The social amplification of disaster: Policy implications for agroecological pandemics

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Abstract

It is well understood that a vast spectrum of RNA virus types is undergoing rapid genetic reassortment and evolution in large-scale animal monoculture facilities, increasingly likely to entrain newer pathogens from neoliberally 'developing' areas to produce a massively fatal human pandemic that will overwhelm even the best possible health system responses. In such a pandemic – that a mathematical model suggests can penetrate far more deeply than the 1918 event – the USA and the PRC, which are parallel in animal monoculture structures, could lose a significant fraction of their populations to direct disease. Here, we examine powerful but less understood mechanisms of social amplification that can greatly raise the ultimate loss of life, roughly similar to the impact of the 'stabbed in the back' myth that emerged in Germany after WW I. It is obvious that effective programs to contain these threats must include – or even begin with – establishment of a close collaboration between interests in the USA and the PRC, where most large-scale animal monoculture is either located or from which it is managed.

Key Words: Ebola; ecological avalanche; Influenza; pandemic penetrance; RNA virus; social eutrophication

1 Introduction

It is almost a truism among epidemic and agroecology researchers that current neoliberal patterns of agroeconomic exploitation and expropriation will likely trigger an RNA virus pandemic, corporate public relations greenwash to the

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contrary. Mechanisms include destabilization of wild virus ecosystems via deforestation and plantation monoculture (e.g., R.G. Wallace et al. 2014), followed by consequent viral entrainment into large-scale confined feedlot animal facilities – factory farms – where wild types undergo selection and reassortment to produce epidemic outbreaks of varying size and virulence (R. Wallace et al. 2015). One or more of these is expected to escape local extinction to become the next '1918' pandemic, with worldwide spread and high rates of incapacitation and mortality.

What is, perhaps, less well understood is that such a pandemic, devastating as it may be, can represent only the beginning of a greater and longer-term policy-driven disaster – defined as a man-made event causing large-scale population stress. At this writing, the example comes to mind of how the 9/11 attack on New York City triggered the subsequent occupation of Iraq, leading to enduring low level conflict resulting in the current excesses of religious fanaticism afflicting the region. Similar excess followed the 1980's Soviet invasion of Afghanistan, and other examples can easily be found.

Here, we will examine in some detail the human ecological collapse which followed the 1970's 'planned shrinkage' dismemberment of minority voting blocs in New York City, carried out by withdrawal of essential municipal services from overcrowded, low income, neighborhoods of color. This ignited a relatively rapid large-scale process of contagious fire, building abandonment, and forced population displacement that had surprisingly long-term impacts on patterns of public health and public order at various scales and levels of organization (D. Wallace and R. Wallace 1998, 2011; Gould and Wallace 1994; R. Wallace et al. 1999). It is even possible to make a back-of-the-envelope calculation of the social amplification factor associated with this event. We will then apply the insights gained from this example upward to pandemic scale using a standard epidemic model, taking 1918 influenza as a kind of boundary condition.

2 The New York City fire epidemic

Television coverage of the 1977 Baseball World Series at Yankee Stadium in New York City's Bronx section showing relentless visions of tenements on fire brought the phrase 'the Bronx is burning' into public consciousness. In reality, crowded minority neighborhoods of New York had suffered high levels of fire and building abandonment since the late 1960's. Figure 1 shows a citywide index of building fire damage based on official fire department statistics (D. Wallace and R. Wallace 1998, 2011; R. Wallace and D. Wallace 1977, 1990). Of particular note is the sharp rise between 1967 and 1968, followed by a plateau and decline through 1972. This was the result of the opening of some twenty new fire companies as 'second sections' of existing fire units in high fire incidence areas that was forced under an arbitration agreement awarded to the city's fire service unions, the Uniformed Fire Officers and Uniformed Firefighters Association. This action served like a boost to an immune system facing an infectious disease, allowing more immediate suppression of visible fire damage and permitting landlords to rebuild rather than abandon their damaged buildings. For the details of contagious building fire and abandonment, and their relation to fire service levels, see D. Wallace and R. Wallace (1998, 2011) or Wallace and Wallace (1977, 1990).

