



BLACK SWANS, GREY RHINOS, & DRAGON KINGS: HOW WE MIGHT CONSIDER THE NEXT GREAT CHALLENGES FOR EMERGENCY MANAGEMENT

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This paper summarizes a presentation made at the May 2023 California Emergency Services Association Annual Training Conference. All images not credited were created by the author using a commercial AI application. Additional related materials are available at cgodley.su.domains

Preface

The world is clearly changing - as it always has. However, in recent years, the pace and scope of change seems to have accelerated – including the area of disasters. Those whose work is to anticipate and prepare for disaster have been significantly challenged in the number, variety and scope of catastrophes that have befallen communities around the world. Per Yogi Berra, “It's tough to make predictions - especially about the future.” As Emergency Managers look to the future, it may be worth a moment to consider how our view of the world may profoundly shape our efforts. In this paper, we will explore several areas that influence how emergency managers view future disasters including psychology, math, and philosophy. We will also look at five major disasters that could significantly impact the field of emergency management in California.

Most of the concepts and ideas shared here are not my own. Rather, this is a distillation of thoughts and concepts from a variety of sources especially the book “The Black Swan” by Nassim Taleb. I have attempted to cite source material via footnotes and a full list of references is attached here.

I earnestly hope that in considering how we think about the world and disasters that the reader will know less about the future than they think they do right now.

Introduction

2020 was a big year but 2019 was when I started wrestling with how I saw my role as an Emergency Manager and how to view the potential for future disasters. In one period of 36 hours in October 2019, the County of Sonoma, California was confronted with what was originally thought to be an active shooter incident, a major Public Safety Power (electrical system) Shutoff, and the ignition of a wildfire that would ultimately result in one of the largest evacuations in California history.

While driving back from the wildfire Incident Command Post, I thought to myself this seems both extraordinary and also par for the course – we seem to be not only busier



as emergency managers, but we were also confronting new and more dynamic hazards. I had to consider that my experience was no longer as relevant and that I was missing something critical. That realization started me on the path of trying to assess how the world was changing and how emergency management may have to also change in order to respond. This presentation is not a clear roadmap for how to approach future disasters but is more of a thought experiment bringing together what I learned in my efforts to better understand what the future may hold in store.

Language

Words are important and powerful. Let's review a few key terms commonly or increasingly used in emergency management:

Crisis: a threat to a system which can sometime occur without serious consequence. Ex. "Miracle on the Hudson"

Disaster: Crisis but includes a horrific consequence. Ex. CA wildfires

Catastrophe: Disaster plus the loss of the ability to manage. Ex. Hurricane Katrina



Resilience: Latin: the ability to rebound or spring back. FEMA suggests this definition: "The ability of a community to prepare for anticipated natural hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions."¹ The United Nations offers: "The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management."² Personally, I informally define resilience as the ability to take a punch to the nose. Also, the term has been overused to the point where you could sardonically define it as from the Latin term 'resili', "meaning anything I want it to mean."

Anti-Fragile: Coined by Taleb, the term has recently gained more attention due to its simple promise. Refers to a property of systems in which they increase in capability to thrive because of stressors, shocks, volatility, noise, mistakes, faults, attacks, or failures. Antifragility is beyond resilience or robustness. "The resilient resists shocks and stays the same; the antifragile gets better." An appealing concept but one hard to put into practice.³

Paradigms

We use language to define concept and meaning. However, language can only describe our reality. Let us instead take on the fundamental subject of how we perceive and conceive of reality. Each of us have our own view or lens for how we see and think about the world - this is called a paradigm or worldview.⁴ For those of us in emergency management, we focus on those incidents that take life, destroy property, and disrupt all our social/economic systems. This is not simply a consideration of philosophers – as emergency managers, I suggest that the way we view risk in the world shapes our actions and may

¹ FEMA "Community Resilience"

² United Nations "Sendai Framework Terminology"

³ See a review of Taleb's book at <https://www.theguardian.com/books/2012/nov/21/antifragile-how-to-live-nassim-nicholas-taleb-review>

⁴ See also Wikipedia, <https://en.wikipedia.org/wiki/Paradigm>

ultimately determine just how successful we are in safeguarding that world. Emergency Managers must become more adept at perceiving if we are to truly remain effective at protecting.

