Scientists warn of emerging fungal peril

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Little brown bats showing signs of white nose syndrome.

Fungal diseases are a major threat not just to wild plants and animals, but to us.

A new *Nature* paper shows we're already heading for huge fungal damage to vital crops and ecosystems over the coming decades. If we don't do more to stop these diseases' spread, their impact could be devastating.

Fungi already destroy at least 125 million tonnes a year of rice, wheat, maize and potatoes and soybeans, worth $60 billion. Researchers estimate that in 2009-10, this lost food could have fed some 8.5 per cent of the world's people. And this is just the result of persistent low-level infection; simultaneous epidemics in several major crops could mean billions starve.

But the threat has gained a new urgency lately, and crops aren't the only thing at risk. More and more of these killer fungi are appearing, and they're increasingly attacking animals.

Emerging fungal epidemics already account for 72 per cent of extinctions from disease – more than bacteria and viruses put together. For instance, amphibians are being wiped out at an unprecedented rate by a deadly chytrid fungus that's been spread by the global animal trade; at least 500 species are thought to be at risk. Likewise, bats are being struck down by so-called White Nose Syndrome, which has spread all over North America since it was first spotted in 2006.

"We've known for a long time about fungal pathogens like Dutch elm disease and potato blight," says Dr. Mat Fisher, an expert in fungal infections at Imperial College London and one of the paper's authors. "But we're seeing more and more of these pathogens, and they are starting to affect animals in a way we've never seen before. The chytrid fungus has wiped out 40 per cent of amphibian species in some parts of Central America in just a few years, and we don't know what the knock-on effects will be."

New fungal diseases keep appearing, affecting organisms from bees and corals to sea otters. If we don't do more to control them, we could see species wiped out all over the planet.

In many cases there are direct consequences for humans. For example, bats eat insects that would otherwise attack crops; studies suggest White Nose Syndrome could end up costing farmers some $3.7 billion a year. But even organisms that aren't obviously useful to us will have unpleasant consequences somewhere down the line if they disappear.

"Ultimately you can't separate ecosystem health from human health – eventually, these birds will come home to roost," Fisher says, adding that

the less diverse ecosystems become, the less they can stand up to sudden changes.

Fungal diseases are even making climate change worse; scientists estimate that the trees they've killed or damaged would otherwise have absorbed 230-580 megatonnes of CO2 – around 0.07 per cent of the total in the atmosphere.

Unfortunately it's almost impossible to eradicate fungal disease once it's loose in a wild population. But by tightening rules on the transport of plants and animals around the world, we could limit these pathogens' spread into new areas.

Why have fungi become so deadly? Many have tough, long-lived spores, so they can survive without a host for much longer than most bacteria or viruses. Combined with our unprecedented levels of global trade and travel, this makes it easy for fungi to reach new areas. And environmental change may be helping them thrive once they've arrived.

Moreover, many fungi – particularly those that target animals – can infect several species. If a pathogen affects just one victim and it wipes it out, it has doomed itself too. So most single-species infections reach equilibrium with their host population, and never kill it off entirely.

But diseases that jump between species work differently. They aren't tied to one species, so there's no reason to avoid wiping a host out. And some species will be more vulnerable than others. The more resistant ones can carry the fungus without serious harm, so they can spread it about, infecting even isolated pockets of their more vulnerable cousins. For instance, in the UK the invading North American signal crayfish is wiping out the native white-clawed crayfish with the help of a fungus-like disease that the invader tolerates but that's deadly to its indigenous rival.

Finally, fungi are adept at swapping genes between themselves, so when we bring different species into contact, dangerously virulent combinations can result.

Fisher says we need to start taking biosecurity far more seriously – cutting down the amount of living material we transport around the world, quarantining what we do transport far more rigorously, and doing more to stop the illegal trade in plants and animals. Eventually, breakthroughs in genetic diagnostic technology may make it possible to screen plants and animals for fungus or spores. But in the meantime, we need to do more to prevent outbreaks, and move quickly to control those that do happen before they get out of hand.

He adds that we also need to train more mycologists to analyse these emerging threats - the subject has itself come dangerously close to extinction in recent years. And mycologists need to communicate their work more effectively to policy-makers and the public.

More information: MC Fisher et al. Emerging fungal threats to animal, plant and ecosystem health. *Nature*, 12 April 2012. DOI 10.1038/nature10947