In essence, increased fire extinguishment services permitted maintenance of significant levels of badly overcrowded housing in poor neighborhoods. Cuts in fire service, justified by simplistic mathematical models developed by the Rand Corporation at the request of New York City (D. Wallace and R. Wallace 2011; Wallace and Wallace 1977), reduced epidemiologic threshold below existing rates of overcrowded housing, setting the stage for contagious fire and abandonment to proceed to completion. Indeed, in the Bronx, the 1970 synergism between poverty and housing overcrowding closely predicted subsequent burnout (R. Wallace 1990). Figure 2 shows, for the Bronx, the integral under the curve of figure 1, 1970-1980. Some sections of the borough – one of the largest conurbations in the Western world – lost more than 80% of their occupied housing units in that time, massuring by Health Areas, which are the small aggregates of Census Tracts by which health statistics are reported.

Other areas of the city – Central Harlem in Manhattan, Bushwick, Brownsville, East New York in Brooklyn, Jamaica and South Jamaica in Queens – suffered similar devastation as a result of fire service reductions targeted against them (D. Wallace and R. Wallace 1998, 2011). Citywide, some 1.2 million persons were directly and indirectly displaced, with some 600,000 remaining behind in the devastated zones. Photographs from this time show large areas that resembled Berlin after WW II, an unprecedented circumstance for a Western nation outside of wartime conditions.

In reality, historical analysis shows this devastation to be the deliberate outcome of policy aimed at dispersing minority political power in the city, and stalling the advance of the Civil Rights Movement from the American South into the heavily segregated cities of the North (D. Wallace and R. Wallace 1998). The mathematical models of the Rand Corporation used to justify these policies, while ludicrous on their face from a fire service perspective (Wallace and Wallace 1977; D. Wallace and R. Wallace 2011) were sufficient to prevent accusations of 'arbitrary and capricious behavior' to proceed under US law, and smoothed the way for de-facto ethnic cleansing carried out under color of law. A complaint to the US Attorney for the Southern District in the waning days of the Carter Administration elicited the comment by an FBI agent assigned to these matters by the Civil Rights Division of the Justice Department that the city was clearly 'trying to break up voting blocs' using fire service reductions as the principal tool, perhaps the most definitive professional opinion on the matter to date.

Although the public health consequences of this event have been a matter of some study (R. Wallace and D. Wallace, 1990; D. Wallace and R. Wallace 1998, 2011; R. Wallace 1990), for the purposes of a larger analysis we wish to compare direct and indirect loss of life, and will infer the general from the particular of this case history.

