



Hawaiian green turtle severely afflicted with fibropapillomatosis. ©Peter Bennett & Ursula Keuper-Bennett

## DIAGNOSIS

# Turtle Tumors

Researchers connect herpes virus to a domino effect set off by nitrogen pollution

**Researchers may have** solved the mystery behind a disease that leaves Hawaiian sea turtles with hideous tumors—and the tracks lead back to land, and to an amino acid called arginine.

The green sea turtle (*Chelonia mydas*) is an endangered species found around the world, mostly in tropical seas. Off Hawaii, populations have been relatively healthy and even growing. But in the 1980s, researchers noticed an uptick in a disease called fibropapillomatosis (FP), which can cause massive tumors to grow on a turtle's skin and face. Animal health specialists eventually linked the disease to a herpes virus, perhaps spread by

parasites. Why some turtles were struck by FP while others remained healthy, however, remained a puzzle.

In an effort to get a better handle on the threat, three researchers with the National Oceanic and Atmospheric Administration's Pacific Islands Fisheries Science Center decided to take a close look at the medical charts of nearly 4,000 turtles that had washed up dead or moribund on Hawaii's beaches between 1982 and 2009. Then they looked for clues that might explain the distribution of the turtles with FP, examining links to everything from age to where the turtles lived and what they ate.

Although they were working with imperfect data, the researchers saw some intriguing patterns emerge from the numbers, they report in *PLOS One*. For example, the disease appears to strike subadult turtles the hardest, perhaps because adults develop immunity.

More interesting, however, was that sick turtles were often found near landscapes with big "nitrogen footprints." The nutrient, heavily used as a farm fertilizer and produced by sewage-treatment plants, often washes into near-shore waters, where it can fuel algal growth. Indeed, after 1950, invasive algae had begun to thrive in Hawaiian waters with high nutrient loads—and many

green turtles had become dependent on the exotic plants for up to 90 percent of their food.

"The implications of this dietary shift may be profound," write Kyle S.

Van Houtan and his colleagues. That's because the invasive algae store up nitrogen in their tissues, specifically in the amino acid arginine. And arginine, it turns out, "is specifically important for herpes viruses which are linked to FP tumors." In particular, previous studies have found that the amino acid



promotes eye-related tumors. “This is particularly relevant,” the authors note, because “93 percent of Hawaiian green turtles with FP have ocular tumors.”

Although the links between nitrogen pollution, turtle diet, and disease seem strong, the authors “urge interpretative caution,” since “many factors contribute to the course of an infectious disease.” Still, the sleuthing suggests that “environmental factors are significant in promoting FP” and that the role of nitrogen pollution—and arginine—in viral diseases is worth a closer look. ♣

—David Malakoff

Van Houtan, K., S. Hargrove and G. Balazs. 2010. Land use, macroalgae, and a tumor-forming disease in marine turtles. *PLoS ONE* doi:10.1371/journal.pone.0012900.



get cracking on finding nonpolluting ways of producing energy.

In *Science*, Steven Davis and Ken Caldeira of the Carnegie Institution for Science in Washington, D.C., and Damon Matthews of Concordia University in Montreal calculate the answer to a deceptively simple question: what would future global temperatures and carbon dioxide levels be if we never built another emitting device and then let the rest live out their normal operating lives over the next 50 years? The exercise assumes that something like a current coal-fired power plant would last about 40 years, while a gasoline-powered clunker would last about 20 years.

The answer, says Davis, “surprised us.” According to climate models, average global temperatures would rise just 1.1 to 1.4 degrees Celsius over pre-industrial levels—well below the 2-degree rise that many scientists believe will cause catastrophic damage. And atmospheric concentrations of carbon dioxide would stabilize at about 430 parts per million (ppm), below the 450 ppm threshold that many experts believe should be the upper limit.

The results suggest that “we haven’t reached the point of no return” on climate, says Caldeira. “Most of the threat from climate change will come from energy infrastructure we have yet to build,” he notes, so “it is critically important that we build the right stuff now—that is, low-carbon-emission energy technologies.”

But saying farewell to fossil fuels will require big changes in policy and breakthroughs in energy technology, Martin Hoffert of New York University argues in an accompanying perspective. Governments, for instance, need to dramatically step up subsidies for renewable energy sources—which currently get less than

10 percent of the money given to fossil fuels. “We have to stop marching the wrong way,” he writes, “before we can turn around.” ♣

—David Malakoff

Davis, S., K. Caldeira and H. Matthews. 2010. Future CO<sub>2</sub> emissions and climate change from existing energy infrastructure. *Science* doi:10.1126/science.1188566.

Hoffert, M.I. 2010. Farewell to fossil fuels? *Science* doi:10.1126/science.1195449.



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## CLIMATE CHANGE Planned Obsolescence

Could freezing construction of new carbon-emitting devices keep us off the hot seat?

**If it were a game**, it could be called climate freeze-tag. A new study finds that freezing construction of all new carbon-emitting machines—and then letting the remaining cars, power plants, and factories run until they rust away—could prevent catastrophic global warming. But such a radical solution would be possible only if we

## PSYCHOLOGY

### Money Can't Buy Love

Compensation payments may not increase goodwill toward wolves



**Wolf conservation** has an unwelcome side effect: these carnivores prey on livestock and can breed hostility among rural communities. To address this problem, some regions offer compensation programs that pay residents for losses caused by wolf attacks. But such programs may do