NAVIGATING DISRUPTION:
MOBILE SOCIETY
AND
HURRICANES JUAN AND IGOR

A TRAVELOGUE

By

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ABSTRACT

In the course of a decade, two record-breaking hurricanes made landfall in Atlantic Canada: *Juan* (2003) and *Igor* (2010). During each hurricane, mobility networks central to the movement of people and goods (i.e. road, marine, air and rail) were disrupted, interrupting emergency services, commercial operations and personal transport. In some cases, alternate transport modes and routes emerged, while in other cases people and goods were rendered immobile.

The anchoring idea for my research is that fossil fuel-powered transport contributes to climate change and climate change disrupts transport. The energetic boomerang comes full circle with severe weather events disrupting complex, weather-exposed transport networks. While linking specific weather events to climate change is tenuous, I explore these hurricanes as examples of the type of conditions (e.g. high winds, intense precipitation, storm surges) that are expected under a changing climate. To build societal resilience to extreme weather events, we need both theoretical and applied approaches to transport that incorporate recognition of climate change.

Through this project I ask what responses and frames, particularly related to social-ecological interactions, emerge when mobility networks are impacted by hurricanes. I examine sources of resilience and vulnerability (e.g. social, ecological, infrastructural), as well as ask how greater social and ecological resilience can be achieved. Using an inductive case study approach and drawing on media articles, legislative transcripts, policy documents and semi-structured interviews with key informants, I identify and analyze the resulting responses and frames as they pertain to social-ecological resilience and vulnerability.

This research is grounded within the mobilities literature and informed by the disaster literature to elaborate an *eco*politics of mobility. I complement the applied areas of sustainable mobility (i.e. climate change mitigation) (Banister 2008) and resilience (i.e. transport, infrastructure, social-ecological) (Brown 2014; Folke 2010), with the theoretically oriented mobilities paradigm (Sheller and Urry 2006), including the politics of mobility (Cresswell 2010). Further, I inflect the politics of mobility, which provides a nuanced approach to the analysis of power within mobility systems, with Foucault's work on governmentality and circulation of societies and ecologies.

In terms of practical contributions, I find that in the aftermath of Hurricanes Juan and Igor, reinstatement of mobility was an uppermost priority with a dominant tension between the frame '*we've never seen anything like it*' and '*we need to get things back to normal as quickly as possible*.' I develop a list of practices used for managing mobility in the preparation, response, recovery and mitigation phases of disaster, as well compare the resiliencies and vulnerabilities of Nova Scotia and Newfoundland's mobility networks.

In the case of Nova Scotia, a key source of vulnerability in the context of Hurricane Juan was the entanglement of trees and power lines. Key sources of resilience include the

cultural instinct to batten down the hatches, the adaptable role of transit and the coordination of emergency services. Residents successfully, if somewhat precariously, governed their own mobility (i.e. governmobility). Further, the experience of successive intentional, technical and ecological adversities fostered a culture of all-hazards disaster readiness.

In the case of Newfoundland and Labrador, a key source of vulnerability in the context of Hurricane Igor was the scale of road washouts combined with limited routes, modes (e.g. car, truck), fuel types and fuel storage. Key sources of resilience were coordination and cooperation among different levels of government, the private sector and residents demonstrating a high capacity to restore the road network to functionality within ten days and coordination among residents to cope in the interim.

Based on the empirical case studies, I develop and elucidate three ideas that are valuable in reconceptualizing the social and environmental power dynamics inherent in transport networks: *mobility webs*, the *ecopolitics of mobility* and *climate routing.* I describe this set of concepts as an *ecopolitical approach to mobility*. Borrowing from the ecological concept of food webs, I use the term *mobility webs* to reflect the environmentally exposed, but also diverse and adaptable dimensions of contemporary transport networks arguing for an approach that cooperates with, rather than dominates, the environment.

To underscore the view that transport networks and ecological flows are interwoven and, in an anthropogenic age, co-constructed, I forward the concept of an *ecopolitics of mobility*. Adapting Cresswell's (2010) six elements of the politics of mobility – motive force, velocity, rhythm, route, experience and friction – to the interface of the environment and contemporary social-technical assemblages of mobility, I analyze social-ecological power dynamics, including related sources of resilience and vulnerability to disrupt and reframe interactions between mobility and the environment.

Informed by the disaster sociology of Freudenburg (2009), Klinenberg (2004) and Murphy (2009), I consider the possibilities for an ecologically reflexive modernization in the field of transport, extending the focus of transport resilience from restoring the status quo to include reflecting on the role of mobility in contemporary society (Beck 2015). I adapt the marine navigation concept of weather routing – the practice of altering a ship's course to take maximum advantage of tidal, current and wind conditions to reduce the physical resistance of the ship moving through water – and posit the concept of *climate routing*. As conceived, climate routing involves six measures: creating a transport resilience task force, deliberating decentralization, internalizing externalities, planning for green and blue flows, rebranding redundancy and thinking flex. Primary considerations are lessening social-ecological contention, increasing resilience, questioning mobility practices and maintaining or increasing quality of life.

In sum, my research offers innovative contributions by orienting mobilities research to social-ecological considerations – extending previous work on sustainable mobility even further – and orienting disaster sociology to mobility and related transport considerations.

And when I sleep that final sleep
I can only hope and pray
That someone's life will brighter be
Because I have passed this way

Allen Duffett
This Thing Called Life
1930-2010

…

Newfoundland and Labrador

Allen Duffett

Nova Scotia

Stephen Munro

John Rossiter

Mary Sack

Zachary Sack-Amro

Samia Sack-Amro

To the woman in Paris –
per aspera ad astra.

FIRST MATE AND CREW

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CAPTAIN'S LOG

SHIP'S MANIFEST

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Alex Colville (1920-2013)
Assorted paintings with permission from the Colville Estate

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Sue Goyette
1964 - Present
Assorted selections: *Oceans* (2013)
With permission from Gaspereau Press

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There is a whirlwind in southern Morroco, the *aajej*, against which the fellahin defend themselves with knives. There is the *africo*, which has at times reached into the city of Rome. … These are permanent winds that live in the present tense. There are other, less constant winds that change direction, that can knock down horse and rider and realign themselves anticlockwise. The *bist roz* leaps into Afghanistan for 170 days — burying villages. … As well as the other "poison winds," the *simoom*, of North Africa. … The *harmattan*, which blows and eventually drowns itself in the Atlantic. *Imbat*, a sea breeze in North Africa. … Herodotus records the death of various armies engulfed in the *simoom* who were never seen again. One nation was "so enraged by this evil wind that they declared war on it and marched out in full battle array, only to be rapidly and completely interred."

Michael Ondaatje
The English Patient
1993

A Cape Verde-type hurricane is an Atlantic hurricane that develops near the Cape Verde islands, off the west coast of Africa.

Wikipedia
2014

Risk is said to derive from the Italian word risco which meant 'that which cuts,' hence 'reef' and consequently 'risk to cargo on the high seas.'

Ewald
Insurance and Risk
1991

[Governmentality] means to safeguard the population, as if it was 'the government of a ship' taking care of the ship, its sailors and its cargo, taking care of things, navigate safely and 'establishing a relation between the sailors' (Foucault 1994: 235).

Bærnholdt
Mobilities 8(1)
2013

1 SETTING SAIL: INTRODUCTION

…And what a hurricane of a question!
What a tidal wave of disruption. It got worse

when we walked into it and let it taste us. Courtship!
We had never heard of marriage let alone ceremony.

When we wrote our names in the soft sand of its back,
we didn't know the first thing about commitment

or about being out of our depths.

Sue Goyette
One
2013

Alex Colville
Couple at Beach
1957

Studying the responses and frames used to navigate mobility disruption caused by severe weather events is a 'hurricane of question,' bringing together in new ways the spheres of climate change, transport and disaster. Just as the couple on the beach is in a relationship, society is 'out of its depth' in its relationship with the environment, grappling with an era defined by profound climatic change.

Situating the study

Two intersecting trends help define our times: an intensification of transport and an upsurge in severe weather events. Movement is central to our society. Like oxygen, we both rely upon it and take it for granted. From commuting to work to shipping freight, from school buses to ambulances, from destination weddings to academic conferences, mobility punctuates the story of our lives. The transport sector is a fast growing source of greenhouse gases, with global emissions projected to double by 2050 due to growth in the passenger and freight sectors (Intergovernmental Panel on Climate Change 2014).[1] Likewise, problematic severe weather events are increasingly prevalent; the United Nations (2013) reports a doubling of extreme weather events in the past two decades.

The trends of intensifying transport and increasing severe weather events are related. Fossil-fuelled mobility contributes to climate change and climate change disrupts mobility; climatic disruptions entail mobility disruptions. Almost all of global transport energy, 95 per cent, is derived from fossil fuels such as oil, gas and diesel (Urry 2013). The atmospheric accumulation of greenhouse gases released during the course of fossil-fuelled transport increases global average temperature and triggers a cascade of climatic

[1] There is preliminary evidence of 'peak travel' and specifically 'peak car' – a phenomenon akin to peak oil where transport demand abates – particularly in terms of private car ownership and use in Western countries (see Goodwin 2012 for a research agenda). However, growth rates in aviation and freight show no sign of abatement.

changes, such as intensifying weather, rising sea levels and acidifying oceans. The energetic ‘boomerang’ comes full circle with severe weather disrupting the complex transport networks upon which societies rely (Beck 1992). The fifth assessment of the Intergovernmental Panel of Climate Change states that: “it is *extremely likely* that human influence has been the dominant cause of the observed warming since the mid-20th century” (emphasis in original) (2014: 17).

The links between climate change and hurricane activity are less clear, in part due to the lack of historical data and confounding meteorological events such El Niño and the multi-decadanal North Atlantic Oscillation. The current state of knowledge suggests an overall trend of decreased hurricane frequency, but increased hurricane intensity (e.g. 4 to 6 per cent) (Environment and Climate Change Canada 2016). However, in any given year there will be variation. For example, 2016 is projected to be slightly above average in terms of hurricane activity. Regardless of hurricane trends, rising sea level will exacerbate all storm impacts (Sobel 2014).

In this research I explore what happens when the two trends of intensifying transport and severe weather intersect, studying the cases of two record-breaking hurricanes: Hurricanes Juan (2003) and Igor (2010). I focus on two regions that were heavily impacted by each hurricane, the Canadian provinces of Nova Scotia and Newfoundland and Labrador (Figure 1). I explore ways that resilience can be enhanced in the face of increasing severe weather events such as Hurricane Juan and Igor.

Juan and Igor

Both events share important commonalities and differences (Table 1.1). While most North Atlantic hurricanes dissipate in the open ocean, these hurricanes made landfall (Sobel 2014). Energetic movements of wind and water collided with the fossil-fuelled movement of people, goods and services. Transport networks were exposed to, and tested by, extreme coastal conditions. States of emergency were declared. Lives were lost. In recognition of the hurricanes' severity, the names *Juan* and *Igor* were retired by the World Meteorological Organization. Hurricane Juan was defined by higher wind speeds, ranking a category 2 event according to the Saffir-Simpson Hurricane Wind Scale (Figure 1.2). By contrast, Hurricane Igor was defined by precipitation, ranking as the third wettest hurricane in Canadian history. Indeed, while its wind speeds only ranked a category 1 hurricane, the slower moving storm allowed for greater damage from precipitation to amass (Masson 2014).[2]

The two impacted jurisdictions – Nova Scotia and Newfoundland – share not only a coastal geography, but are defined by peninsular and island geography that further complicate transport logistics (Figure 1.1).[3] Hurricane Juan impacted Atlantic Canada, making landfall in Nova Scotia, which is a peninsula (together with the island of Cape Breton), and Prince Edward Island. Within Nova Scotia, the capital city and my home, is located on Halifax Peninsula. I focus my research on Nova Scotia, with an emphasis on

[2] See Sobel (2014) for a discussion on the limited ability of current meteorological tools to adequately communicate risk to governments and populations.