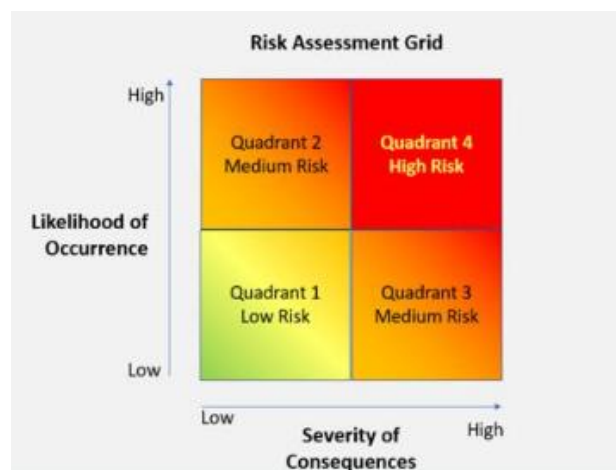
We can start by looking closer at the actual word “disaster”. The word comes from the Latin roots “Dis” meaning ‘negative force’ and “astro” meaning ‘star’. Once upon a time, the fate of a person – of the world – was influenced by the alignment of the stars. So, “disaster” becomes synonymous with bad luck. Essentially, experiencing a disaster was simply a case of back luck.⁵

This perspective has survived even until today - our world usually views disasters as improbable, unexpected, and/or a case of people simply being in the wrong place at the wrong time. Individuals, communities, and even nations are often - if not almost always - shocked when a major disaster strikes. Ex. an aircraft disaster, 2004 Tsunami disaster.

One Current Paradigm

Most of us are familiar with thinking about risk in this way – a combination of probability and potential impact or severity. Often represented as a four-quadrant chart. Pick a disaster and it falls into one of these areas. An earthquake may be a low probability/high impact event for your jurisdiction or organization whereas a structure fire may generally be thought of as high probability/low impact. This view is helpful for comparing potential hazards or communicating the significance of the hazards to others.

Risk managers and emergency managers often use this approach in their work (ex. a Business Continuity Risk Analysis or a Threat and Hazard Identification and Risk Assessment⁶). While driving back from that 2019 wildfire, this is the model or paradigm I had in my head – but it just seemed to no to longer encompass the complexity of multiple and overlapping incidents.



Source: CMKSelect⁷

⁵ See Wucker (2016), chapter 1, for greater detail.

⁶ See FEMA National Risk and Capability Assessment, <https://www.fema.gov/emergency-managers/risk-management/risk-capability-assessment>

⁷ <https://www.cmkselect.com/knowledge-insight/risk-management-and-disaster-recovery-in-the-age-of-covid-19/>

An Alternate Potential Paradigm for Emergency Managers

Let me suggest another view or framework that may be more helpful in identifying not only which potential disasters deserve attention but also shift how we think about developing resilience for them. I suggest making use of several new concepts developed in the last twenty years that attempt to reframe broad parts of our world. While predominantly being picked up in the field of economics, there may be significant value in applying to emergency management. These concepts include the "Gray Rhino", Black Swan", and "Dragon King."

Gray Rhino



Conceptualized by Michele Wucker, a "gray rhino" is a dangerous, highly probable and understood (but ignored) threat. Gray rhinos are not random surprises but occur after a series of warnings and visible evidence. In the examples of Hurricane Katrina, or the 2007 Minnesota Bridge Collapse, all had telltale signs evident well in advance.

There will probably be more than one rhino on our horizon. Interestingly, a gathering of rhinos is called a "crash."

One example of a future Gray Rhino disaster would be a major wildfire in California.

Black Swan



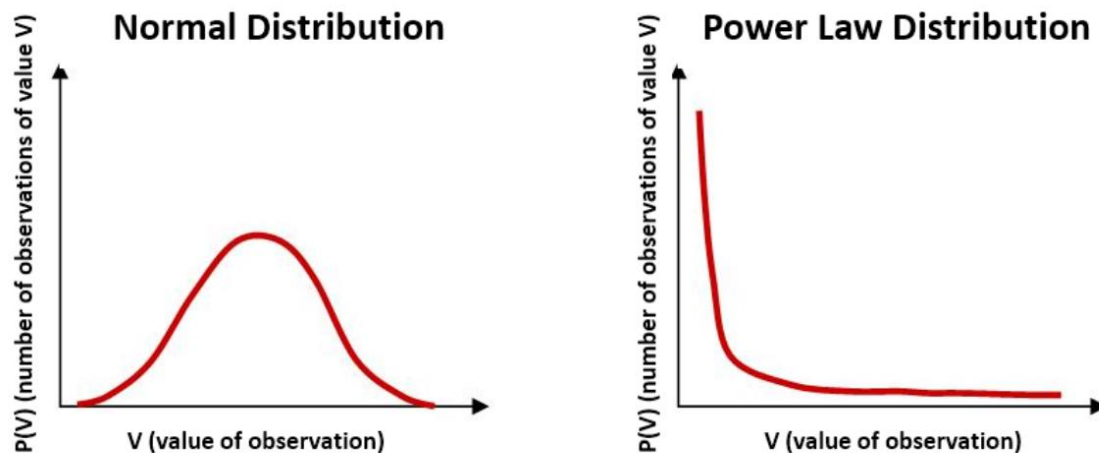
Many may have heard the term "black swan". Conceptualized and made popular by the author Nassim Taleb, a "black swan" describes a significant event that surprises everyone when it occurs.