Direct loss of life to the New York City fire epidemic must be indirectly esti-

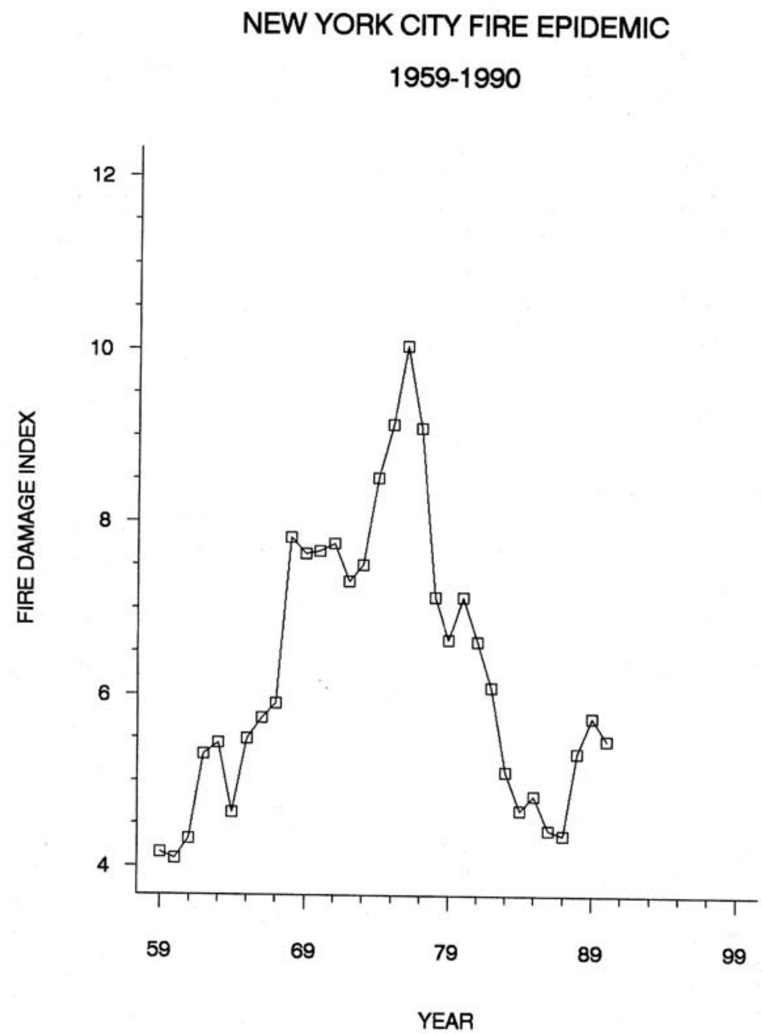

Figure 1: The epidemic curve for contagious fire and building abandonment in New York City, 1959-1990. Note the stabilization between 1968 and 1972 caused by significant increase in fire extinguishment service, and the subsequent sharp rise caused by the closing of some fifty firefighting units and the destaffing of those that remained. The decline after the peak represents the wholesale loss of housing units, causing forced population shifts that drove those with resources out of the city, leaving their evacuated housing units to displaced refugees. This brought the number of badly overcrowded housing units below epidemiologic threshold.

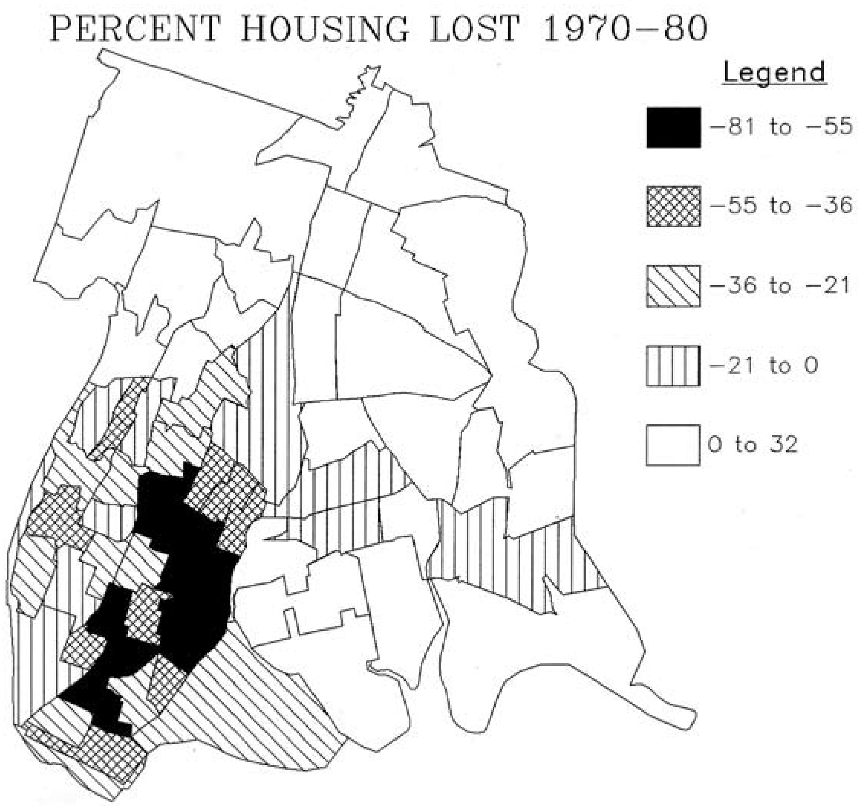

Figure 2: Percent occupied housing lost in Bronx Heath Areas, 1970-1980. Large regions of a conurbation containing 1.4 million people lost over half their housing units. Subsequent massive population displacement dismembered community structures among both those displaced and those forced to leave the overwhelmed receiving neighborhoods.