[3] The province of Newfoundland and Labrador consists of an island in the North Atlantic (Newfoundland) and a portion of the continent that borders the province of Quebec (Labrador). Both have limited transport options due to their remoteness. However, I focus on the island portion, Newfoundland, as this received the brunt of Hurricane Igor's impact.

Halifax, given my familiarity with the province and because its transport profile is more varied compared to Prince Edward Island. While Hurricane Igor impacted American states, I focus on its landfall in the island portion of Newfoundland, which heavily impacted the Bonavista and Burin Peninsulas. As a doctoral candidate at Memorial University in Newfoundland conducting research on Igor was convenient as well as theoretically and practically relevant. Consequently, I tether my research in these areas while also maintaining a regional focus (i.e. Atlantic Canada).

Nova Scotia is a regional passenger and freight hub in Atlantic Canada. The Port of Halifax is a node in a global shipping network, receiving and distributing cargo via marine, road and rail networks. Nova Scotia has a population of approximately 943,000 and a Gross Domestic Product (GDP) of $39 billion (Statistics Canada 2015, 2014).[4] Newfoundland is geographically and commercially more peripheral than Nova Scotia. Further, its coastal communities are connected by one major highway and secondary roads, or in some cases, connected by ferry.[5] Cars and trucks, both passenger and freight, are the main mode of transport on the island, while off-highway vehicles are an informal means of transport. The island itself is accessed by air, ferry and other marine transport. Newfoundland and Labrador has a population of approximately 528,000 and a GDP of $33 billion (Statistics Canada 2015, 2014).[6] The two provinces are interconnected.

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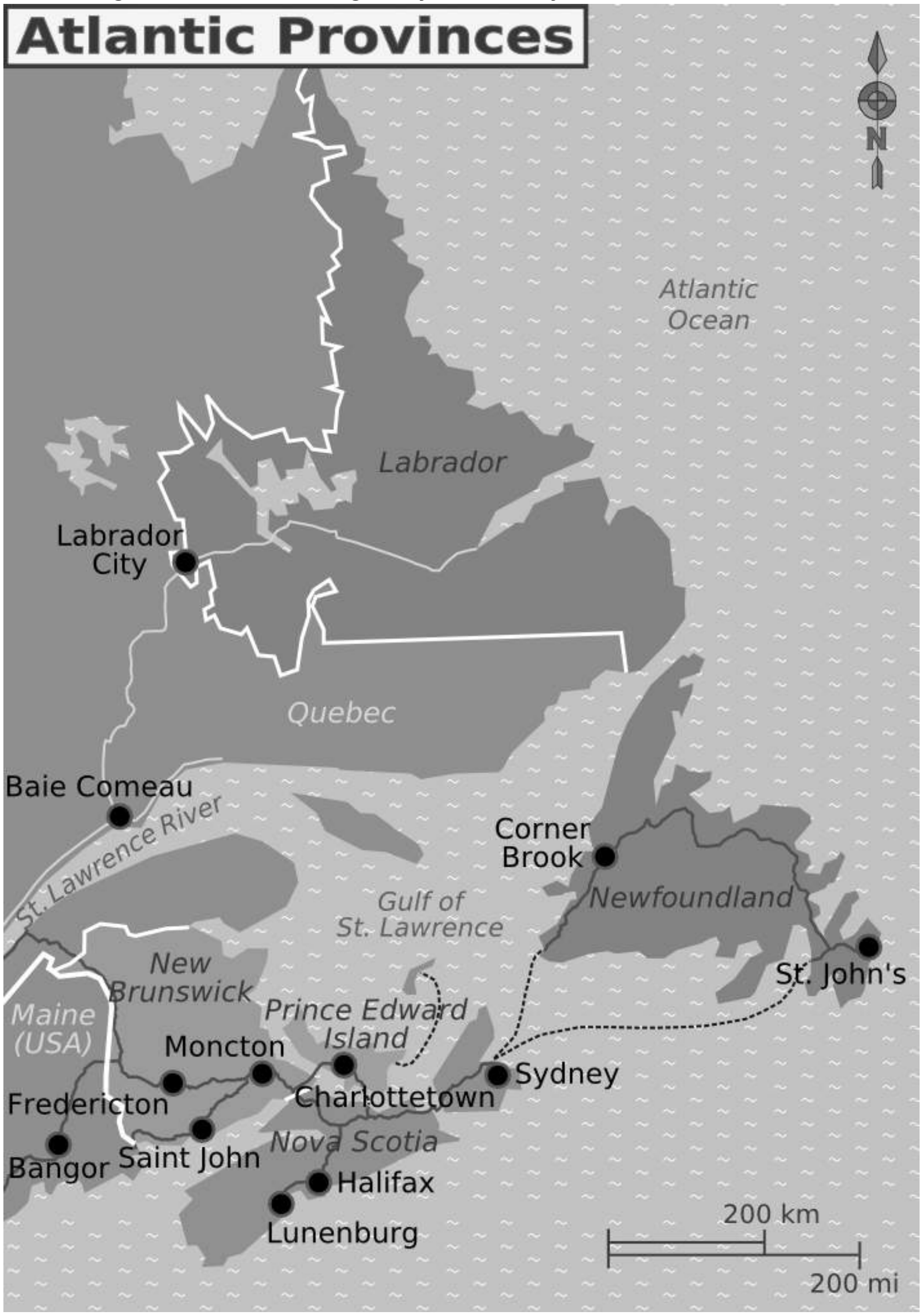
[4] During the years that Hurricanes Juan and Igor hit, Nova Scotia and Newfoundland's population were slightly smaller: Nova Scotia (2003) 936,000 and Newfoundland (2010) 522,000. Likewise, provincial GDP in 2005 was $31 billion and $29 billion respectively.

[5] Such as Bell Island, profiled on the Canadian Broadcasting Corporation's (2015f) Ideas as part of the On the Move work-related mobilities research project.

[6] As of 2015, the oil and gas sector accounts for about one-third of Newfoundland's GDP (Government of Newfoundland and Labrador 2014). However, with recent declines in oil prices Newfoundland's GDP is on a downward trend (Canadian Broadcasting Corporation 2015b). By contrast, the oil and gas sector accounts

Figure 1.1: Map of coastal case study regions: Nova Scotia and Newfoundland, including TransCanada highway and ferry routes (Wikimedia 2015)



for only a sliver of Nova Scotia's GDP, with exports declining 98 per cent between 2003 and 2012 (Ivany 2014).

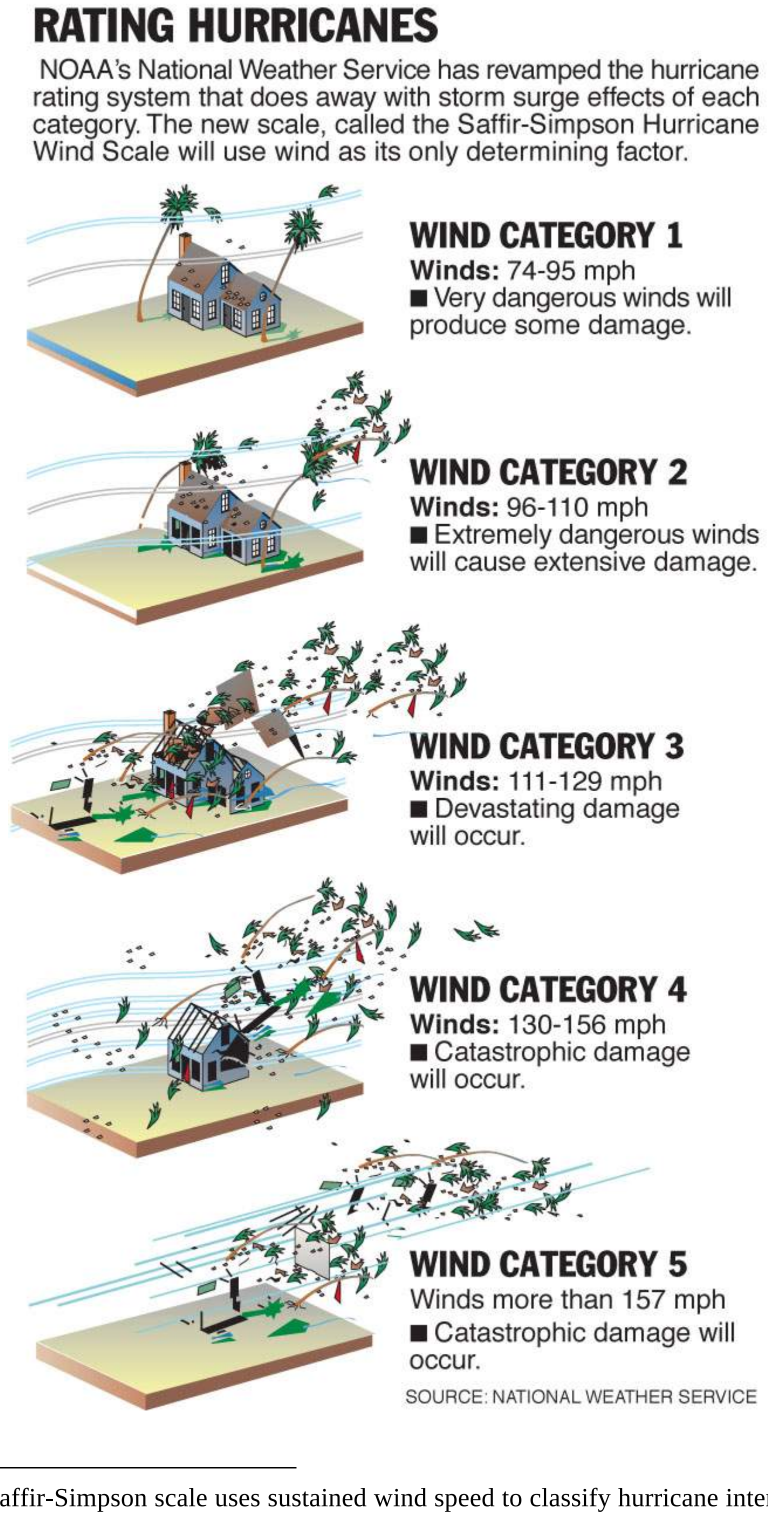
Table 1.1: Statistical comparisons of Hurricanes Juan and Igor for case study regions

	HURRICANE JUAN[7]	HURRICANE IGOR[8]
Date	September 29, 2003	September 21, 2010
Saffir-Simpson Wind Scale (Figure 1.2)	2 (154-177 km/h; 83-95 knots)	1 (119-153 km/h; 64-82 knots)
Storm width	n/a	1,480 km
Highest sustained wind speed	151 km/h	130 km/h
Highest wind gust	176 km/h	172 km/h
Precipitation	25-52 mm	90-238 mm
Ocean surface temperature	18°C (versus normal of 15°C) Gulf stream: 24°C to 28°C (unseasonably warm)	(Warmer than average)
Peak stream flow	n/a	$600 m^3/s$ (versus mean of $10 m^3/s$)
Peak wave height	9-20 m	13-25 m
Storm surge[9]	100-150 cm (Combined with high tide for 290 cm total)	70-100 cm
Barometric pressure[10]	973 hPa	952 hPa
Epicentre	Halifax Regional Municipality	Bonavista and Burin Peninsulas
Lives lost[11]	6	1
Cost (provincial)[12]	$100 million	$100-200 million
Last storm of equal or greater magnitude	- Groundhog Day Gale (1976) - August Gale (1893): Category 3; 25 deaths	- Burin Tsunami (1929): - 27 metre waves; 28 deaths - Great Independence Hurricane (1775): ~4,000 deaths

[7] Data in column from Environment Canada (2003a, 2003b, 2003c and Novaweather.net 2003).
[8] Data in column from Environment Canada (2011).
[9] Between lower barometric pressure and leading winds, hurricanes result in temporarily higher water levels, that in turn, can be exacerbated by tidal cycles and lunar activity. These are the conditions for a storm surge, defined as water levels one metre or more above normal levels. Hurricane Juan hit when these forces aligned to produce high water levels, though had the storm hit two hours earlier or ten hours later the storm surge could have been as much as one metre greater (i.e. 3.9 metres) (Environment Canada 2003c).
[10] Standard atmospheric pressure is 1013 hectopascals (hPa) (Environment Canada 2003b)
[11] During Hurricane Juan, two people died when trees fell on vehicles and two fishermen were lost at sea. In the aftermath of the storm a mother and two children died in a house fire caused by the use of candles. Notably, the electricity-powered smoke detectors did not function during the power outage. One man died while assisting with relief work (Environment Canada 2003c). In Newfoundland, one man lost his life when the driveway upon which he was standing was washed out (Environment Canada 2011).
[12] Costs for Hurricanes Juan and Igor are estimates that include insurable and uninsurable costs, as well as costs recovered under the Federal Disaster Financial Assistance Arrangement (DFAA). They do not include indirect costs, nor ecological and social costs not reflected in the market.