A Black Swan event has three characteristics:

1. First, it is an outlier – basically, outside the realm of regular expectations, because nothing in the past could convincingly point to its possibility. Not just rare or wild – it seems to be impossible.
2. It carries an extreme impact.
3. Despite its outlier status, "human nature makes us concoct explanations for its occurrence after the fact, making it explainable and predictable." That is, we can work to rationalize how this came to be – but only afterwards.

Examples of black swans include 9/11, massive earthquakes, financial crises, and wars.

In science, there are two common ways to look at how frequently events occur. In the chart below, the left-hand figure shows the Gaussian Normal Distribution – this is the famous bell curve. Whereas the figure on the right illustrates the Power Law which is an extension of Mandelbrot's Fractal Geometry.



Source:

In comparing the two, the normal distribution is a good model for values of tangible/physical things (e.g., height, weight, life span, or IQ). Whereas the Power Law gives us a better picture of earthquakes, financial crises, daily stock market returns, identity theft losses, and wars.

The key in the Power Law is the “long and fat tail” – this shows that there are a much greater number of extreme events at the far edge of occurrence than what the bell curve would predict. This means in our world of disasters, there would be far more extreme disaster events than we might expect.

From the perspective of human nature or psychology, there are several reasons why we don't consider these extreme occurrences. Our human nature has built-in biases – we basically don't want to think about them. We prefer and indeed even somewhat “hardwired” to prefer the Normal Distribution Curve. Taleb suggests that there are several reasons for this including:

1. As individuals, we generalize from the past – This is known as the Problem of Induction.
2. We focus only on some of what we see in the world and we generalize from that to what we don't see. Error of Confirmation.
3. We become engaged in a story that seems to explain or justify the facts – looking for patterns. The Narrative Fallacy. Essentially, we prefer the simple symmetry of the bell-shaped curve over the power curve.
4. What we see is not necessarily all that is there. History hides Black Swans from us [if they didn't happen] and gives a mistaken idea about the odds of these events: this is the distortion of silent evidence. Instead, we hear mostly about the confirmatory evidence; We never hear about the disasters that did not happen.



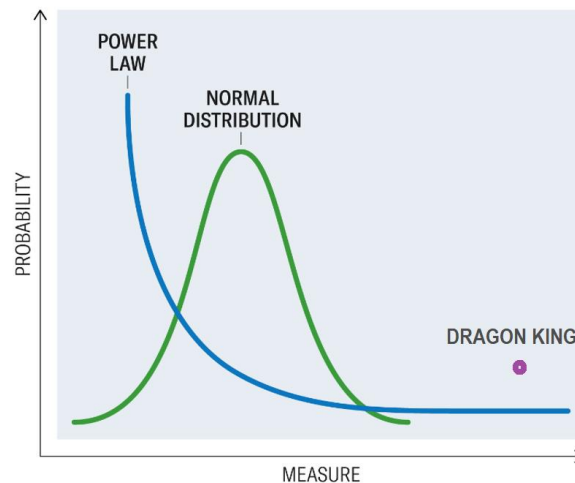
The term “Dragon King” refers to an event that is extremely large or has an outsized impact and is statistically an outlier. These lie even outside the Power Law distribution.

However, they do have some degree of predictability – if you know what to look for.

A Dragon King may arise at a tipping point in an unstable system or from positive feedback like a cattle stampede. One example of a Dragon King would be the 1979 Three Mile Island nuclear accident.

Another way to visualize these three beasts is to look at the mathematical graphic representation for all three as per the diagram below.

