous and simply intended to promote the notion of a lack of consensus about the core findings, which in fact is a false notion.”

Indeed, studies have consistently found that the vast majority of scientists agree that the burning of fossil fuels is the main driver of climate change.

However, Curry and Christy question the extent of human activity’s influence on the changing climate (although both acknowledge that it does play a role).

Christy points to his own research which suggests that the projections of certain climate models fail to match with observed temperature data (although, as our own Jason Samenow pointed out earlier this week, other analyses have shown climate models agreeing well with observational data). Curry has also questioned

The EPA has defined 43 areas of concern within the United States and Canada, which require special attention to return to an acceptable level of health. Three in the U.S. and four in Canada have been restored to acceptable levels through the Great Lakes Restoration Initiative.

Because the lakes were created by glaciers about 14,000 years ago, they do not have traditional watershed with tributaries. Instead, the Great Lakes basin collects water that falls within the immediate area.

Nutrients from agriculture flow into Lake Erie, causing algae blooms.
obvious choice. Secondarily, falling costs of wind turbines and solar panels made these new renewables more affordable in windy and sunny locations.

The result has been dramatic: In 2016, 30 percent of U.S. electricity came from coal (a reduction of more than 40 percent in 15 years), 34 percent originated from natural gas, and more than 6 percent came from wind and solar. Coal might not have fallen so quickly had electricity demand kept growing, but since 2010, consumption has been either flat or slightly declining.

The other formerly large coal market is almost gone: More than 90 percent of China's steel production starts with iron produced in blast furnaces fueled with coke, but two-thirds of America's declining domestic steel production now comes from recycled metal melted in electric arc furnaces. As a result, coking coal's share in America's overall coal use has fallen below three percent.

And while the United States is still a net coal exporter, foreign sales declined by nearly 60 percent between 2014 and 2016. International coal prices have been falling as well. So where would additional coal go in a country with stagnating electricity generation that is now dominated by natural gas, with marginal need for coking coal and with plummeting exports in a softening global market?

Exceptional circumstances can accelerate the gradual process of energy transitions: France's decision to develop nuclear energy on a grand scale is perhaps the best example of how that can be done by government fiat. In contrast, America's accelerated shift from coal has been driven by an inevitable embrace of cheaper natural gas.

And this substitution has another welcome consequence: Because per unit of energy natural gas combustion produces only about 45 percent of the carbon dioxide that coal does, energy-related emissions of this leading greenhouse gas in the United States declined by about 15 percent since fracking took off in 2005 — at a faster rate than in Germany with its “Energiewende,” a highly subsidized pursuit of accelerated shift to non-carbon energies.

This all leads to an unexpected conclusion: Actions by Trump may have as little effect on America's energy use as did those issued by the previous administration. Economic and technical imperatives — not any preconceived directives — will keep propelling the process of energy transition.

Vaclav Smil is a distinguished professor emeritus at the University of Manitoba and a fellow of the Royal Society of Canada.
Change in Climate Policy?

1. On March 28, President Trump signed an executive order at the Environmental Protection Agency. What actions are included in the order?
   a. 
   b. 

2. Why has President Trump issued this executive order?

3. What will influence the immediate implementation of this executive order?

4. What is the stand taken, point of view expressed or research finding by the following groups? Respond on your own paper.
   a. National Mining Association
   b. Bloomberg New Energy Finance
   c. Institute for Energy Economics and Financial Analysis
   d. Stanford University’s Wood Institute for the Environment

5. Summarize the argument made by Vaclav Smil in his guest commentary, “Trump’s coal policy will likely do just what Obama’s did.”

6. Which two of the supports for his position do you find most effective? Explain your response.
   a. 
   b. 

7. Why would it be good business to adhere to carbon standards of California, a state that has the sixth largest economy in the world?

