Vol. 15 No. 5 SPECIAL FOCUS + WILDLIFE EXTENSION September/October 2021

THE WILDLIFE PROFESSIONAL

Hitting the Lights

Illuminating the effects of artificial light at night

The 'N of 1 problem' in management agencies

A complex disease, simplified

Combating climate change with 'poo-namis'

Improving our Carbon Flukeprint

CONSERVING WHALES — AND THEIR 'POO-NAMIS' — CAN HELP COMBAT CLIMATE CHANGE

By Felicity Johnson

Credit: Felicity Johnson

▲ **A humpback whale lunge feeds in the Southern Ocean off the coast of Antarctica.**

As we near a point of no return in combating climate change, it is more urgent than ever that we curb carbon dioxide emissions, but taking action has not been easy. Many proposed solutions to reduce our carbon footprint are complex, untested and expensive.

What if there were a low-tech solution that was effective and economical, benefited wildlife and made use of nature's own systems?

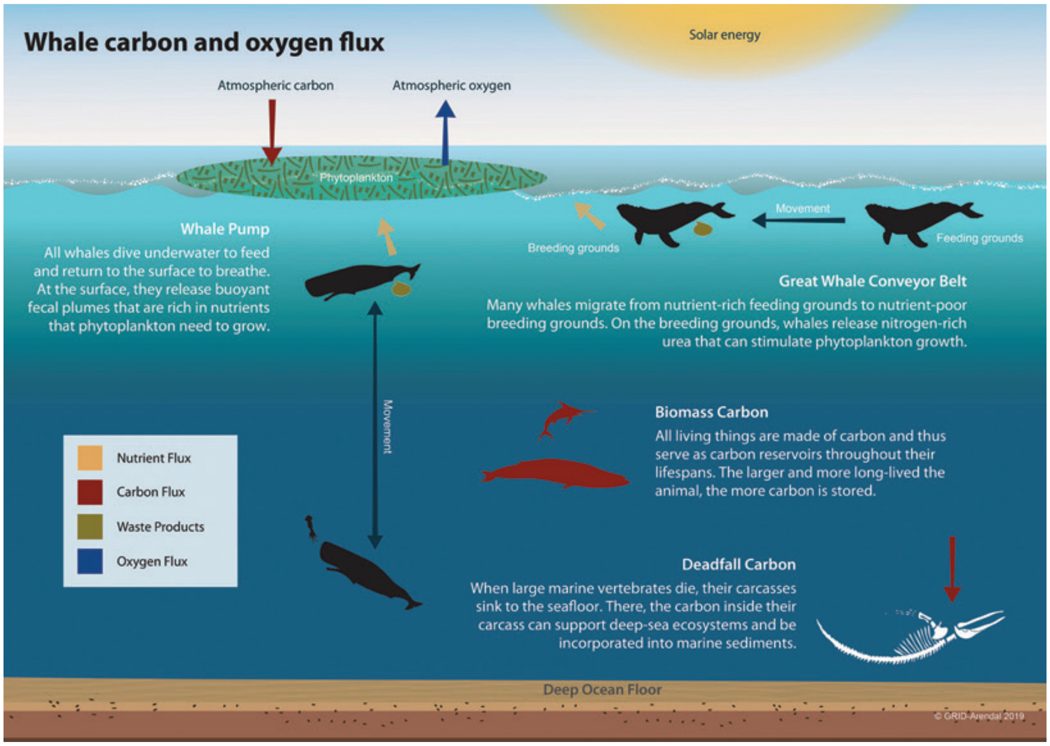
We have long recognized the important role that forests play in removing CO_2 from the atmosphere, but we have not paid enough attention to the sea. Oceans, however, are by far the planet's largest carbon sink. Carbon is captured across trophic levels, from microscopic plankton to the largest creatures on earth. At the base of the marine ecosystem, plant plankton contributes more than half of all oxygen in our atmosphere and captures nearly a third of all CO_2 produced (Basu and Mackey 2018). That's equivalent to 1.7 trillion trees — as much as four Amazon rainforests.