Figure 1.2: Illustration of the Saffir-Simpson Hurricane Wind Scale

(Pensacola News Journal 2013)[13]



[13] The Saffir-Simpson scale uses sustained wind speed to classify hurricane intensity, ranging from 1 to 5: 1 (119-153 km/h), 2 (154-177 km/h), 3 (178-208 km/h), 4 (209-251 km/h), and 5 (252 km/h or higher).

in terms of transport networks, including air and marine passenger and freight transport. A quintessential example is the diversion of flights to Halifax, Nova Scotia and Gander, Newfoundland and Labrador, among other Canadian airports, following the closure of American airspace due to the events of 9/11. Halifax and Gander were key nodes in an impromptu and massive reconfiguration of global air traffic. Environmentally both provinces are situated in the North Atlantic and have common issues related to fisheries and offshore oil and gas development

Extreme weather events, such as Hurricanes Juan and Igor, illustrate the types of conditions that are projected to increase under a changing climate (i.e. high winds, intense rainfall, storm surges exacerbated by sea level rise) (Intergovernmental Panel on Climate Change 2012a; Sobel 2014). Such conditions highlight societal reliance on the movement of people and goods and our vulnerability when people and goods fail to move. Such disruptions can mean that basic, life-supporting necessities are missing in action. Specific to transport, road, marine, air, rail, as well as walking and cycling networks experienced severe damage, disrupting numerous systems, including emergency services, personal transport and commercial operations. In Nova Scotia, fallen trees and electrical lines blocked streets, making it treacherous for emergency and power crews to navigate, nonetheless average community members (The Chronicle Herald 2003). In Newfoundland, communities isolated by Igor experienced difficulty accessing food, water and fuel, as well as health-related supplies such as oxygen and insulin (The Telegram 2010a).

The hurricane impacts brought daily life to a standstill. In some cases, alternate transport modes (i.e. helicopters, boats) and alternate transport routes (e.g. cabin roads, decommissioned bridges) emerged, while in other cases immobility was the optimal or only option. Cruise ships destined for Halifax were diverted to Saint John in advance of the storm as the tourism industry changed course in response to weather warnings. Further, global flows of travellers and highly integrated supply chains that operate according to ‘just in time delivery’ principles were disrupted. The crux of this research is an exploration of social and ecological implications that emerge when heavy weather meets populations that are heavily reliant on mobility for accessing goods and services.

Hurricanes and climate change

Hurricanes originate in the warm water of the tropics when clusters of thunderstorms, shaped by the Coriolis effect, coalesce and rotate, reaching minimum sustained wind speeds of 119 kilometres per hour (Hyndman et al. 2008).[14] While linking discrete short-term weather events to long-term climate change trends is tenuous, I explore these hurricanes as examples of the type of conditions (i.e. high winds, intense precipitation, storm surges) that may be expected under a changing climate. While there is a high level of scientific certainty regarding specific impacts of climate change, such as increased precipitation intensity and more frequent heat waves, given a lack of historical data and changes in monitoring technologies, the Intergovernmental Panel on Climate Change notes the difficultly in assessing long-term variations in hurricane frequency and severity: “There is *low confidence* in any observed long-term (i.e., 40 years or more) increases in tropical cyclone activity (i.e., intensity, frequency, duration), after accounting for past

[14] The terms hurricane, typhoon and cyclone are regional terms for the same weather phenomenon. The Coriolis effect also shapes ocean gyres.

changes in observing capabilities" (2012a: 8).[15] The World Meteorological Organization, drawing on National Oceanic and Atmospheric Administration data, observes that 2001 to 2010 was a record-breaking decade in terms of hurricane activity:

> [it] was the most active decade since 1855 for tropical cyclones in the Atlantic Basin. An average of 15 named storms per year was recorded, well above the 1981–2010 long-term average of 12 named storms per year. The most active season ever recorded was 2005, with a total of 27 named storms, of which 15 reached hurricane intensity and seven were classified as major hurricanes. (Category 3 or higher) (World Meteorological Organization 2013)

The World Meteorological Organization identifies that such anomalous weather is due to natural climatic variation and anthropogenic climate change, and that distinguishing between the two is a key challenge for climate scientists (World Meteorological Organization 2013). Such scientific uncertainty about climate change generally, and the impacts of climate change on hurricanes specifically, is indicative of the range of uncertainties related to how best to adapt to a changing climate.

Of relevance to Atlantic Canada, there is evidence of shifts in hurricane activity towards the polar regions and away from the equator, due in part to the warming of ocean waters which fuel hurricanes into higher latitudes (Intergovernmental Panel on Climate Change 2012b). Further, there are indications that maximum hurricane wind speeds and precipitation levels will increase, with higher sea levels exacerbating storm surge impacts (Intergovernmental Panel on Climate Change 2012b). Critically, even if hurricane activity remains the same or even weakens, sea level rise will exacerbate impacts (Sobel 2014).

[15] See Peréz (2001) for an historical documentation of, and related social-economic impacts of, hurricanes in Cuba.

Rather than focusing on long-term storm trends – data that will emerge over time – severe weather events provide an opportunity to focus on short-term disaster prevention, preparedness and response strategies (Sobel 2014). My research explores the area of overlap between recovering from a severe weather event on one hand and adapting to climate change on the other hand.

Research questions

My research was guided by the overarching question: *what responses and frames, particularly related to social-ecological interactions, emerge when transport networks are impacted by hurricanes?* I focus on shorter and longer term responses of transport providers, as well as the frames presented by key informants including transport providers, in addition to the media and government. I define response as an action taken in response to unfolding events. I define frame as a discursive means to provide meaning to the same unfolding events (Chong and Druckman 2007). To examine the intersection of transport networks and hurricanes as a climate change-related risk, I address three questions: **1.** What sources of resilience emerge? **2.** What sources of vulnerability emerge? **3.** How can greater social and ecological resilience be achieved with respect to transport networks? I examine sources of resilience and vulnerability (e.g. social, ecological, infrastructural, etc.), as well as ask how greater social and ecological resilience can be achieved. Using an inductive case study approach and drawing on media articles, legislative transcripts, policy documents and semi-structured interviews with key informants, I identify and analyze the resulting responses and frames as they pertain to social-ecological resilience and vulnerability.

Analytical framework

This research is grounded within the mobilities literature and informed by the disaster literature to elaborate an ecopolitics of mobility (Table 1.2). I complement the applied areas of sustainable mobility (i.e. climate change mitigation) (Banister 2008) and resilience (i.e. transport, infrastructure, social-ecological) (Brown 2014, Folke 2010), with the theoretically oriented mobilities paradigm (Sheller and Urry 2006), including the politics of mobility (Cresswell 2010). I inflect the politics of mobility, which provides a nuanced approach to the analysis of power within mobility systems, with Foucault's work on governmentality and circulation of societies and ecologies. Informed by the disaster sociology of Freudenburg (2009), Klinenberg (2004) and Murphy (2009), I consider the possibilities for an ecologically reflexive modernization (Beck 1992) in the field of transport, extending the focus of transport resilience from restoring the status quo (e.g. technical fixes) to include critically reflecting on the role of mobility in contemporary society (Beck 2015). I consider how environmental impacts of mobility can be mitigated, and conversely, how disruptions to mobility webs caused by environmental conditions can be managed.

Table 1.2: Analytical framework combining mobility and disaster literatures to create an ecopolitical approach to mobility

THEORY	THEORISTS/PRACTITIONERS[16]
MOBILITY	
Mobilities paradigm Politics of mobility	Sheller and Urry Cresswell
Sustainable mobility	Banister, Schwanen, Anable
Resilience (with a mobility focus) Transport Infrastructure Social-ecological	 Transport Canada; UK Department of Transport Brown Folke/Adger/Berkes/Holling
Governmentality Social and ecological circulations	Foucault
+ DISASTER	
Disaster sociology	Freudenburg/Klinenberg/Murphy
Reflexive modernization Emancipatory catastrophism	Beck
= ECOPOLITICAL APPROACH TO MOBILITY	

[16] As transport and infrastructure are applied fields, I opted to include practitioners to get a sense of how these concepts are operationalized. The academic fields are so new that there is little sense of coalescence. For example, articles referencing infrastructure resilience typically have no or only citation. In terms of transport resilience, Reggiani et al. (2015) and Mattsson and Jenelius (2015) are more frequently cited (five and six citations respectively). Both articles conceptualize transport resilience and vulnerability from engineering and economic perspectives.

Sheller and Urry (2006) developed the mobilities paradigm to theorize the prevalent, but traditionally overlooked, role of mobility in contemporary society. Sheller and Urry refer to the recent mobility turn in the social sciences, including ideas from "anthropology, cultural studies, geography, migration studies, science and technology studies, tourism and transport studies, and sociology" and other fields, as a paradigm (2006: 207). A paradigm is an "exemplary way of conceptualising and intervening in particular situations" (Schwanen, Banister and Anable 2011: 996).

For the purposes of this research, and informed by Sheller and Urry's work on the mobilities paradigm, I define mobility as the co-constructed, dynamic movement of people, goods and services via transport modes (e.g. airplanes, cars, ferries, rail, transit, walking, cycling) as supported and limited by a myriad of social and environmental, as well as infrastructural, organizational, informational and technological systems. The mobilities paradigm is used in dynamic and diverse ways, including analysis of the mobilities and immobilities that resulted from the 2010 Icelandic ash cloud event (see *Mobilities* (2011) special issue) and conceptualizations of post-carbon transport futures (Urry 2013, 2011, 2008).

I draw on Cresswell for an elaboration of the power dynamics expressed via mobility, what I term an *eco*politics of mobility, exploring and articulating the social-ecological power dynamics expressed in transport networks. I incorporate a Foucauldian analysis of governmentality, often used in the mobilities paradigm (see Manderscheid, Schwanen and Tyfield 2014; Sheller 2016b), exploring how the concepts of circulation, surveillance, discipline and security apply to societal interactions with ecological systems.

What comes to light is a picture of contemporary mobility as inseparably intertwined with flows of fossil fuels and greenhouse gas emissions, iceberg calving and hurricane tracks.