8. Find examples of cities and “states taking control of their destiny” regarding power and energy regulations, climate change issues and environmental concerns.
9. Read the articles and do your research. What is the position and key actions on climate change of each of these actions and organizations?
   a. 2016 White House directive on climate change
   b. Clean Power Act
   c. Department of the Interior, Bureau of Land Management
   d. Duke University, Nicholas Institute for Environmental Policy Solutions
   e. Environmental Protection Agency
   f. National Environmental Policy Act
   g. National Rural Electric Cooperative Association

10. After considering the different perspectives on President Trump’s executive order to relax regulations on the coal industry, research and discuss one of the following topics. Web resources provide initial information.
   a. The coal industry, employment and the U.S. economy
      https://www.eia.gov/energyexplained/index.cfm?page=coal_environment
   b. Fossil fuel versus renewable energy generation for home and business use
   c. Impact of coal-burning on the environment
   d. Chile, China and other countries that are turning to solar power
      http://www.washingtonpost.com/sf/world/2017/03/31/while-trump-promotes-coal-other-countries-are-turning-to-cheap-sun-power/?hpid=hp_hp-more-top-stories_chilesolar-910pm%3Ahomepage%2Fstory&utm_term=.5d294d00bc07
   e. Conservationists’ response to President Trump’s order.
In the spring of 2010, a lone gray whale was spotted off the Mediterranean coast of Israel, an event that sparked international interest for an important reason: It was the first North Atlantic sighting of a gray whale, a species nowadays restricted to the Pacific Ocean, in about 200 years.

The case is just one example in a recent spate of animals turning up in places they don’t belong — generally, either Pacific species showing up in the Atlantic, or vice versa. Northern gannets, a North Atlantic species, have been spotted off the coast of California several times in recent years, for instance, while several Pacific species of auks, a type of diving bird, have recently been observed in the Atlantic.

It’s a perplexing — yet apparently increasing — trend. And while animals do occasionally wander outside of their ranges, scientists are starting to believe that the recent flurry of movements between the Arctic ice melt has animals migrating to strange places

By Chelsea Harvey

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A great shearwater, a species with a normal range in the North Atlantic, sighted among a flock of Bulle’s shearwaters and pink-footed shearwaters off of central California.
Atlantic and Pacific ocean basins are early evidence of yet another consequence of climate change. They’re arguing that as sea ice continues to melt in the Arctic, passageways are opening for certain animals — heretofore restricted by the ice — to start moving through, enabling them to cross into new territories.

This is the focus of a new paper, released Monday in the journal *Global Change Biology*, that explores the recent uptick in what the authors refer to as “faunal exchange,” or the movement of wildlife between the Atlantic and Pacific ocean basins, via the Arctic. Such movements are likely to be made possible by the opening up of passageways, including the famed Northwest Passage, a shipping route through the Arctic currently largely blocked by sea ice.

Marine mammals, such as whales or seals, are often physically prevented from moving through the Arctic by sea ice, which gets in the way of their swimming or prohibits them from coming up to breathe. And seafaring birds, while capable of flying over the frozen ocean, frequently choose not to do so because the ice prevents them from diving for fish.

But as passageways open up in the melting ice, these animals become more free to move about as they please. Such exchange could cause a variety of ecosystem-level changes down the road, the authors of the new paper argue, such as the potential for dramatic changes to food webs.

The paper bases its argument on the growing list of recent examples — the gray whales, the gannets and the auks, as well as unusual sightings of other birds and mammals, such as bowhead whales and shearwaters.

“Animals on occasion get lost and they show up in strange places — ‘birds have wings’ is the saying,” said the paper’s lead author, the aptly named Seabird McKeon, a research scientist with the Smithsonian Institution’s National Museum of Natural History. “There are some species that are more prone to vagrancy than others, and so we do have this backdrop of motion.”

However, he added, “when we’re talking about this exchange, and when the exchange starts becoming noticeable,” that’s when it becomes apparent that a pattern — likely caused by some other, external factor — is emerging.

“Some people might feel that this paper is not loaded down with evidence — they’re basically talking about 10 or 20 species that have been seen out of their geographic range — but they make a good point,” said Larry Crowder, science director for Stanford University’s Center for Ocean Solutions, who was not involved with the paper. “If there hasn’t been a gray whale in the Atlantic in 200 years and now there is one, that’s a change,” he said, adding, “They certainly didn’t overreach.”

