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A study on the resilience and vulnerability of New York City in the wake of 9/11, the financial crisis, and Hurricane Sandy

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Ås, 2018

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Declaration

I, William Altoft, declare that this thesis is a result of my research investigations and findings. Sources of information other than my own have been acknowledged and a reference list has been appended. This work has not been previously submitted to any other university for award of any type of academic degree.

Signature.....

Date.....

Clarinet in B \flat

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– *Rhapsody in Blue*
by George Gershwin

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Ås, 14th May 2018

William Altoft

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Abstract

Urbanisation is set to continue rapidly in the 21st century, with a further two and half billion projected to join the urban population by mid-century. Since the founding of a trading port at the tip of Manhattan, New York City has grown through self-organisation from the bottom-up, met forcefully by the top-down implementation of the 1811 grid, and has spread to the surrounding boroughs to become the urban example that led the twentieth century. In the first two decades of the 21st century, it has faced extreme tests of its resilience and vulnerability, with the terrorist attacks of September 11th, 2001, the financial crisis born of the Wall Street crash in 2007, and the climatological hazard of Hurricane Sandy in 2012. The theory of social-ecological resilience was developed to explore complex, adaptive systems, and their capability to deal with shock and surprise, originally within the context of ecosystems in the natural world. Studies of cities have taken on this theory, and now talk of urban resilience, with policy by both city governments and various organisations informed by and acting upon it – yet much of this is limited to dealing with threats from the natural world, which is only one of the many hazards a city faces. The City of New York produced literature and policy purporting to rely on resilience to move forward in the wake of Sandy, and this is reviewed in order to explore what the city means by resilience, and if it has learnt from the effects of the hurricane. Models from resilience and vulnerability theory are then utilised to analyse the events before, during, and after the September 11th attacks and the financial crisis of 2007/08, to explore the city’s resilience, or lack thereof, in areas beside the climate. Though the city is adapting to the prospect of floods and storms, its financial system remains as vulnerable as before, having learnt little after being rescued from the crash of 2007. In the face of unexpected violence in the autumn of 2001, the city demonstrated remarkable resilience in disaster response, the emergency services, infrastructure, and general recovery and rebuilding. However, the New York and American psyche proved vulnerable, and the lasting effect of 9/11 was not in physical destruction, but a cultural, societal trauma. The legacy of the 1811 grid – a much more significant disturbance – is not clear, but it seems to be a fundamental limit to the city’s future options for adaptability and transformability. Despite coming through these early crises of the new century, and though its pride in its resilience has in many areas been earned, New York City has shown some important vulnerabilities in the face of what has been, and what may come.

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1. Introduction

1.1. Urbanisation

“The city is the most complex and typical social-ecological system shaped by human beings.”
(Zhang & Li, 2018, p. 147)

Hubs of innovation across multiple scales (Ernstson et al., 2010), entities made of a mass of parts co-evolving inter-dependently (Batty & Marshall, 2009), often seeming more akin to the feats of social insects than those of social mammals (Davis, 1965) – the city is our settlement. Even beyond the height of industry, the urbanisation of the world looks set to continue rapidly: between 2014 and 2050, there is a projected increase of almost 2 and a half billion in the urban population of the planet, with India set to add 404 million, China to add 292 million, and with the US on course to add 90 million to its own urban population (McPhearson et al., 2016). Urbanisation is particularly pertinent in developing countries, where the majority of what remains of global urban growth will take place (Fuller & Romer, 2014; McPhearson et al., 2016).

The question is not will the world be urban, but what will the urban world be: many cities of many sizes, or one vast urban interconnectivity (Batty, 2011)? Whatever path it ultimately takes, which cities will lead the way?

One of the cities to have so far led the way has had a turbulent history, though never has disturbance been enough to change its trajectory toward pre-eminence. Yet its capacity to come through and continue on has faced serious tests since the turn of the century, and its economic function, its stance beside the ocean, and its national and international cultural aura are the key points that have been hit by shocks, and subsequently highlighted, and called into question.

A city full of towers with their tops in the heavens, it has made something of a name for itself.

1.2. New York City

“It was a society that was both haphazard and planned.”
– The Island at the Center of the World (Shorto, 2005, p. 317)

From the hills to the Lenape to the Duke of York, the island at the centre of the world has a history deep and rich beyond the final claiming of the prized fort at its southern tip, no longer New Amsterdam in name, yet irrevocably shaped by the culture of the Dutch of the 1600s. A new, nearly-modern society was moulded out of a mix of principles: the free-trade and the grudging toleration of many cultures that it required of the seventeenth-century Dutch, and the notions of self-

government, experimental with reason and the rights of man, of the English of the 1700s (Shorto, 2005).

Before and since the world-shaping turbulence of that span of decades, across the line between two centuries, there is much history to tell, and it all offers up crucial pieces, large and small, with which to shape an explanation of how the New York City that ushered in the 21st century became what it was, what it is. One piece of that history, and the progress that followed it, is worth stopping at and considering, for the purposes of this study.

From the deepest tunnel of the subway to the spire of the World Trade Center, standing watch above the white roses that adorn the names engraved along the edges of the pools at Ground Zero, from the sight of the freedom-statue seen from Battery Park to the Heights of Washington, there is another foundational element, sat atop the legacy of the mixing of the outcasts and explorers, the merchants and traders, from the empires across the ocean, that has quite literally shaped the city since its appearance as a finalised plan in the year 1811: the Manhattan grid.

The Commissioner's Plan of 1811

It was in the year 1807 that three people were commissioned by the City Council to create a plan for the expansion of the already built-up area of Manhattan island (Angel & Lamson-Hall, 2014). After four years, both of surveying for the grid and of politicking to render that grid unchallenged, the plan, completed in March of 1811, detailed an expansion which would increase the city sevenfold (Angel & Lamson-Hall, 2014; Museum of the City of New York, 2015a). It took roughly 60 years for the implementation of the grid as far as 155th Street (Museum of the City of New York, 2015a), and by 1910 any further expansion would be forever limited, as 90% of Manhattan's buildable land was now built upon (Angel & Lamson-Hall, 2014).

Thus, the skeleton of the central borough of the future city was not circular, nor an oval, nor a star. It was not a city fated to spiral, slowly, outward from a medieval port upon a river, dictated to by the contours of the landscape, as had been the story of many of the distant and famous cities it would soon usurp, standing on the shoulders of their lessons learnt through history. Instead, despite its fort and harbour origins, the decisive order and rigidity of an oblong, with perhaps as many right angles as some towns and smaller cities had people, was pressed down upon the many hills that had given it the name *Manna-hata* in the Unami language of the tribes who had found the place by foot and not by sail. With the exception of the north-south thoroughfare of Broadway, a Native American trail



Figure 1: A modern re-drawing of the 1807 map, eventually adopted in 1811 (Wikipedia, 2016).

turned primary road for the Dutch that cuts diagonally, east to west, through the middle of the island, the future was to be straight and numbered strips of streets and avenues and their intersections.

In figure 1 can be seen the darker shading of the built-up area at that time, and the astonishing plan for pushing that northward. Problem-causing arrogance and problem-solving confidence married in ingenuity, this was a plan that would instigate tremendous change and leave a legacy throughout the island.

One of the key questions in a city is population density, and this plays a role in the building of pressure discussed within the context of vulnerability and disaster in chapter 3.2. Historical maps show that a mere 2% of this soon to be built upon land contained any structures, yet a census from the year 1800 gives a population of around 15,000 people – resulting in a very high density within built-up areas (Angel & Lamson-Hall, 2014). Over the next 110 years, while the city expanded to ultimately 14 times its earlier size, its population multiplied by 40, tripling the average density of paved Manhattan (Angel & Lamson-Hall, 2014).

The 1811 plan gave strict constraints regarding the dimensions of blocks, streets, buildings, and avenues, but not for the specifics of land use, nor, importantly, for the height of buildings (Baics & Meisterlin, 2016). Despite being bounded by the details of the expansion plan and the presence of the rivers that surround it,

and limited by the transportation technology at the time, there was much chaos and creativity in the island's full urbanisation throughout the 19th century (Angel & Lamson-Hall, 2014; Baics & Meisterlin, 2016). It was not until the creation of three bridges across the East River in 1883 (Brooklyn), 1903 (Williamsburg), and 1909 (Manhattan), the development of the urban rail service and the cheap transit of the subway system, and the formation of the suburbs and the larger city, that average densities and overcrowding throughout the city were reduced as the city was de-concentrated (Angel & Lamson-Hall, 2014).

Rhapsody in Blue

“People goin’ down to the ground.
Buildings goin’ up to the sky.”

– Talkin’ New York (Dylan, 1962)

The mad, metropolitan melting pot that George Gershwin sketched out and captured in the form of musical notes emanating from out of instruments, beginning with a clarinet, burst up and out across the island and the surrounding city boroughs from this point on. Skeleton in place and growing beyond the water, the story of high density was reversed, with Manhattan's population declining from 2.31 million in 1910 to 1.46 million in 1980, and a density decline from the 575 persons per hectare of 1910 to 350 persons per hectare in 2010 (Angel & Lamson-Hall, 2014). Yet the story of density in modern Manhattan goes far beyond its residents not yet surrendered to the surrounding boroughs: with 1.6 million residents, the weekday daytime sees just under 4 million people upon the island, down to just over 2 million at night-time, while the daylight hours of the weekend sees approximately 2.9 million (Moss & Qing, 2012).

In 1914, the Committee on City Planning sought the creation of a permanent agency for city planning, and a couple of years later another committee issued a report that resulted in the 1916 Zoning Resolution, which divided the city into districts and gave regulation regarding the height of buildings, as technological restraints for vertical planning rapidly fell away (Department of City Planning, 2018). What had been needed for the phenomenon now sprouting was aluminium, steel-framing, and the new technology of hydraulic elevators (Graham, 2016). Born in Chicago, iconised in and by the New York City skyline, this was the skyscraper: “a phenomenon that is spreading all over the world, to the point where it has become typical not just of American cities but of the architecture of our time” (Gottmann, 1966, p. 190).

The protesting against the negative impact that the presence of taller buildings was having on light and air quality began in the 1870s, but, despite some height restrictions being put into an Act of

1901, the financial centre of the city was quickly exacerbating those problems in the early 20th century (Department of City Planning, 2018; Fischler, 1998). However, both the functionality and concentration that skyscrapers offered (Gottmann, 1966) and the force of aesthetic vanity (Graham, 2016) meant that this feature was to be permanent, and today skyscrapers and supertalls abound, hardly halted by the violent exposure of an inherent weakness in the early autumn of 2001 (Lamster, 2011). In spite of controls and regulations, corporations and companies continued the development of their tall towers throughout the 1900s, despite debate among a public still very much anxious about the negative effects (Weiss, 1992).

This conflict generated between planners and inhabitants by decision, direction, planning, and foresight (and its lack) alludes to an important element, as it relates to the city as a system. This top-down mapping, planning, and implementation is only one set of processes within the system that is the city. The Gershwin rhapsody was not just inspired by the skyline, the subway, the grid, and the futuristic Fords now finding new uses and limitations to the intersecting streets and avenues. The notes denote the people, too.

In *The Death and Life of Great American Cities* (Jacobs, 1961), Jane Jacobs discussed the persistent clashes that occurred in the American cities of the twentieth century between the theorising, policy-making, and top-down order and problem solving of the city planners, and the daily realities of the city makers, the self-organisation and -regulation of the living components residing in the tenements and wandering the streets. In Part One of her book, Jacobs tells of how this plays out on city sidewalks, in neighbourhood parks, and in neighbourhoods as a whole.

Through her insightful text, we see planned parks going unused despite all the thorough planning involved, due to a fundamental lack of understanding regarding the daily reality and movements of the people who are supposed to use the parks and their differing commutes and schedules (Jacobs, 1961). We see how planned and pristine streets and indoor-complexes result in less safety and more crime than the ragged, emergent ecosystems on the grittier and self-organising streets: what is truly required to avoid an abduction or a rape is not a sketched-out formula born of statistics and the newest or oldest principles of landscape architecture, but a self-organised street community, where watchers from apartment windows, loitering kids, and local store-owners have eyes on the street at varying and coinciding times, regular communion with and awareness of one another, and a sense that they are not just simply existing in these neighbourhoods, but are living in them (Jacobs, 1961). Moreover, children find infinitely more fun and intrigue in wandering these streets and their back alleys than in the ultimately desolate playgrounds designed and designated for them – playgrounds

which, as with the aforementioned parks, go unused as a result of attempts at organisation so out of touch as to think that play can be planned for (Jacobs, 1961).

The population that forms this living layer underwent significant changes during these centuries of grids and expanding city limits, of subway trips and skyscrapers, beyond the density issue already discussed. Three-quarters of the 33 million immigrants to the US between 1815 and 1915 came through New York City's port, and many of those stayed put (Angel & Lamson-Hall, 2014). From less than 1% in 1800, to a peak of 48% by 1910, the percentage of Manhattan's population that was foreign-born never fell under 40% after 1850, and this was a significant part of the density and overcrowding of the city, before it was ultimately alleviated (Angel & Lamson-Hall, 2014). To the already much-mixed heritage of the existing *demos*, it was not merely numbers added, but an infusion of the language in the air and the culture on the ground, a trend that continued well into the 1900s from without and also from within, as more and more African Americans began leaving or fleeing the south of the nation, tired of a place where the contempt of slaves had decidedly outlived the legality of slavery (Wilkerson, 2011).

The Picture Painted

As seen in the behaviour and the make-up of the population, and in the technology and design of transport and architecture, there is an ongoing fluidity and flux to the city that has never abated. Yet that appears to be unfolding within a context that is somehow fundamentally fixed, and largely inflexible. In terms of physical space and the city skeleton, New York City, Manhattan in particular, is in a way long finished. The grid of 1811 and its implementation may have major implications for the future resilience and vulnerability of the centre of the larger city, particularly regarding its adaptability and transformability. Where other cities through their history have slowly added to existing areas, re-moulded, replaced, re-worked, and built on top of what has been pieced together in the centuries before, the extensive and comprehensive New York plan that was realised throughout the 19th century still underlies and permeates the system facing the shocks of the 21st. While this general character trait of the modern urban landscape – the past underlying the present, the legacy of planning affecting its future – can be seen in many other developed cities, it appears to be a fairly unique exaggeration of something otherwise prevalent in this case. As is ever the way with New York City.

To reiterate: within the ghost of the fort at the southern tip and through the grid extending northward, between the people and the structures above and the island under it, there is much history to tell. The particular periods and aspects looked at here were not the result of an arbitrary focusing in on some points along that history. With the grid of 1811 and the city development and

sociological make-up that followed on from it, confronting complementing and contradicting, contrasting visions and realities of the city's future by skipping across and just below the surface with a glimpse of the edges of the details, as a musical theme passed back and forth between the factions of the orchestra, there is encountered the shape of a story of creative chaos and planned rigidity, of top-down, bottom-up, and middle-out organisation and emergent properties, signs of the complex flows and transformations of a dynamic system. The commonalities of the city system taken to unique extremes.

Ecosystems are self-organising sets of processes that interact to make up an overall system (Peterson et al., 1998). Cities are highly complex, with many, many different agents and actors interacting and operating, together and side-by side (Barthelemy et al., 2013). The simultaneous operation of such a diversity of agents across multiple scales and layers hints at a unique ecosystem that, on the one hand, emerges through self-organisation, and on the other, finds that emergence restricted, and perhaps at times complimented, by planning interventions from above and from without (Barthelemy et al., 2013). In chapter 3, the theories of social-ecological resilience and of vulnerability are explained, and, though the recourse for analogy and explanation is largely to ecological examples, what has been touched on in this introductory chapter, regarding New York City as a planned and unplanned city system within rigid bounds, can begin to be seen in the context of this study, and how it all comes together to meet the question of resilience.

1.3. Research Question

This thesis seeks to explore, and, if possible, to offer potential answers to, the following questions:

Research Question (RQ):

- Has New York City demonstrated social-ecological resilience as an urban, city system in the opening decades of the 21st century?

Sub-questions (SQ):

- SQ 1 – Does New York City's policy and practice during and after Hurricane Sandy suggest an understanding of social-ecological resilience, and demonstrate a commitment to engendering it?
- SQ 2 – Do the adaptive cycle, panarchy, and pressure and release (PAR) models offer useful analysis of New York City's resilience and/or vulnerability in the face of two major disturbances of non-climatological kinds: economic (the financial crash of 2007/8) and socio-political (the terrorist attack of 9/11)?

- SQ 3 – What, if anything, do the opening decades of the 21st century indicate regarding the current and future resilience and vulnerability of New York City?

2. Methods

In order to tackle the research question and its sub-questions, this thesis relies upon a combination of reviewing and discussing literature (SQ 1, 3) and the utilisation of models from resilience and vulnerability theory as analytical tools (SQ 2, 3). In addition to published scientific and policy literature, online information from various official websites has been utilised (SQ 1, 2, 3), due to their up-to-date and public-facing nature.

When reviewing literature, the scientific, academic discussion on urban resilience will be highlighted and discussed. However, the scope and focus of this thesis allows for a summary regarding that discussion, rather than a full engagement with it. Instead, what will be given greater focus is policy literature and public information published by organisations that purport to be informed by and adhere to the idea of resilience in the urban setting, and that have a direct and substantial influence on practice and planning.