1. Gaussian Normal Distribution – this is the famous bell curve
2. Power Law with the long, fat tail
3. The Dragon King which falls outside both the Normal Distribution and Power Law



Potential Disasters: Rhino, Swan and/or Dragon?

To assess the potential use of the Rhino/Swan/Dragon paradigm, I offer five hypothetical major disaster scenarios that could impact California by the year 2045. Also, some considerations on how the disaster might affect organizations/governance and emergency management.

Profound Drought

(Rhino)

This is not the drought most recently experience in California - this scenario envisions what that could have become – something on par with the Great Australian Drought. Scenario: The drought runs 2023-2042 with only 78% of median rainfall received each year due to climate change. Also, six record dry years with rain reaching less than 50% of median. Impacts included an 0.2% increase in CA resident mortality due to heat, disease, and respiratory illnesses. 3% of the state's population moved out – mostly north and to the Midwest. Agriculture losses exceed those of the entire 20th century. Rice, almonds, and cotton are no longer permitted crops. Total economic losses exceed \$2 trillion over 20 years – not including indirect economic losses as businesses moved out or did not move to the state. In 2039, the Sacramento River effectively ran dry resulting in large saltwater intrusion into the Delta. Environmental losses were staggering – with almost 10% of all trees in the Sierras succumbing.

Effects on Organizations/Governance:

- The historic mix of state, regional, local, and federal water agencies and boards were replaced by the US/CA Joint Water Authority in 2037 by a joint act of Congress and the State Legislature. All water rights were assumed by the Water Authority resulting in massive economic and social disruption including more than one hundred acts of violence.
- Additional powers were granted to state and local authorities to inspect and regulate groundwater pumping including mandatory irrigation and pipeline monitoring.

Effects on Emergency Management:

- After a few years of initial responses, most local governments established Drought Response Joint Powers Authorities to unify efforts, consolidate funding and prioritize regional projects. Some JPAs were managed by Emergency Managers but most came under direct supervision of senior county or city executives.
- Emergency Managers were left to address many of the consequence management issues including public health and emergency water supply coordination.

Catastrophic Flooding

(Rhino and Dragon King)

Scenario: The ArkStorm⁸ of January 2030 hammered California resulting in the greatest natural disaster in the nation's history. Rainfall exceeded the historic 1862 flood with almost 70% of annual rainfall coming in just 27 days. Much of the Sierra Nevada sees 55-70 inches of liquid equivalent (max of 126 inches); the Coast Ranges generally saw 30-45 inches; and the Central Valley 15-35 inches; and Southern California anywhere from 20-35 inches along the coast to 40-55 inches in the Transverse Ranges.

⁸ See also ArkStorm 2.0, <https://weatherwest.com/archives/16626>

However, it was also the intensity of rainfall that produced the most intense flooding with levees failing up and down the central valley including the massive losses in and around Sacramento.

Watersheds across the state were challenged with multiple dams experiencing uncontrolled spillway releases – at least 13 smaller agricultural dams failed due to overtopping. Losses included more than 1,000 fatalities, 1.7M residents displaced, 74,000 homes heavily damaged or destroyed, more than \$630B in public infrastructure damages, and almost \$3T in private losses. Agricultural and livestock/dairy losses of almost 45%. Combined, these losses reduced the nation's GDP by almost 3% and disrupted local economies to the point where CA is expected to take almost 20 years to fully recover.

Effects on Organizations/Governance:

- The public anger at the failure to prepare and respond produced significant fallout. The Governor convened a special session of the Legislature at its alternate meeting site in San Francisco. A political movement swept local and state elections later in the year and created the massive “build more/higher/faster” programs including the partial repeal of CEQA.
- In three cases, the state had to reconstitute a county Board of Supervisors.

Effects on Emergency Management:

- To get more participation, the State's Emergency Management Mutual Aid (EMMA) program was revised to enable the State to directly pay responders utilizing a transformed version of the California Emergency Services Act.
- More than 30% of local government emergency managers in the Central Valley left their positions or were forced out within 12 months.

Blackout

(Rhino and Dragon King)

Scenario: The Great Southwest Blackout of 2037 affected almost half the state as well as Arizona, Nevada and Baja, Mexico. A 500 kV transmission line between an Arizona Public Service substation in Tonopah and one in Yuma was accidentally shut down – this resulted in rerouting power through other lines and substations. However, two substations had transformers that were offline for replacement and efforts to shed load resulted in large outages as well as damage to remaining lines and substations. 3 distinct events occurred on 5 separate power grids in a span of 11 minutes. Starting on the afternoon of September 8th, power was off for more than 45 million residents and it took more than 7 days to restore service in all areas.

