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7 reasons Arctic sea ice matters

By Russell McLendon
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The Arctic has seen better years than 2012. Its sea ice melted to an all-time low this summer, and by fall it was 18 percent smaller than at any point in recorded history. As U.S. scientists noted in their annual Arctic Report Card (http://www.arctic.noaa.gov/reportcard/), the region's sea ice is now "a younger, thinner version of its old self" – and that's not as flattering as it sounds.

This year wasn't just an anomaly, either. Arctic sea ice always waxes and wanes with the seasons, but its average late-summer minimum is now shrinking by about 13 percent every decade, according to the National Oceanic and Atmospheric Administration, and its six smallest Septembers have all occurred in the past six years.

Scientists widely agree the main catalyst (http://iopscience.iop.org/1748-9326/7/3/034011/pdf/1748-9326_7_3_034011.pdf) is manmade climate change, boosted by a feedback loop called "Arctic amplification." (Antarctic sea ice, meanwhile, is more buffered against warming – http://www.nasa.gov/topics/earth/features/earth20121112.html – and has actually expanded lately.) The problem has become well known even among laypeople, thanks largely to its compelling effect on polar bears.

But while many people realize humans are indirectly undermining sea ice via global warming, there's often less clarity about the reverse of that equation. We know sea ice is important to polar bears, but why is either one important to us?

Such a question overlooks many other dangers posed by climate change, of course, from stronger storms and longer droughts to desertification and ocean acidification. But even in a vacuum, the decline of Arctic sea ice could be disastrous – and not just for polar bears. To shed some light on why, here are seven of its lesser-known benefits:

1. IT REFLECTS SUNLIGHT.

Earth's poles are cold mainly because they get less direct sunlight than lower latitudes do. But there's also another reason: Sea ice is white, so it reflects most sunlight back to space. This reflectivity, known as "albedo," helps keep the poles cold by limiting heat absorption. As shrinking sea ice exposes more seawater to sunlight, the ocean absorbs more heat, which in turn melts more ice and curbs albedo even further. This creates a "positive feedback loop," one of several ways in which warming begets more warming.

2. IT INFLUENCES OCEAN CURRENTS.

By regulating polar heat, sea ice also affects weather around the world. That's because Earth's oceans and air act as heat engines, moving heat to the cold poles in a constant quest for balance. One method is atmospheric circulation, or the large-scale movement of air. Another, slower method occurs underwater, where ocean currents move heat along a "global conveyor belt" in a process called thermohaline circulation. Fueled by regional differences in warmth and salinity, this drives weather patterns at sea and on land.

Sea-ice loss affects the process in two basic ways. First, warmer poles can disrupt Earth's overall heat flow by changing its temperature gradient. Second, altered wind patterns push more sea ice to the Atlantic, where it melts into cold freshwater. (Seawater expels salt as it freezes.) Since less salinity means less density, melted sea ice floats rather than sinking like cold saltwater. And since thermohaline circulation needs cold, sinking water at high latitudes, this can halt the flow of warm, rising water from the tropics.

3. IT INSULATES THE AIR.

As cold as the Arctic Ocean is, it's still warmer than the air in winter. Sea ice serves as insulation between the two, limiting how much warmth radiates up from the ocean. Along with albedo, this is another way sea ice helps maintain the Arctic's chilly climate. But as sea ice melts and cracks, it becomes dotted with gaps that let heat escape. "Roughly half of the total exchange of heat between the Arctic Ocean and the atmosphere occurs through openings in the ice," according to the National Snow & Ice Data Center (http://nsidc.org/cryosphere/seaice/environment/global_climate.html).

4. IT KEEPS METHANE AT BAY.

Heat isn't all that can seep through weak sea ice. Scientists have long known that Arctic tundra and marine sediments contain large, frozen deposits of methane, posing a climatic risk if they thaw and release the potent greenhouse gas skyward. But in April 2012, researchers from NASA's Jet Propulsion Laboratory

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discovered "a surprising and potentially important" new source of Arctic methane: the Arctic Ocean itself (http://www.nasa.gov/topics/earth/features/earth20120422.html ; the study was published in the journal Nature Geoscience).