The panarchy, adaptive cycle, and PAR models (SQ 2), which are explained in chapter 3, will be used to explore the Wall Street crash that started the global financial crisis (hereafter referred to as the 'GFC') and the terrorist attack of September 11th, 2001 (hereafter '9/11'). Coming after the reviewing of literature heavily focused on natural shocks, this will be in the service of producing more insight into the resilience and/or vulnerability that New York City has displayed in other areas for the discussion.

As a wholly qualitative enterprise centred around a particular (and peculiar) case study, there are, of course, limitations in this study's approach and methods, inhibiting how much this thesis may contribute to the larger conversation on urban resilience. On the question of New York City's resilience, the lack of primary research in this thesis limits the qualitative analysis and discussion to a reliance on the literature and research of others. Furthermore, the vast complexity and globally interlinked nature of both New York City and the three shocks this study highlights necessitates an approach that is, to some degree, ahistorical and apolitical. A somewhat arbitrary line has to be drawn around the case study and the three shocks that leaves aside many pertinent, yet less geographically and temporally immediate, parts of the conversation. As undesirable as this is for fully examining the processes at play, it is necessary to maintain a focused and manageable study.

3. Theoretical Background and Framework

In this chapter, the theory of social and ecological resilience, along with its component of panarchy and accompanying theory of vulnerability, is presented.

The ecological origin of this theory is made quite apparent by how easily and often the recourse for analogies and examples is to the natural world, to ecosystems, and to non-human animals. While a few non-ecological examples are given, this chapter will rely heavily on the ecological side of things, before moving on in subsequent chapters to the issue of urban resilience, and the applicability of this theory and its components to the city.

3.1. Social-Ecological Resilience

“Individuals die, populations disappear, and species become extinct.

That is one view of the world.”

(Holling, 1973, p. 1)

The theoretical idea of resilience – far from its dictionary definitions of toughness and elasticity – has grown to prominence, wide usage, and very oft to misunderstanding in the last two decades (Brown, 2016; Chelleri, 2012; Stockholm Resilience Centre, n.d.). As with the terms ‘sustainability’ and ‘sustainable’, it is a word very often used, and often used inappropriately, due to its meaning being so diluted and assumed, rather than well understood. Yet, resilience as a theoretical approach has been clearly laid out, defined, and built upon since the 1970s.

The cornerstone of this theory’s foundation is a review in which C. S. Holling sought to explore ecological theory and the behaviour of natural systems (Holling, 1973). In his own words, resilience “determines the persistence of relationships within a system” (Holling, 1973, p. 17), and refers to a system’s ability to absorb shock, surprise, and disturbance and still persist in its overall form and function. If an island population of birds or small mammals has been free of the threat of predation for a long period of time, over many generations, and has lost the collective and individual instincts and behaviours generated by the landscape of fear a predator imposes, and by the regular encounter with chaos that a chase or an ambush represents, then that population’s apparent equilibrium is within a system with low resilience: the disturbance brought about by the introduction of cats to the island would be catastrophic. If a child is parentally over-protected to the point where it has never had to heal a wound or fight off a cold, then the lack of shocks that would build up antibodies and a skin that is quick to repair results in low resilience, and a system that may collapse when faced with an injury or a virus. Vaccination works by deliberately introducing a safe or totally benign version of a possible future threat in order to cause the body to react, learn, and remember,

resulting in a high resilience gained without dangerous exposure to disturbance that might throw the system into another state. A population of primates that has to regularly avoid and watch for snakes, hawks, and leopards, and needs the capacity to react to any of those threats at any given moment and recover immediately after an encounter, will likely develop a system resilient in the face of the sudden appearance of a novel threat, due to the specific and generalisable memory, knowledge, and suite of behaviours generated and nurtured through regular disturbance.

Resilience fundamentally critiques the idea of and assumptions about stability. What amounts to a superficial illusion of stability can often be the consequence of high resilience, particularly when the temporal scale relevant to a system is beyond the four or five decades that is generally the maximum scope of modern human sight and endeavour. However, within both social and ecological systems it is change, and not stable equilibrium, that is the norm. Holling raises this by pointing to the example he uses in his review of a spruce budworm forest community, in which low stability appears to engender high resilience (Holling, 1973). The nature of equilibrium is, in resilience theory, not fixed, static, and singular. The landscape is conceived of as having multiple possible states of equilibrium, found within different basins of attraction, and all are temporary and in flux, to a greater or lesser degree.

Building on this earlier work, there have been four critical factors for social-ecological resilience identified (Folke et al., 2003):

- 1) Learning to live with change and uncertainty
- 2) Nurturing diversity for resilience
- 3) Combining different types of knowledge for learning
- 4) Creating opportunities for self-organisation toward social-ecological sustainability

There is nothing here to demand or expect stability, in the sense one usually uses the word, and neither do they suggest engineering resilience, which relates to the ability to snap back into the form present prior to disturbance, and the speed at which this is achieved (Holling, 1996). Two of the factors relate to knowledge, whether gaining it or using it (1 and 2), and these, combined with diversity held in store and upkept well (3), feed into the final factor that deals with the ability to treat shock and disturbance as a chance for renewal and reorganisation (4). Thus, the keys are knowledge and memory that can be drawn on in both a conservative and a creative manner, before, during, and after shocks.

Resilience is not normative: that is, high and low do not equate to good and bad, nor to bad and good. It is relative and contextual. To be highly resilient may mean being the only system capable of

maintaining form and function across a landscape of uprooting unrest – the only forest that can absorb the pestilence and the fire and grow ultimately taller for it – or, conversely, high resilience may mean being trapped in a relatively undesirable state – a desertified plain that no amount of rainfall or primary succession can break into so as to bring back vitality.

Whilst much of resilience is focused on maintaining function after absorbing shocks of various kinds and degrees, a further, equally important, aspect is the capacity for renewal, regeneration, and reorganisation after disturbance and shock (Folke, 2006). This is conceptualised well as an adaptive cycle, featuring the four ecosystem functions: exploitation; conservation; release; reorganisation (Holling, 1986).

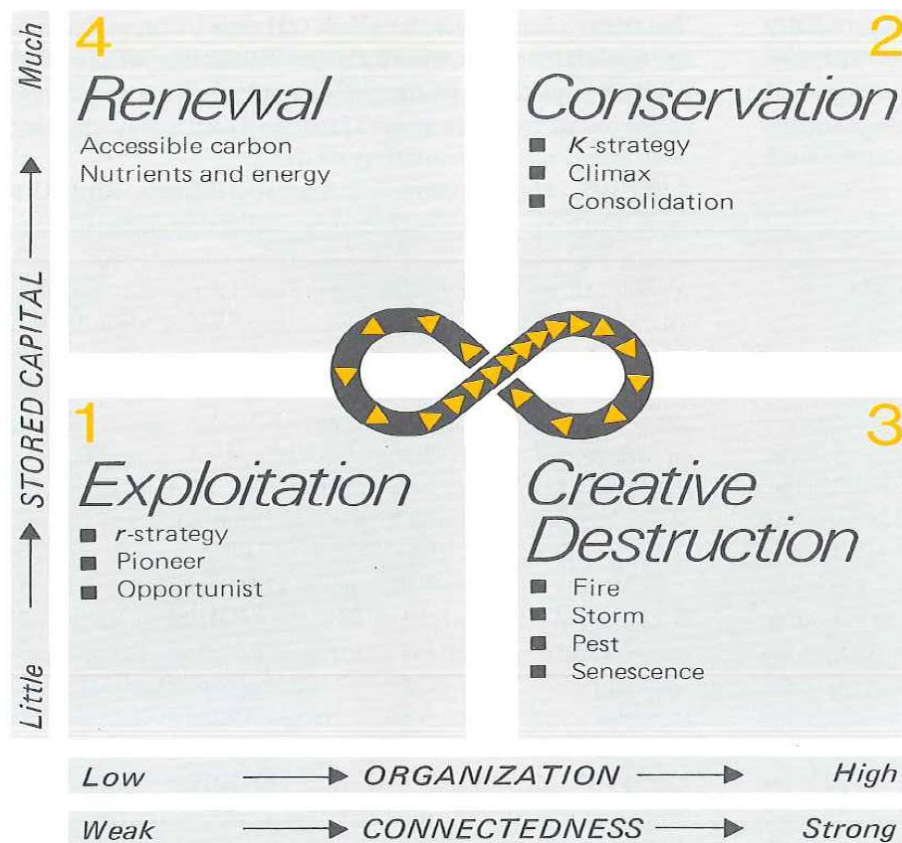


Figure 2: The original figure showing the four functions of an ecosystem and their relationships and connectedness (Holling, 1986, p. 307).

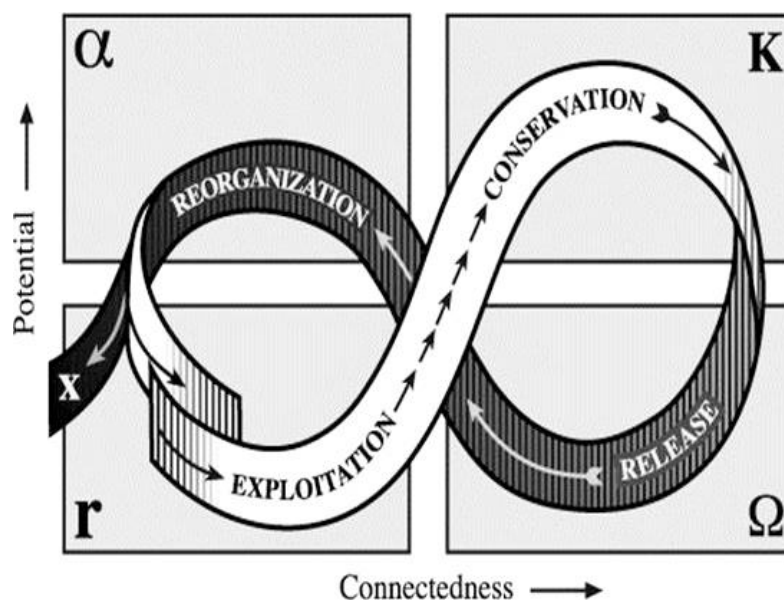


Figure 3: A later, stylised representation of the four ecosystem functions and the interaction and flow between them – the adaptive cycle (Resilience Alliance, n.d., based on Holling, 2001, p. 394).

Following is an explanation of what occurs at each stage of the adaptive cycle, in ecological terms (from Holling & Gunderson, 2002; Holling, 1986; Holling, 2001):

1. Exploitation – r

The rapid colonisation of areas that have been recently disturbed. Species that are pioneering and opportunist thrive, exploiting niche-gaps and resources. Connectedness of ecological webs and systems increases, as does stability, the closer an ecosystem gets to the second stage. Ecological capital, such as biomass, nutrients, and physical structure, accumulate. Here, where the competition manifests as a scramble, the life strategy known as r is most successful.¹

2. Conservation – K

Here the processes in the first stage climax and consolidate, as carrying capacity is reached. As the ecosystem matures, dominance of relatively fewer species has been achieved with diversity preserved in patches, and all the capital gained has increased the potential future systems, forms, and uses, yet is for now bound tightly within a temporary equilibrium. The

¹ There are two major life strategies, generally speaking, that are discussed in biology and ecology: shorter juvenile periods, with rapid development to maturity, followed by reproduction that aims at producing the maximum number of offspring in the shortest time, offspring which will then receive minimal to no parental investment and resources (r); much longer juvenile periods and slower development to maturity, followed by the production of few or one offspring that will receive sustained parental investment and resources (K) (Hatchwell & Komdeur, 2000; Promislow & Harvey, 1990; Stearns, 1977).

storage of energy and material takes primacy over accumulation. Here, where the competition manifests as a contest, the life strategy known as K is most successful.

3. Creative Destruction/Release – Ω

Having become overconnected, rigid, and thus increasingly fragile, the system's resilience has reached a lower point, and the sequestered energy and resources are suddenly released upon change triggered by agents of disturbance – such as fire, wind, a pest or virus, or simply senescence (deterioration with age). The organisation unravels, and the connectedness becomes less tight and less reinforced.

4. Renewal/Reorganisation – α

From the third stage to the fourth, a rapid reorganisation takes place, in what is renewal, and more than just recovery. Having been released from storage, energy and materials are accessible and can manifest some or all of the potential previously latent. Retention and innovation, conservative and creative use of knowledge and memory, the utility of redundancy and diversity: while also present and relevant to previous stages of the cycle, this is where these features and factors of resilience matter most. This back-loop, from Ω to α , adds invention, reassortment and change, and variety to the production, accumulation, and growth of previous stages.

5. Starting again, or exiting the cycle – x

In the process of leaving the α phase and returning to the start, some of the accumulated resources will leak, or be eroded, and thus certain potential will be lost. This also applies to relationships and inter-scale dynamics. If the resilience of the system is high enough to absorb the shock or disturbance it was subject to, then the system restarts the cycle with its overall form and function retained, and possibly improved. If the resilience is low – if there is a lack of redundancy, or memory, for example – then the system may fail to renew itself, changing into another system by falling toward another basin of attraction, another temporary equilibrium. This is represented by the tail present in figure 3, labelled x.

Take the example of a herd of African elephants (*Loxodonta africana*). Elephants are a K-strategy species, in that they give birth to a single offspring, and invest time and resources heavily over the long period of juvenility before reproducing again (Moss & Lee, 2011; Moss, 2001). However, the r phase of the adaptive cycle still applies.

A season of abundance begins, following an equally abundant last four or five years. Due to the sustained general productivity of the previous period, the number of bull elephants, genetic outsiders to the herd, around is high, the number of herd-young that have now survived beyond the most dangerous first few years is high, and the older generation of matriarchs is still surviving. This

abundant season is exploited (r), and many of the cows become pregnant, the young, the adults, and the old of the herd are well-fed, and the security of food and water means the relatively intense social bonds within elephant groups can be exercised, upkept, and built upon. As the new generation is born and nurtured by mothers, aunts, and sisters, the herd falls into the second stage of the cycle (K). The herd is sustained but is now at carrying capacity, relative to the resources available and the maximum number of individuals the social system can contain. A drought hits, extending far enough that a short migration will not bring the herd to areas unaffected. Here the cycle enters the third stage (Ω), as the herd is hit with scarcity of food, straining the physical health of individuals and the social connectedness of the herd. Certain of the youngest and the oldest die, and the herd moves much further than has previously been necessary. However, the presence of a significant number of much older individuals in the herd acts as the storing of memory, as the final stage begins (α). The previous period of drought was beyond the memory of the young and the adults, and had there been no drought to act as disturbance for many decades more into the past, then the herd would not have the knowledge and memory to survive the system shock, and there could be a local extinction of the elephant population (x). The oldest matriarchs, however, know other areas of abundance further off, as well as how to find water through extensive digging in areas that seem barren. The make-up of the herd is changed, certain bonds are lost while others are strengthened, but when the drought passes, the herd is there to grow again (r).

Panarchy

Across various scales within ecosystems and social-ecological systems, hierarchies and adaptive cycles form a common basis (Holling, 2001). The adaptive cycle may represent a national park, a patch of forest within it, a single tree, a particular branch, or any one of its leaves, which leads to an image of nested adaptive cycles, manifesting at every level of resolution, identifiable but ultimately inseparable from all others above, beneath, and beside. This conceptualisation is known as a panarchy, with the name coming from a synthesis of the word 'hierarchy' and the name of the Greek god Pan, who represents unpredictability (Holling, 2001).

Figures 4 and 5 are representations of a panarchy, which is a "hierarchical structure in which systems of nature... and humans... and social-ecological systems... are interlinked in never-ending adaptive cycles of growth, accumulation, restructuring, and renewal" (Holling, 2001, p. 392). Each level is semi-autonomous and slower than the levels below it, and is formed through the interaction of processes and variables that are similar speeds, contributing information or material to the level above (Holling, Gunderson, & Peterson, 2002).

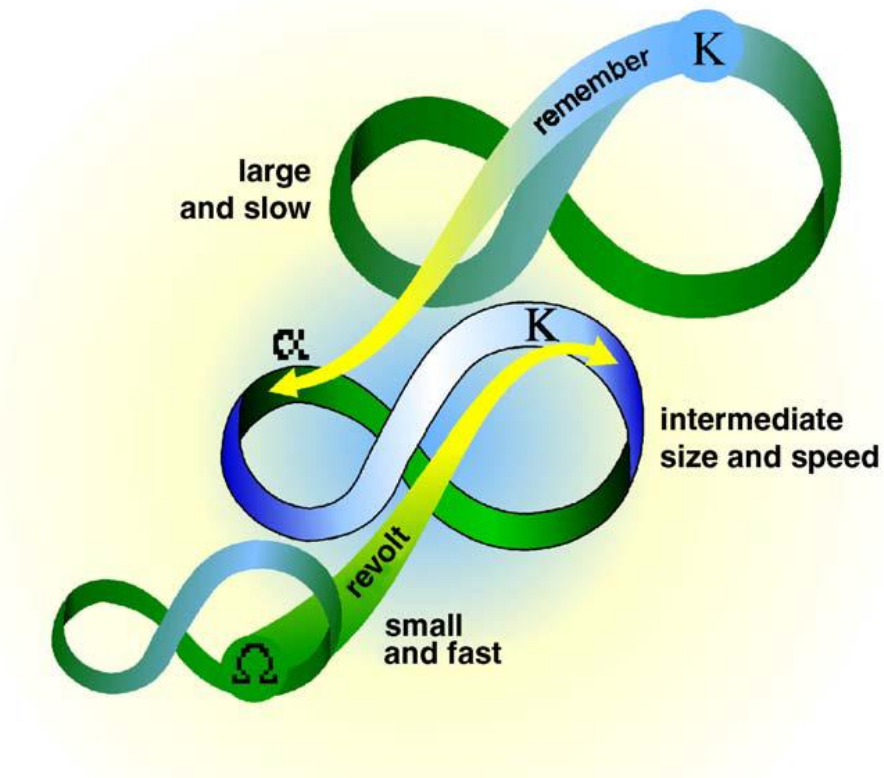


Figure 4: Demonstrating the two critical connections within a panarchy: revolt and remember (Folke, 2006, p. 258).