Effects included massive disruptions in communications, transportation, commerce, education, fuel production, potable water delivery and wastewater treatment. About 7% of backup power systems eventually failed impacting hospitals, public safety facilities, and airports. Most homes with solar panels and many of the new microgrids were able to enjoy electricity during the day but were not able to keep up with the demand to charge electric vehicles and went as dark as their neighbors at night.

Most notably, the new 5G wireless broadband systems catastrophically failed and the remaining legacy prime site antennas proved unable to cope with the volume of digital traffic – combined with the loss of wireline broadband systems, CA residents had not been this isolated in terms of communication in almost 100 years. Even the fully realized commercial satellite data systems failed due to oversubscription. The federal Department of Energy After Action Report concluded “like a bird's wing, the elegant and extreme efficiency of the system proved no match for the brittleness of its bones.”

Effects on Organizations/Governance:

- The initial fear that this was a deliberate act – either criminal or nation-state – resulted in significant fear mongering and panic buying of fuel and food.
- The public anger at the utilities and local governments evolved into a larger distrust of integrated systems and caused many residents, communities, and even some cities to isolate themselves and go off-grid.

Effects on Emergency Management:

- Most EOCs and public safety facilities were able to maintain internal functions with backup solar/battery and generator systems but soon found themselves unable to communicate and manage events due to failures of the 5G and land mobile radio systems.
- Many government and critical sector employees stayed home to safeguard their families and property thus hampering response efforts.

Migration Crisis

(Dragon King)

Scenario: With the effective economic and political collapse of several Central American governments in 2045 due to large-scale conflict, the humanitarian crisis became the most acute ever seen in the Western Hemisphere. Almost 114 million people lost their sources of income. Despite massive efforts to fund social support programs in their native countries, more than 12 million people sought to migrate to Mexico, the U.S. and Canada in just 6 months – this was known as the “Ultimo Camino”. Mexico accepted and supported more than 2 million refugees while developing massive transportation networks to speed the movement of people to the US Mexico border.

With more than 50,000 people a day crossing the border, conflicts developed including rampant criminal activity, as well as massive human suffering. Mobilizing most of the US military assets in the nation, the President proclaimed a Catastrophic Major Disaster and sought additional powers from Congress to address the crisis. While federal resources, including military bases were brought onboard, California was required to take in and accommodate 400,000 refugees. The state subsequently levied counties with their share as a quota allocation with corresponding funding.

Effects on Organizations/Governance:

- Public worry and anger pushed local governments to demonstrate their effectiveness in communicating and addressing the massive social, logistical, and economic impacts. All non-essential services were stopped to move staff into the primary efforts of care & shelter, public health, communications, and long-term stabilization. In some counties, more than 25% of annual General Fund allocations were redirected to the response.
- The CDAA was overhauled in just 45 days, enabling the state to effectively guarantee full reimbursement to local governments and vendors for eligible expenses as well as authorizing advance payments to ensure local governments would remain solvent.
- The Stafford Act was overhauled in 3 months, eliminating the Public Assistance program for this disaster in favor of block grants and FEMA was elevated to a cabinet level position which directed all response efforts not associated with border security.

Effects on Emergency Management:

- Mass Care & Shelter efforts were swamped, forcing many local governments to set aside procurement requirements and rapidly contract for services – the competition for scarce resources resulted in significant increases in costs.
- The convergence of Emergency Management and Business Continuity Planning accelerated with new Emergency and Crisis Management organizations being established in larger jurisdictions which were staffed with people from multiple disciplines including public safety, public health, social services, planning, finance, and legal.

Geopolitical Conflict

(Swan)

Scenario: The 2032 outbreak of limited clashes among its allies in SE Asia quickly moved the U.S. closer to war than it had been in a generation. Despite no formal declaration of war, just the threat of potential escalation was enough: California along with the rest of the country was quickly confronted by significant challenges in supply chains, transportation, energy, and communications due to the “Ghost Fights”. Less-than-overt exchanges of cyber-attacks and public disinformation challenged local governments – especially smaller jurisdictions that could not afford or implement the new AI-drive cyber security measures.

Effects on Organizations/Governance: The State legislature expanded the authorities provided under the California Disaster Service Worker program to ensure state and local government workers could be reassigned to new duties.

