CIBUS and Environment, Part One:
How Can We Save Both the Rainforests and Sharks? Gene editing.

While attention on precision gene editing rightly has been focused on its potential to power the next agricultural revolution, the technology can also help solve a number of pressing environmental problems. Gene editing can do this by breeding substitutes for species and ecosystems now imperiled by demand for products for human consumption.

The Destruction of Palm Oil

For instance, in Indonesia and Malaysia, huge tracts of pristine tropical rainforest have been cut, burned and converted to palm plantations in order to meet the global demand for palm oil. Borneo, one of the most biologically diverse places on earth, has lost nearly 1/3 of its original forests, and conversion of forest to palm oil accounts for nearly 40% of that loss. Palm plantations are biological deserts -- the Union of Concerned Scientists estimates that only 15% of animal species can survive the transition from forest to plantation -- and the conversion has drastically affected such iconic creatures as orangutans, tigers, rhinoceros, toucans, leopards, pygmy elephants, as wells a countless other species, many of them unique to the island. The clearing of the forests and peatlands on the island, usually through burning, also contributes enormous amounts of greenhouse gases to earth's atmosphere, already overburdened with carbon dioxide.

The current trajectory is for things to get worse as global demand for palm oil continues to grow. The oil has uses in everything from making soaps and shampoos to frying fast foods to fueling diesel vehicles. Notably, however, almost all the demand for palm oil comes from its usefulness as an ingredient or facilitator – not an end product. In this, the hope and opportunity for gene editing emerges.

Let's put this another way: demand for palm oil has been driven by what it does. *Not* what it is. This means that if there was a cost-effective substitute for palm oil's usefulness as an ingredient in soaps and cosmetics, or as a cooking oil, or as the basis for biodiesel fuel, demand for palm oil itself can be reduced, which, in turn, will take some pressure off of Borneo's remaining forests. As it turns out, there are substitutes for all of these uses in various stages of development, and some of them are already in commercial production.

For instance, at Cibus, we have bred a canola plant that has ultra-high levels of what is called oleic acid, a naturally-occurring fatty acid that has the stability and shelf-life that makes a vegetable oil suitable for cooking and industrial lubricants. This high-oleic canola is already being grown commercially in the United States for the use as a lubricant. Separately, Cibus has been developing another variant of canola that has high levels of another part of the fatty acid chain. These are fatty acids commonly called MCTs, and the plants we are breeding will produce oils that match the composition of palm kernel oils, offering a substitute for palm oil in the production of soaps, washing powders and personal care items.

Precision gene editing can accomplish this breeding virtuosity by precisely tweaking those parts of the canola plant's genome associated with the specific parts of the fatty acid chain. Moreover, because the edits occur entirely within the genome of the plant, no foreign DNA is introduced, and the entire process is non-GM. The USDA affirmed that more than a dozen of Cibus' applications are not subject to regulations designed for GMO organisms.

Substituting the 21st Century Version of Whale Oil: Squalene

Far from the rainforest, in the coldest and deepest parts of the oceans, the global demand for cosmetics, lubricants and now, a vaccine for COVID-19, has also been putting pressure on other creatures. Over the eons, deep water sharks have adapted to the cold depths by developing livers than can produce an extraordinary oil called squalene, which maintains its viscosity at low temperatures. Unfortunately for the sharks, squalene has other properties that make it ideal for human applications ranging from facial cosmetics to the production of vaccines (where the oil's anti-inflammatory properties can give a vaccine more bang for its buck).

Because of the oil's unique properties, squalene (and it's widely used derivative squalene from olive) command high prices -- $20-$30 a pound. These prices in turn have spurred a hunt for the deep-water sharks reminiscent of the hunt for whale oil in the 19th century. The problem for the deep-water sharks has been compounded because they are adapted to an environment where they have few enemies and they are *very* slow to reproduce. A Greenland shark, which might live as long as 500 years, typically doesn't have offspring until it is 150 years old. Harvesting for shark liver oil thereby has upset the delicate balance that has allowed these extraordinary animals to persist for millions of years.

As in the case of palm oil, Cibus offers a solution. Nucelis, Cibus' subsidiary for non-agricultural applications of its technology, has been breeding a chubby yeast (scientific name *Yarrowia lipolytica*) to produce squalene and squalane. And in something of a two-for-one, the yeast's main feedstock is an industrial waste called glycerol. As of now, the oil has met the standards for cosmetic use, and efforts are being launched to determine whether the oil meets the pharmaceutical standards of purity that would make it suitable as an immune-boosting ingredient in vaccines.

There are but two of the environmental positive's gene editing can deliver. Cibus' technology also has much to offer in the fight to adapt the world's crops to the changing conditions wrought by climate change, all while helping reduce the use of fungicides and enabling farmers to make more efficient use of fuel and fertilizers. All of these efforts fall within Cibus' commitment to environmental sustainability. It is not an overstatement to assert that ESG is integral to Cibus' DNA.