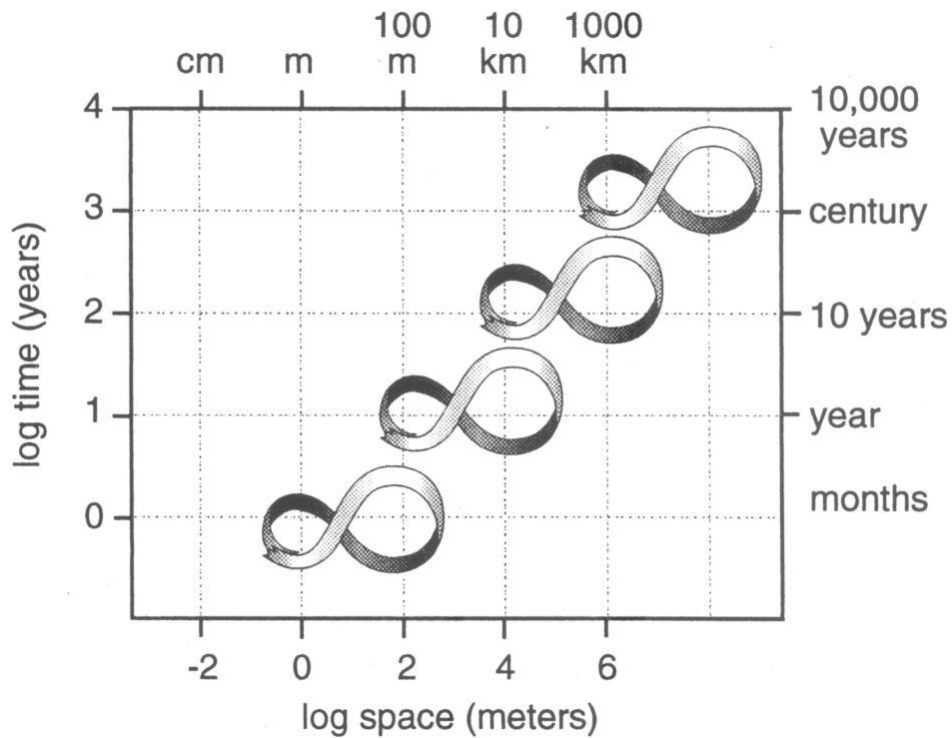


Figure 5: A stylised representation of panarchy, showing it as a cross-scale, nested set of adaptive cycles, and indicating the relationship of and between various levels to space and time (Holling, 2001, p. 397).

Panarchy is therefore different to the traditional notion of hierarchy: unlike hierarchy, panarchy is not focused on control and influence being exerted from larger levels down to smaller, but recognises bottom-up change amongst and resulting from middling and lower levels (Allen et al., 2014). When discussing the four critical factors for resilience above, the point was raised that drawing on knowledge and memory should be conservative and creative. Each panarchy is both conserving and creative, being invigorated by faster, innovative cycles at the smaller levels, whilst being protected from destabilisation by the slower, conservative larger levels (Holling & Gunderson, 2002; Holling, 2001). The renewal and collapse happening within and between scales at different speeds and magnitudes makes panarchy far more dynamic than traditionally static hierarchy (Allen et al., 2014) – arguably, far more representative of the reality of social and ecological systems.

The closeness, strength, and integrity of cross-scale interactions creates the resilience necessary to dampen disruption by complementing within-scale resilience (Peterson et al., 1998). An element of this is redundancy, which, as with the word ‘resilience’ itself, does not mean here that which it means more commonly and colloquially: i.e. useless. Here it refers to the presence of, for example, species with overlapping functions, operating at the same and at different scales (Peterson et al., 1998). If seed dispersal is only achieved through one bird species, then a decline or extinction of that species will disrupt the entire ecosystem. Yet, if there are multiple bird species involved, as well as smaller mammals such as monkeys, then the role is filled to redundancy: a decline or extinction of one will not greatly affect seed dispersal. When members of a community have broad education and training to complement their specific careers and roles, it builds both their own personal resilience in the face of a changing job market, and the community’s resilience in the face of a disaster or change due to political and economic factors at a higher level. If most adults have first aid training and competence, then the reliance on paramedics is complemented to some degree, and when trained paramedics are stretched to the point of being unable to respond quick enough during a disaster, things do not fall apart.

Looking back at figure 4, there are two arrows that join the bottom-most cycle and the top-most cycle to the middle one, and are labelled ‘revolt’ and ‘remember’. This demonstrates the cross-scale interplay of two significant factors for building resilience (Folke, 2006; Holling et al., 2002). Having discussed already memory and the combination of creative and conservative reaction to surprise and change, it is further demonstrated and built on in this conceptualisation. It signifies that processes at the largest levels are the slowest, while the fastest processes occur at the smallest levels, and that memory acts from the top down, while revolt and change tends to act from the bottom up (Folke, 2006). The revolt connection is capable of causing critical change to cascade upward to a vulnerable point in a larger, slower process; the remember connection facilitates

renewal as it draws on accumulated and stored potential when confronted with revolt (Holling, 2001). If the type of revolt is entirely novel, or if memory has been lost, then collapse and fundamental reorganisation across all levels may be the result.

When looking at a system, any given focal point or scale can only be fully understood when the processes above and below it are taken into account (Walker et al., 2006). The utility of this conceptualisation of panarchy includes: as a heuristic to envision complex systems; as an abstract concept, and; as a model of the dynamics within systems (Allen et al., 2014).

Adaptability and Transformability

Two central aspects within resilience theory are particularly pertinent to social-ecological systems (SES): adaptability and transformability.

Within an SES, it is the choices and actions of humans which prevail and dominate (Walker et al., 2004). Thus, while adaptability pertains to a system's capacity and ability to utilise memory, knowledge, and experience to adjust how it reacts to inside and outside processes while staying within its basin of attraction (Folke et al., 2010), in an SES this relates primarily, overwhelmingly even, to the social factor, and the human agents within it: "[adaptability in an SES] amounts to the capacity of humans to manage resilience" (Walker et al., 2004, p. 3). This adaptability can range from minor and middling management of certain aspects and variables within the system, to more significant actions, such as the moving of thresholds and the managing of or interference with cross-scale interactions (Walker et al., 2004).

In contrast to this is transformability. This refers to the capability to create and to transform into a system that is fundamentally new and different, once the previous system has become untenable (Walker et al., 2004). This includes the loss of certain variables and boundaries, and the introduction of new ones, and the finding of a new landscape of equilibrium (Folke et al., 2010; Walker et al., 2004). Whilst on certain scales this transformation equates to a flip into a new system, this is part of the resilience of the system overall, at larger scales, seen via the panarchy conceptualisation. This might manifest in the radical change of the species make-up of a forest, without resulting in an ecosystem shift away from forest entirely: a fungal pestilence does enough damage to mean vast swathes of the current established tree species in the highest levels of the canopy are destroyed, but their replacement by pest-resistant species waiting in the soil brings new equilibrium. The revolt of the catastrophic plague on certain scales within the panarchy is ultimately mediated by the memory within the overall forest ecosystem. With its adaptability not enough in this case on one scale, it took transformability to manifest resilience at a larger scale.

3.2. Vulnerability

Something so far implicit in this theoretical overview of the resilience of ecological, social, and social-ecological systems is vulnerability. This might be taken to be merely low or no resilience, simply the inverse phrasing of what has already been explained, but the concept of vulnerability has been discussed in its own right, primarily regarding risk from natural hazards and their development into disasters.

Where all that has been discussed thus far has been centred on ecological and social systems, their cycles, and their scales, with some discussion of disturbance and shock as an integral part of that, vulnerability theory focuses on that back-loop of the adaptive cycle, from Ω to α , and unpacks risk, hazards, and disasters, defining and making distinctions between each. That back-loop is the most vulnerable stage within the adaptive cycle, and, within the panarchy of nested cycles of a larger system, it is where the effects of interaction from scale to scale become more pronounced (Walker et al., 2006). Whether a system reorganises, and to what degree and on which scales, whether there is much or little renewal, and whether the system flips into a new state (x) or not, is decided in this phase.

In the book *At Risk*, Wisner et al. (2004) recognise that, just as with resilience, there is the common usage of the word, but clarify and define vulnerability for their usage as “the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard (an extreme natural event or process)” (Wisner et al., 2004, p. 11). Vulnerability is the susceptibility of a system to harm generated by exposure to exogenous shocks (Adger, 2006; Aven, 2011; Briguglio et al., 2009), and is a determinant of the differences between groups and individuals regarding their susceptibility to the negative effects of hazards and disasters (Paton, Smith, & Violanti, 2000). The outside stress a system is exposed to, the sensitivity of that system, and its adaptability: these are the key parameters (Adger, 2006).

Figure 6 is a model used by Wisner et al. (2004) to explore vulnerability, and conceptualises the progression of vulnerability as one of the two forces required to bring about disaster, the other being the presence of a hazard, usually a natural event. Titled Pressure and Release (PAR), it outlines an explanatory chain to illustrate how building pressure increases the likelihood of a hazard resulting in a disaster, and incorporates the idea of release with regards to how the reduction of vulnerability across the chain releases pressure that would otherwise be stored, built upon, and contribute to greater suffering and negative effect.

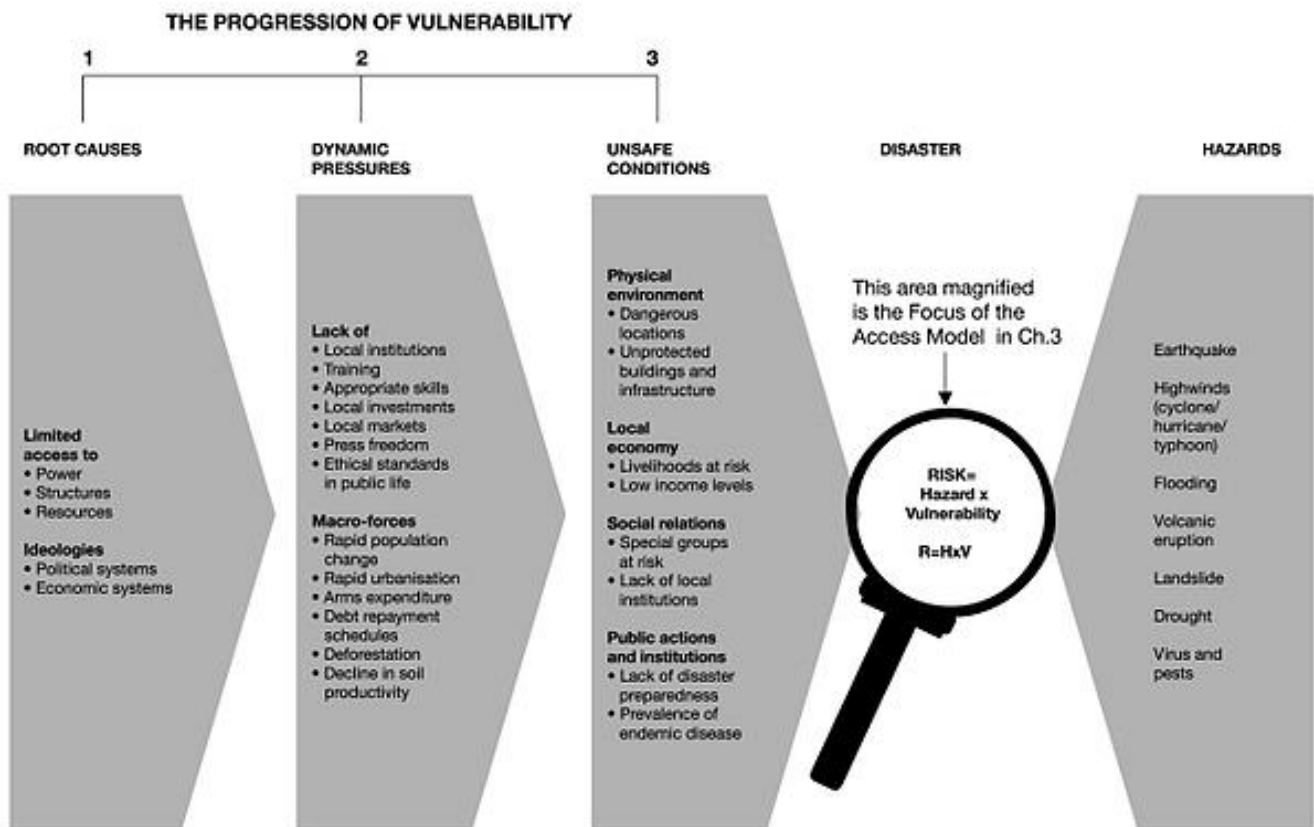


Figure 6: The pressure and release (PAR) model, demonstrating the progression of vulnerability (Wisner et al., 2004, p. 51).

Here each third of that progression is explained (from Wisner et al., 2004):

1. Root causes

Not only spatially and temporally distant, but distant in the minds of individuals and society at large, root causes are underlying, foundational processes, widespread and interrelated with and surrounding a system, across the panarchy. Many of the most important of these pertain to demographics, economics, and politics, and are connected to the functioning or dysfunctioning of society at various scales. Despite being so fundamental, they are likely to be furthest from action taken and policy formulated on hazard mitigation and the reduction of vulnerability, before or after a disaster event.

2. Dynamic pressures

These activities and processes take the effects of the root causes and channel them into the following stage, 'unsafe conditions'. Yet these pressures are not necessarily negative or vulnerability-inducing, in and of themselves. Being more immediate than root causes, dynamic pressures are more easily mapped, either in the wake of a disaster or before, to analyse the progression of vulnerability.

3. Unsafe conditions

These are the expressions of vulnerability in specific forms, contemporary with and in proximity to the presence or occurrence of a hazard. Where people are to be considered as vulnerable, the conditions they exist within and are surrounded by may be considered as unsafe, fragile, or hazardous.

When a hazard approaches, if pressure has built-up across these three elements this can result in the impact of the hazard being exacerbated, creating a disaster when pressure that has not been released finds that release suddenly, and all at once.

A second model by Wisner et al. (2004) was produced to compliment the first – in fact, it is essentially to be found within the PAR. This is the Access model, focusing on the pressure point, where the progression of vulnerability meets the incoming hazard, something which goes largely unanalysed within PAR. It is intended to allow for the understanding of far more complex and long-term processes and events than PAR, which is static, and makes an exaggerated separation between society and the hazards threatening it (Wisner et al., 2004). However, it goes into such a level of detail at many different stages that it arguably takes away from being able to look with any real clarity at events, making things near as messy as they are in reality. As useful as the Access model may be in some contexts, for the purposes of this study the PAR model is a good compliment to the adaptive cycle and the panarchy. The concern over the PAR being static and simplistic seems to be more a pre-emptive concern over unreasonable interpretations and extrapolations based on analysis through the PAR model, rather than a problem within the PAR model itself, which is quite fit for its purpose.

Along with panarchy and the adaptive cycle, this study will utilise the PAR model to analyse the resilience and vulnerability of the modern city of New York in the face of 21st century shocks. Indeed, urbanisation has been considered as “a major factor in the growth of vulnerability” (Wisner et al., 2004, p. 70), due to the magnification of the dangers that hazards inherently present. We saw the density surge in 19th century Manhattan before the surrounding boroughs alleviated that, and we saw how each day Manhattan goes from a population of 1.6 million to 4 million – many hazards could become disasters when hitting areas with such high concentrations of people, whether that concentration fluctuates over a day or a century. Urbanisation is itself often a process resulting from response to disasters elsewhere, particularly in the form of forced migration and displacement (Wisner et al., 2004).

Conclusion

Much of the literature cited throughout this chapter contains extensive definition and discussion of

all that has been summarised here, with examples and case studies in greater depth. This will continue to be drawn on and discussed throughout this study, bringing it more to light, but readers are directed toward the sources cited for further detail and discussion (in particular, see: Holling & Gunderson, 2002; Holling, 1973; Walker et al., 2006; Wisner et al., 2004). The following chapter looks to resilience theory in an urban context, exploring and reviewing some of the scientific literature on urban resilience, before moving to focus on policy for urban resilience produced by governments, organisations, and other actors.