Effects on Emergency Management: Old law and authorities from the days of Civil Defense were dusted off and even reinstated placing some emergency management programs back in the role of homeland defense.

Conclusion

The key question for emergency managers is how do we think about the future and potential disasters? Should we move beyond traditional risk measures and embrace the uncertainty of a new paradigm? If so, a few suggestions on how to proceed:

1. Continue to prepare for the Gray Rhinos – what we know is coming (i.e. Big One in SoCal). With the intersection of demographics (older populations, brittle infrastructure, and climate change there will be herds of rhinos on the playing field.
2. But we will also need to dedicate time and resources to prepare for the Black Swans i.e. expect the unexpected. We will need to lead efforts to build capacity and capabilities to meet unforeseen challenges – including those that seem improbable or even impossible. It may be time to consider moving communities away from being just resilient and making them “anti-fragile.”
3. Reflect upon what we each know and upon what we don’t know.
4. We need to stop being surprised. If we are not surprised and instead actually expect the unexpected, our personal outlook will inform our programs and influence the people and organizations that we bring to the table.

In the jungle of the future, we will need to spot the rhinos before they get too close, always be ready for the black swans and all the while being on guard for the dragon kings.

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CALIFORNIA EMERGENCY SERVICES ASSOCIATION (CESA) 2023 CONFERENCE: GREAT FORECAST OF FUTURE DISASTERS AND COLLECTION OF DEFINITE MAYBES

May 2023

As the world was transitioning out of formal emergency COVID-19 response and as the effects of climate change were becoming truly significant, attendees of the CESA 2023 Conference were asked to participate in a very informal poll as part of a plenary presentation on potential future disasters. Attendees were asked to consider future disasters in California (aside from earthquake, flood, and wildfire) in two categories:

1. Suggest one major disaster that would probably occur by 2045; and
2. Suggest one major disaster that could occur by 2045 but “would make you sound crazy if you suggested it out loud.”

106 attendees submitted responses. The most suggested disasters by category:

Probably Occur		Could Occur	
Cyber Incident	18	EMP/Solar Flare	8
Power Failure	9	Civil Unrest/Anarchy	8
Flood/ARkStorm	7	Global Conflict/War	7
Extreme Drought	7	Hurricane/Tornado	6
Extreme Heat	5	Meteor	6
Climate Change/SLR	5	Cyber Incident	5
Pandemic	5	Volcano	5

Complete Results are listed on the next page. Note: If two or more disasters were suggested in a category, only the first was included in the tally. Some attendees did not offer suggestions in both categories.

Event	Probable	Event	Possible
Cybers Incident/Disruption	18	EMP/Solar Flare	8
Power Failure/Black Sky	9	Civil Unrest/Anarchy	8
Extreme Drought	7	Global Conflict/War	7
Flood/ARkStorm	7	Hurricane/Tornado	6
Extreme Heat	5	Meteor	6
Climate Change/SLR	5	Cybers Incident/Disruption	5
Pandemic	5	Volcano	5
EMP/Solar Flare	4	Artificial Intelligence	5
Tsunami/Seiche	4	Aliens/Alien Life	4
Economic	4	Power Failure/Black Sky	3
Global Conflict/War	3	Extreme Drought	3
Hurricane/Tornado	3	Major EQ	3
Train Derail	3	Nuclear	3
Civil Unrest/Anarchy	2	Terrorist Attack	3
Volcano	2	Zombies	3
Major EQ	2	Tsunami/Seiche	2
Nuclear	2	Bioweapon/Disease	2
Terrorist Attack	2	Extreme Heat	1
Bioweapon/Disease	2	Landslide/Mudslide	1
Landslide/Mudslide	2	Food Crisis/Famine	1
Food Crisis/Famine	2	Tech/Infrastructure	1
Tech/Infrastructure	2	Wildfire	1
Extreme Snow	2	Climate Refugees	1
Active Shooter	2	Space Junk Collision	1
Meteor	1	Dust Storm	1
Aliens/Alien Life	1	Antibiotic Resistant Bacteria	1
Wildfire	1	Government Collapse	1
Climate Refugees	1	Depopulation of CA	1
Space Junk Collision	1	Chemical Warfare	1
Supply Chain	1	Loss of Ozone Layer	1
		Locusts	1
		Mass Extinction Pollinators	1
		Disclosure of all emails/texts	1
		Fuel Shortage	1
		Battery Disposal Explosion	1
		Refinery Explosion	1
		Water Conflict	1