

America's troops came to liberate Italy in the Second World War, but they may have brought with them a deadly fungus that is still killing trees now

ON THE Italian coast, just 15 miles south of Rome, lies the Presidential Estate of Castelporziano. The size of a town, it has been virtually sealed off to the public for centuries. Except for a handful of eucalyptus interlopers, the forest is celebrated for its exclusively Italian flora and its rich history. Popes favoured it as a hunting ground; it became the property of the Italian king in the late 19th century and, after the dissolution of the monarchy, passed into presidential hands.

The 15,000-acre estate also played a starring role in the Second World War. American soldiers set up camp there to direct their drives against German troops, and their assault against Mussolini.

Now the cost of that brief settlement has become painfully clear. As well as their supplies, the soldiers may have brought with them an uninvited guest — a deadly fungus that, decades later, appears to have wiped out large chunks of Italian stone pines by causing them to rot from the inside out. Mycologists say it is possibly the first example of a pathogen hitching a ride across continents as a result of military activity.

The conclusion is a result of an investigation that began in the 1980s, when staff on the estate noticed that the pines were showing signs of rotting. The infected trees died quickly, leaving a desolate spot dotted with a few survivors. Analysis showed that the culprit was the *Heterobasidion annosum* (*H. annosum*), a root fungus that spreads destruction by moving between tree roots. It is known to target pine, fir and spruce.

Dr Paolo Gonthier, from the University of Torino, and Dr Matteo Garbelotto, from the University of California, Berkeley, collected samples of the fungus for genetic analysis. Garbelotto was particularly interested in locating the origin of the scourge — his laboratory had been compiling a genetic database for *H. annosum*, showing how the fungus from different parts of the world varies genetically.

Their results were surprising — all the samples contained DNA signatures characteristic of North American variants. Moreover, the samples at Castelporziano differed among themselves, showing that the fungus had lain in the forest long enough to be many generations removed from the founding pathogen that had colonised the woodland.

The discovery that the fungus was American rather than European immediately raised the question of how it had ended up so far from home. Its arrival could not have been via an infected newcomer — no exotic (ie, non-native) species had been planted, except for the eucalyptus trees, which stood too far away to be responsible. Visitors, especially foreign ones, had been few and far between over the centuries. The pathogen's airborne spores cannot survive over great distances — the farthest documented airborne leap for this fungus is a few miles. Moreover, the fact that the pathogen had mutated into several forms showed that it was not a recent settler.

The clue came when the scientists, whose study appears in the journal *Mycological Research* this month, traced the history of the estate. During interviews with staff and a subsequent search through military archives, they learnt that, for one month in 1944, the 85th Infantry Division had set up an encampment. This looked like the missing link — *H. annosum* most probably sneaked in on military equipment constructed from untreated lumber, such as crates or pallets.

Because the fungus, known to be a slow killer, wreaks its damage from the inside out, it could established itself undisturbed over the following decades. Its presence became known only in the 1980s.

“There is little doubt in my mind that the source of the pathogen was the US Army,” says Garbelotto, an assistant professor in ecosystems science. “Everything matches — the timeline and location of infection, plus the region of origin of the fungus.”

It may not be an isolated case, according to Garbelotto. The American military may have carried several pathogens from army bases into Europe: “The sources of tree diseases that have afflicted Europe this past century, including chestnut blight, often seem to be near US military bases, but (plant pathologists) had no way of proving the link. This study is as close to a link as we've got.”

The scientists suggest that the military imposes selfregulation to ensure that the movement and stationing of troops abroad does not spread unwanted microbes into virgin territory. It is more effective, they say, than cleaning up the environment afterwards because — as Castelporziano shows — it can take decades for a pathogen to reveal itself, by which time eradication becomes all but impossible.

“Quarantines and regulations already exist to guard against the introduction of pests and pathogens from lumber brought in through commercial and other sources, but there is no equivalent standard for lumber brought in by the military,” says Garbelotto, also an expert in forest pathology. “This study suggests that when planning military operations abroad, there is a need, and a responsibility, to check for potential micro-organisms that could be introduced to foreign lands, and to take measures to prevent them from spreading.”

Efforts are now focused on stopping the fungus spreading beyond the estate. Exposed stumps and bark can be sprayed with anti-fungal treatments, and pruned trees are also treated to minimise infection.

Only time will tell whether the Italian stone pines — regarded as the landmark tree of the Mediterranean coast — can survive the onslaught of this foreign invader.

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