4. Literature Review

Now that the specific conceptualisation of resilience and vulnerability, pertaining to social-ecological systems, rather than the colloquial, common sense usage, has been explored, this chapter will review something that has been already alluded to: urban resilience. Rather than explore the scientific literature in focus and in depth, this section will summarise the conversation that has been ongoing in academia, before moving the focus onto policy literature published by governments, policy makers, and various organisations. This literature review will primarily explore and analyse the way in which resilience is understood and spoken of in actual policy and practice by the City of New York.

4.1. Urban Resilience

In Academia

There has been much work produced on seeing the city as an ecosystem, with its system dynamics and energy flows, unique but inseparably within the larger ecosystem that is the non-urban and the natural world (Bodini, Bondavalli, & Allesina, 2012; Golubiewski, 2012; McPhearson et al., 2016; Nilon, Berkowitz, & Hollweg, 1999; Parlange, 1998; Vasishth & Sloane, 2002), and there has been close association between resilience and sustainability for many years (Redman, 2014; Zhang & Li, 2018). From out of that, resilience has since come into its own, and been touted as the key to the exaggerated ecosystem complexity² of the city (Beilin & Wilkinson, 2015), with complexity also being the cause of one of the major challenges in using resilience theory on and for the city: that is, somehow bringing all the many, varying scales and dimensions of the city system together under one framework (Anderies et al., 2013; Beichler et al., 2014; Jabareen, 2013).

Yet that initial and sustained close association with sustainability, and the crossover in some of their aspects, has the potential to weaken the theory and its efficacy (McPhearson, 2014). When resilience is regarded as simply a perspective, as opposed to a scientifically defined concept (which it is), its efficacy and clarity are further threatened (Brand & Jax, 2007). Much has been done in the arena of scientific and academic literature to address this problem, and to not only reiterate the theory of social-ecological resilience, explaining its key characteristics and their implications, to avoid the dilution of the term, but also to then fit it fully onto cities as a concept, so that it may be as useful as it could potentially be (Anderies et al., 2013; Beichler et al., 2014; Chelleri, 2012;

² That is to say that the complexity of an ecosystem is heightened in the case of the city, not that the complexity of the city has been overblown.

McPhearson, 2014; McPhearson et al., 2016; Meerow, Newell, & Stults, 2016; Pickett, Cadenasso, & Grove, 2004).

While urban resilience has primarily covered issues of climate and natural hazards (Cutter & Finch, 2008; Ernstson et al., 2010; Leichenko, 2011), it has been brought to bear on other aspects of the urban ecosystem. From infrastructure, including the issue of physical structures and the power grid (Godschalk, 2003; Ernstson et al., 2010; Ouyan, Dueñas-Osorio, & Min, 2012), to the topic of planning and sustainable land use (Eraydin & Tasan-Kok, 2013), to socio-political issues (Bahadur & Tanner, 2014; Cote & Nightingale, 2012; Ernstson et al., 2010; Friend & Moench, 2013). In recent years, it has received comprehensive discussion by the widely differing in discipline team that is mathematical scientists and social scientists (Yamagata & Maruyama, 2016).

Throughout all of this, resilience has oftentimes flirted with the danger of becoming an uncritically accepted normative good. There has been concern voiced over the ethical implications of pursuing urban resilience, relating to the necessity of accepting both real risk and the collapse of some system processes, and over the social consequences of different interests seeking a system that lives with disturbance (Derickson, 2016; Martin-Breen & Anderies, 2011). Furthermore, it has been highlighted that all too often the question is begged but rarely answered: to what and for whom is this resilience (Cote & Nightingale, 2012; McPhearson, 2014; Meerow & Newell, 2016)?

Take this quote as an example:

“What I have argued instead is that resilience talk directs our attention toward a social formation that is uninspiring in its emphasis on enduring the effects of the very processes we ought to be focused on transforming.”

(Derickson, 2016, p. 165)

This is certainly a valid concern: for example, there is the problem that we may accept and adapt to climate change and, in doing so, not be driven to alter the practices that have negatively contributed to it, or to not alter them sufficiently. In chapters 5.1 and 6.1 we will look at the dynamics of the GFC, and see this concern relating to modern, neoliberal capitalism – that is, the potentially negative acceptance of capitalism with its occasional crises as the only way forward. However, for the situation raised in that quote to come about, it requires a misunderstanding of what resilience is, or a deliberate misuse of it. The emphasis in systems resilience is not on merely accepting and enduring things passively, and the transformation of processes is absolutely central to it. Particularly when it comes to a human system, something that the city so pre-eminently is, to foster social-ecological resilience is to reflect on practices and norms and their impacts with the aim of change.

In Policy

While this conversation and debate has been and is underway in research and academia, governments and organisations creating and implementing policy for the city have certainly taken up and run with resilience as a normative good, and what is needed is a look at what the understanding of resilience appears to be in that arena, and where it is being applied.

The World Bank brings resilience into its arena of tackling poverty. This would be an interesting opportunity to look at the apparently extremely high resilience of poverty itself, and to use the idea of basins of attraction (to build on the notion of poverty traps) and panarchy to really explore how poverty works, and perhaps gain new insight, or to explore insight already gained through other frameworks and models. However, the World Bank's discussion of resilience is predominantly on resilience as part of sustainable cities (The World Bank Group, 2018), and is only truly developed in the context of climatological hazards, even when discussing keeping people out of poverty (The World Bank Group, 2016a). When there is discussion around resilience and increasing a nation's stability and governance, improving infrastructure and services, and empowering communities, it is with the aim of building an overall resilience to natural hazards (The World Bank Group, 2016b; 2016c; 2017). Of course, this is important work, yet it seems that a theory with such a high utility and relevance to such a broad range of issues is being seen as having found its place of applicability, to remain there save for the occasional mention.

UN-Habitat's discussion and work on urban resilience has a heavy focus on developing countries, and though there is mention of human-made hazards such as "conflicts and technological disasters" (UN-Habitat, 2012a) and their concern is stated as being over "multi-hazard impacts, including those associated with climate change" (UN-Habitat, 2012b), UN-Habitat comes across as the most narrowly focused on climatological threats of the organisations looked at here, both above and below. Of the 10 partner city profiles it lists, nine of the city summaries talks about threats from and resilience to natural events: those of earthquakes, flooding, cyclones, and landslides (UN-Habitat, 2012b). Only the summary for Barcelona includes non-climatological issues, speaking instead of urban resilience in the context of infrastructure and services (UN-Habitat, 2012b). While resilience does not receive much space on the digital page for explanation, the little that is there is good, and an understanding of resilience and vulnerability comes through in UN-Habitat's discussion and plans for environmental hazards.

The OECD breaks slightly from this narrowness of urban resilience as a solution predominantly to climatological threats. In its own list of 10 case studies for resilient cities, only two (Kobe and Brazil) are in that context (OECD, 2018). With the others, it tackles areas such as industry and markets

(Antalya and Lisbon), international enterprise (Oslo), and labour (Bursa and Cardiff) (OECD, 2018) – and, crucially, this is not within an overall ‘thus they are prepared for natural disaster’ framework. However, the only real way in which resilience has been applied in these eight other urban case studies is through the issue of diversification to foster resilience. Though it is central, and though the policy created for these cities from that is clearly good, diversity is not all that resilience entails or requires. Just as it is a shame to under-utilise resilience thinking by only thoroughly applying it to climatological threats, it is a shame to apply it elsewhere within the myriad processes of urban systems in a limited fashion.

In the case of the organisation ‘100 Resilient Cities’, who offer city governments expert support and advice, and financial and logistical guidance in building urban resilience into their policy, there is displayed a fairly fleshed-out understanding of resilience. The information they provide regarding urban resilience puts the focus on the endurance of systems, through the varying methods of coping, adaptation, and transformation (100 Resilient Cities, 2018a; 2018b). It also covers flexibility and redundancy as core principles (100 Resilient Cities 2018a; 2018b): they declare that building a road with resilience in mind is to ensure that it has more than one purpose (100 Resilient Cities, 2018a).

“[R]esilience looks for ways to make systems endure and even thrive in an imbalanced world... resilience is about developing a proactive and integrated plan addressing both shocks and stresses, from natural disasters and to adverse socio-economic trends.”

(100 Resilient Cities, 2018a)

In contrast particularly to UN-Habitat and the World Bank, 100 Resilient Cities demonstrates the most application and development of resilience thinking in non-climatological urban issues. For example, in somewhat of a reversal of what has so far been seen, the strategies for the City of London and the City of Bristol in the United Kingdom deal with economic and social inequality, unemployment, population demographics, the cost of living, and air pollution, and only briefly talk of the issues of climate change, severe weather, and natural events (100 Resilient Cities, 2018c; Bristol City Council, 2016).

In amongst a thorough mixture of developed and developing, old and young, New York City is one of the 100 resilient cities, and the resilience challenge put centre-stage is the threat of flooding and sea-level rise (100 Resilient Cities, 2018d). In order to address the research question of this thesis, it is necessary now to address the first of the three sub-questions: does New York City’s policy and practice during and after Hurricane Sandy suggest an understanding of social-ecological resilience, and demonstrate a commitment to engendering it?

4.2. New York City's Plan for Resilience

The Language

“We are a coastal city—and we cannot, and will not, abandon our waterfront. Instead, we must build a stronger, more resilient city.”

(The City of New York, 2013, Foreword)

In 2013, the City of New York released a publication entitled *A Stronger, More Resilient New York* (The City of New York, 2013). This document was the latest in a series of City publications and efforts which were begun in 2007 by then-Mayor Michael Bloomberg. Previous iterations had talked of sustainability, combatting climate change, and creating a New York that was greener. In the wake of Hurricane Sandy, 2013's publication was dedicated to the issue of rebuilding communities and infrastructure in the aftermath of that storm. And, while the term 'resilience' appeared in at least one earlier publication, the contrasting prominence given to resilience in this document is notable, beyond simply the fact of its inclusion in the title.

The second page of the document is entirely given over to a definition of the word 'resilient':

- “1. Able to bounce back after change or adversity.
 2. Capable of preparing for, responding to, and recovering from difficult conditions.
- Syn.: Tough”

(The City of New York, 2013, second page)

It is a positive sign that the authors and designers seek to offer up a definition of 'resilient', clearly aware that there exist several colloquial and professional uses of the term, requiring a clarification for what it means to be resilient in the context of this document and the policies and actions it describes and prescribes. The first of the two numbered bullet points seems to be a simple rendering of reorganisation and renewal. It is quite telling, however, that after giving a second bullet point that reasonably, if vaguely, represents and summarises the theory of Holling and others, this is undermined immediately by the claim that 'resilient' means, in other words, 'tough'.

A forest can be tough in the face of regular bouts of tremendous wind, but fall apart at an unfamiliar blaze. The toughest of cities that has stood the test of time can be decimated by a disturbance it has no practice in facing. This hypothetical forest and this hypothetical city are systems which have low to zero social-ecological resilience: they are tough when outside forces are predictable, but their processes and inner relationships fail to persist in the face of uncertainty, change, and surprise. The use of 'tough' at the outset of this document suggests an understanding of the word 'resilient' that still clings to earlier theories of resilience which, in chapter 3.1 and in table 1 below, can be seen to

differ fundamentally to social-ecological resilience (Folke, 2006; Holling, 1996). Resilience, when speaking of social-ecological systems, refers to that system’s ability to absorb shock, surprise, and disturbance, to learn and adapt (and to transform if necessary), yet to persist in its overall form and function. A system can certainly be resilient *and* tough. But to place them as synonyms indicates, if not a misunderstanding or a lack of understanding of social-ecological resilience theory, then at least a thorough mixture of ideas and approaches regarding resilience.

Table 1: A summary of three different ideas of resilience, and their differences (from Folke, 2006).

Resilience Concepts	Characteristics	Focus on	Context
Engineering Resilience	Return time, efficiency	Recovery, constancy	Vicinity of a stable equilibrium
Ecological/ecosystem resilience, Social resilience	Buffer capacity, withstand shock, maintain function	Persistence, robustness	Multiple equilibria, stability landscapes
Social-ecological resilience	Interplay disturbance and reorganisation, sustaining and developing	Adaptive capacity, transformability, learning, innovation	Integrated system feedback, cross-scale dynamic interactions

The pages following this defining moment contain the foreword from the Mayor and the overall preface, and the language of it fluctuates. The hope for the future of the city is described as “much stronger, better protected... far safer, more resilient... stronger, more resilient” (The City of New York, 2013, Foreword), with hardest hit areas needing to emerge as “safer, stronger,” (The City of New York, 2013, Foreword), and other buildings aiming toward being more “flood-resistant” (The City of New York, 2013, Foreword). Efforts are underway to “prepare for a future with climate change” (The City of New York, 2013, Foreword), accepting the impossibility of being proofed against it, and steps are being taken to prepare and to adapt for and to what may come next (The City of New York, 2013).

There is talk of vulnerable neighbourhoods sitting behind an array of defences, with wetlands and offshore sea barriers as a frontline, with healthier dunes and beaches to meet the waves that get past them, acting as shields for communities inland. Floodwalls, both temporary and permanent, will be present to hold off rising water, complimented by raised and reinforced bulkheads, tide gates, and other coastal protection for surges in the storm. Hardened, sometimes elevated, homes will make it more difficult for water that finds its way inland to separate buildings from their

foundations, and more difficult to knock out mechanical and electrical systems, with the water being absorbed by green infrastructure, or sent away toward new sewers at higher levels. The aim is that networks within the city will be able to operate without interruption, or swiftly return to operational if shut down or knocked-out.

Clearly there are elements here that absolutely follow social-ecological resilience and vulnerability, with policy and practice aimed at releasing the pressure that may turn a hazard into a disaster, and others aimed at learning and adapting, so as to create system that is fundamentally the same but improved, and better prepared to keep networks and processes functioning whatever may come. However, the idea of increasing toughness, resistance, and constancy is also present – and that may well be appropriate, this discussion of the language used is not necessarily condemnation.

Another moment of note, and relevant to discussion later in this study (see chapter 6.4), is when the issue of the medium and long term is raised. To the authors – and thus to the Mayor, the City, and its citizens – the medium term is considered to be the 2020s, and the long term is considered to be the 2050s (The City of New York, 2013). Conversation and analysis over systems, the adaptive cycle and the panarchy within, and hazards, disasters, and the progression of vulnerability, all succeed or fail on the suitability of the timeframe being considered and referred to. As stated, this will be discussed in detail at a later stage of this thesis, but the question is worth raising now, as it is raised by the foreword and preface of the City’s publication: should either of these decades – the 2020s or the 2050s – be even considered the medium term, let alone the long?

Within this preamble to the rest of the publication, readers are introduced to a new term: ‘resiliency’.

In the first four pages of search results generated in a Google Scholar search, the word ‘resiliency’ garners (besides the query ‘Did you mean *resilience*?’) work in cognition, psychology (particularly around children, adolescents, and families), and education (Google Scholar, 2018). Only one result is a study using social-ecological resilience and vulnerability theory, applying them to evaluating water resource systems. Yet, this term ‘resiliency’ is used 910 times throughout the PlaNYC document, while ‘resilient’ appears at just over a third of that (332), with ‘resilience’ appearing only 13 times (see table 2). So, the most commonly used articulation of the core concept appears to be the least appropriate, and is not the term closest to that which was given an entire page in the report for the clarity of definition. The word, when searched on the website of the Oxford English Dictionary, automatically brings up the page for ‘resilience’ (Oxford University Press, 2018), and ‘resiliency’ remains undefined in the City document or on the official website of the City of New York, despite the relevant branch of the Mayor’s Office bearing the title *Recovery & Resiliency*.

Table 2: Showing the prevalence of the ‘buzzwords’ across different NYC policy documents.

	Resilient	Resilience	Resiliency	Vulnerable	Vulnerability	Sustainable	Sustainability
PlaNYC 2007	0	0	0	13	3	41	43
PlaNYC 2011	9	56	0	7	2	92	68
PlaNYC 2013	332	13	910	371	106	34	42
OneNYC 2017	88	17	211	36	18	35	28

It might be regarded as pedantry to discuss this terminology so: clearly ‘resiliency’ is being used as a synonymous replacement for ‘resilience’, and given that the document in question is not a scholarly, academic work drawing explicitly on the literature discussed and referenced in chapter 3, lax and incorrect terminology might be argued as forgivable. Yet it is certainly worth highlighting the vagueness and inconsistency to be found in the very opening of a document on creating a more resilient New York. It is unclear why ‘resiliency’ is used when ‘resilience’ is the appropriate term. It could be that this new word allows for the cutting or relaxing of ties and obligations to a theory that will be borrowed from, but not entirely adhered to. In some ways, it seems to seek to mix and to compliment various theories of resilience with each other, with the psychological and colloquial notions of resilience thrown into that mix. That might turn out to be a sensible mix of ideas when creating policy for the city; it might turn out to be problematic.

This language that suggests a conceptual mixture continues through the next few pages. Relief and recovery efforts are acknowledged as not enough, with the need to prepare for the many possible futures, yet there is a repeat of that which we have seen on the second page of the document:

“The underlying goal of this report is resiliency. That is, to adapt our city to the impacts of climate change and to seek to ensure that, when nature overwhelms our defenses from time to time, we are able to recover more quickly. In short, we have to be tough.”