Transport resilience, as currently practiced, pertains largely to the ability of transport networks to withstand disruptions caused by severe weather with a goal of minimizing economic and social disruption. Other types of disruption, related to labour strife and terrorist threats are also considered but are less central. The field of transport resilience tends to focus on restoring the status quo as quickly as possible using largely, though not exclusively, engineering-based technical solutions (e.g. raising rail track heights, investing in infrastructure maintenance and identifying priority routes). The transport resilience literature is fledgling and at this point largely focuses on resilience (as compared to transformation to a low-carbon society), namely minimizing economic disruption during severe weather events (see Transport Canada 2015, UK Department of Transport 2014). My research broadens this focus by questioning societal reliance on mobility in the first place. A closely related field is that of infrastructure resilience (i.e. next generation infrastructure, green infrastructure) which aims to work with, rather than dominate, ecological systems (Brown 2014; see also, for example, Choi et al. 2016).

Social-ecological systems (SES) theory originates from the discipline of ecology and focuses largely on understanding and managing integrated social-ecological systems. Within SES, resilience is a complex and emergent concept that varies in terms of both theoretical and applied understandings (see Brand and Jax 2007). Resilience refers generally to the capacity of a community and/or ecosystem to withstand challenges either by returning to its original state (passive resilience), adapting within its current state or by transforming into a different state, such as a low-carbon or post-carbon society (Folke et al. 2010; Frantzeskaki et al. 2010). What emerges in my research is the necessity of all three in the context of severe weather events: with resilience needed to regain basic functioning, adaptability needed to respond to changing climate dynamics and transformability needed in terms of transitioning to a post-carbon mobility system for long-term resilience. Vulnerability refers broadly to the reduction or absence of these capacities and specifically to "the susceptibility to extreme strains on a dynamic system" (Reggiani et al. 2015: 1). Social-ecological systems theory informs the disaster risk reduction and climate change adaptation fields.

My research augments the existing literature by foregrounding the environmental impacts of transport and, reciprocally, the impacts of severe weather on transport networks. I situate mobility not only as socially-technically co-constituted, but also as environmentally contingent. I bridge sustainable mobility, with its focus of climate change mitigation, descriptive analyses of the contemporary mobilities paradigm, such as used in the Icelandic ash cloud event, and imagined social futures, namely Urry's (2008) conceptual work on mobility in a carbon-constrained future. [17]

Given the intrinsic weather-sensitivity of transport networks and the fact that such sensitivity is compounded by increases in severe weather events, I situate this research within the disaster literature, including disaster sociology and reflexive modernization (i.e. emancipatory catastrophism) (see Andrey, Kertland and Warren (2014) on the interface between transport and weather). During extreme weather events, such as hurricanes, the

[17] The Icelandic ash cloud event was a geological phenomenon to which anthropogenic emissions from the transport sector are not a contributing factor. However, ash cloud events are related to climate change in that the particulate matter released temporarily mitigates the effect of global warming.

co-constructed relationship between the human and non-human environment, normally taken for granted, is exposed. Concepts of prevention, preparedness, response and recovery, as well as risk, hazard and social-technical dimensions are central considerations in disaster sociology. Freudenburg et al. (2011) distinguish between natural disaster and tragedy: natural disasters are unpreventable, whereas tragedies result from human error or hubris. However, in an age of anthropogenic climate change, that is, the Anthropocene, what constitutes a 'natural' hazard is obfuscated. I draw on Beck's theorization of reflexive risk (1992), as well as his more recent work on the emancipatory potential of catastrophe to explore anthropogenic risk.[18]

Disasters such as the 2010 BP oil spill (Gramling and Freudenburg 2012), the 1998 North American ice storm (Murphy 2009) and the 1995 Chicago heat wave (Klinenberg 2002) are understudied in terms of mobility considerations. Mobility dimensions and implications – such as demand for energy, including transport fuel, that contributed to the BP oil spill, treacherous roads caused by the ice storm, and the role neighbourhood safety concerns related to mobility (e.g. walking) played in exacerbating the vulnerability of seniors during the heat wave – are often described, but are not the primary topic of analysis. A notable exception is Hurricane Katrina (2005), in part because its mobility implications and failures were starkly apparent in terms of both mass and failed evacuations (Cresswell 2008) and the resulting long-term diaspora (Weber and Peek 2012).

[18] 'Anthropocene' was coined to describe the current geological epoch, defined as the point at which humans have a discernable impact on global ecosystem functioning. Given the social and technical lock-in of carbon-intensive mobility pathways, the Anthropocene is taken as a given for the purposes of this research,.

Reflexive modernization considers the fact that much of the risk managed by society is, in fact, created by society (Beck 1992). Beck (2015) forwards the possibility of emancipatory catastrophism – what disaster sociologists refer to as windows of opportunity – where negative effects of disaster can be leveraged to create positive societal change. I also draw on governmentality to explore techniques for managing social and environmental circulations – and related risks (e.g. scarcity, inundation) through the concepts of surveillance, discipline and security. In sum, my research offers innovative contributions by orienting mobilities research to social-ecological considerations, particularly climate change and severe weather events, and orienting disaster and risk theorization to mobility considerations. I explore the concept of resilience in the context of turbulent climatic conditions and disrupted mobility systems.

Theoretical contribution

From a Foucauldian perspective, discourse matters. It not only describes, but actively constructs, the art of government and the orientation of research agendas (Bærenholdt 2013). Therefore, through my research I developed and elucidated three concepts that are valuable in reconceptualizing the social-ecological power dynamics inherent in transport networks, as reflected at the interface of the mobilities paradigm, disaster sociology and resilience literatures: *mobility webs*, the *ecopolitics of mobility* and *climate routing*. I refer to this group of concepts as an *ecopolitical approach to mobility*. Informed directly by empirical data collection and analysis, these concepts offer considerable analytical purchase in addressing my research questions. First, they position social-ecological contention as a key source of vulnerability. Second, they position societal adaptation as central to increasing resilience and reducing vulnerability.

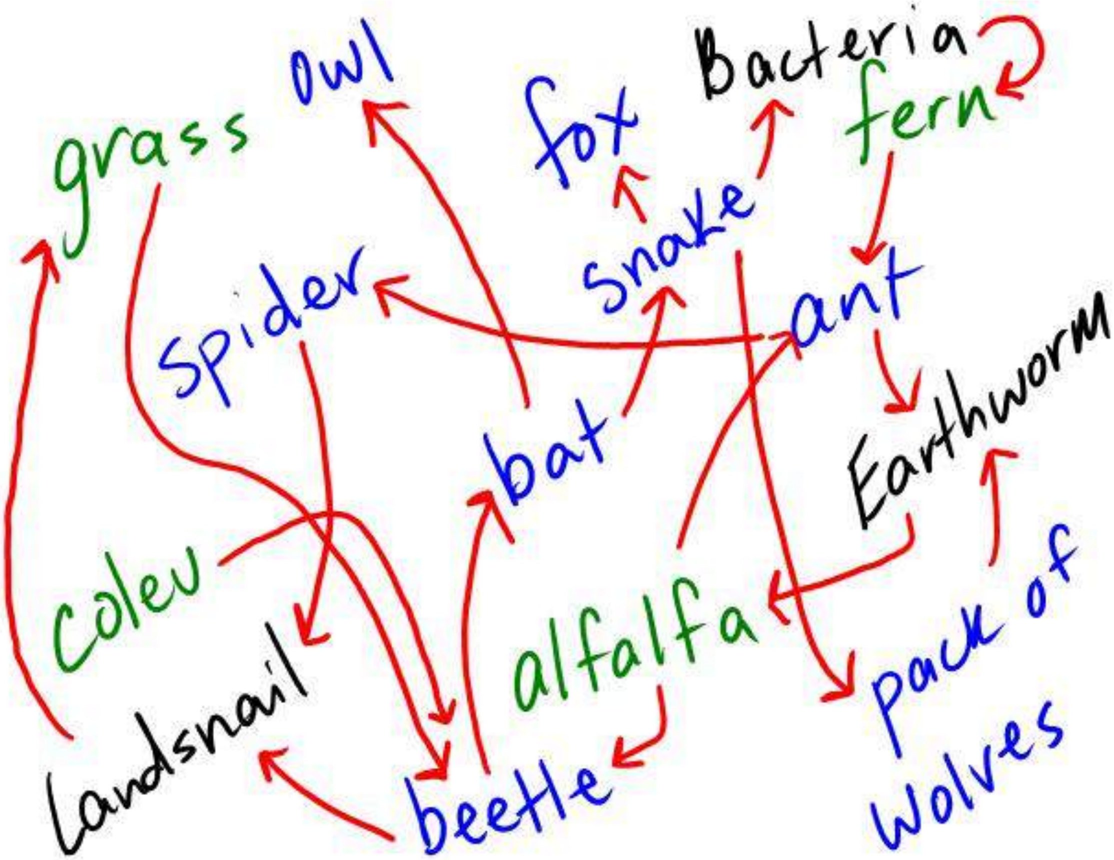
Mobility webs

Drawing on my case studies, I combine the concept of network society, which considers global linkages forged by information and communication technologies (Castells 2009), with the ecological concept of food webs. While the emphasis in network society theory is often on information and communication, transportation also plays a role and is key to this dissertation including the possibility for virtual mobility to supplant physical mobility. I developed the term *mobility webs* to refer to the integration of mobility via nodes in complex and adaptable social-technical-ecological assemblages. The concept of ecological webs is used to describe the complex interactions between animals, birds, insects and nutrients that allow for ecosystem functioning (Figure 1.3). Disruptions to the web, up to a certain threshold, can be accommodated. Likewise, the image of a spider web is useful – the design of a spider's web is tailored to available anchors (e.g. tree trunks and poles) and breakages in the web can be worked around, repaired or, alternately, the web abandoned. Lastly, the image of the worldwide web given its global reach and potential to supplant physical mobility is useful (see Graham (2010) on physical ruptures of fibre optic cables in the context of urban infrastructure disruptions). My intention is not to overstate the parallels between food and spider webs on one hand, and the socio-technical-ecological assemblages that constitute human mobility on the other hand, but rather to reframe mobility as environmentally contingent as well as adaptable. What emerges is a type of transport ecology and web ontology.[19,20]

I differentiate mobility webs from the conventional term, transport networks, which can be defined as structures and systems that permit the movement of people, goods and services (Graham and Marvin 2001). The term mobility web adds purchase to the term transport network by drawing ecological considerations into theorizations of human mobility. This phrasing acknowledges and cooperates with, rather than excludes and dominates, the environment. Such mobility webs often include multiple scales, from the local to the global, and may be routine or temporary. These webs may exist within the same transport mode (e.g. transit system) or between transport modes (e.g. freight container moved from ship to rail to truck). I augment the mobilities paradigm by exploring traditional and potential social-ecological power dynamics inherent in mobility webs, as well as potential for adaptation and transformation. Further, informed by the measures taken in the aftermath of Hurricanes Juan and Igor, I forward the concept of *shadow webs* to describe the materialization of alternative mobility webs in the face of disruption to the dominant web.

[19] See Scott (2015) for work on experiential cycling habitats.
[20] Deleuze and Guattari's (1987) concept of rhizomatic formations also offers conceptual purchase (e.g. mobility rhizome).

Figure 1.3: Schematic of food web as analogy for mobility web
(Panther Science 2015)



What emerged in my research is profound recognition on the part of transport operators of the environmental contingency of contemporary mobility. This reinforced a shift away from the persistent, but continually proven fallible, modernistic notion of transport as isolated feats of design and engineering. From the *Titanic*'*s* decisive interaction with an iceberg in 1912 to the derailment and explosion of a train carrying crude oil in the town of Lac-Mégantic, Quebec in 2013, examples of the risks inherent in isolating ecological considerations abound. Beck observes that in an era of climate change, “the idea that we are masters of the universe has totally collapsed and has turned into the opposite" (2-15: 75). By contrast, what surfaces through my research is the possibility of an *eco*politics of mobility under a changing climate.

