

A tropical parasitic disease has invaded Europe, thanks to a hybrid of two infectious worms

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At least 120 people contracted schistosomiasis in the Cavu River; another river nearby has become infested as well.

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By [Elizabeth Pennisi](#) Aug. 28, 2018 , 4:30 PM

MONTPELLIER, FRANCE—Infecting an estimated 230 million people, schistosomiasis is the world's most widespread parasitic disease after malaria. But temperate latitudes were thought to be spared: Schistosome flatworms are common only in warm places in Africa, India, and South America. So parasitologist Jerome Boissier was surprised when, in a single week in 2014, physicians in France and Germany called him to report that two families who had never left Europe had developed the disease, which can cause fever, chills, muscle aches, and bloody urine.

Epidemiologists later traced the cases to the Cavu River on Corsica, a French island in the Mediterranean Sea, where the patients had swum during a vacation. Scientists found that a local freshwater snail was serving as the intermediate host that's essential to the flatworms' complicated life cycle. The river is still infested: At least 120 people have become infected. And the disease is turning up elsewhere on Corsica.

In earlier work, Boissier, who's at the University of Perpignan Via Domitia in France, had shown that the culprit is no ordinary schistosome parasite, but rather a hybrid of two species. Now, his team has uncovered the hybrid's advantage: It appears to be better than the parent species at infecting both the snails and its unfortunate mammalian hosts. Such hybrids, discovered in other parasitic species as well, could widen a parasite's range of host mammals, complicating efforts to control it. Presented here last week at the Second Joint Congress on Evolutionary Biology by Boissier's grad student Julien Kincaid-Smith, the work "is changing the way we think about disease transmission," says Christina Faust, a disease ecologist at the University of Glasgow in the United Kingdom.

Humans and other mammals infected with schistosomiasis shed eggs in their feces or urine, which hatch if they reach freshwater in time. The hatchlings then take up residence in snails, where they mature and reproduce asexually, yielding tiny larvae that exit the snail. If those larvae encounter another swimming or wading mammal, they burrow into its skin and settle in blood vessels, completing the life cycle. Two species infect humans; the most common one, *Schistosoma haematobium*, causes urogenital schistosomiasis. It often resides in veins in the bladder wall or the reproductive tract and can damage organs or impair fertility. Although the antiparasitic drug praziquantel is effective, patients in developed countries can go undiagnosed for years.

S. haematobium probably reached Europe after a patient infected elsewhere traveled to Corsica and urinated in the Cavu River, Boissier says. An intermediate host was waiting: The river is home to the snail *Bulinus truncatus*—one of a few *Bulinus* species that can support schistosomes—which also occurs in some African and Middle Eastern countries. The outbreak "is a wake-up call that this disease can establish itself wherever the right [conditions] exist," says immunologist Daniel Colley of the University of Georgia in Athens, who notes that global travel makes such introductions more likely.

Two years ago, Boissier's team reported that DNA tests on the parasite eggs suggested the new arrival was a hybrid of *S. haematobium* and *S. bovis*, a schistosome species that infects livestock; on the basis of the hybrid's DNA, Senegal was the most likely source. The hybrids themselves were not news; Tine Huyse, a parasitologist at the Catholic University

of Leuven in Belgium, and a colleague had found them in Senegal in 2008. But Kincaid-Smith traveled to Senegal and Cameroon to collect the parent strains, and the team bred them in the lab to re-create the hybrid. The researchers then tested the ability of the parents and hybrid to infect snails and—as a stand-in for humans—hamsters.

A European foothold

Schistosomiasis was discovered on the French island of Corsica in 2014; a DNA analysis suggests it originated in Senegal.



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The human parasites found in Africa didn't infect the Corsican snails, Boissier reported. *S. bovis*, the animal variety, did infect the snails, but the hybrid did so even more readily, and it thrived not only in Corsican snails but also in *B. truncatus* snails from Spain and a related snail species from Portugal. The hybrid also developed faster in hamsters and made them sicker.

Hybrids have emerged in other parasites, including the agents that cause malaria, leishmaniasis, and Chagas disease. Just how important they are in epidemiology is still unclear, but their existence is worrisome, Huyse says, and they seem set to become more common as travel and migration expand. Hybrids are more likely to infect multiple hosts, allowing some of them to “hide” in nonhuman animals, out of reach of the drugs given to people. And combining two genomes gives a parasite more genetic variation with which to adapt to new places and hosts, Faust says.

When Kincaid-Smith and his colleagues teamed up with the Wellcome Sanger Institute in Hinxton, U.K., to fully sequence the hybrid, they found that three-quarters of its DNA came from the human parasite and the rest from *S. bovis*. That mixture may boost the ability of the hybrid to infect the Corsican snail, but with a quarter of the genes from *S. haematobium* missing, “it’s a wonder how the parasite can still infect humans,” said Kincaid-Smith, who with his colleagues posted a preprint about the genome study on bioRxiv on 11 August. The fact that DNA from the two parent species was quite mixed up—

sections of *S. bovis* chromosomes appeared at various places along the *S. haematobium* chromosomes—indicates that hybrids have been around long enough to mate with parents and with each other over multiple generations.

“The level of genomic information [in the study] is impressive,” Colley says. But he’s cautious about extrapolating the findings about the infectious superpowers of the labmade hybrid to what happens in nature. “We do not know how it will play out in the long run in terms of worsening the spread of or impeding the control of schistosomiasis,” he says.

Schistosomiasis seems set to stay on Corsica. Although no human cases occurred in 2017—after a total of seven cases in the two preceding years—the worms still occur in snails in the Cavu River; they also have surfaced in the nearby Solenzara River, Boissier says. Whether they overwinter in snails or take refuge in rodents or some other mammalian host isn’t clear, Kincaid-Smith told the meeting: “That’s also something that needs to be investigated.”