(The City of New York, 2013, p. 6)

This rallying cry of toughness is then reiterated in a bigger font, and in bold, stating that the “time has come to make our city even tougher” (The City of New York, 2013, p. 6), only moments after speaking of making New York City stronger, safer, and more resilient, through slowing climate change whilst adapting to existing changes and preparing for those to come.

There is a box that appears on page 7 of the PlaNYC document, titled “What resiliency means?” (The City of New York, 2013, p. 7). Earlier, I declared that ‘resiliency’ is undefined in the document, and,

despite the presence of this box, that statement holds true. The box explains what a resilient city is: protected, adapted to mitigate most impacts from the climate, and able to bounce quickly back when defences are breached (The City of New York, 2013). It then explains some resiliency principles that have been formulated and that suffuse the whole report – however, neither the box nor the principles do anything to elucidate on the meaning or importance of setting a ‘y’ in place of the ‘e’ at the end of the word ‘resilience’, resulting, as highlighted before, in the least appropriate – and most incorrect – articulation of a concept that it is vital to have some commonality and clarity on.

Perhaps ‘resiliency’ could be defined as an adherence to the theory of social-ecological resilience that is inevitably attached onto, or combined with, an attitude to resilience that still roots itself in robustness and constancy wherever possible. Beyond that, it appears to be nothing more than a terminological expression of individuality that is, at best, completely unnecessary, and, at worst, fuel for confusion and inconsistency, exacerbating a problem discussed in the previous short review of scientific literature on urban resilience – the threat to the theory’s efficacy when inconsistently defined. However, despite this critique of the terminology of the document and how it is employed, it is clear that there is an understanding of the theory of complex adaptive systems, and recognition that resilience is not a case of simply toughening up, in the colloquial, common-sense use of the phrase. We have seen already some evidence of that understanding, and it is further evidenced when contrasting this document to a PlaNYC report from 2007, entitled *A Greener, Greater New York*. In this, there is talk of repelling the threats of climate change, rather than acceptance and adaptation, and under a heading of “Preventing Global Warming” (The City of New York, 2007, p. 8) there is talk of what it would take to stop it (The City of New York, 2007). Of course, this document still is permeated with a general understanding that the solution cannot be to build a high, thick wall and carry on as usual behind it. Yet, there is the sense of a quite different attitude in the older report.

“What kind of city should we become? ... In all our conversations, one core emerged: the strengths of the city are in concentration, efficiency, density, diversity; in its people, but above all in its unending sense of possibility. We must reinforce these strengths.”

(The City of New York, 2007, p. 10)

If social-ecological resilience and urban resilience were the zeitgeist of the time back in 2007, this quote above is very likely where they would have been emphatically stated. While certain elements of this section of the introductory pages to PlaNYC 2007 align with resilience theory – diversity, for example – it lacks both the explicit terminology and the implicit tone of later reports. As shown in table 2, there is not a single instance of ‘resilient’, ‘resilience’, or ‘resiliency’ in this report from 2007,

with the terms appearing from 2011 and 2013 onward. In the most recent of these publications, now titled OneNYC, from 2017, the three r's have been dialled back, but remain far more present than they were pre-Hurricane Sandy (see table 2). For all the valid cynicism over resilience-as-buzzword and my concern (or pedantry) over the inconsistency of language, the opening pages of the report that followed in the wake of Hurricane Sandy suggest two things: one, that these policy reports do seem to tend toward using whatever word and framework is popular at the time, and; two, that they are, however, to some degree, at least in the case of resilience, informed about the theoretical background and the implications of taking it on board.

As with the culture on the streets and the towers in the skyline, the terms emerge, have their time in the sun, and settle, some to fade, others to endure at a more modest prominence, there to build upon one another in true city fashion. 'Greener' may have long ago fallen by the wayside, but with the new title of *The Plan for a Strong and Just City*, last year's OneNYC report looks to the future, and declares:

“We are committed to building a stronger, sustainable, resilient, and equitable city.”

(The City of New York, 2017, p. 3)

The Plans for Action

Words and how they are used matter, as they not only express underlying attitudes and philosophies, but shape and inform their future – hence a reviewing of the language of the document. Yet it is action, both planned and implemented policy, that needs to be looked at now. If the underlying attitude and the language used appears, despite imperfections, to genuinely be informed by the theory of social-ecological resilience and the idea of complex, adaptive systems, then what of the report's plans for developing the city in the wake of Hurricane Sandy?

Throughout the rest of the PlaNYC document, it is clear that, when it comes to resilience in the face of climate, there is much that the city's governance is getting right. Before, during, and after 2012, there has been a concerted effort to gather data surrounding floodplains, the nature of storms and the climate, and the assessment of current and future risks and vulnerabilities (The City of New York, 2013, p. 19-36). There is reflection and analysis on and of the city's history with storms and hurricanes, which is incorporated into the assessment of the present and near-future (The City of New York, 2013, p. 19-36). It looks beyond the physical damage that Sandy has caused, and that which future iterations may cause, to consider the economic and societal impact and disruption, aware of the many various systems and processes in play, and the individual and interacting dynamics of different climatologic hazards, including flooding, heat, drought (The City of New York,

2013, p. 19-36), as well as the underlying geomorphology of the region (The City of New York, 2013, p. 37-66).

Here is being demonstrated the third of the four critical factors for fostering resilience: the combination of different kinds of knowledge in order to learn (Folke et al., 2003). Further, while generating memory for the future to draw upon in the form of knowledge gathered now, it is seeking to engender future resilience, rather than solve only the disturbance felt in the immediate present and then rebuild things as before. This could be seen as reorganisation and the subsequent exploitation of resources, one side of the adaptive cycle, following a disturbance.

A little further in, there is a page dedicated to responding to the idea of storm surge barriers in the harbour area, proposed by some as a measure to block surging waters while allowing normal water flow and shipping activity under normal circumstances (The City of New York, 2013, 37-66). After explaining why this would be impractical and difficult based on cost and timespan for design, approval, and construction, the document then further explains why this kind of resilience measure is not appropriate in this case:

“... the possible hydrodynamic and environmental impacts (on fish migration, siltation, river flow, and water quality) of harborwide barriers are likely to be substantial... any barriers would create an ‘insiders/outside’ dynamic, with only those behind the barriers receiving maximum protection... [they] may also cause additional flooding in areas outside the barriers (especially in tighter waterways, such as the Upper East River), thus making those communities more vulnerable...”

(The City of New York, 2013, p. 49)

This shows an understanding of a complex array of interwoven systems that render the barrier response as inappropriate, including the societal effects alongside the physical, financial, and environmental. However, while it can be interpreted as an understanding of engendering social-ecological resilience, it appears to be primarily about practicality, and the likelihood of the project being approved and completed. For example, the mention of environmental impacts seems to stand out as a concern born of a resilience approach. However, after raising the issue of the environmental impact of such barriers, the document follows it with: “These impacts also could be the subject of lawsuits—which have, in New York’s relatively recent past, led to the cancellation of major in-water projects” (The City of New York, 2013, p. 49). It is not made clear that this storm barrier response is being set aside because of its inability to create a long-term resilience for New York. Rather, it seems to have been set aside because of financial constraints and likely political difficulties that would prevent it being finished, either in good time or at all. On the other hand, the document does go on

to then speak of deciding on more discrete solutions in order to create a far more diversified defence in the face of future storms. While it does not use the word until later in the document, when it discusses power and transportation infrastructure, this is striving for redundancy, the overlapping of functions within the same and at different scales that improves the chances of the persistence of processes and relationships when disturbance hits (Peterson et al., 1998).

Interestingly, the document makes a point of ruling out another tactic for dealing with the climatological future of the American coast: retreat. Adamant that the city's future "lies along its coastline" (The City of New York, 2013, p. 46), there is a recognition that the built-up area within the city's floodplain is not something easily reversible nor particularly transformable, and in the decades ahead the already dense boroughs will see more people arrive, looking to stay (The City of New York, 2013, p. 37-66). This speaks to why the historical picture painted in the closing pages of the introduction of this thesis underlies a discussion of New York City's resilience just as the 1811 grid underlies Manhattan – the physical foundations of the city are fundamentally intransformable, and the population is not easily reversed or uprooted. The idea of retreat also ties in to the issue of the time horizon that is being considered, which, as mentioned above, will be discussed in chapter 6.4.

After highlighting the undesirability and impossibility of retreat, the document states a commitment to some measures that fall more in line with the separated ideas of social resilience and ecological resilience explained by the second point in table 1. In short, these are the plan to increase the height of the vulnerable areas of the coast, and the attenuation (reduction of the force and effect) of waves, by diminishing their speed or knocking them down (The City of New York, 2013, p. 46).

As critical as I have been with the consistency of terminology, it would be unfair not to recognise that this document aims toward adaptation and subtle transformation to avoid collapse, and cannot have put together these plans if it had merely thrown the word 'resilience' onto its pages after recognising its popularity and prevalence. It is overall an intelligent and necessary combination of the three kinds of resilience laid out in table 1, with an awareness of how crucial the third kind, social-ecological resilience, is for what is, to their minds, medium- and long-term persistence.

On Hazards

A year after this document in the wake of the hurricane, the NYC Emergency Management department released a thorough update to their previous Hazard Mitigation plan, and this update followed on from PlaNYC 2013 and is effective from April 2014 until April 2019 (NYC Emergency Management, 2018).

A list of hazards is given, both within the report and on the webpage dedicated to it (NYC Emergency Management, 2018; The City of New York, 2014):

- Building collapses and explosions
- Carbon monoxide
- Coastal storms and hurricanes
- Disease outbreaks and biological events
- Earthquakes
- Extreme heat
- Fire
- Flooding
- HazMats (hazardous materials), chemical spills, and radiation
- High winds
- Terrorism
- Thunderstorms and lightning
- Tornadoes
- Utility disruptions
- Winter weather

This is reasonably extensive, and the aim of sharing hazard mitigation knowledge with the people of New York City speaks to an understanding of the limits to any top-down approach. Where so much – most, in fact – of the discussion and policy, of the PDFs and web pages, on New York City’s resilience is on natural events and the changing climate propelling them, here can be seen the inclusion of other hazards, with the most notable being terrorism. This speaks to a threat that is not undirected but involves intent, while chemical spills, fire, disease outbreaks, and utility disruptions can be thus, though are not inherently so. While these non-natural hazards are recognised and included under the umbrella of resilience and what it is needed for, the focus falls quickly and heavily back onto climate-based risk – something that happens regularly across the policy and information on urban resilience provided by different groups and organisations. That is not a grievous fault to be raised against these policy-makers and information-providers, but it certainly seems to be a repeated sign that resilience theory has only been shown to have become seriously taken on board and utilised in the area of risks and shocks from natural events.

One important and impressive aspect of the Hazard Mitigation plan is its considerable consideration of factors, and factors within factors, that all interplay and are necessary to understand. When discussing the city’s population, it not only highlights age and income, but social isolation and

disability (The City of New York, 2014, p. 21-24). It looks at the transportation by road and rail, and sea and sky, and how they relate to the electrical infrastructure and the geography of the city and its floodplains (The City of New York, 2014, p. 30-31). With the built environment, it looks not only at location and age, but construction type and structural variation (The City of New York, 2014, p. 27). As has already been noted, this is nearly always in the context of resilience in the face of climate: when discussing the vulnerability of the economy, it is regarding disruption and recovery in the wake of natural disaster (The City of New York, 2014, p. 24), rather than anything inherent in how the financial system functions – something that will be discussed in chapters 5.1 and 6.1. However, there is a good foundation of understanding of and knowledge about the systems of the city that is available now for discussing other shocks and hazards, even if it was primarily, overwhelmingly researched to deal with threats from the natural world.

Conclusion

It has been five years since the PlaNYC document was released by the City of New York, and though the OneNYC report of 2017 does not give pre-eminence to resilience, it remains significant, and regarded as crucial to the city's future. There has been a taking on board of much of what social-ecological resilience theory discusses regarding complex, adaptive systems, though this is fused with other understandings of what it is to be resilient. This has been demonstrated when creating city policy for dealing with climate change and natural hazards, but the city system and the processes within it face more than just exterior climatological hazards hitting hard. We saw earlier how there is policy out there that does bring resilience theory to bear on non-climatological hazards and risks, yet to a limited degree, and usually within a larger concern of climate change and its observed and/or predicted impacts. For New York, the intense focus on the issues of flooding and hurricanes may be beyond what is actually warranted (see chapter 6.3), and it may be preventing resilience and vulnerability being fully developed in other areas that need it.

In the following chapter, the adaptive cycle, panarchy, and PAR models will be used to explore the dynamics of New York City in the recent past during major non-climatological shocks. The events of 9/11 and the GFC will be explored – both events that occurred prior to this phase of more explicit resilience thinking, planning, and action. This analysis, building on what we have seen of the city's ideas on and policy for resilience, will lead into a discussion on the social-ecological resilience of the urban system that is New York City.

5. Analysis

5.1. Global Financial Crisis

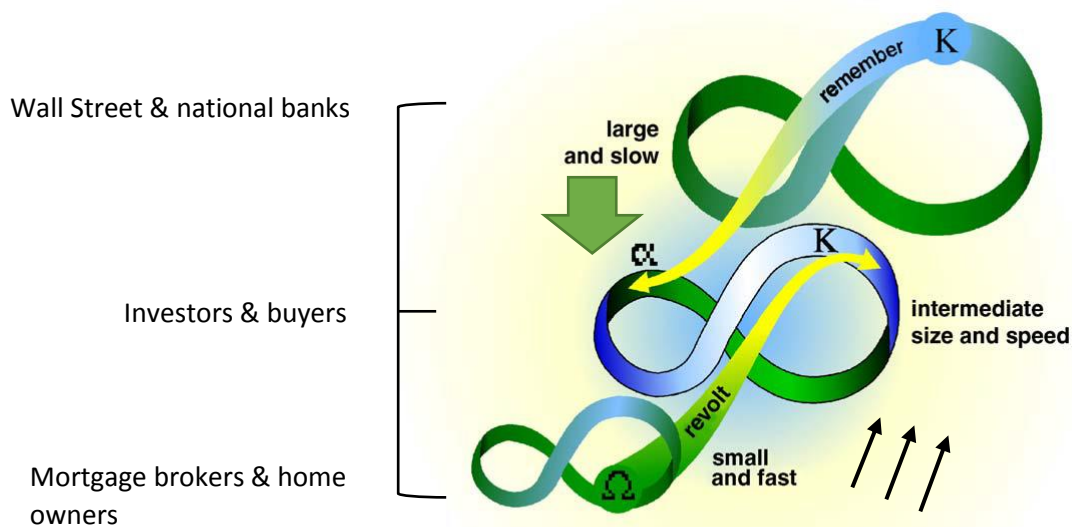


Figure 7: A panarchy model demonstrating what would likely have occurred on Wall Street in 2007, had the financial system been functioning properly, without the weakening that occurred during the early 2000s. The black arrows represent the revolt of the high levels of defaulting on mortgages coming from below, with the problem being resolved between the functioning of the middle cycle and the memory from the upper level, as represented by the green arrow. Adapted from Folke (2006).

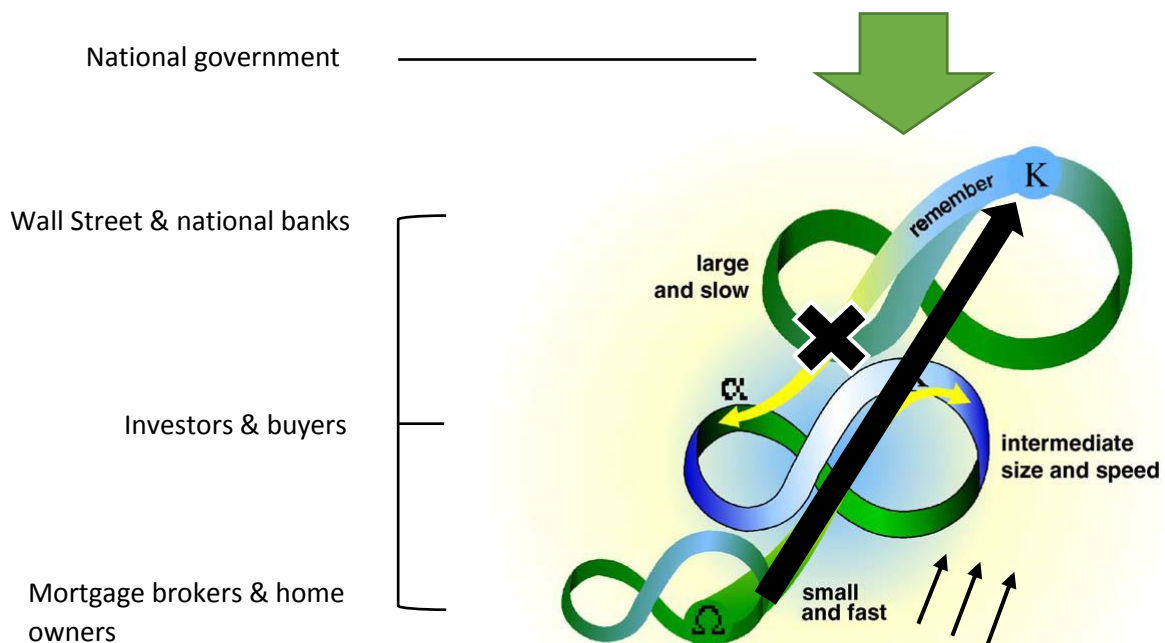


Figure 8: A panarchy model demonstrating what occurred in 2007/08 as the housing bubble burst. The smaller black arrows represent the revolt from the high levels of defaulting on mortgages coming from below, with the black cross representing the failure of the middle and upper levels to contain and resolve it. The large black arrow represents the spread of the revolt to higher levels, which had to receive intervention to save the failing system, as represented by the green arrow. Adapted from Folke (2006).