In fact, Kristin Laidre, a principal scientist at the University of Washington’s Polar Science Center (who was also not involved with the paper), said that the ideas presented in the paper have been floating around the scientific community for some time. “I think in the kind of ecological studies that consider the consequences of ice loss, the idea that species in the Pacific may become more connected with species in the Atlantic [or vice versa] isn’t really a new idea,” she said.
Laidre was the lead author on a recent paper in Conservation Biology that explored the conservation status of Arctic marine mammals in light of the increasing effects of climate change in the region. The paper touches on the potential for increased movement of animals in the Arctic — and many of the species discussed in that paper also appear in McKeon’s new paper, where he and his colleagues have compiled a list of marine mammals and birds that they expect will move increasingly between the Atlantic and Pacific ocean basins in the future.

The list includes bird species such as Arctic terns, common eiders, Atlantic puffins and short-tailed shearwaters and mammals such as beluga whales, ringed seals and Atlantic white-sided dolphins. Altogether, the list contains dozens of species, including both polar species, which typically inhabit open waters above the Arctic Circle, and what the authors refer to as ice-edge species, which live south of the Arctic sea ice.

While no one can say for sure yet what consequences these types of movements could have, McKeon and his colleagues discuss a number of possible outcomes in the paper. It’s important to note that these outcomes are all speculative for the time being. However, scientists can look at past examples of other faunal exchanges to get a sense of what could happen in the future.

One example the authors point to is the Great American Biotic Interchange, which occurred several million years ago when the isthmus of Panama formed, allowing land animals a bridge to cross between North and South America. As the authors note, the fossil record indicates that in this case, mammals from North America invaded South America and outcompeted many of the native species there for resources. This type of outcome is a potential concern with species crossing from the Pacific to the Atlantic, and vice versa.

Additionally, introducing new predators into an area where they didn’t previously exist can “change food web dynamics profoundly,” Laidre pointed out, noting that the killer whale is a recent prime example. As the authors wrote in the paper, killer whales recently “expanded into ice-free areas of Hudson Bay where they were documented preying upon Arctic marine mammals including beluga (Delphinapterus leucas), narwhal (Monodon monoceros),
bowhead, and at least four species of seal.”

There could be genetic changes within migrating populations, as well, as they move and mix with one another. One consequence could be an increase in hybridization, whereby some species or subspecies could eventually be genetically phased out of existence, suggested Ryan Terrill, a Ph.D. candidate at Louisiana State University’s Museum of Natural Sciences, who served as a peer reviewer on the paper. On the other hand, this type of mixing could add genetic diversity to small subpopulations, which could be a good thing, said Laidre.

In general, Laidre said, the effects of the exchange will not necessarily be all negative. “It’s more of a big baseline shift,” she said.

And McKeon noted, “Populations of animals have been moving as long as there have been populations of animals.” So it’s not necessarily a good idea to try and stop them. The key, he said, is rather to increase the monitoring of wildlife as they move about in the Arctic to better understand which species are ending up where and how they might be affecting their environment. This information can help inform conservation tactics moving forward, including the need for updated international conservation agreements.

“As the Arctic opens, environmental protections may be undermined,” said Kirsten Oleson, an assistant professor of ecological economics at the University of Hawaii and a co-author on the paper. “We haven’t really thought about protecting fauna in the Arctic because it’s been so remote and there’s been so little access to the area. But as the access increases and these animals are moving through the newly liquified waters, then new environmental protections may need to be put in place.”

For instance, as animals move around and their surrounding ecosystems correspondingly adjust, humans may need to alter certain behaviors in order to avoid harming an already shifting and vulnerable environment.

“The paper stressed a lot about shifts in food webs of oceanic organisms, but not too much shifts in threats from humans,” Crowder pointed out. “If you have a lot of ships moving through the Northwest Passage, you’re also likely to have the potential for ship strikes of whales, which hasn’t been an issue because shipping [in the Arctic] has been pretty limited.”

In general, it’s fair to say that faunal exchange between the Atlantic and Pacific will largely be a “wait-and-see” kind of situation. Scientists seems to agree that it’s already beginning to occur, and will only increase as more passages open up in the Arctic — but its exact effects remain to be seen. Nevertheless, the phenomenon represents yet another — and little talked-about — consequence of anthropogenic climate change, one with potential far-reaching and large-scale implications for the world’s ecosystems.