Flying north of the Chukchi and Beaufort seas, the researchers found mysterious methane fumes that couldn't be explained by typical sources like wetlands, geologic reservoirs or industrial facilities. Noticing the gas was absent over solid sea ice, they finally traced its source to surface waters exposed by broken ice. They still aren't sure why there's methane in Arctic seawater, but microbes and seabed sediments are likely suspects.

"While the methane levels we detected weren't particularly large, the potential source region, the Arctic Ocean, is vast, so our finding could represent a noticeable new global source of methane," NASA's Eric Kort said in a statement. "As Arctic sea ice cover continues to decline in a warming climate, this source of methane may well increase."

5. IT LIMITS SEVERE WEATHER.

It's well-established that global warming boosts severe weather in general, but according to the NSIDC, sea-ice loss also favors bigger storms in the Arctic itself. Under normal conditions, unbroken swaths of sea ice limit how much moisture moves from the ocean to the atmosphere, making it harder for strong storms to develop. As sea ice dwindles, though, storm formation is easier and ocean waves can grow larger.

"(W)ith the recent decline in summer sea ice extent," the NSICS reports, "these storms and waves are more common, and coastal erosion is threatening some communities."

In Shishmaref, Alaska, for example, years of fading ice have let waves eat a shoreline on the island location already softened by permafrost thaw. The sea is now invading the town's drinking water, threatening its coastal fuel stores and even forcing its residents to consider relocation. At the same time, a swell in Arctic storms and waves could also create yet another feedback loop, damaging current ice and impeding new growth as it agitates the ocean.

6. IT SUPPORTS NATIVE PEOPLE.

Shishmaref is an extreme case, but its residents aren't alone in watching their home crumble. Nearly 180 Alaskan native communities have been identified as vulnerable to erosion, Smithsonian anthropologist Igor Krupnik said at a 2011 summit on Arctic climate change, and at least 12 have already decided to relocate to higher ground.

Many Arctic people rely on seals and other native animals for food, yet the deterioration of sea ice can make it increasingly difficult and dangerous to pursue certain prey. Hunters must not only wait longer for ice to form, but must travel farther over mushier terrain. "Everywhere we asked people, they talked about increasing uncertainty," Krupnik said. "They talked about irregular changes in weather and weather patterns, they talked about flooding and storms, they talked about new risks of going out on thin ice."

Farther offshore, the retreating ice is often deemed good news for the oil, gas and shipping industries, which are already jockeying for drilling rights and shipping routes in newly ice-free waters. Such activity could pose risks on its own — from whales killed by ship strikes to shores fouled by oil spills — yet may also be hindered by stronger storms and waves, thanks to the same declining sea ice that enabled it in the first place.

7. IT SUPPORTS NATIVE WILDLIFE.

Sea-ice loss has made polar bears into poster children for climate change, and the shoe unfortunately fits. Like people, they sit atop the Arctic food web, so their plight reflects an array of ecological woes. Not only are they directly hurt by warming, which melts the ice rafts they use to hunt seals, but they also indirectly suffer the effects on their prey.

Arctic seals, for instance, use sea ice as everything from a maternity ward and pup nursery to a cover for stalking fish and escaping predators. Walruses also use it as a place to rest and congregate, so its absence often forces them to overcrowd shorelines and swim greater distances to reach food. Caribou have reportedly fallen through thin sea ice while migrating, one of many threats the hardy herbivores face from climate change.

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Not all wildlife likes Arctic sea ice, though. Warm, open seas let migratory whales stay later in the summer; some bowheads from Alaska and Greenland have even recently begun mingling in the Northwest Passage. And less ice means more sunlight for phytoplankton, the base of the marine food web. Arctic algae productivity rose 20 percent from 1998 to 2009, according to NOAA, especially in giant blooms near "skylights" in the ice.

Less sea ice also helps the Arctic Ocean absorb more carbon dioxide from the air, removing at least some of the heat-trapping gas from the atmosphere. But like most apparent perks of climate change, this silver lining has a cloud: Excess carbon dioxide is making parts of the Arctic Ocean more acidic, NOAA reports, a problem that's potentially fatal to marine creatures such as shellfish, coral and some types of plankton.

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