2. The immense profitability produced and experienced on Wall Street within the housing market in turn results in mass complacency to risk, given the peak success position that the r stage has pushed the financial sector toward. Mortgages previously judged too risky are re-classified and taken on, draining stability from the system.

4. 2009/2010 onward presents a choice, as the opportunity to transform in a manner that is controlled and begin a new cycle is represented by x. Lessons learned from Ω to α could be utilised. The curved arrow of darker blue represents the path ultimately taken.

5. With the bailouts and a paucity of serious consequences for individuals, institutions, and ideologies responsible for what occurred in the previous K stage that resulted in collapse, the cycle is allowed to start again, recovered and rebooted yet weakened. Any lessons that are learnt fade with time and with new political cycles and changes. The faded-blue arrow represents the opportunity missed.

6. As of 2018, the situation appears to be between the r and K stage again. The prospect of deregulation, due to a lack of memory and adaptation, threatens to run the cycle through an Ω and α stage as dangerous as before, if not more so. The potential regime shift represented by x may not be a matter of choice in the future, and a transformation that is not controlled, desired, or guided may occur.

3. GFC event occurs in 2007/8. This stretches from the end of the K stage to the early α stage. Mass defaulting on mortgages as the housing bubble bursts causes the time bomb developed and nurtured through the 2000s to finally become thoroughly unstable, and bankruptcy spreads through Wall Street and into the myriad national and international rivers it is a wellspring to.

1. Within the r stage of the early 2000s, the innovation of securitisation in the mortgage market generates excitement among those involved, and spreads the belief that both the stability and resilience of the system are being bolstered by the spreading of risk. Borrowing and lending of large amounts of money proliferates, with an increasing number and diversity of players involved. Each success begets more, and loans are paid back and greatly profited on. Free of strict market regulation by the state or federal government, Wall Street can exploit, and reap and share the benefits.

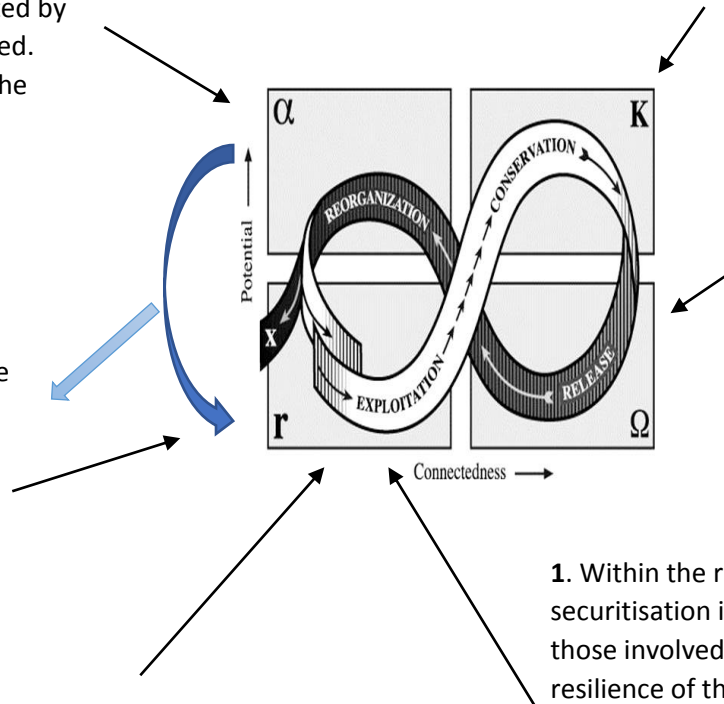
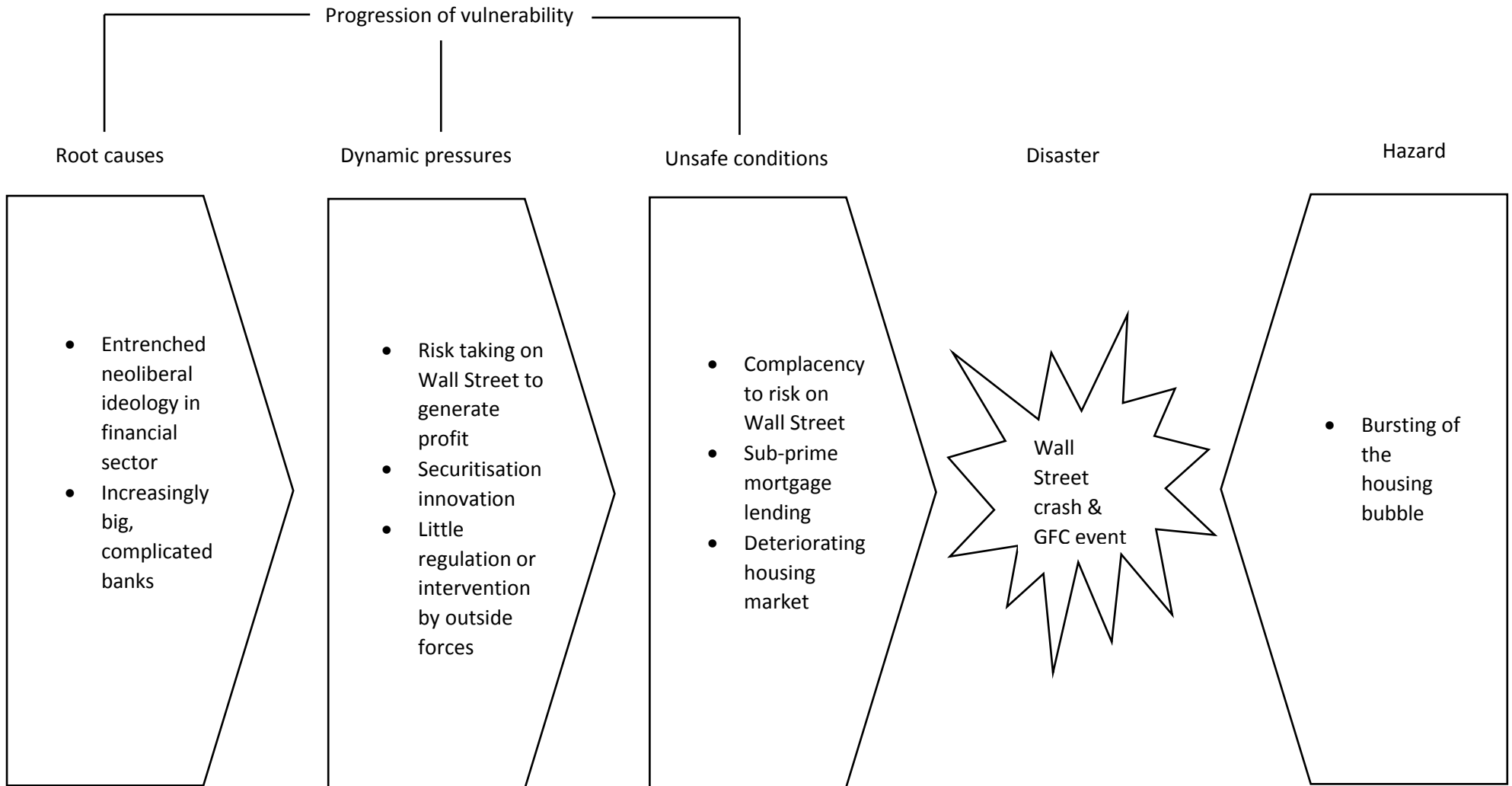


Figure 9: Showing an adaptive cycle of the American financial system from 2005 (r) to 2015 (once r has been reached again after one full cycle). Adapted from Holling (2001).



The blue arrows represent the depth to which the issue was dealt with from 2009 onward. Unsafe conditions were rectified, and dynamic pressures somewhat alleviated – temporarily. Root causes remained untouched.

Figure 10: A PAR model demonstrating the progression of vulnerability toward the GFC within the financial system on Wall Street, and the nature of the response after the crisis. Adapted from Wisner et al. (2004).

5.2. September 11th Attacks

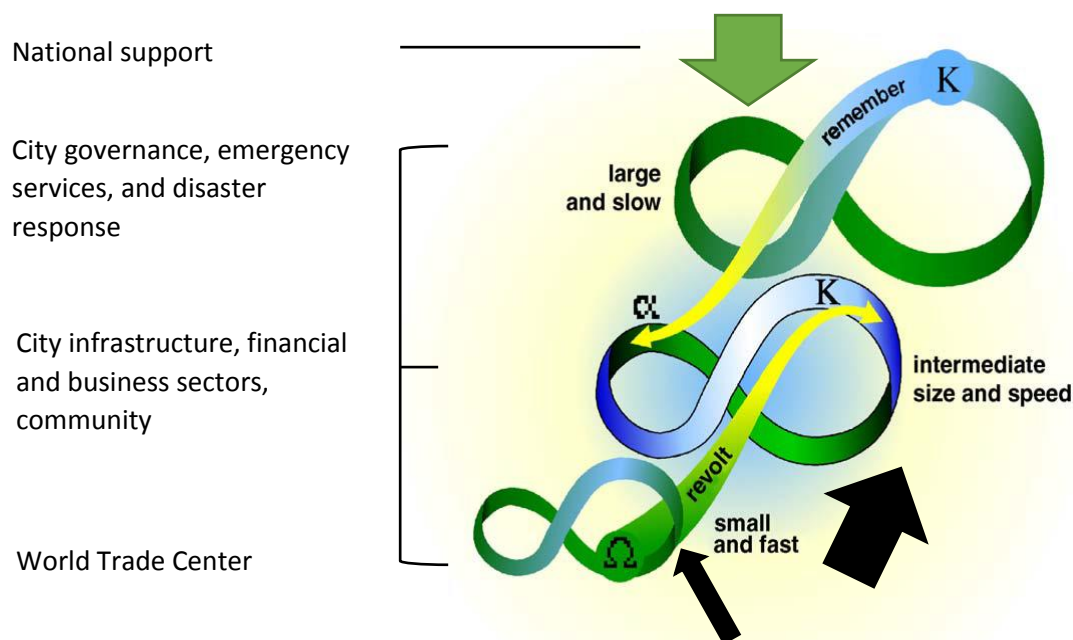


Figure 11: A panarchy model demonstrating the functioning of the city panarchy in the immediate and short term following the attack. The large black arrow represents the massive revolt upward caused by the attack, whilst the smaller black arrow represents the exogenous attack. Things do not fall apart, due to sufficient memory from the upper levels. The city does, however, require support from outside itself. Adapted from Folke (2006).

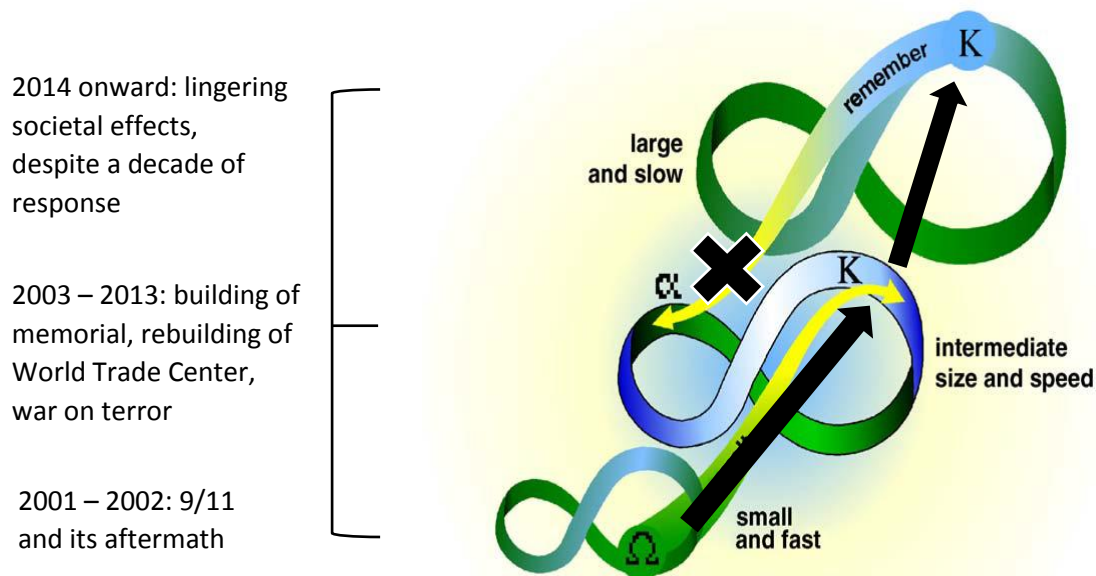


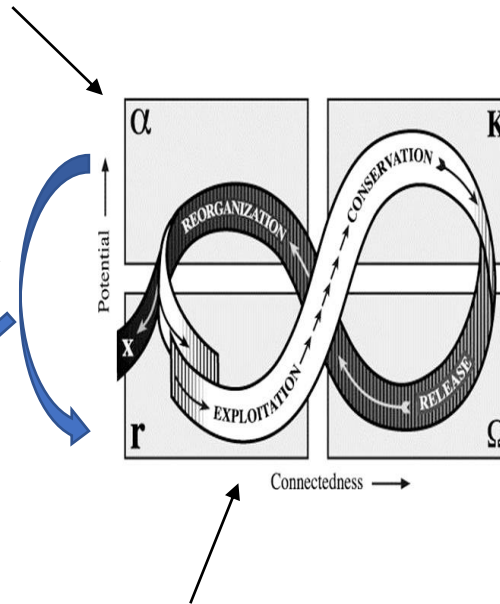
Figure 12: A panarchy model demonstrating the long term, non-physical impact of the attack of 9/11 and its aftermath in the cultural psyche. While the city proved resilient in recovering from much of the damage caused, security measures and practices changed dramatically, and a bubble of safety and distance from political and religious conflict was punctured. The black cross represents the lack of memory and experience with which to fully comprehend and resolve the trauma of such a sudden and symbolic attack. The black arrows represent both the initial effect, and its slower continuation upward over time. Adapted from Folke (2006).

3. Disaster and emergency response take immediate effect; the city has massive stores of experience and knowledge available, complimented by volunteers from within and without the city. In the short term, and regarding rescue, recovery, and rebuilding, the city demonstrates immense capacity for reorganisation and resilience. The experience, redundancy, and knowledge gained by city governance, the emergency services, and the population through regular small and middling shocks allows the city to hold. However, in the long term there are areas where the trauma of the event causes irreversible change.

1. Though often wracked with unrest due to significant levels of crime from within, and though the nation has been involved in war across the ocean, the city has not faced any kind of exogenous attack in living memory.

4. The two arrows represent differing outcomes. The curved arrow represents the rebuilding of the physical infrastructure of the city, and the eventual return to financial functioning and everyday life: reorganised but not transformed, the city recovers and begins the cycle anew.

5. The straight arrow, however, represents the failure of the system at other levels to reorganise and continue on. Regarding national and local security measures, and a cultural, societal attitude and atmosphere, things are unable to avoid flipping out of the previous cycle, and are instead fundamentally transformed.



2. The attacks of 9/11 occur in the span of a few hours: two attacks in Manhattan, one on the Pentagon, and a failed fourth attack directed at Washington, D. C. They cause the loss of almost 3,000 lives, the injury of a further 6,000 people, and greater than \$10 billion worth of physical damage.

6. The following few months and years see the city demonstrate resilience on some levels despite tremendous damage to buildings, to infrastructure, and to the daily workings of the city. Recovery, reorganisation, and rebuilding carry on even into the r stage of a new cycle, with the city system and many of its processes overall intact. The following decade sees the lasting effect of the attack, however, and on other levels the city and its people are in a new cycle, permanently interrupted.

Figure 13: Showing an adaptive cycle of New York City in the face of the terrorist attack of 9/11, from the turn of the century to the years following 2001. Adapted from Holling (2001).