mated (Wallace and Wallace 1977), since fire death statistics were systematically falsified by the fire department. On September 26, 1977, then-Assemblyman (now US Senator) Charles Schumer issued a press release (Schumer 1977) titled 'Schumer Reveals: Fire Department Death Statistics May be Falsified...'. One section in particular is worth direct quotation

> With respect to fire fatalities, the figures after 1972 show an almost perfect (.99) correlation between an increase in the number of structural fires and a decrease in the number of people dying in fires. This is a statistical relationship that is virtually impossible: i.e. the more fires, the fewer people die. This is particularly hard to believe in view of the fact that in the 10 year period before 1972, the statistics show a strong *positive* correlation between the number of structural fires and the number of fire deaths.

Details of the analysis can be found in Wallace and Wallace (1977, p. 30).

As best as we can reconstruct the direct loss of life (Wallace and Wallace 1977), over a ten year period following the fire service cuts, the number of fire deaths jumped from about 100 annually to about 400, suggesting a maximum possible total excess burden of around 3,000 fatalities.

Figure 3, however, raises the stakes. Adapted from Monkkonen (2001), it shows the homicide rate per 100,000 for the US and for New York City between 1900 and 1998. For most of that period, NYC lags the US rate. During and after the 'planned shrinkage' fire service cuts and the social disintegration that followed the processes characterized by figures 1 and 2, the rate rose catastrophically, and remained raised for some twenty years. See Wallace and Fullilove (2014) or Wallace (2015, Ch. 8) for more detailed arguments on how massive social disintegration can cause raised rates of interpersonal violence. The mechanisms are well studied across much of social science, and are a particular focus of refugee and colonization studies (Fanon 1966).

Of central interest is the two-peak form of figure 3. The first peak seems associated with the direct consequences of urban burnout. The second peak, almost a decade later, represents the 'crack wars' consequent on the persisting destabilization of the illegal drug trade (Wallace and Fullilove 2014).

The direct excess loss of life is represented by an increase from a base of about 500 annual homicides to about 2000, over a twenty year period, suggesting a primary burden of some 30,000 excess deaths. Assuming another 30,000 were badly injured and displaced onto truncated life course trajectories via substance abuse, behavioral reaction pathologies, and similar mechanisms, there were perhaps as many as 60,000 premature mortalities consequent on the violence epidemic that followed the events of figures 1 and 2. More deaths, however, can be associated with New York City's ethnic cleansing efforts: as one public official put the matter, "Planned shrinkage shotgunned AIDS over the Bronx". It also shotgunned AIDS over Manhattan, Brooklyn, and Queens, and perhaps, since New York City sits atop the US urban hierarchy, nationally as well (Gould and Wallace 1994, Wallace et al. 1999). The total burden in premature mortalities resulting from the policies causing figures 1 and 2 may, over a 30 year period, exceed 100,000, in comparison with the 3,000 direct fire deaths. Certainly an order of magnitude increase due to social amplification seems likely, for this case history.

In the next sections, we begin to infer the general from the particular, extending the analysis to the social amplification of devastating pandemic disease.

3 Pandemic penetrance: 1918 vs 2015

The pandemic influenza of 1918 is estimated to have affected some 500 million out of a total population of about 1.5 billion, a 1/3 penetrance (Taubenberger and Morens 2006). This benchmark allows calibration of Kendall's simple epidemic model with removal.

Assuming a total of N individuals, classified as X susceptible, Y infective, and Z removed, the dynamic equations of the Kendall model (Bailey 1975) are

$$\begin{aligned} dX/dt &= -\beta XY \\ dY/dt &= (\beta X - \gamma)Y \\ dZ/dt &= \gamma Y \\ N &= X + Y + Z \end{aligned} \tag{1}$$

β is the rate of infection and γ the removal rate. Letting $\rho = \gamma/\beta$, no epidemic can spread if the removal rate is greater than the infection rate, i.e., $X(0) < \rho$, where $X(0)$ is the susceptible population at time $t = 0$.