By way of cursory illustration, I share two examples reflected in regional transit system maps. The first was created by a citizen volunteer who redesigned the London tube map to include the River Thames, albeit in a highly stylized format (Figure 1.4). This conscientious inclusion was in response to the traditional exclusion of the dominant environmental feature by Transport for London. While the intention of the volunteer was to facilitate way finding by including the landmark, it simultaneously serves to bring nature 'back in' to the representation of human mobility (Latour 2004). A second, more dramatic example is illustrated in a depiction of the inundation of seawater into the New York subway system following Hurricane Sandy (Figure 1.5). In this case, conceptions of the ecological as separate from society are washed away, raising questions about the wisdom of locating high cost and high demand infrastructure in flood prone regions (Sobel 2014).

Figure 1.4: Map of the London Underground (Alex Blog 2015)

Figure 1.5: Map of New York's subway system in the aftermath of Hurricane Sandy (greyed out portions represent damage caused by storm surge) (Huffington 2012)

Ecopolitics of mobility

As I engaged in data collection and analysis, it became apparent that I required a more nuanced language to describe the nature of the mobilities and immobilities that resulted from both Hurricane Juan and Igor. Cresswell's six elements of the politics of mobility – motive force, velocity, rhythm, route, experience and friction – provided just such a language. I adopted the politics of mobility to describe the interface of the environment and contemporary social-technical assemblages of mobility. To underscore the view that networks and ecological flows and turbulences are interwoven and, in an anthropogenic age, co-constructed, I forward the concept of an *eco*politics of mobility. Foucault's theory of governmentality complements the ecopolitics of mobility, particularly as it relates to attempts to discipline and secure the circulation of societies and ecologies. Here I use the term politics to refer to the complex and co-constructed relations between the social and ecological, grounding the broad politics of climate change in specific case studies an specifically the framing and management of these relations.

Given the stark disparities highlighted by extreme events such as Hurricane Katrina and the Haitian earthquake, a 'traditional' approach to the politics of mobility is critical in identifying how different people are differently impacted by the same event (e.g. class, age, gender, race). Such social-economic disparities are present though arguably less pronounced in Atlantic Canada, idealistically this is due to a more (though far from) equal society and realistically due to a more homogeneous population than, for example, New Orleans. Examples of such dynamics that emerged in the cases of Hurricane Juan and Igor include tensions involving youth, frictions between urban and rural communities, and adverse impacts on lower-income households and individuals who are precariously employed. Research into these issues, as well as issues of longer-term recovery, is valuable and necessary. I opt to focus on one particular political dimension of the storms, social-ecological dynamics, not to discount the import of other intersectional politics but to foreground environmental considerations.

Climate routing

Elaborating an ecopolitics of mobility and informed by the work of Beck (1992), Freudenburg (2012) and Murphy (2009) on environmental risk, I consider the possibilities for an ecologically reflexive modernization in the field of mobility, extending the current focus of *transport resilience* from restoring the status quo to include, first, critically reflecting on the role of mobility in contemporary society, and second, considering how environmental flows (e.g. hydrology) and systems (e.g. forest regeneration) can be accommodated in concert with mobility webs. How can the environmental impacts of mobility be mitigated (e.g. decarbonization), and conversely, how can disruptions to mobility networks caused by environmental conditions be managed?

To this end, I adapt the marine navigation concept of weather routing, which refers to the practice of altering a ship's course to take maximum advantage of tidal, current and wind conditions to reduce physical resistance of the ship moving through water. I posit the concept of *climate routing*. As conceived, climate routing involves six measures – creating a transport resilience task force (i.e. creating a forum to discuss social response to severe weather), deliberating decentralization (i.e. countering a push to centralization of services such as education and health care), internalizing externalities (i.e. pricing fossil fuels to reflect the environmental costs of carbon emissions), planning for green and blue flows (i.e. incorporating natural processes such as forest regeneration and river hydrology into the built environment), rebranding redundancy (i.e. countering a push to streamline supply chains and services) and thinking flex (i.e. fostering a culture that accommodates disruptions and delays due to environmental forces) – where primary considerations are lessening social-ecological contention, increasing resilience, questioning mobility practices and maintaining or increasing quality of life (see Chapter 7: Navigating Transition).

Practical contribution

In terms of practical contributions, I find that in the aftermath of Hurricanes Juan and Igor, reinstatement of mobility was an uppermost priority with a dominant tension between the frame '*we've never seen anything like it*' and '*we need to get things back to normal as quickly as possible*.' I develop a list of measures used for managing mobility in the preparation, response, recovery and mitigation phases of disaster that emerged out of interview and document analysis, as well as compare the resiliencies and vulnerabilities of mobility webs in Nova Scotia and Newfoundland with reflections on future implications. For example, officials in both Nova Scotia and Newfoundland responded with a suite of short-term preparedness, response and recovery measures specific to mobility, including monitoring weather, reconnecting roads and increasing redundancies.

In the case of Nova Scotia, a key source of vulnerability in the context of Hurricane Juan was the entanglement of trees and power lines. Key sources of resilience include the cultural instinct to batten down the hatches, the adaptable role of transit and the coordination of emergency services. Residents successfully, if somewhat precariously, governed their own mobility (i.e. Bærenholdt (2013) on governmobility). Further, the experience of successive intentional (e.g. 9/11), technical (e.g. SwissAir crash 1998) and ecological (e.g. White Juan blizzard 2004) adversities fostered a culture of all-hazards disaster readiness. In the case of Newfoundland, a key source of vulnerability in the context of Hurricane Igor was the scale of road washouts combined with limited routes, modes (e.g. car, truck), fuel types and fuel storage. Key sources of resilience were coordination and cooperation between different levels of government, the private sector and community members demonstrating a high capacity to restore the road network to basic functionality within ten days and coordination between community members to cope in the interim.

Each jurisdiction embraced varying long-term responses. Nova Scotia, which experienced diverse extreme events leading up to and following Hurricane Juan, took the opportunity to reflect critically on disaster preparedness, climate change and mobility. By comparison, my analysis finds that while Newfoundland changed its approach to emergency preparedness, it adopted voluntary climate change measures and did not question the mobility status quo, skirting critical reflection on the implications of mobility disruptions in the context of severe weather.

Officials in both provinces advocated the frame '*stay at home and off the roads*' and provided regular updates on the status of infrastructure reconnections (electricity in Nova Scotia; roads in Newfoundland). In terms of the governance of mobility, a tension arises between what I term *charismatic mobility*, that is the compulsion of some to experience the approaching storm by travelling to coastal sites or viewing the aftermath of the storm in a form of disaster tourism, and strongly-worded advisories for immobility promoted by emergency management officials. Particularly in Nova Scotia, officials expressed frustration at residents who opted to venture out into the weather. By contrast, Newfoundland officials praised the resilience and initiative of community members in meeting their own needs, diverting attention from larger picture issues such as disaster preparedness, infrastructure design and maintenance, as well as climate change mitigation and adaptation.

Travelogue

Given my subject matter, I infuse my writing with a sense of the movement and precarity involved with both physical and academic journeys. To this end, I have opted for a travelogue format – a recording and telling of a journey. As Lockie states in the inaugural issue of *Environmental Sociology*:

> This is, of course, a journey without end. No matter how much effort has been expended attempting to apprehend the relationships between environment and society, there will always be gaps to be filled, unexpected problems to resolve, new travellers to welcome and fresh insights to consider. We have only begun to think through the implications of more ecologically sophisticated social theory for the practice of sociology more generally and, as environmental sociology develops, new challenges will emerge. (2015: 2)

This journey is both through time and space in the form of two case studies, or *ports of call*, of coastal regions impacted by Atlantic hurricanes. The journey is also intellectual, reflecting the process of expanding or charting spheres of knowledge. I start the journey with Canadian novelist Michael Ondatjee's inventory of African winds, the incubator of Atlantic hurricanes, including Juan and Igor. I begin each chapter with excerpts of poems by 'ocean biographer' Sue Goyette (1964-) who lives in Halifax and paintings by the

Nova Scotian realist artist Alex Colville (1920-2013) for whom the tension entailed in movement was a central theme. Select illustrative photos and figures from media sources are also included. These pieces echo and enrich the academic writing, providing an auditory and visual dimension to the travelogue. The poems, paintings and text work in concert to convey the research findings.

The dissertation is organized to echo a sea voyage. We have already ‘Set Sail’ in this the Introduction. In ‘View from the Crow’s Nest: Literature Review,’ I provide a bird’s eye view of the academic literature. In ‘Charting Course: Methods,’ I justify the research methods selected. Moving from these foundational chapters, I detail the research findings. In the two Ports of Call, I detail the mobility webs for each storm-impacted region and give an example of the *eco*politics of mobility entailed therein, before I explore the responses and frames used in each hurricane event as they pertain to mobility. Moving in chronological order, the first ‘Port of Call: Results’ is Hurricane Juan, characterized by extensive tree falls that blocked roads. The second ‘Port of Call: Results’ is Hurricane Igor, characterized by extensive flooding and road washouts. Material related to Hurricane Juan was previously published in *Between the Issues* (Sodero 2014a). Material related to Hurricane Igor was previously published in the *Newfoundland Quarterly* (Sodero 2014b) and *Environmental Sociology* (Sodero and Stoddart 2015).

In ‘Zone of Imperfect Visibility: Analysis,’ I compare responses and frames, examining the theoretical insights and applied lessons that are yielded in terms of the social-ecological resilience of mobility webs in a changing climate. I summarize best practices, as well as elaborate on mobility webs and an ecopolitics of mobility as useful reconceptualizations of the social-ecological power dynamics expressed in mobility webs.

In ‘Navigating Transition: Conclusion,’ I reflect on my methodological and analytical approaches, and detail climate routing as a conceptual way forward.

Captain

Given my literary orientation, this positions me as captain. My background as a researcher provides important context in terms of both my interest in, and entry points to, this topic. The seed for this research was planted in 2003 when I was an intern for UNICEF in Central Asia. During the course of six months overseas I heard only two references to Canada on the television news media; both related to severe weather events that caused states of emergency to be declared in Halifax: Hurricane Juan (September 2003) and a blizzard dubbed White Juan (February 2004). The fact that I had travelled around the world to help others when my own community was in need of assistance made an impression. Upon my return, I saw how Hurricane Juan devastated (but also rejuvenated via disturbance ecology) Point Pleasant Park, an expansive green space in my neighbourhood. The impact of severe weather was literally starting to hit home. Years later, walking to work daily along the waterfront I gained familiarity with the tidal range and harbour dynamics – some days the tide was almost high enough to top substantial wharves. The vulnerability of Halifax’s downtown coastal infrastructure, where I enjoy the Farmers’ Market, the *Al Fresco Film Festo*, restaurant patios and an expanse of bikeable boardwalk, became increasingly apparent. Notably, I did not directly experience either of the hurricanes that are the focus of this research.

My academic and professional work also informed this project. As a Master of Environmental Studies student (MES Dalhousie 2001), I studied Transportation Demand

Management, which employs a suite of infrastructural, financial and behavioural incentives and disincentives to curb transport demand and decrease related emissions and infrastructure investments. I later worked for the Ecology Action Centre, one of Nova Scotia's most prolific environmental organizations, where I advocated for sustainable transportation, including the implementation of university and workplace transit pass pilot projects. Through the Ecology Action Centre, colleagues and I conceived of and developed a small-scale transportation infrastructure grant program funded by Conserve Nova Scotia. In its first of four years, nine projects across Nova Scotia were funded.

I also worked closely with a colleague to develop a comprehensive *Green Mobility Strategy*. We conducted dynamic and interactive public and stakeholder consultation sessions in eight urban and rural communities. Our goal was to work with community members to learn about their transportation needs and vision, as well as to identify opportunities to decrease environmental degradation and increase accessibility. The *Green Mobility Strategy* was launched in 2008 and informed the *Nova Scotia Sustainable Transportation Strategy* (2013), one of the documents included in the policy review for this project. I know a number of individuals who participated in interviews for the Nova Scotian case study component of this project due to past professional engagement.

