



Contents lists available at ScienceDirect

Forest Policy and Economics

journal homepage: www.elsevier.com/locate/forpol

Tree disease and pest epidemics in the Anthropocene: A review of the drivers, impacts and policy responses in the UK

Clive Potter, Julie Urquhart *

Centre for Environmental Policy, Faculty of Natural Sciences, Imperial College London, London SW7 1NA, UK

ARTICLE INFO

Article history:

Received 21 December 2015

Received in revised form 28 April 2016

Accepted 17 June 2016

Available online xxx

Keywords:

Anthropocene

Global trade

Tree pests and diseases

ABSTRACT

The growing incidence of new tree pest and disease epidemics, many of them with the potential to radically reshape our native woodlands and forests, is closely linked to a significant upsurge in global trade and transportation in recent decades. At the same time, interventions designed to actually manage any pest and disease outbreaks that occur can reshape forest landscapes in a variety of ways. In this review-based paper we argue that disease-driven interactions between biology, public policy and human agency along pathways of introduction and at outbreak sites will become increasingly common in the Anthropocene, where the latter is understood as an era in which human influence over non-human nature is ever more pervasive. We discuss the nature of these interactions in terms of the increased risk of disease introduction via various trade pathways and through the subsequent policy and behavioural responses to two disease outbreaks made by policymakers and stakeholders in the UK (*Phytophthora ramorum* and ash dieback (*Hymenoscyphus fraxineus*)). Human influence is evident both in terms of the underlying risk drivers and in the subsequent course and management of these and other outbreaks.

© 2016 Elsevier B.V. All rights reserved.

1. Introduction

If it is true, as advocates of the Anthropocene contend, that humans have become the dominant force influencing natural systems, then the introduction and spread of invasive pests and diseases via commercial trade and transportation since the Industrial Revolution must be one of its most troubling features. Indeed as Anderson et al. (2004) argue, the introduction of alien pathogens has until recently been one of the most underestimated causes of global anthropogenic environmental change. The growing incidence of new disease outbreaks and epidemics, many of them with the potential to reshape our native and commercial woodlands and forests at a landscape scale, is closely linked to a significant upsurge in the global movement of plants and plant products and the use of infected or infested wood for the packing of other goods in trade in recent decades (Brasier, 2008; Eyre et al., 2013). As Evans (2014) observes, the resulting unprecedented mixing of species across continents and ecosystems is surely one of the most profound manifestations of the Anthropocene. Insects that previously had been constrained by native predators that limited their population growth are being introduced into new environments in which natural predation is much less or even absent altogether; newly introduced pathogens, meanwhile, are presented with potential new host species and microbial and biotic opportunities to exploit. Moreover, human mediated

climate change, by creating opportunities for spread for organisms previously constrained by low temperatures, further exacerbates the problem. Alongside increased temperatures, more frequent severe weather events such as storm, drought and fire are likely to provide further opportunities for both alien and native pests to flourish (Evans, 2014).

The resulting tally of new pest and disease outbreaks, many of them unknown to science a decade or two ago, now pose a significant threat to the world's trees, woods and forests. For example, the spread of *Hymenoscyphus fraxineus* (Chalara ash dieback) throughout north-western Europe, and its arrival in the UK in 2012, is just the latest in a series of pest and disease outbreaks that have swept through Europe's forests over the last 10 years (Boyd et al., 2013). Well documented outbreaks include those due to oak processionary moth (*Thaumetopoea processionea*), an insect pest now widespread throughout Belgium, the Netherlands and Germany, chestnut blight (*Cryphonectria parasitica*), a fungal pathogen that had a devastating impact on the American chestnut (*Castanea dentata*) in the eastern United States in the early 1900s and pine tree lappet moth (*Dendrolimus pini*), a native of continental Europe, Russia and Asia, where it has long caused periodic and large-scale damage to pine plantations (*Pinus* sp.).

The cumulative impact of these and various other pests and diseases is often dramatic and widespread. Globally, the damage caused by invasive forest pests and diseases can significantly impact on a range of ecosystem services, reducing biodiversity and wildlife habitats, altering natural landscapes and their recreational or cultural value, as well as affecting the ability of forests to sequester carbon, protect watersheds or combat desertification (Boyd et al., 2013; FAO, 2009). In addition,

* Corresponding author.

E-mail addresses: c.potter@imperial.ac.uk (C. Potter), j.urquhart@imperial.ac.uk (J. Urquhart).

there are impacts on the productivity of forests in terms of timber, fuel wood and non-wood forest products that have economic and livelihood implications (FAO, 2009). For instance, the North American mountain pine beetle (*Dendroctonus ponderosae*) epidemic has had serious consequences for local economies as well as having significant effects on the ability of these forests to sequester carbon. In the UK, the loss of almost 30 million elms (*Ulmus* sp.) between 1970 and 1990 due to an outbreak of Dutch elm disease (DED) was a very significant environmental event by any standards, impoverishing many upland woodland communities in Scotland and Wales but also removing the culturally highly valued 'elmscapes' of lowland England (Tomlinson and Potter, 2010). The European outbreak of ash dieback in Poland and Lithuania since the early 1990s and Denmark since 2002 has been similarly damaging, with extensive loss of woodland areas traditionally dominated by ash (*Fraxinus* sp.) and serious impacts on commercial forestry operations. In some locations, dieback has been so severe that up to 90% of standing trees have been lost (Kowalski, 2006). Other less pathogenic outbreaks can have equally serious long-term consequences. Fungal-like pathogens such as *Phytophthora alni* have been identified as a significant cause of long-term decline in native alder (*Alnus glutinosa*) communities across Europe, for instance, while a number of weaker invasive diseases are thought to be contributing to acute oak decline syndrome across much of Europe (Boyd et al., 2013).

