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Editorial

EcoHealth and the Black Death in the Year of the Rat

The current issue of *EcoHealth*, timed to coincide with the Olympic Games in Beijing, has a special focus on China. China's history is complex, steeped in a culture that intertwines philosophy, science, and art, and has a great deal of relevance to the ecological context of health. For example, this year marks the 662nd anniversary of the second siege of Caffa (in modern-day Ukraine), where the Black Death first entered European history (Wheelis, 2002). In the West, students are taught that the Black Death originated in China and swept across Central Asia into Europe via the Silk Road. To all intents, this appears as a simple case of globalized trade driving the emergence of a new pathogen from China, with echoes of SARS in 2003. Of course, this is not just a simplified view of one of the world's greatest pandemics, it's also wrong. There is convincing historical evidence that the plague bacterium, *Yersinia pestis*, and its rodent reservoirs were present much closer to Europe than often realized, including in the steppes of Southern Russia (Benedictow, 2004) where the Mongol leaders that besieged Caffa originated. Furthermore, religious and political changes meant that the Silk Road was effectively closed for European traffic in the few years prior to 1346.

So what were the origins and causes of the Black Death? As so often is the case with emerging diseases, the underlying causes are a complex amalgam of social, environmental, and ecological drivers that provided ideal conditions for Black Death's rapid spread and high mortality rate. First, there was demography, with the burgeoning population of Europe (around 75 million) emerging from the Dark Ages into relative prosperity, stretching resources in the countryside, and flocking to overcrowded cities, leading to poverty and squalor—perfect breeding grounds for the key plague reservoir, the black rat. This inserts another driver, invasive species—the black rat is not endemic to Europe and was likely introduced from Asia many centuries earlier through trade. The plague vector, the rat flea, also finds ideal conditions in Medieval Europe, with the average peasant rarely bathing as part of a Christian ethos of avoiding temptations of the flesh, and for convenience's sake. Indeed, Catherine of Siena (born in 1347) is alleged to have never bathed. Then there was a potential link with climate—the beginning of the Little Ice Age, which led to reduced crop yields, famine, and destitution of much of the peasant population. In Italy, the famine was still raging as the first plague deaths began. These climate changes also dried out some parts of the steppes, pushing human populations into new areas, and changing the spillover dynamics between plague reservoirs and people. Thus, when the plague entered the Tartar armies laying siege to Caffa, and moved over into the Genoese Italian merchants who founded the port, it entered a population and region primed for its explosive spread.

Returning to China, we are reminded that 2008 is the Year of the Rat. The Year of the Rat is not a celebration of this animal's predilection for sewage systems and garbage. It's more a celebration of the rat's incredible propensity for industry in pushing the boundaries of escapism, colonization, and persistence. With this symbol in mind, and the global collective community focused on China for this unique sporting event, we ask ourselves what lessons we can learn from history about modern day plagues such as SARS. It's true that the SARS pandemic of 2003 has many features in common with the Black Death. First, its origins are complex, and rooted in social change, demographic and ecological dynamics. The same demographic changes affecting Europe in the Middle Ages have swept across China in the last few decades, with a booming population and a massive influx into urban centers, as discussed in the article by Ali and Zhao (2008) in this issue. This expanding prosperity and development is the overriding feature of modern

China that will confront the millions of first-time visitors to our country this year. With it, we see an increasing demand for traditional wildlife food sources. At the same time, we are witnessing a period of globalization based around a still expanding air transport network which brings a dangerous type of close, yet poorly perceived contact with wildlife all around the world (Daszak et al., 2007). When SARS spread regionally and then internationally, just like the Black Death, it emerged into a dense, interconnected population of people with little (or no) herd immunity and an unprecedented ability to move around the planet.

So, how has our global response to pandemics changed over the six centuries since the siege of Caffa? In 2003, China moved rapidly and dramatically to deal with the threat of globalized outbreaks. Hospitals were built, quarantine measures put in place, and collaborative teams from around the world invited to work on identifying the cause of the outbreak and preventing its further spread. This spirit has continued, with pressure put on the wildlife markets (some of which were convincingly identified as the source of the agent) to close, and continued efforts to collaborate internationally to prevent the emergence of another pathogen. The SARS outbreak also made us realize the value of global communication. The world understands now that when someone in China butchers a wild animal in a restaurant, or for that matter, a farmer in Washington state sends a BSE-infected cow for slaughter, the impacts can be felt on the other side of the globe within days. The ultimate solutions to this weakness in our global system need not require dramatic modification of global behavior. Just like building in an earthquake zone—development within, and connections across, the network of emerging disease hotspots need to combine progress in commerce and trade with surveillance and control measures. In China, our own efforts, built around a new joint center for research on wildlife zoonoses in Shanghai, adjacent to a key hotspot, bring together a global network of scientists committed to identifying pathogens that threaten to emerge from wildlife into our globalized population. There are other significant advances—a network of CDCs across China linked to well-supported infectious disease labs, substantial and increasing international support from groups like the Pasteur Institute, Shanghai and the WHO, and a sophisticated body of Chinese research on biomedical solutions to emerging diseases.

There remains a great deal to understand about SARS and the ability of future pathogens to emerge in Southeast Asia. For example, we are still uncertain about exactly how (or if) the chain of transmission occurred from progenitor viruses in bats to SARS in people (Halpin et al., 2007). Here, we need to bring social science, demography, ecology, and infectious diseases together—a truly "EcoHealth" approach. We also might ask what is being done to uncover the social networks that underlie disease emergence globally. Who is studying global patterns of travel and trade as it relates to disease, or the ability of climate change to shunt disease vectors from A to B? Who is working on how livestock production patterns change as countries become richer and poorer, and how this relates to the risk of disease emergence? The answers, we hope, may be found with people reading this article—the new generation of EcoHealth scientists who see disciplinary boundaries as an interesting challenge to be broken down rather than an insurmountable obstacle. To you, we say *jìxù hǎo hǎo gōngzuò* (继续好好工作)[1] and welcome you to this issue, with its special focus on EcoHealth in China.

Shu-yi Zhang

School of Life Science
East China Normal University, Shanghai, China,
e-mail: syzhang@bio.ecnu.edu.cn

Lizhong Yu

East China Normal University, Shanghai, China

Peter Daszak

Consortium for Conservation Medicine, New York, NY
e-mail: daszak@conservationmedicine.org

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[1] Keep up the Excellent Work!