the weekly anthropocene

dispatches from the wild, weird world of humanity and its biosphere

By Sam Matey

North Carolina: Sharks and Shipwrecks. In a fascinating example of citizen science's potential for amazing new discoveries, the crowdsourced "Spot A Shark" program has revealed that female sand tiger sharks (*Carcharias taurus*) return year after year to the same sites. Even more interestingly, those sites are in North Carolina's famed "Graveyard of the Atlantic," a stretch of coastline home to hundreds of shipwrecks. Spot A Shark USA is a citizen science project run by North Carolina Aquariums that collects photographs of sand tiger sharks taken by scuba divers. (It's safe for the divers, as sand tiger sharks are a vulnerable yet docile species). The sharks' unique brown spot patterns are then analyzed to identify specific individuals. In this case, the researchers noticed that female sand tigers with the same spot patterns were returning, year after year, to the same wrecks (pictured above). Next, the researchers plan to look into why these patches of habitat are so important, and if they serve as breeding sites, birthing sites, or something else for the sharks. Fascinating news! For more, see https://tinyurl.com/y487y3xq.

Antarctica: Emperor Penguins and Eroding Sea Ice. For at least the last 60 years, the massive Halley Bay colony of emperor penguins, once home to 5-9% of the entire species, have raised chicks on the stable ice of Antarctica's Weddell Sea. Then, in 2016, 2017, and 2018, the sea ice broke up before the chicks were fledged. Thus, for the last three years, essentially all of the penguin chicks born at the Halley's Bay colony have drowned as their nurseries melted beneath them before they were able to swim. This has led to an immense drop in the colony's population, to the extent where it has now essentially disappeared. There is some good news, though. Many adults appear to have relocated to the neighboring colony of Dawson Lambton, a more stable place to raise chicks (for now). Although it's impossible to prove, this unprecedented collapse is likely to be due to climate change. For more, see https://tinyurl.com/yxchyjr5.

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New Technologies: Samarium-Water Ammonia Production. The Haber-Bosch process is one of the least known yet most vital contributors to humanity's current technological civilization. The process was invented in the early 1900s and uses hydrogen plus nitrogen from the air to create ammonia (NH_3), a vital fertilizer. Abundant, cheap ammonia enabled immense growth in agricultural productivity during the 20th century, making it possible for the planet to produce enough food for billions of humans. However, the Haber-Bosch process is also highly inefficient, converting only 10% of its source material to ammonia per cycle. It also only works at high temperatures and pressures, making it a major energy-guzzler, accounting for 1-2% of all human energy consumption and, specifically, 3-5% of all natural gas consumption. Now, a research team at the University of Tokyo has developed a revolutionary new means of ammonia production: the Samarium-Water Ammonia Production process, or SWAP. The researchers reverse-engineered the nitrogen-fixing capacities of the nitrogenase enzyme (found in plants' symbiotic nitrogen-fixing bacteria) to create a process in which protons from water and electrons from samarium are added to nitrogen gas from the air to form ammonia. The SWAP process can be run with common lab materials on a desktop scale at room temperature (as pictured, above) and is highly energy-efficient. "Our SWAP process creates ammonia at 300-500 times the rate of the Haber-Bosch process and at 90 percent efficiency," said team leader Professor Yoshiaki Nishibayashi. "Factor in the gargantuan energy savings in the process and sourcing of raw materials and the benefits really show." If this technology gets refined enough to be scaled up to industrial levels, it could be an incredible breakthrough. Great news! For more, see https://tinyurl.com/yyywdspd.

New Technologies: Neopentylglycol Cooling. Refrigerators and air conditioners are a surprisingly major concern of many climate scientists. As the world warms, more people will need cooling devices, yet most modern models rely on hydrocarbon (HC) and/or hydrofluorocarbon (HFC) gasses, which are toxic, flammable, and, if the device leaks, can contribute to climate change. Now, a Spanish team of materials scientists have found a solid crystal that acts as an efficient, harmless coolant. A crystal of neopentylglycol, when compressed, reconfigures its molecules to absorb a surprisingly immense amount of heat. Lead researcher Dr. Xavier Moya is currently working with Cambridge Enterprise to bring this transformative technology to market. Spectacular news! For more, see https://tinyurl.com/y637cvbb.