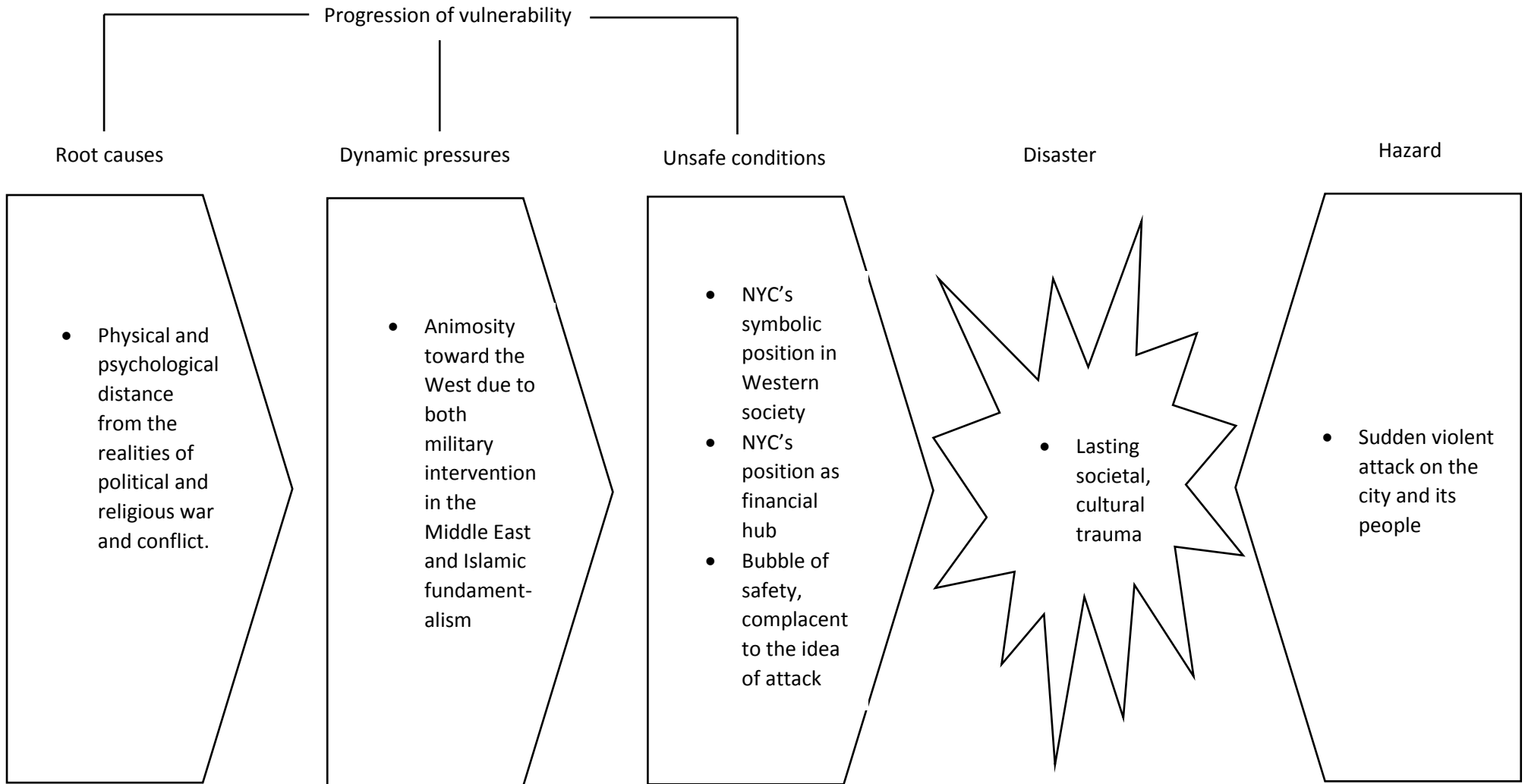


Figure 14: A PAR model demonstrating the progression of vulnerability that made the lasting effect of 9/11 possible, even as the hazard of 9/11 did not result in disaster regarding the infrastructure and functioning of the city, despite the damage and difficulty in the short term. Adapted from Wisner et al. (2004).

6. Discussion

6.1. A Financial Storm

“The financial crisis was not like a freak weather event, as some bankers and regulators had claimed. Rather, it was man-made, predictable and entirely avoidable.”

(DePillis, 2018)

At a time when the reorganisation of the US financial system ought be well underway and traversing the r stage of a new and more resilient adaptive cycle, instead the high resilience of a financial ideology has trumped all else, and, without even fully recovering from the massive shock that hit a wilfully weakened system in 2007 (DePillis, 2018), looming deregulation and the undoing of the safeguards put in place as response to the disaster of the GFC appear to be clearing anew the road already travelled, to be emphatically re-taken (see points 4, 5, and 6 in figure 9).

For the full story of the GFC, readers are directed to Helleiner (2011), Goodhart (2008), French et al. (2009), and Barrell and Davis (2008). A financial innovation known as securitisation, itself not inherently negative or positive, was introduced on Wall Street and took hold in the lending, borrowing, buying, and selling of the housing market. Initially resulting in significant profits, it began to be used to reclassify mortgages that had been previously regarded as risky, and increasingly unsafe investments suffused the market. The excitement initially generated begat serious complacency to risk, due to the erroneous belief that securitisation had increased the resilience of the housing market, and the financial system it sat within, by dispersing risk. The worth of houses soon dropped, homeowners defaulted on their mortgages – with some, instead, walking (quite literally) away from their homes – leaving the hands of investors full of worthless investments, and millions upon millions borrowed from banks that would no longer be possible to pay back.

As shown in figure 7, some degree of risk taking and failure in the housing market should not have been disastrous, as it would have been handled by a functioning financial market panarchy. However, the situation described above meant that revolt spread up uncontrollably, and a market desperate to be fully and forever unregulated required enormous and sustained government intervention to save it from collapse and the pulling down of much that it was connected to (see figure 8). The revolt was larger than it ought to have been, and the vulnerability of the middle and upper levels of the panarchy was far greater than it ought to have been.

Since the turn of the century, deregulation in the US had been increasing, following a *lasses-faire*³ economy being enshrined at the national level (Helleiner, 2011). As with securitisation, this was not something inherently bad; rather, it is the degree, not the kind, that caused the crisis. The incentivisation of competition, the freedom to take risk, the freedom to act creatively: these are all needed, and rigidity born of severe regulation would also take a system to crisis, and pave the way for a hazard to become a disaster.

International competition between centres of finance further pushed the spread of little to no regulation over markets and how they operated (French et al., 2009), and, particularly in the case of Wall Street and its banks and investors, the US state and national governments were unwilling, or unable, or both, to prevent poor practice from proliferating (Coffee Jr, 2009; DePillis, 2018; Helleiner, 2011). A further interesting element raised by Crotty (2009) is that the persistence of occasional bailouts from the government over previous years and decades allowed practices, actors, and institutions to remain that should have been comprehensively weeded out in the wake of their own failings. This would have acted as the regular and relatively safe pressure release required to avoid the build-up of vulnerability, and to avoid the reduction of resilience across the panarchy. Conversely, while avoiding crisis and repercussion for itself at its heart in this way, neoliberal, *lasses-faire* capitalism seems to thrive by generating and permitting crises elsewhere (Harvey, 2007). Seeing the ideology as essentially creative destruction (Holling, 1986), Harvey (2007) stipulates that the management and manipulation of crises at a safe distance is what keeps neoliberal capitalism functioning and justifiable, as it then offers itself as solution to that which it brought about.

This takes us to the message of the left-side of figure 9, to the root causes and blue arrows shown by figure 10, and to the opening paragraph of this section.

What Crotty (2009) highlighted as happening regularly on a small to medium scale throughout the years leading up to the GFC, happened on a new and much larger scale in the wake of the crisis itself. Intervention and bailouts in the wake of the GFC were absolutely necessary – there was no other choice, unless one were to take an eerily detached view and declare that things should have been allowed to fall apart entirely to result in real transformation that would otherwise not occur. That extreme solution is not necessary: once the hazard of the housing bubble had burst and become disaster, the system could have been rescued with bailouts, as happened, but followed with actual and lasting repercussion for the actors and institutions that caused the crisis, and the root causes of ideology and overreaching complexity in the financial system could have been addressed

³ A *lasses-faire* approach is a policy of non-interference, allowing things to unfold as they will. In the context of economics, it refers to the government abstaining from intervention in a free market.

and altered over the following 10 years. As it happened, that opportunity was not taken up, and the financial system was dropped only a little further back along the progression of vulnerability, and set right back on the same loop, ever increasingly free to creatively exploit its way to the next inevitable crash.

“Memories of those difficult days seem to have faded from the public consciousness, as have the lessons we learned on how we got there in the first place.”

(DePillis, 2018)

6.2. A Flood of Fear

“There is America, hit by God in one of its softest spots.”

(Osama Bin Laden, 2001, quoted in Graham, 2016, p. 768)

Regarding the response of its governance, its emergency services and disaster response, and its communities during September of 2001 and the months that followed, New York City displayed very high resilience in the face of the destruction of the World Trade Center, born of the city’s learnt experience and stored knowledge, memory, redundancy, and preparedness (see figures 11 and 13). It took what it had learnt in the past and built up within itself, and utilised it to weather a storm that it had no practice in facing, nor any reason to anticipate. Yet, beyond the more obvious effects of the attacks of 9/11, and for all its self-confidence, self-assuredness, and toughness, the cultural psyche of the city and the nation was highly vulnerable to surprise and uncertainty of such a sudden, shocking, and symbolic nature (see figures 12, 13, and 14).

The attacks had an immediate and lasting effect on discussion and action on security in urban settings (Coaffee, 2013; Coaffee & Rogers, 2008; Godschalk, 2003), including changing policies and practice beyond the US: in the UK, mainland Europe, and internationally (Coaffee, 2013). Within the first weeks and months after the attack there were symptoms of post-traumatic stress displayed by not only people who were present, but other Americans who were not in or around the city at the time (Galea et al., 2003; Schuster et al., 2001; Silver et al., 2002). Support for military action overseas both rose and fell, due to anger and to fear of further attack respectively (Huddy & Feldman, 2011), and values over civil liberties were in flux, flexible where they had not been before, particularly regarding surveillance, and the retention and treatment of suspects and prisoners when relating to the war on terror (Skitka et al., 2004).

Beyond the permanent heightening of security and the shorter term psychological impact on the population, what is shown by figures 12, 13, and 14 is that the real disaster and revolt of that day was not in the form of physical damage, interruption to financial and working life, nor a falling apart

of the city. Rather it was the longer-term undermining of a self-perception and self-confidence. A defiance and a toughness, from city and nation, certainly came through over the next few years, manifest most clearly in invasion and a ten-year manhunt, and the construction of a freedom tower to guard the memorial pools, a new skyscraper that became the nation's tallest building at its completion, counter-symbolic to the violent bringing down of the previous century's display of wealth and ambition.⁴ Yet behind this outward reactionary phase were established the roots of a 'post-9/11' mindset.

If the latter half of the 20th century was deep into the K stage of the adaptive cycle that is US confidence, with an r stage stretching back to the experiment that was Dutch Manhattan, then the first years of the 21st century had presented a true and stark, destructive test, and set the nation and its leading city onto the path of reorganisation, either into a more resilient form of its previous self, or into something new. The more years that pass, the more it seems the latter, where once it might have been possible to look at the military response, the defiant rebuilding, and the assertion of continued confidence from city and nation as evidence that nothing had been truly undermined.

While the cities of Britain and mainland Europe knew well the disturbance of incendiary metal and the collapse of buildings, the only comparable incident in living memory for the US had been Pearl Harbour in 1941 – yet this was an isolated site, far from the mainland, and an act against a military base in the middle of the Second World War. In and out of wartime, the reality of attack and hostility has been relatively regularly known to London. New York knew well violence from within, but not from without. Outside animosity to the US was not something ever directly faced, and New York City and its tallest structures were the icons of that unfazed assuredness procured over two hundred years, ultimately chosen as targets by a politically active manifestation of Islam for their international visibility, financial functioning, densely populated surroundings, and perceived audacity (Graham, 2016).

As time tilts toward two decades since the event, the capacity of the city to bounce back is both clearly evident and still in question. Though there is a tower once more with its top in the heavens, and a city that still does not sleep, there is no longer such an aura of a city and a nation with reach but itself unreachable. The resilience demonstrated in the face of those attacks was remarkable on many levels, but the assertive culture and the confidence of place in the world proved decidedly vulnerable.

⁴ To further illustrate the defiant nature of this initial wave of response and reaction from NYC and the US: the spire atop the new One World Trade Center brings the total height of the building to 1,776 feet. This was quite deliberate – the United States Declaration of Independence was signed in the year 1776.

6.3. The Three Shocks

Bringing Hurricane Sandy back into the mix brings together the three major shocks that New York City has faced in the opening decade or so of the 21st century. These are three outstanding examples of crises that have been faced before, and look set to typify the next 100 years as well: threats from the climate, the economy, and terrorism.

Unpredictability?

“On October 23, 2012, the path of Hurricane Sandy was correctly predicted by the European Centre for Medium-Range Weather Forecasts (ECMWF) headquartered in Reading, England nearly eight days in advance of its striking the American East Coast. The computer model noted that the storm would turn west towards land and strike the New York/New Jersey region on October 29, rather than turn east and head out to the open Atlantic as most hurricanes in this position do. By October 27, four days after the ECMWF made its prediction, the National Weather Service and National Hurricane Center confirmed the path of the hurricane predicted by the European model.”

(Wikipedia, 2018)

As with the GFC (see chapter 6.1), Sandy was an event that could be (and was) seen developing. While one might argue that there were warning signs indicating the chances of an attack on the US within Palestine or other parts of the Middle East, the events of 9/11 were not predictable in the slightest. This is why the preparedness and resilience demonstrated by the city on the day and in the weeks and months following is so remarkable, and it is also why the event had such a devastating impact culturally in the long term (see chapter 6.2). Yet, even if it was too late in the 2000s to prevent the crash of 2007 and the storm of 2012, there was ample opportunity to put some preparation and mitigation in place. The city need not have been so blindsided by the full impact of Sandy if it had followed predictions (available in real-time, no less), and complacency is what had stopped the fervor for climate resilience post-2012 from being developed far earlier. It is not only suddenly made clear in the wake of Sandy that Manhattan is an island beside the ocean.

An undue focus on resilience to storms

When reviewing some of the non-New York policy and conversation on urban resilience, through looking at the UN, the World Bank, the OECD, and 100 Resilient Cities, I have already raised the issue of resilience being only fully utilised in the urban context when it comes to climate (see chapter 4.1). We then saw how the City of New York had gone to great lengths to understand and build on a few ideas of resilience, including social-ecological resilience, in its policy for creating a more resilient

New York – more resilient in the face of future storms and future flooding. With both the New York policy and those discussed before it, when there was talk of and action for seeking urban resilience in non-climatological areas, such as infrastructure and inequality, it was nearly always framed within engendering overall resilience to coming climate change. This might be regarded by many as entirely warranted. However, if we look at the situation that New York City finds itself in, the extent to which storms and flooding have been prioritised appears unreasonable – though, of course, still needed to some degree:

“As a city with more than 520 miles of coastline (one of the most in North America), the potential for more frequent and intense coastal storms (with increased impacts due to a rise in sea level) is a serious threat. This threat, in various forms, touches every part of the city and not just waterfront areas.”

(Zhang & Li, 2018, p. 145)

Despite this, the narrative that storms are increasing and increasingly severe does not match with the data (see figure 15 below).

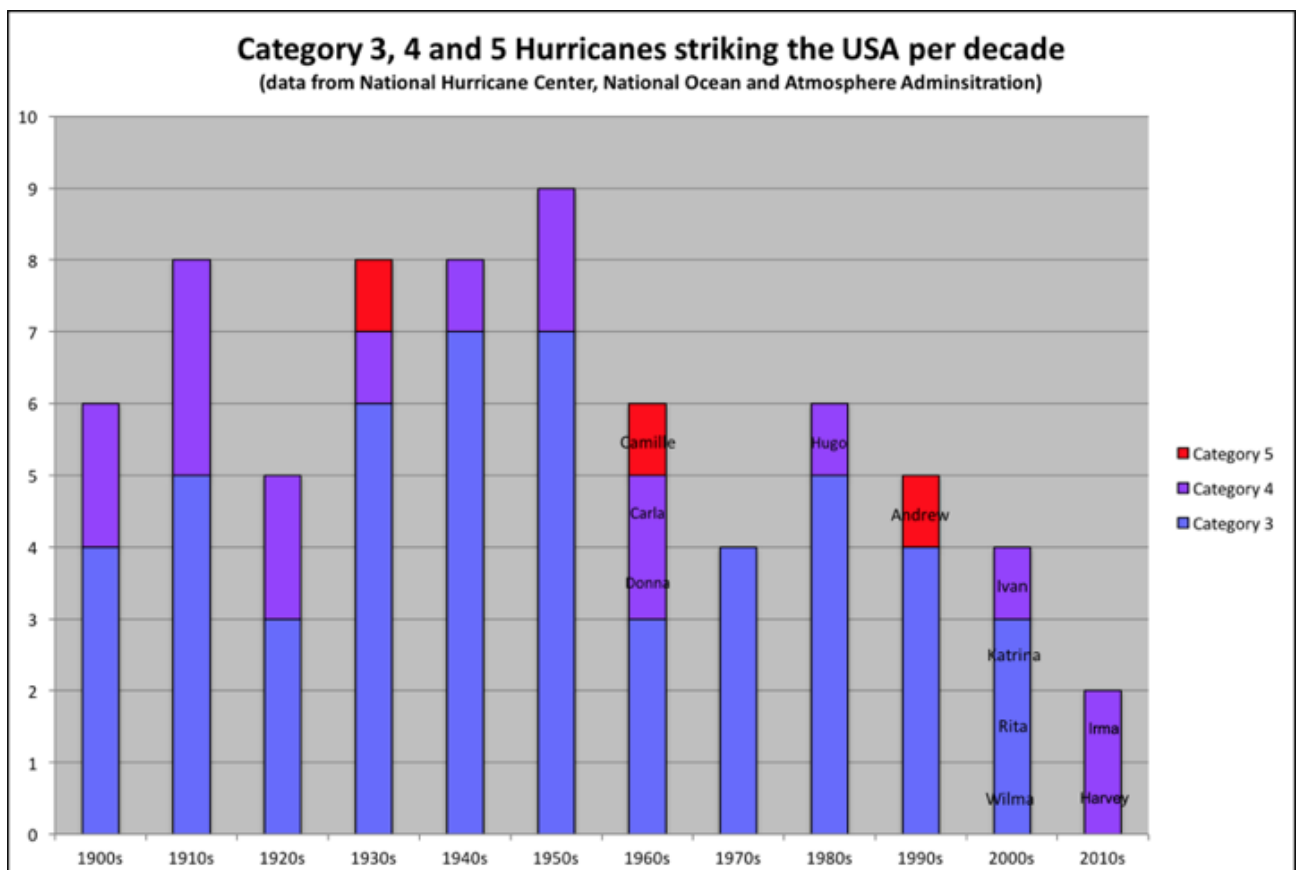


Figure 15: A bar graph showing the frequency of category 3, 4, and 5 hurricanes hitting the US per decade (1900 to 2010) (Bryceson, 2017).