After working at the Ecology Action Centre, I researched the development of British Columbia's carbon tax with a focus on the transport sector (MSc Oxford 2010). Having worked in the nexus of climate change and transport from a mitigation standpoint, including both incentives and disincentives, it was a natural progression to study how transport networks are impacted by, and respond to, climate change. Therefore I embarked on this journey with a firm grounding in transport and climate policy, and immersing myself in the mobilities and disaster literatures.

2 VIEW FROM THE CROW'S NEST: LITERATURE REVIEW

We woke one morning and the ocean was gone. Some of us
were relieved. Who can blame it if it had been our audience?

We kept forgetting our lines and driving into the props.
If we were the audience then its dramatic monologue was going on

forever. It was either all plot or all character. Setting,
if you were a landscape artist. You can see how difficult

a relationship it was. We'd never met anything so stoic.
Decisive yet meandering.

Sue Goyette
Fifty-two
2013

Alex Colville
Family and Rainstorm
1955

In the poem the ocean is gone – "turns up missing" to borrow Latour's (2004) phrase – frustrated by its inept human audience. In the painting the family leaves, a day at the beach ended by an approaching storm. Traditionally, sociology turned its back on ecological considerations causing Beck (2015) to ask: "How can we reinvent sociology for the 21st century?"

Introduction

In this leg of the journey, I explore how social-ecological dynamics are treated in the literature. By combining the mobilities and disaster literatures I developed an ecopolitical approach to mobility. First, I survey the conceptual and empirical literatures, starting with sustainable mobility and resilience as pragmatic concepts. Second, I draw on the mobilities paradigm including governmentality and circulation as theoretical approaches to mobility. Third, I examine disaster sociology and reflexive modernization as theorizations of disaster risk in tightly coupled social, technical and ecological systems. I conclude with a discussion of theoretical fits and tensions between these complementary, but diverse, literatures.

Sustainable mobility

What constitutes sustainable mobility and how such a desired state can be achieved, are central questions addressed by the interdisciplinary field of transport studies. The literature focuses predominantly on how to mitigate greenhouse gas emissions (i.e. decarbonization) (Schwanen, Banister and Anable 2011). More recently (i.e. since 2011), there has been a growing emphasis in the literature on climate change adaptation, transport and infrastructure resilience and the intersection between transport and disaster. Transport studies, as it relates to climate change, tends to be technically oriented and focuses on five main areas: technology uptake and diffusion, economic instruments, transportation infrastructure and land use planning, behaviour change and policy (Schwanen, Banister and Anable 2011). There is a predominant emphasis on "physical infrastructure, price and technology and extensive reliance on forecasting models" (Schwanen, Banister and Anable 2011: 999). The literature is "vibrant and varied, exploring multiple pathways in which carbon use can be reduced" (Schwanen, Banister and Anable 2011: 996). Morency (2015) discusses the challenge of evaluating the sustainability of mobility systems, including the number and weighting of numerous indicators (i.e. an overemphasis on carbon emissions), data availability issues and lack of understanding of causal chains. It is generally recognized that decarbonization "can only be achieved (if at all)" through the implementation of multiple and diverse interventions (Schwanen, Banister and Anable 2011: 996). Less prevalent, and key gaps I address through my research, is the circular relationship between transport and climate change, as experienced through disruptive severe weather events, as well as critical reflection on the centrality of mobility to contemporary society.

Schwanen, Banister and Anable call for greater engagement with the social sciences:

> Techno-economic and psychological thinking provides compelling insights into transport's decarbonisation. Yet, like all scientific perspectives, techno-economic and psychological approaches are inevitably partial; they articulate the objects of knowledge/government in particular ways, expelling certain of their facets into invisibility. Examples of sidelined facets include the societal embedding of new transport technologies, the inherent uncertainty and novelty of new technologies and such economic instruments as PCT [personal carbon trading] insert into travel behaviours, the semi-conscious more-than-rational dimensions of those behaviours, and the *non-linear and catastrophic dimensions of climate change*. (emphasis added) (2011:1002)

Even the examples cited are strongly anchored within technical, economic and psychological concerns. It is the last point, the “non-linear and catastrophic dimensions of climate change,” that is the greatest departure in terms of the current sustainable mobility research agenda and the starting point for my research.

Schwanen, Banister and Anable (2011) argue for a pluralism of theoretical and methodological approaches, observing that different perspectives trigger different questions. They posit that the social sciences are more suited to answer questions such as:

- What is the kind of world that we would like to live in and find desirable and how should mobility be configured in that world?...
- Will business models in manufacturing and leisure/tourism based on current global production chains and aviation networks remain feasible?
- Is mobility in principle a right to which people are entitled? (2011: 1004).

Bringing to the fore severe weather events of the type anticipated under a changing climate, my research uses a social science perspective to analyze social, ecological and technical disruption and transition. A socio-technical transition is a

> major shift or step change, in which an existing socio-technical system – a cluster of aligned elements including technology, regulations, consumer practices, cultural meanings, markets, infrastructure, scientific knowledge, supply and maintenance networks – is *durably reconfigured* (emphasis added) (Schwanen, Banister and Anable 2011:1003).

While Schwanen, Banister and Anable (2011) focus on the example of the innovation, adoption and diffusion of electric vehicle technology, I focus on the ecological phenomena of severe weather events.[21] Further, my use of a case study approach with a focus on societal responses and frames complements the model-oriented field of transport studies (Schwanen, Banister and Anable 2011).

My research builds on contrasting approaches to transport planning (Table 2.1). In the 20th century, transport planning focused on roads and cars, on engineering and economics. In recent decades, a gradual (and far from fully realized) shift towards sustainable mobility gained momentum. Sustainable mobility humanizes traditional approaches to transport planning, incorporating social dimensions of transport decisions (e.g. liveability).

To this, based on my empirical case study research, I add my own iteration: an *eco*political approach to mobility. This approach more consciously accommodates and integrates ecological circulations and flows. For example, in traffic planning, a street is viewed one-dimensionally as a road for car use; under sustainable mobility a street is viewed as a space with potential to be liveable and vibrant (see Appleyard 1969); while under an ecopolitical approach to mobility, the street is viewed as a component of an ecological system, including urban forests and hydrology. Likewise, in terms of velocity, traffic planning focuses on facilitating flows of car traffic; sustainable mobility focuses on slowing movement down (e.g. traffic calming); while an ecopolitical approach to mobility accommodates both fast (e.g. storm surge) and slow (e.g. sea level rise) ecological processes. Based on my case studies, I forward an ecopolitical approach to mobility as the next iteration of transport planning.

[21] With the recent emergence of UAVs (unmanned aerial vehicles or drones), driverless cars and trucks, ride sharing services (e.g. Uber), the transport sector is rapidly innovating.

Table 2.1: Contrasting approaches to transport planning
(Adapted from Banister 2008 and Marshall 2001)

TRAFFIC PLANNING (MARSHALL 2001)	SUSTAINABLE MOBILITY (BANISTER 2008)	ECOPOLITICS OF MOBILITY (SODERO 2016)
Physical dimensions	Social dimensions	Ecological, social and physical dimensions
Mobility	Accessibility	Human accessibility and non-human mobility
Traffic/ car focus	People focus, either in (or on) a vehicle or on foot	People as part of larger ecosystem
Large scale	Local scale	Interscalar
Street as road	Street as space	Street as ecological corridor
Motorized transport	All transport modes in carbon-intensity hierarchy	Ecological flows included within considerations of all modes of human mobility
Forecasting traffic	Visioning cities	Transforming social-ecological relationship
Modelling	Developing scenarios and modelling	Imagining futures (e.g. utopian, dystopian)
Evaluating economic criteria	Analyzing multiple criteria, including environmental and social	Analyzing multiple criteria, including environmental (e.g. carbon budgeting), social, safety (e.g. disaster relief), economic (e.g. infrastructure maintenance)
Travelling as derived demand	Travelling as derived demand as well as a valued activity	Travelling as derived demand, valued (in)activity and environmentally contingent
Demand-based	Management-based	Ecologically-constrained
Speeding up traffic	Slowing down movement	Accommodating fast and slow social, ecological and technical movements (e.g. tipping points, turbulence)
Minimizing travel time	Aiming for reasonable travel times and travel time reliability	Recognizing timeless time including "longue durée" or "glacial time (Castells 2009)
Segregating people and traffic	Integrating people and traffic	Incorporating ecological flows and turbulences with flows of people and traffic

Resilience

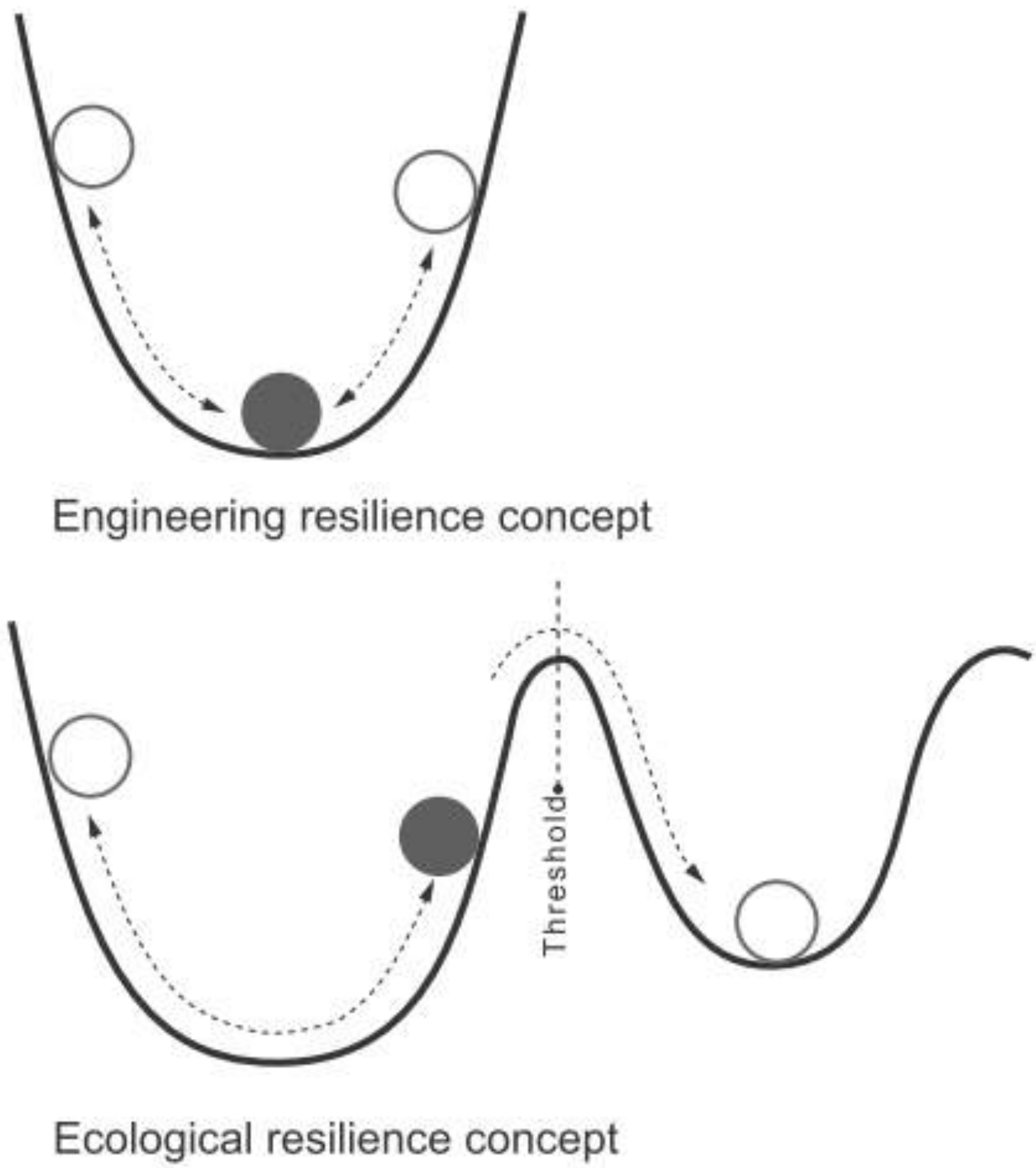
Resilience is a burgeoning literature. There are numerous resilience typologies, from individual/psychological (e.g. Ungar 2015) and community (e.g. Fleming 2014), from material (Meza et al. 2015) to climate (Adger et al. 2011). I focus on just three strands: social-ecological systems theory, transport resilience and infrastructure resilience. Social-ecological systems theory originates from ecology (see Holling 1973), while transport and infrastructure resilience are newly emergent applied fields. In combination, they provide a suite of concepts valuable in articulating ecologically contingent mobility webs.

