Spread of Tropical Livestock Virus Linked to Climate Change

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Scientists have been predicting the spread of pathogens and diseases as the global climate warms and the global economy provides the pathways. But the appearance of a new insect-borne disease of livestock in the Netherlands this past summer went beyond the predictions, on several counts.

European governments and scientists had been aware of the possible spread of bluetongue disease since 1998, when it emerged in Greece and then in several other Mediterranean countries of Europe. Before that, the virus that causes the disease had largely remained at lower latitudes; 24 serotypes of the virus—a double-stranded RNA virus of the Reoviridae family—are known from Africa, Asia, Australia, and the Americas. Blood-feeding midges transmit the virus, which attacks the blood vessels of ruminants, primarily sheep, causing high fever, sweating, swollen feet, and in some animals a characteristic enlarged blue tongue. In Italy millions of sheep have died as a result of the disease.

Modelers at the University of Oxford studying the dynamics of the disease and the midge vectors had predicted bluetongue would not spread much farther north of the Mediterranean countries. That's why experts were stunned when bluetongue disease appeared on Dutch farms, well beyond the predicted range. But that wasn't the only surprise.

Genetic analysis revealed the virus did not match any of the serotypes that have become established in southern Europe. Instead, the northern virus turned out to be serotype 8, which is the type of bluetongue virus found in Nigeria and elsewhere in Central Africa. "That was the biggest surprise," says veterinary entomologist Willem Takken of Wageningen University, who studies the biting midges that transmit the virus.

The vector accounted for another surprising difference. In northern Europe, the virus seems to be transmitted primarily by *Culicoides dewulfi*, an abundant midge species that is difficult to distinguish from *Culicoides obsoletus* because of their similar morphologies. By contrast, the species that transmits the southern European viruses is *Culicoides imicola*, which was used in the Oxford model. And the northern virus seems to affect more hosts: Cows in northern Europe have come down with the disease while elsewhere cows are mainly carriers of the disease. Deer and other ruminant wildlife may be affected or be carriers as well.

No one can say how the virus arrived, or that global climate change is responsible, but the evidence "suggests it is related to global warming," says Takken. Somehow—perhaps on an illegally transported animal—the virus from tropical Africa arrived in the rural Netherlands, where in July 2006 it encountered not only a suitable insect vector but the hottest weather since record keeping began there in 1703.

The virus "jumped continents, and we had a suitable climate for this to emerge," says Takken. He and his coworkers have found that the temperature threshold at which the disease is transmitted is about 18°C—warmer than northern Europe's average summer temperature of about 16°C. But with the general warming in Europe of about 1.5°C over the last century, and last summer's temperatures averaging 20°C, the disease was able to take hold.

Other experts agree that climate warming has played a role in bluetongue's expansion, first into the Mediterranean region and now, from a different reservoir, into northern Europe. "The tantalizing association is that temperature exerts a profound effect on the ability of the virus to replicate in insects," says James MacLachlan, a pathologist at the University of California–Davis who studies bluetongue disease. "The warmer the temperature, the greater the ability of virus to replicate."

Ecologist Andy Dobson of Princeton University, who studies wildlife diseases, says bluetongue's appearance so far north "is the first convincing case" of what scientists have been predicting: a warmer climate allowing vectors and pathogens to find suitable hosts and to thrive in new territories. And bluetongue most likely won't be the last. "You should be very worried," he told the audience during his keynote speech at the EcoHealth One conference held in Madison, Wisconsin, in October.

Despite quarantine and other efforts at containment, the new disease has been spreading in northern Europe. As of late October, bluetongue had been found on 320 farms in the Netherlands, 250 in Belgium, 200 in Germany, and 4 in France. Trade in livestock, a major industry, has come to a standstill. Despite the disease's spread, optimists are hoping the virus will not survive this winter, but Takken raises the possibility that "we'll have to live with the situation."

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