Antarctic krill (*Euphausia superba*), a type of animal plankton, ingest iron-rich particles as they feed on fragments of decaying organisms on the sea floor. When they return to the surface, these iron-rich krill become prey for filter-feeding baleen whales. A whale can swallow almost 2 tons of Antarctic krill a day and release a 200-liter plume of nutrient-rich feces sometimes nicknamed a "poo-nami." Freed metabolically from the ingested krill, the iron recycles back into the euphotic zone — the upper 200 meters of the ocean penetrated by sunlight. This positive feedback loop — known as the "whale pump" — leads to greater primary productivity and uptake of CO_2 from the atmosphere (Nicol et al. 2010).

In the Southern Ocean surrounding Antarctica, iron is a limiting nutrient. Without it, phytoplankton cannot reproduce and grow. While other oceans receive a steady stream of trace metals from continental runoff and dust, in the remote Southern Ocean, fecal matter may be the critical source. Thus, nutrient-rich fecal plumes — with iron concentrations 10 million times higher than the iron concentration in the Southern Ocean (Nicol et al. 2010) — are vital to stimulating phytoplankton growth and fixing atmospheric carbon.

The whale pump doesn't just work vertically, transporting nutrients between the sea floor and the surface. On their seasonal migrations, whales bear nutrients horizontally as they travel from cold waters to warmer, nutrient-poor waters, boosting productivity across all trophic levels.

Whales, and the great whales in particular — species such as the blue (*Balaenoptera musculus*), fin (*B. physalus*), and humpback whale (*Megaptera novaeangliae*) — play a significant role in capturing carbon from the atmosphere (Roman et al. 2014). The average lifespan of a great whale ranges from 60 to 90 years. In that time, a great whale can



Credit: GRID-Arendal

The whale pump mechanism transports nutrients both vertically and horizontally.

accumulate 33 tons of carbon in its body. That's more than 16 times the carbon a tree would absorb if it lived 100 years.

In addition to nutrient transportation, whales remove carbon by accumulating tons of it in their bodies. When they die, they sink to the seabed, providing an important small-scale, concentrated ecosystem (Lutz and Martin 2014). Known as a whale fall, the carcass is vital for deep-sea biodiversity, supporting rich communities for years. A whale fall passes through three stages. In the first, scavengers spend months or years consuming the whale's soft tissue. In the second, stretching months or years more, dense aggregations of polychaete worms and crustaceans surround the skeleton. In the final stage, microbes live off organic compounds from the decaying skeleton (Smith and Baco 2003) for decades, transporting captured CO_2 from the whale throughout the ecosystem.

The reason whales were commercially hunted for so long is precisely the reason they are so valuable now. Carbon-dense whale oil was a useful fuel. Only about 1.3 million whales swim the world's oceans today. If they returned to their pre-whaling numbers of 4 million to 5 million, they could add significantly to the abundance of phytoplankton in the oceans and boost the entire marine ecosystem. Even if whales could increase enough to boost phytoplankton productivity just 1%, we would capture hundreds of millions of additional tons of CO_2 each year — the equivalent of the sudden appearance of 2 billion trees. Emerging technologies may be able to do the same (Hepburn et al. 2019), but they are still in development, costly and potentially unreliable. Whale-based carbon sink technology has been in operation for millions of years.

Despite the drastic reduction in commercial whaling (since 1986, Japan, Norway and Iceland have been the only countries to continue commercial hunts), whales still face significant threats, including ship strikes, entanglement in fishing nets, noise pollution and climate change. Climate change can affect whales in a variety of ways, including rising sea levels and ocean acidification. But rising temperatures alone can affect their prey distribution, which could change whales' foraging behavior, cause nutritional stress and lead to fewer opportunities to reproduce.

The recovery of humpback populations in the Southern Hemisphere, however, stands out as a conservation success, demonstrating that we can recover and protect whale populations. Enhancing public awareness about man-made and climate-related threats to whale populations is vital. Simply by shopping locally — and shopping less — would help avoid excessive shipping, leading to fewer CO_2 emissions and diminishing the chances of ship strikes.

The important role whales play in carbon capture is clear. Protecting whales would deliver lifelong benefits to ourselves, the planet and of course, the whales. Nature has had millions of years to perfect whale-based carbon sink technology. If we let them live, the whales can help us continue on, too. ■

Felicity Johnson, MS, is a polar expedition guide and lecturer.