Social-ecological systems

Social-ecological systems theory emphasizes the inextricable links and reciprocal impacts between social and ecological systems, highlighting the potential for adaptive and transformative change (Folke et al. 2010; Folke, Colding and Berkes 2003). The social-ecological systems literature examines how relationships between the human and the non-human environment contribute to, or undermine, social-ecological resilience (Folke et al. 2010). Social-ecological systems are defined as having three trajectories: resilience, adaptability and transformability. Resilience in this context refers to returning to a normal state as quickly as possible, that is, getting things back to normal or bouncing back (Holling 1996). The term transport resilience, as employed by the Canadian and British governments, constitutes a combination of passive and adaptive resilience. Similarly, in the case of the Icelandic ash cloud there was a strong discursive push to ‘get Europe moving’ (Budd et al. 2011). The term basin of attraction is used to describe the rigidity or propensity of systems to remain or return to the status quo (Figure 2.1).

Adaptability and transformability refer to leveraging the disruption caused by an event as an opportunity to implement systemic changes that reflect a greater consideration of ecological limits (i.e. ecological resilience; bouncing back *even better*). Adaptability occurs within the dominant paradigm or development trajectory, while transformability shifts to a new paradigm or development trajectory (Adger et al. 2011; Folke et al. 2010). The latter aligns with the *mobilities transition*, a term used in the mobilities literature to describe efforts to shift to post-carbon (i.e. decarbonized) mobility systems (Caletrio 2015). Social-ecological systems theory focuses on understanding social-ecological dynamics as well as exploring the potential for adaptive and transformative change in the relationship between the human and non-human environment (Frantzeskaki et al. 2010). Extreme weather events, such as hurricanes, provide windows of opportunity to "navigate social-ecological transitions," such as switching from high carbon to low carbon development trajectories (Folke et al. 2010: 20).

Figure 2.1: Visualization of passive (engineering) versus transformative (ecological) resilience (The Royal Society 2015)



There are numerous, albeit similar, definitions of resilience in academia and beyond. The Stockholm Resilience Centre uses an accessible and descriptive definition:

> The capacity of a system be it a landscape, a coastal area or a city – to deal with change and continue to develop. This means the capacity to withstand shocks and disturbances such as a financial crisis or use such an event to catalyse renewal and innovation. (No date: 3)

The American National Academy of Sciences succinctly defines resilience as “the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events” (2012: 1). The Intergovernmental Panel on Climate Change elaborates upon this definition, referencing the anticipation of such events, timely recovery and the possibility of improving services:

> The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic services. (2012a)

(see Binder et al. (2013) and Cutter et al. (2008) for comparisons of resilience frameworks).

In general public discourse, resilience is defined as bouncing back or bouncing back even better. For the purposes of this research, I define resilience as *the capacity of stakeholders of an integrated human-environment system, such as a mobility web, to anticipate, prepare for, respond to, recover from and improve upon quality of life in the face of an adverse event*. This definition includes the specificity of the Stockholm Resilience Centre’s definition, as well as the variety of instructive verbs included in the definitions of the American National Academy of Sciences and Intergovernmental Panel on Climate Change. I opted, however, to exclude references to ‘timely and efficient recovery,’ as though while important, they occur in the Hurricane Juan and Igor case studies as characteristic of passive resilience rather than transformation.

Social-ecological systems theory holds that experimentation and intervention at all scales can have knock-on effects that precipitate adaptive and transformational change in support of resilience on broader scales (Folke et al. 2010, see Gunderson and Holling 2002 on panarchy). As linear prediction models become less viable under changing climatic conditions, a dynamic approach may foster heterogeneous resilience initiatives. Such adaptation and transformation can be proactive or forced upon a community, but in either case may be hindered by social constraints such as habits, identities, values, power dynamics or budgets (Brand and Jax 2007). Central to my research is exploring the extent to which the experience of a hurricane was viewed, and pursued as an opportunity to initiate change.

In opposition to notions of equilibrium in both social and ecological systems, social-ecological systems theory recognizes and incorporates the “cycles of organization, collapse, and renewal” (Ommer 2007: 14). Such cycles may include emergent trends, abrupt changes, tipping points and regime shifts (Brand and Jax 2007). The “interplay of disturbance and organization” – or flow and turbulence – are central to social-ecological systems theory (Brand and Jax 2007: 27).

Highly optimized tolerance refers to a system that is resilient in the face of certain types of disturbances (e.g. snow storms), but are rendered vulnerable by infrequent (albeit increasing) disturbances (e.g. ice storms) (Folke et al. 2010). Jensen refers to the “experience of difference between ‘normal use’ and an ‘abnormal situation’” (2011: 70), while Brown describes the risk that a “narrow focus of optimizing the various parts of complex systems may undermine the sustainability of the whole” (2014: 2).

Dynamics, uncertainty and variability underpin social-ecological systems theory, making it amenable to the issue of climate change generally and hurricanes specifically. The global climate is complex. Confounding factors such as anthropogenic climate change and the related cascade of positive feedback effects contribute further complications. Likewise, hurricanes are variable in terms of frequency, intensity and storm track, and the impacts of climate change on hurricane activity is unclear, fostering uncertainty for decision-makers and community members alike (Intergovernmental Panel on Climate Change 2012a).

Social-ecological systems theory focuses on local resilience initiatives that draw on the experience and expertise of the local community, government and ecologists (Folke et al. 2003). Adger et al. (2005) assess resilience in the context of coastal disasters, arguing that participation from multiple levels of government is critical. Adger explores the complexities entailed in trying to actualize an ecological resilience approach. For example, Adger et al. (2011) through an assessment of nine climate change initiatives (e.g. biofuel production) find substantial variability in the effectiveness of such interventions on overall social-ecological resilience (e.g. industrial-scale biofuel production compromises resilience).

In a study of social-ecological practices in response to climate change in an Inuvialuit community in northern Canada, Berkes and Jolly (2002) identify two types of transitions undertaken by community members: short-term coping mechanisms, such as changing where and when they hunt, and longer-term cultural and ecological adaptation, such as diversifying hunting practices and adapting food sharing customs. From a policy perspective, Ommer (2007) uses a social-ecological health approach to study the social and ecological stress that results from economic restructuring in rural coastal communities in Newfoundland and British Columbia. Adopting a comparative historical lens, Ommer examines how policies in different sectors and at different scales intersect to either enhance or undermine resilience. Mobility is an underexamined dynamic of both of these studies: hunting-related movement in the former case and work-related migration in the latter case.

One of the main critiques of the resilience framework is its insufficient treatment of social power. Davidson (2010), for example, questions the comparability of social and ecological systems due to the differentiating factor of human agency. Such critiques are also raised in terms of Latour’s Actor-Network Theory, which assigns symmetry to human and non-human actants. Latour’s work is akin to resilience theory in that ecological dynamics emerge from the background (see Latour (1996) on the failed personal rapid transit system Aramis). Such strongly ecological and material approaches, I argue, shed light upon processes of social power, as well as social vulnerability. Despite these concerns about the applicability of resilience theory in terms of social contexts (see Davidson 2012, 2010; Weichselgartner and Kelman 2014), the intersection of climate change, hurricanes and mobility provides a ripe opportunity to further elaborate social-ecological systems theory.

Transport resilience

What does resilience look like in the face of two intersecting trends that help define the contemporary era: the increase in severe weather events and the intensification of mobility in our daily lives? Transport resilience is an emerging field. By briefly profiling applied work underway in Canada and the United Kingdom, I highlight how, from a Foucauldian perspective, the dominant approach to transport resilience is ensuring the continuation of circulation. While important, I enlarge such conversations, questioning assumptions of our societal reliance on fossil-fuel intensive circulation to meet basic needs.

Transport Canada is broaching the topic of resilience within the context of climate change. A nation-wide assessment of risks and adaptation practices in the transport sector is being developed, with an anticipated publication date of March 2016, organized by region and with a chapter dedicated to urban issues (Transport Canada 2015). Given the rapidly changing climatic conditions in the Arctic, there is a Northern Transportation Adaptation Initiative that focuses on melting permafrost and increases in navigable water, as well as assessment of three northern airports “to identify those components of the specified airport infrastructure that are/may be at risk of failure, damage, loss of service and/or deterioration from extreme climatic events” (Transport Canada 2015). [22] Simultaneous efforts to mitigate the impacts of climate change on transport, as well as efforts to leverage environmental changes (i.e. increasing navigable waters) to enable greater fossil-fueled mobility are evidenced.

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[22] Climate change impacts are exacerbated in polar regions.

More broadly, the Economic Analysis group studies supply chain disruptions in terms of labour, global supply, capacity and demand, while the Marine Security Group addresses the issue of transport resilience by, for instance, promoting the development of regional marine commerce resilience plans (the Canadian marine sector generates approximately $10 billion per year). These are examples of supply chain resilience, a counterpart of transport resilience that has an even greater economic emphasis: "contemporary efforts to protect supply chains invest logistical systems with biological imperatives to flow and prescribe "resilience" as a means of sustaining not only human life but the system itself" (Cowen 2014: 3).

Foucault, too, acknowledges this self-fulfilling or self-propelling nature of circulation:

> By 'circulation' we should understand not only this material network [e.g. of roads, rivers, and canals] that allows the circulation of goods and possibly of men, but also the circulation itself, that is to say, the set of regulations, constraints, and limits, or the facilities and encouragements that will allow the circulation of men and things in the kingdom and possibly beyond its borders. (2007: 235)

Current transport resilience work focuses on the maintenance of circulation, a practice that, on one hand, directly responds to extreme weather and changing environments that result from climate change, and on the other hand, appears divorced from the contribution of the transport sector to climate change. Transport resilience as currently framed is insufficient in the context of anthropogenic climate change.

The focus of transport resilience on minimizing economic disruption is not limited to Canada. In response to a series of flooding events in the winter of 2013/14, the United

Kingdom (2014) developed a comprehensive analysis of transport resilience which explores vulnerabilities by mode: national highways, local roads, rail, marine and ports. The report defines resilience as “the ability of the transport network to withstand the impacts of extreme weather, to operate in the face of such weather and to recover promptly from its effects” (2014: 8). The authors identify three components of resilience: physical, organizational and communicative:

> It is about increasing the physical resilience of transport systems to extreme weather, so when extreme weather is experienced, people and goods can continue to move. It would be both very difficult and prohibitively expensive to ensure total physical resilience, so secondly it is equally about ensuring processes and procedures to restore services and routes to normal as quickly as possible…. Thirdly, as part of this, it is essential to ensure clear and effective communications to passengers and transport users so that the impact of disruption on people and businesses is minimised. (2014: 8-9)

The guiding analysis centres on minimizing disruption to the economic system in the face of growing transport demand. To this end, the report identifies a series of short-term measures to be implemented in 2014/15 (e.g. raising track height; flood-proofing electrical equipment; testing communication plans), as well as longer-term measures (e.g. developing Asset Management Plans; identifying a priority critical transport network; improving the granularity of weather forecasting). While such efforts are laudable, they are framed in isolation, distinct from complementary efforts to mitigate both emissions and transport demand.