Following Kendall, Bailey (1975, eq. 6.22) shows that, if I is the proportion of the total number of susceptibles that finally contract the disease, assuming a small initial number of infectives, then

$$N/\rho \equiv s = -\log[1 - I]/I \tag{2}$$

This has the solution

$$I = 1 + \frac{W[-s\exp(-s)]}{s} \tag{3}$$

where $s = N/\rho$ and W is the Lambert W-function, which solves the relation $x = W(x)\exp[W(x)]$. Equation (3), however, also represents the size of the 'giant component' in a random-network percolation model (e.g., Parshani et al., 2010; Gandolfini, 2013). See figure 4, which shows I as a function of the ratio N/ρ. It is worth noting that, in more highly connected network structures, for example stars-of-stars-of-stars, there may be no threshold condition whatsoever.

A simple calculation can be based on the 1918 observations as a boundary condition. In 1918, some 1/3 of the total population of 1.5 billion became infected, suggesting a critical population ρ of about 1.233 billion, under 1918 travel conditions. By 2015, the total population has reached about 7 billion, suggesting a ratio N/ρ of 5.68. This leads to a pandemic penetrance of about .9965, under 1918 contact probabilities. In reality, travel patterns have much tightened in the last hundred years: jets rather than steamers.

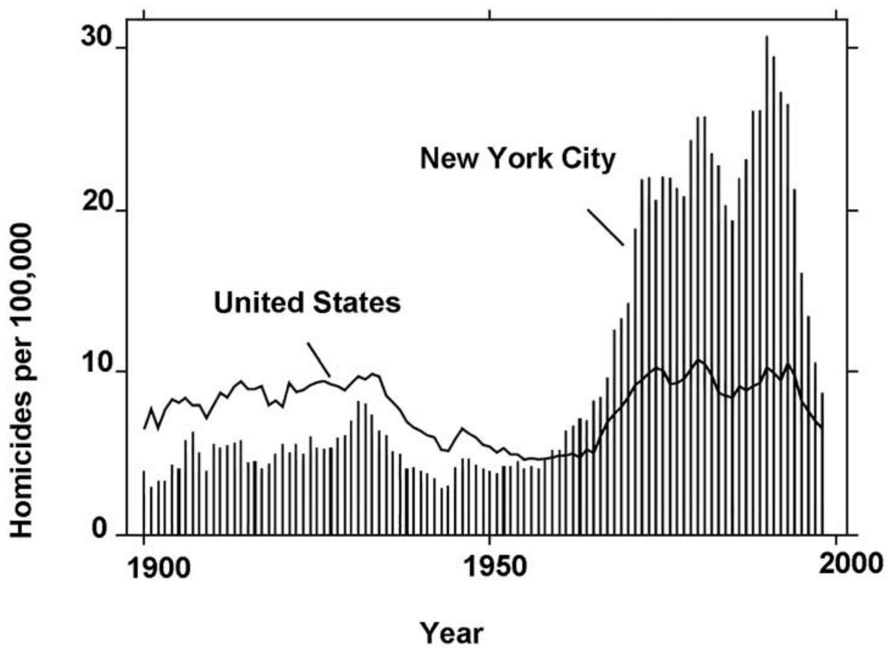

Figure 3: The social amplification of disaster. Figure adapted from Monkkonen (2001), showing the homicide rate per 100,000 for the USA and NYC, 1900-1998. After the devastation following 'planned shrinkage' fire service cuts, the number of NYC homicides rose from about 500 to 2000 per year for twenty years, an excess of some 30,000 direct fatalities. Supposing another 30,000 were badly injured but not directly killed, and put on a deteriorating life course trajectory, there may have been as many as 60,000 premature fatalities over a 30 year period following the fire service reductions. Note the two separate NYC peaks. The first is coincident with the fire epidemic. The second, larger peak represents the 'crack wars' consequent on destabilization of illegal drug marketing pattern and practice by the forced migration associated with large-scale urban desertification. Other premature mortalities may have followed the shotgunning of AIDS and contagious behavioral pathologies across the city, the metropolitan region, and down the US urban hierarchy.