The nature of the reactions

This may speak to something of the nature of these shocks, which begets the varied reactions. The destruction wrought by the GFC was – and still is (DePillis, 2018) – immense and lasting, and stretched far beyond the city and its nation, yet hardly touching the people, institutions, policies, and ideology responsible. But to say ‘destruction’ conjures instead the images seen in 2001 and 2012. The loss of life, the debris, and the impact of a flooded tunnel and a plume of smoke in the events of Hurricane Sandy and 9/11 required equally visible and sizeable reactions (see chapters 4.2 and 6.2). The height of the freedom tower and the over-dedication to storm preparation are the result of such visceral events. With terrorism in particular this is the nature of response, where there is a political statement to be made, a demonstration of reactive and protective action (Coaffee, 2013). The similar size and type of destruction caused by Sandy, but with a lack of immediate human intent behind it, renders its response similar to, though not the same as, that of 9/11. The GFC was not free of human action and intent, and so it could not garner the reaction that Sandy received. Yet despite the presence of human action and intent, it was not exogenous, nor attributable to foreign politics and other religion, nor was it violence, and so it could not garner the reaction that 9/11 received. Instead, it was quite evidently brought about by what had been going on in the city’s own heart, and due to an ideology widely cherished and which had played a large role in bringing the current prosperity and position of the city and the nation into being. Without the immediate visibility of the other two shocks, and requiring a far more introspective reaction that would result in a difficult and drawn-out transformation, the GFC was enough of a crisis to be counted alongside Sandy and 9/11 here, but not the right kind of crisis to beget real change. This is significant, as all the best laid schemes for climate resilience risk going awry when the foundation stone that is the financial system is nothing like as resilient as the city it is holding up.

The root causes

To different degrees, the response to Sandy and to the GFC both evade the root causes, and it may be that 9/11 is the only shock to have, in the longer term, driven through to change something at the more fundamental levels.

Figure 10 and chapter 6.1 portray the shallowness shown in dealing with the financial crisis, and how that has allowed the rebuilding of pressure toward more disaster, and the lack of learning and transformation. Despite the short term, surface-level ‘back to normal’ in the wake of 9/11, over time it has been simply not possible to ignore the root causes and continue culturally, societally as before (see figures 12 and 14). The New York City and American psyche may be in a new and more resilient cycle precisely because the events of 9/11 found their way forcefully down to the roots, and up through the panarchy.

In its response to Hurricane Sandy (see chapter 4.2), the City of New York did not leave much room for the questioning of practices that are argued as giving rise to the climatological hazards that can beget disaster; rather it dealt with more immediate unsafe conditions, and dynamic pressures. While less egregious than with the GFC (PlaNYC seeks to at least not re-tread the path already taken, even if it does not fully delve into the root causes), this speaks to the more general response to the looming challenges of a changing climate seen in the West, where there is more action taken to cope with what will change than there has been action taken to not reach that point in the first place.

“The improvement of a wrong thing resolves itself into an even more wrong ‘solution’: this is what I call a better kind of wrongness.”

(Soleri, 2012, p. 33)

This relates to the concern voiced by Derickson (2016) and highlighted in chapter 4.1, that speaking of resilience results in a framework that allows the underlying practices that cause problems to remain in place, and simply demands that we get good at putting up with the subsequent effects. Yet it is not a failing of resilience theory that results in the endurance of problems in place of addressing their deepest causes. Instead, what results in this is an incomplete understanding and application of resilience theory, as well as the erroneous notion that comes with a lot of the discussion and policy on resilience that sees resilience as inherently positive. A further question may in fact have been necessary, to come after the question of this study that asks if New York City has demonstrated resilience: if yes, is that a good thing, or a problem?

6.4. Time horizon

Back in chapter 4.2, a question was raised, in response to the time horizon of the PlaNYC document and its aims for a resilient New York City: should either the 2020s or the 2050s be even considered the medium term, let alone the long?

Whether one is discussing the climate, the economy, or the socio-political situation; whether one is discussing the city, the forest, or the immune system; whether one is looking through the lens of the adaptive cycle, the model of panarchy, or the progression of vulnerability through the PAR model – time is a key component in all of this, arguably challenged only by scale for the position of *the* key component. The simplest application of the theory of social-ecological resilience could be said to be utilising the adaptive cycle to take an overall look at an ecological system – even this utilisation of resilience theory can be thrown by incorporating, explicitly or implicitly, a time horizon that is not appropriate for the question at hand. Understanding the equilibria, the basins of attraction, both potential and manifest, and the processes within a system is not possible without this. One needs to identify where the four stages of r , K , Ω , and α fall, and what may be considered the root causes, the

dynamic pressures, and the unsafe conditions. One needs to know the time to identify the scale, and to fully recognise the revolt and the memory. All this even more so, when it is in the service of planning active intervention.

During my explanation of the adaptive cycle in chapter 3.1, I used the analogy of a herd of elephants to go through the various stages. One of the key points here was the utility of memory, stored, in this example, within the minds and intuitions of much older cows within the herd. Their presence is proved of the utmost importance in the face of droughts that do not occur more regularly than every 40 to 50 years – without their memory of surviving drought that the adults and the young have never experienced, those adults and those young will be lost when it hits.

To a conservationist seeking to implement intervention, it is crucial here to have an appropriate view of time. For example, if one were to argue for the sustainability of trophy hunting as a part of conservation, and thus a practice worth keeping, one might rest it on the argument that if only the oldest individuals are taken, then it has no negative effect on the relevant herd, because it does not remove individuals either in their reproductive prime or those approaching it, and in fact has a positive effect by introducing periodic shock to a system that can be strengthened by the experience. Unless one understands why certain species of animal spend the significant effort and energy on keeping alive their seemingly burdensome oldest individuals, one's only counter-argument here might be the resulting grief and strain on the social system. Without looking into the future many more decades hence, the needed argument on social memory cannot be made. Thus, the resilience of the herd can be considered unhampered, or even bolstered, to the one who does not take the deeper future and the deeper past into consideration. If that affects policy surrounding regulation on the hunting of elephants, then the oldest individuals will not remain for long, the memory needed for the survival of periodic but relatively rare droughts will be lost, and the herd will not survive beyond the next one.

Active intervention is precisely what we are dealing with in discussing here Hurricane Sandy, the GFC, and the events of 9/11 and its aftermath. This thesis was introduced and framed by pulling back from a view of the last two decades to get at least a surface understanding of the past 200 years. Of course, there is much more scope and information available when looking backward, rather than forward, and it cannot be reasonably demanded of a city's government that they lay out their vision for the year 2207, simply because they mentioned the plans of 1807. But to only look forward at the equivalent of looking as far back as the 1960s at most does great discredit to our capabilities, and makes nothing like efficient use of our copious and varied research and knowledge, and of our slew of city case studies from so many different geographical, cultural, and temporal contexts. We cannot

fault the planners of 1811 for not incorporating social-ecological resilience theory, but we should push ourselves to see farther than the middle of our current century.

We have seen the way in which the GFC unfolded, and the way in which that crisis was responded to, both initially and in the years afterward. Not considering the long term has allowed for a lack of necessary transformation and no addressing of the root causes of the crisis, giving an illusion of recovery, leading to the fuelling of the regeneration of dangerous complacency to risk in the market, alongside new deregulation.

With Sandy and PlaNYC, and with the broader conversation on urban resilience in policy, we have seen the resulting exaggerated focus on storms due to an improper view of events over time, and the erroneous perception that they are increasingly severe and increasingly regular. Retreat has been stated as off the table regarding options for response to a changing climate (The City of New York, 2013), but if any decisions were made and enacted that made retreat truly impossible for future generations then that would come as part of reducing the capability of the system to deal with the unexpected, and yet it would appear a perfectly acceptable standpoint when considering the 2050s as long term.

Today, we are the unimaginable long term from the perspective of that old New York City Council and those commissioned by them to plan the full expansion of the fort split between European empires. Looking back from this 21st century, and through this theoretical framework, it is possible to view the grid of 1811 and its implementation as a great disturbance itself, far more influential than Sandy, the GFC, or 9/11, a lasting shock to a system that had thus far been overwhelmingly self-organising. A shock, perhaps, reducing overall and truly long-term resilience.

Until the first decade of the 1800s, when its modern form began materialising quickly, both in the minds and sketches of men, and then in the flattening of the many hills, there had been little that could be regarded as truly top-down in the formation of New Amsterdam and Dutch Manhattan. There was, of course, some degree of planning, increasingly as time went by and as the settlement developed further, catching the eye of distant authorities. However, any interventions made were forced to collaborate and compromise with the self-organisation of the bottom-up and middle-out (Museum of the City of New York, 2015b; Shorto, 2005).

“Before the grid, New York City grew organically, with no overarching order... [Short streets] were shaped by local conditions, built piecemeal, and lacked a unifying order... During the colonial era, streets were not regarded as a public asset. Developed by private owners, they were weakly regulated by colonial authorities. The city did not implement public street

improvements directly; it incentivized individual property owners to build them.”

(Museum of the City of New York, 2015b)

Take one perspective, and that massive disturbance of the 1811 grid might be seen as a positive, inducing the subsequent progression found in figure 16 below:

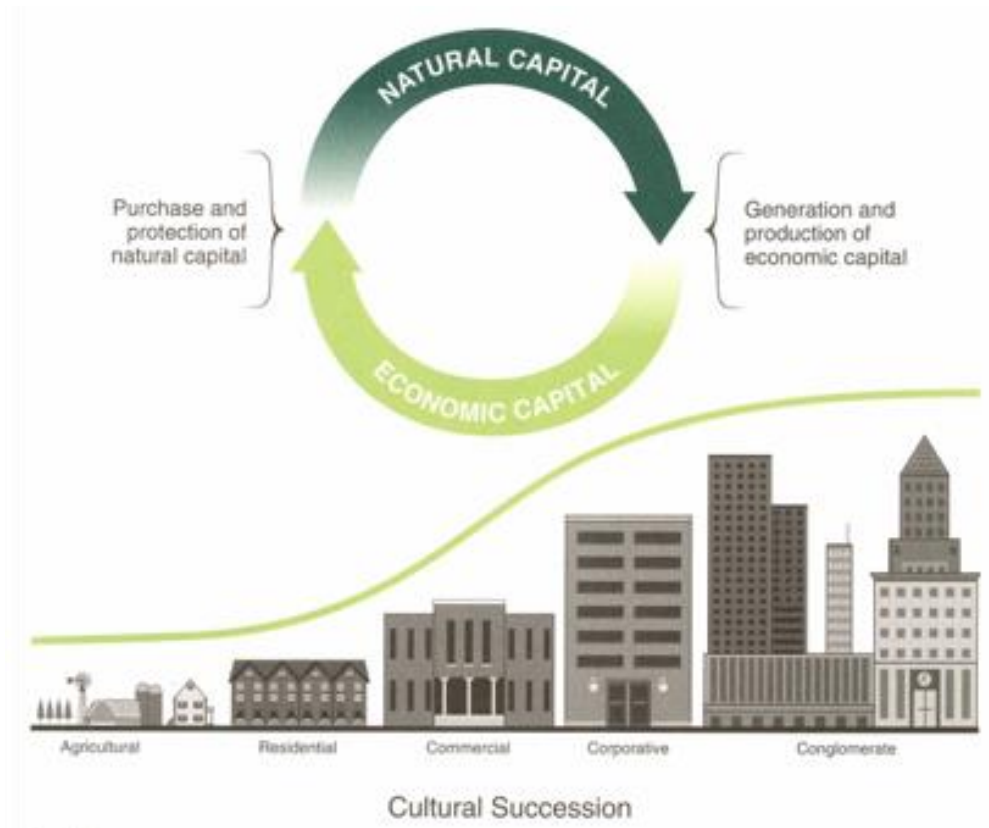


Figure 16: Showing the cultural succession from agricultural society to conglomerate city (Odum et al., 2005).

However, the height to which that green line in its swift succession reaches is all well and good only until it dips inevitably into the second half of the story.

The planned expansion of 1811 did not predict many of the things that came about in its wake, even much that occurred during its implementation. Even so, technological innovation and the surrounding space available allowed for the adaptability that alleviated population density and accommodated efficient transportation. Yet it has ultimately resulted in the limiting of options for transformation and for engendering positive resilience. The rigid skeleton of the modern city is the result of a massive disturbance in the 1800s, one that transformed an exemplar of a bottom-up, self-organising urban experiment into an exemplar of the top-down metropolis. Its adaptability has been proven throughout the two centuries since that process was begun, and the self-organising

communities and city streets have acted as the revolt necessary to keep that spirit within the city (Jacobs, 1961). But with such a seemingly set physical form, and a very different context regarding surrounding space, already established infrastructure, and the stage of development in which the city resides, the challenge of transformation without collapse looks to be much greater than ever before.

7. Conclusion

Having come full circle in the discussion to the impact of the grid introduced in chapter 1.2, it is possible now to look back at the research question and its sub-questions, and to see what answers might be proposed, and what new questions might be asked.

7.1. Answering the Questions

Sub-questions

- SQ 1 – Does New York City’s policy and practice during and after Hurricane Sandy suggest an understanding of social-ecological resilience, and demonstrate a commitment to engendering it?

Generally speaking, yes, with the caveats of a problematic time-horizon, a commitment to multiple ideas of what resilience means, and a focus on storms that is somewhat unwarranted in terms of its extent.

- SQ 2 – Do the adaptive cycle, panarchy, and pressure and release (PAR) models offer useful analysis of New York City’s resilience and/or vulnerability in the face of two major disturbances of non-climatological kinds: economic (the financial crash of 2007/8) and socio-political (the terrorist attack of 9/11)?

These models do offer useful analysis of 9/11 and the GFC. As mentioned in chapter 2, to keep this thesis focused and manageable it has been necessary to leave aside many of the factors that went into both of these events. The analysis done in this thesis indicates that these models could be utilised effectively to delve further into both shocks, incorporating many more of the aspects of each, including the global causes and consequences.

- SQ 3 – What, if anything, do the opening decades of the 21st century indicate regarding the current and future resilience and vulnerability of New York City?

The three events of 2001, 2007, and 2012 and the response to each show a city with an oft impressive capacity for resilience and adaptability in the short term, based on stores of experience, knowledge, and memory. Yet they have also each exposed underlying vulnerabilities that indicate threats and limits to a longer term resilience.

Research Question

- Has New York City demonstrated social-ecological resilience as an urban, city system in the opening decades of the 21st century?

New York City has demonstrated some level of social-ecological resilience in the face of disturbance in the form of climate and terrorism, yet it has failed to do so with the economy. The ideology and practices at play in the GFC have proven highly resilient, however, demonstrating the non-normative nature of the theory – that is, something may prove to be resilient when it is not desirable for it to be so.

It is hard to deny New York City its pride in what it flexibly defines as its resilience (synonym: tough), given its journey through a trial-laden welcome into the new century. Though it has come through these events, and faced these varied crises, when looking through the lens of a time horizon that sees the year 2100 as more medium term than long it is unclear whether the city still has much scope for transformation, and the vulnerabilities exposed have not yet been resolved.

7.2. Further research

One question that was put aside, to narrow down the scope of this thesis, is that of the major East Asian cities. Some of these have grown from fields of grass to mega-cities in mere decades. As this study revolves around themes of the past, present, and future, and the long-term legacy of a city's development pertaining to resilience and vulnerability, the question of the future of New York City should look toward the East to see what lessons, if any, these new cities took from its example, what makes them different, and are they, being so young and having had the opportunity to build on the experiments of the West, more suited to the new century and its challenges?

Building on chapter 5, the lasting effects of 9/11 and the GFC could be explored, separately or together, in much greater depth, utilising the same models and theoretical framework. Many more of the factors involved in each event could be brought in, and the globally connected nature of both the causes and consequences could be taken into account. Furthermore, the same could be done to explore the smaller scale but daily disturbance and revolt found within the city, such as inequality, gentrification, homelessness, and crime.

Having lacked primary research itself, this study could be built upon by interviewing and surveying of academics and non-academics working in urban resilience, both directly in New York City and otherwise. To go further than analysis of the literature produced, interviewing of people working in the Office of Recovery and Resiliency in the City of New York could garner greater insight into how resilience theory is being channelled into policy change and physical change in the city.

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