In this review-based paper we argue that tree disease outbreaks and pest invasions are likely to become permanent features of the Anthropocene forest landscape – and that many of them are traceable, with varying degrees of directness, to commercial interests and human behaviour. Drawing insights from a still emerging literature on the connections between trade, biosecurity and disease transmission, we begin by discussing the drivers of tree disease risk in terms of some of the key trade and human movement pathways, pointing to the ways in which pests and pathogens continue to move along pathways despite international attempts to regulate and constrain them. Based on a review of the documented events surrounding current outbreaks in the UK, we go on to explore the ways in which governments, stakeholders and various publics are mobilised once outbreaks are confirmed. The paper points to a series of interactions between contingent policy responses and human behaviour on the one hand and the biological and epidemiological properties of pests and pathogens on the other. Human influence is thus evident both in terms of the underlying risk drivers and in the entanglements of human and non-human nature that emerge during the course and management of outbreaks. In analysing this double movement, we begin by reflecting on how the globalisation of trade and human movement has enacted complex pathways through which tree pests and diseases are conveyed, considering briefly the four main pathways of 'plants for planting', movement of timber and wood products, wood packaging and human movement. Impacts and policy responses are then discussed by considering two contrasting disease outbreaks in the UK illustrative of the risks associated with the plants for planting pathway: *Phytophthora ramorum* and ash dieback (*Hymenoscyphus fraxineus*). A conclusion of the paper is that interactions between pests and pathogens, human actions and policy responses will help define the forests of the future. Improved biosecurity measures at ports of entry, changes to plant purchasing and sourcing practices and further changes to forestry policy and practice to enhance resilience will all be needed in response.

2. Trade and human movement pathways as disease and pest conveyors

There is growing evidence that the rate at which new tree pests and diseases are being introduced is increasing (Bridges, 1995; Freer-Smith and Webber, 2015). One of the main explanations for this is the growth in trade and the human-mediated movement of huge consignments of plants, timber and wood products that now takes place around the world every day. The upsurge has been particularly strong since the

early 1990s following the rapid export growth enjoyed by newly industrializing countries such as China, Brazil and India and while there are plenty of examples in the history of epidemics that can be linked to movements of diseased timber or infected plants (see below), the number of such cases has increased significantly since the early 2000s and there are positive correlations between the amount of trade imports and invasive species in Europe (Maxwell et al., 2014). The main pathways of pest and disease introduction are already well known and documented (see, for instance, MacLeod et al., 2010), the most important being the timber, wood products, wood packaging and (ever more significant) 'plants for planting' pathways, though other disease conveyors such as the transportation of large volumes of biomass for power generation have the potential to become more significant. Alongside this, global tourism and the movement of people provide opportunities for the unintentional transportation of organisms into new environments.

2.1. The timber, wood product and wood packaging pathway

Of these pathways, the movement of timber and wood products is the longest established and was implicated in the introduction of pathogens such as DED into the UK in the 1960s. Carried on the bodies of scolytid bark beetles, the outbreak has been traced to a single consignment of infected elm logs imported into the UK from Canada in the early 1960s (Brasier and Gibbs, 1973; Brasier, 1979). Historically, the unintended use of infected wood in the packaging of goods for export has given rise to some of the most damaging tree disease outbreaks in recent times. In the United States, the highly invasive insect pest, emerald ash borer (EAB) (*Agilus planipennis*), is thought to have arrived on wood packaging, probably in the form of dunnage from cargo ships (Haack et al., 1997). The US Forest Service has calculated that up to 50% of maritime shipments and 9% of air freight use solid wood as a packing material, and this can play host to insect pests such as the Asian longhorn beetle (*Anoplophora glabripennis*) and the pine wood nematode (*Bursaphelenchus xylophilus*). Asian longhorn beetle was probably introduced into the US in the early 1980s on the wood used to pack and transport the pipework manufactured in China for the refurbishment of New York's sewage system (Haack et al., 1997).

2.2. The tourism and travel pathway

A significant increase in human movement across the globe, especially due to tourism, heightens the risk of unintentional human-mediated introduction of pests and pathogens, either through bringing back plants or wood products or in contaminated soil on footwear, vehicles and bicycles. Although this pathway poses a smaller risk to tree health than other trade pathways, it is not insignificant and may also be a source of pathogen spread within countries as well as between countries. The British have a long history of plant collecting, from the early American explorers who brought back over 100 species of North American trees by the mid-1600s to, more recently, the Victorian obsession with collecting exotic plants from around the world, many of which ended up in botanical gardens or private garden collections. A large proportion of the ornamental plants and shrubs found in British gardens today are the legacy of those early plant hunters, including species such as *Rhododendron*, lupins (*Lupinus* sp.) and lilies (*Lilium* sp.). Today the practice of bringing back plants from different countries continues and while current UK legislation restricts the importation of plant material from outside the Eurozone, individuals are permitted to bring plants (with or without soil), seeds and bulbs into the country from another country in the European Union providing they are free from pests and diseases. Clearly, verifying a plant is pest or disease-free is difficult as many diseases take a long time to show visible symptoms. This is in contrast with the strict biosecurity regime imposed by New Zealand border control that enacts severe penalties on those attempting to import banned goods, including on the spot fines, deportation and, in some cases, imprisonment.

Download English Version:

<https://daneshyari.com/en/article/4759793>

Download Persian Version:

<https://daneshyari.com/article/4759793>

[Daneshyari.com](https://daneshyari.com)