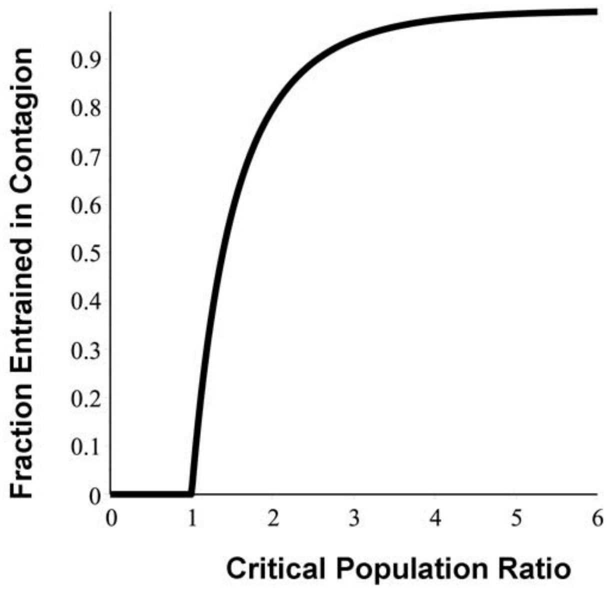

Figure 4: The fraction of a susceptible population infected by a contagious process as a function of the ratio of total susceptible population to the critical population size, N/ρ, from equation 3. In 1918, some 1/3 of the total population of 1.5 billion was infected, suggesting a critical population of about 1.233 billion. By 2015, the total population has reached about 7 billion, suggesting a ratio N/ρ of 5.68. This leads to a pandemic penetrance of about .9965, under 1918 travel conditions.

4 Discussion and conclusions

The fatality rate of the 1918 influenza pandemic has been estimated as greater than 2.5%, under the relatively primitive medical practices of the time, but in the lacuna of political exhaustion that followed World War I (Taubenberger and Morens 2006). A hundred years later, while individual-level medical interventions are more sophisticated, political and resource rivalries are greater than in 1918, particularly under the impact of accelerating climate change. The social forces driving fifty years of Cold War have apparently now turned inward, fractioning the Soviet Union, and driving increasing instability in the USA, the purported 'winner' of the Cold War whose industrial base has crumbled under relentless economic militarization (Wallace 2015, Chapter 7, and references therein). The People's Republic of China is undergoing a wrenching shift of both economic structure and expectation in a population of 1.2 billion. Three thermonuclear-armed states presently ride a tiger of growing destabilization, often managed, in the usual fashion, by identification and pursuit of distractions provided by foreign enemies of various kinds and magnitude. The obsessive attention in the USA given to possible 'terrorist threats' arising from poorly-armed Middle Eastern fanatics serves as a chilling example.

An enterprise of 7 billion people is inherently difficult to manage, in the absence of some kind of economic 'farming' that regularizes both supply and demand (R. Wallace 2015). Given the rate of human-caused climate change, that difficulty becomes deeply problematic. Given the inevitability – under current policy trajectories – of the induction of an agroecological pandemic with a fatality rate greater than 2.5% that achieves universal penetrance, a central question revolves around the expected social amplification factor. A factor of 30 is virtually a human extinction event. A factor of 10 is an unprecedented catastrophe. A factor of 2 exceeds current strategic thinking, which seems focused only on the pandemic event itself.

Given these apparent uncertainties, and indeed the lack of any research program at all on the social amplification of pandemics, at least one policy implication is quite direct: It would seem prudent to begin placing the most draconian restraints on existing plantation and factory farming enterprises, the driving forces behind pandemic emergence. To move in that direction, a second policy implication is the necessity of beginning serious high-level dialog on these matters with the PRC, which, along with the USA, either contains or controls a majority of the world's hog and chicken factory farming. Any such effort, however, must be transverse to the present well-funded riptide of epidemiologically futile corporate greenwash aimed at circumvention of effective regulation.

The political challenges, however, are daunting, as, at least in the USA, RNA viruses have powerful agribusiness interests working on their behalf. A canonical example of political influence might well be how, in the USA, the National Rifle Association uses its Congressional influence to prevent the CDC from examining gun violence as a public health problem, a matter involving tens of thousands of excess deaths each year. Culturally-specific patterns of similar influence are undoubtedly at work elsewhere. Overcoming the global corporate

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'virus lobby' in time to prevent a socially amplified agroecological pandemic appears a considerable challenge.

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