“Inasmuch as we have created the situation, these are natural responses to changing global patterns,” McKeon said. “And so our responsibility, if anything, is to allow species to adjust and to adapt to a changing world in the same way that we are attempting to adjust and adapt to a changing world.”
Tom Toles | Climate Change

Editorial cartoonist Tom Toles often comments on climate change and the health of the environment. He acknowledges that other views exist, but is not hesitant to express his point of view.

In each cartoon, Toles’ alter ego appears in the lower right corner to emphasize the word play, satirize actions, expand the image or add another dimension to his point of view. “Read” each political cartoon before answering the questions.

October 16, 2015  Fish Soup

February 8, 2017  See Level

February 22, 2017  Power Plant

March 5, 2017  The Funding Battle
October 16, 2015  Fish Soup
1. Two figures appear on the right side of the editorial cartoon. What do you know about the Chesapeake Bay to which they refer as a memory?
2. Describe the fish in the “bowl.” Include details used in Toles’ artwork to convey the condition of the fish.
3. “Warming climate” is the provider of the heat to make the soup, according to Toles.
   a. Is his use of this metaphor (and exaggeration) effective in conveying a message?
   b. What is the message?
4. Toles’ alter ego in the lower right corner adds another level of commentary. He continues his metaphor. Explain the “seasoning” that was added to the water.
5. Toles has commented on activities impacting the environment for many years as this cartoon illustrates. Why are clean bays and streams important to communities?

February 8, 2017  See Level
1. What details identify the location of the mass?
2. Editorial cartoonists add labels to their images to provide clarity for readers. “Reality” and “Climate Change Denial” identify conflicting sides on a current issue. What is the issue?
3. a. Identify and describe the figure to the left. What details support your response?
   b. Who are the two figures to the right and above the crack?
4. In addition to using accepted symbols, Toles engages in word play. His alter ego in the lower right corner, states, “Still no increase in see level.”
   a. To what is he referring?
   b. What does “still” indicate?
   c. What does Toles want the figure on the left to “see”?
5. a. This editorial cartoon appears online with the headline: Climate data shows ice thinning and skulls thickening. Does this assist in understanding Toles’ point of view?
   b. What is Toles’ point of view on the topic?
February 22, 2017  Power Plant
1. a. What had been Donald Trump’s position on climate change before becoming a candidate for president?
   b. As president what has he said about climate change?
2. Look at the details included in the editorial cartoon. What signs of changes in climate are illustrated?
3. a. Who is the figure at the podium?
   b. What does the podium represent?
   c. Toles labels the foundation upon which he stands. What is he communicating through these details?
4. What does it mean to be “a plant”?
5. What sources of energy are power plants using today? What percent are renewable?

March 5, 2017  The Funding Battle
1. Two main images work together to establish the subject of this visual commentary.
   a. Select two details from the image on the left to explain what it represents.
   b. Select two details from the image on the right to explain what it represents.
2. This editorial cartoon comments on the 2018 federal budget that the Trump administration proposed.
   a. Which departments or priorities are forced to face off for funding?
   b. From the details in this visual commentary, for which department is the president requesting the most funding?
3. In addition to using symbols, labels and images, Tom Toles enjoys word play.
   a. Discuss his use of “Freeze.”
   b. Explain the word play in the comment of his alter ego who appears in the lower right corner.
4. Summarize Toles’ point of view on the topic, including his use of “protection” in the banner.
5. There are many additional discretionary spending limits and departments covered under the proposed budget. Toles chose these two to highlight.
   a. Do you agree with his commentary and choice of proposals to address?
   b. What is he emphasizing through his choice of proposed budget items to highlight?
Climate Change  | Impact on Ecosystems and Human Communities

In the United States and across the globe, spanning regional boundaries, influencing cultures and changing behavior, climate change has observable impact. Read to learn more about its influence on seven main areas. Summarize current findings.

Agriculture

Ecosystems

Energy

Human Health

Transportation

Travel

Water

Wildlife

Resources

Climate Change Evidence and Causes

Climate Change: Evidence, Impacts and Choices

EPA Climate Change
https://www.epa.gov/climatechange

NASA Vital Signs of the Planet
https://climate.nasa.gov/effects/

NOAA Climate Change Impacts
http://www.noaa.gov/resource-collections/climate-change-impacts