Atun (2014) frames ‘transport resilience’ in a more satisfying fashion, titling her book: *Improving Societal Resilience to Disaster: A Case Study of London’s Transportation System*. Through this framing, societal resilience, rather than transport resilience, arises as the goal. Transport is one sector through which larger social resilience can be achieved. Therefore, what emerges are two interdependent fields: transport resilience which focuses on the functionality of transport systems and social resilience which focuses on the functioning of society. In term of mobility webs, transport resilience pertains to improvisations and adaptations within the web, while societal resilience questions the extent and flexibility of the web, examining options for making nodes within the web more robust and self-sufficient. My research builds on these preliminary efforts in transport resilience, particularly infrastructural and informational resilience practices, questioning the mobility status quo in a time of anthropogenic climate change. Rather than focusing on maintaining carbon intensive mobility webs, how can we mitigate their climatological impact (Cowen 2014)? How can extensive mobility webs be decarbonized?

Infrastructure resilience

Transport resilience is closely related to the field of infrastructure resilience. Brown (2014) describes the concept of *next generation infrastructure.* Such an approach views infrastructure systems as tightly coupled with each other (e.g. electricity systems and road networks), as well as tightly coupled with ecological processes and, by extension, potential environmental harms. In the past, in line with conventional approaches to transport planning,

> the designers of industrial infrastructure presumed an inexhaustible supply of cheap energy, the efficacy of simple and single-purpose solutions to complex problems, and the necessity of brute-force mastery of nature, all executed with bullet proof confidence in endless economic growth on an finite planet. (Orr in Brown 2014: xi).

Next generation infrastructure, in line with sustainable mobility and ecopolitics of mobility (Table 2.2), aims to work with, rather than dominate, ecological systems. The *next generation infrastructure* approach is closely related to the field of green infrastructure and eco-DRR (ecological disaster risk reduction), which embrace the use of ecological methods (e.g. restoring wetlands as storm buffers, planting trees to absorb urban stormwater) in contrast to hard, infrastructural approaches (United Nations Environment Program 2013).[23]

Brown argues for decoupling critical infrastructure (e.g. transport, water, power) from both “carbon-intensive and ecologically harmful technologies” (2014: 3). Rather than avoiding or denying ecological processes, *next generation infrastructure* practitioners asks, “how can we capitalize on the connectedness of our critical systems to nature and to each other?” (2014: 7). Following environmentalist Wendell Berry, proponents ask: “What will nature let us do here? What will nature help us do here?” (Orr in Brown 2014: xii). The result can be infrastructure that is both more resilient to climate change, as well as more cost-effective. In a similar vein, Zimmerman (2012) advocates

[23] See also the Environmental Commissioner of Ontario (2014) for a discussion of infrastructure resilience and climate readiness, with an emphasis on stormwater management. Nova Scotia’s Clean Foundation and the Insurance Bureau of Canada are examples of other organization that have stormwater management pilot projects. Nova Scotia’s Ecology Action Centre (2015) has a Living Shorelines projects which promotes and pilots ecological approaches to coastal erosion.

for the simultaneous consideration of transport, environment and security (including terrorism and natural hazards), leveraging synergies between these matters of concern.

By advocating for a "self-conscious" approach to infrastructure design, Brown practices a reflexive and emancipatory approach to resilience (Beck 1992). Brown identifies five guiding principles to reimagine society's approach to infrastructure:

1. Systems should be multipurpose, interconnected, and synergistic.
2. Infrastructure should contribute few or no carbon emissions.
3. Infrastructure should work with natural processes.
4. Infrastructure should improve social contexts and serve local constituencies.
5. Infrastructure should be resilient and adapt to predicted changes brought along by an unstable climate. (2014: 11)

Brown raises the possibility of a "future-proof" public works that will withstand climate change impacts (2014: 12), contrasting with Urry's (2008) dystopian scenarios based on resource scarcity (see page 59).

Examples of next generation infrastructure exist in the transport sector. For example, Brown (2014) describes a 10-kilometre traffic tunnel in Kuala Lumpur, Malaysia. The majority of the time the tunnel is a major transport route, diverting traffic from the city centre and reducing travel time and related emissions. However, as needed, the tunnel serves as a stormwater retention facility diverting up to 90 per cent of water during severe rainfall events. By using one site for dual infrastructure purposes (i.e. co-location), two infrastructure services (e.g. transport, stormwater management) are tightly coupled. The project was recognized by the United Nations for its intelligent approach to multiple urban design challenges (Brown 2014). Similar examples exist, such as underground parking facilities in the Netherlands and public parks in Brazil that double as flood reservoirs (State of New York 2013). Brown also cites intermodal connectivity supported by integrated passenger and transit hubs as another example of coupled infrastructure (e.g. a terminal that connects rail, truck and air freight transport).

Such projects have merit, however they do not fundamentally question the role of mobility in society. Brown acknowledges the need to manage transport demand: “emphasiz[ing] proximity so that supply chains are mostly local or regional.” Instead examples such as those provided from Malaysia and the Netherlands focus on infrastructure, often mega projects (Orr in Brown 2014: xii). This echoes a “predict-and-provide” tendency in transport studies that emphasizes infrastructure provision (Schwanen, Banister and Anable 2011: 997). The projects Brown profiles aim to accommodate existing mobility demand in a more environmentally sensitive manner.

Further, while there are examples of *next generation infrastructure*, a “policy and development framework” to systematically adapt and transform infrastructure design is lacking (2014: 3). In response to Hurricane Sandy, the State of New York (2013) developed a toolkit profiling 18 community resilience measures implemented globally. Though not specific to infrastructure nor transport, it provides seven focal areas for resilience: conserve, enhance, restore natural protective features; resilient construction; structural defences; land use planning and regulation; market-based methods; awareness, information and preparedness; and systemic resilience (Table 2.2). In Chapter 7: Navigating Transition, I build on this frame to develop the concept of climate routing, which questions societal reliance on mobility.

Table 2.2: Categories of community resilience measures (State of New York 2013)

MANAGEMENT MEASURE	DESCRIPTION	SUB-CATEGORY
1. Conserve, enhance, restore natural protective features	Use the landscape to promote safety and liveability by preserving and expanding natural protective features for their capacity to reduce hazardous impacts and increase capacity to absorb impacts	- Beach protection - Wetland restoration - Vegetation use and management - River protection
2. Resilient construction	Use construction techniques and technologies to provide an enhanced level of safety for structures and occupants	- Elevation, change in design, inputs, etc. for homes and infrastructure - Use of standards to regulate construction
3. Structural defenses	Use structural defenses to resist hazardous impacts by reducing and eliminating exposure to hazard	- Engineered defenses (e.g. levees, storm surge barriers, sea gates, flood walls, revetments) - Natural defenses (e.g. barrier islands and reefs, dunes)
4. Land use planning and regulation	Use land use management approaches to reduce exposure to hazards by removing assets and increase resilience through regulatory requirements	- Development rights - Zoning - Development activities (e.g. green belts) - Relocation of assets and infrastructure
5. Market-based methods	Use market-based methods as incentives to promote and encourage activities that increase resilience and reduce vulnerability	- Incentives (e.g. taxes, fees, subsidies) - Buyout of assets or infrastructure n exposed areas - Insurance programs
6. Awareness, information and preparedness	Use education and outreach materials to better prepare citizens and businesses on potential risks, emergency responses, community preparedness, etc.	- Education and training - Community preparedness - Emergency-response systems and capacities - Vulnerable populations
7. Systemic resilience	Use methods that increase the overall strength of the community and supporting systems by lowering the extent of damage a single event has and increasing the ability to respond	- Redundancies and backups - Information to enable learning and foresight

Mobilities paradigm

The mobilities paradigm examines the importance of mobility and immobility to contemporary society, exploring intersections of people, goods, machines, information and communication technologies, as well as non-material entities such as ideas and images. The mobilities paradigm lies at an interdisciplinary crossroads, incorporating social analysis of power, geographical analysis of space, cultural analysis of discourse and technological analysis of materials: "tracking the power of discourses, practices and infrastructures of mobility in creating the effects of both movement and stasis" (Sheller 2011: 2).

Sheller and Urry (2006) forwarded the mobilities paradigm to explore the interaction of social and spatial dynamics, animating a sedentary social science that tended to overlook the role of mobility.[24] Or, as put more colourfully by Cowen: "interrogating the radically undervalorized role of movement and circulation in everyday life." The mobilities paradigm analyzes flows and blockages of people, materials and information – with power as a central consideration. In their agenda-setting editorial, Hannam, Sheller and Urry (2006) mention global warming, hurricanes and oil wars as potential research trajectories. However, while events such as Hurricane Katrina and the Icelandic ash cloud are research lightening rods, overall the link between mobility, disaster and climate change is undertheorized. In a tenth anniversary editorial on the mobilities paradigm, Schwanen et al. (2011) call for greater engagement of the social sciences with the mobilities literature, including the non-linear and catastrophic

[24] See Cresswell (2010) for examples of historical treatments of mobility, though he argues these tended to focus on place rather than movement per say.

dimensions of climate change. The mobilities paradigm, as with the politics of mobility, is a versatile concept that is applied in myriad ways, including migration, commuting and tourism. The focus can range from the dynamics of international migratory law to detailed ethnographic work on the lived experience of mobility. The intersection of mobility and disaster is a small but growing segment of the literature (see below on 'Geomorphic/biospheric disaster and mobility'). My research begins to address this gap.

Sheller (2011) is careful to distinguish the mobilities paradigm from metaphors of flow, such as Bauman's discussion of liquid modernity where individuals experience continually shifting economic, geographic and personal conditions, and Castells' spaces of flow where social connectedness is permitted via flows of technology rather than physical proximity. This is in part to avoid totalizing narratives and in part to allow space for the blockages that are viewed as an intrinsic and integral component of pervasive movement; the mobilities paradigm is "concerned with frictions, turbulence, immobility, dwelling, pauses and stillness, as much as speed or flow, and examines how these textured rhythms are produced, practiced and represented" (Sheller 2011: 3).

Urry (2007) elaborates on the co-dependence of flows and fixities, or mobilities and moorings.[25] Trans-Atlantic air travel, for example, requires a fixed web of airports, air traffic controllers and customs officials. Further, the mobilities paradigm interrogates a grey area where mobility systems or regimes teeter between entrenchment and evolution, between full functioning and operational shutdown (Sheller 2011). A hurricane can

[25] Mooring is a nautical term referring to means of holding boats or buoys in place (e.g. anchors, ropes, chains).

transform a bustling mobility web operating at full capacity to system-wide stoppage in the course of hours.

I ground the mobilities paradigm within a flow and turbulence analysis – an approach that complements Foucault's (2007) focus on the circulation and governance of societies and ecologies. While Foucault does not address issues of mobility specifically, he applies the lens of circulation to a variety of phenomena: "circulation of ideas, of wills, and of orders, and also commercial circulation … fastening them together and mutually reinforcing them" in an assemblage (Foucault 2007: 15). Foucault's theorization of circulation provides an alternative to the mobility/immobility dichotomy. Rather circulations, as with pulsations of blood through veins, may be strong or weak (Salter 2013).

Further, a flow analysis expands Marx's conception of circulation, whereby the mechanisms of capitalism are always in process and in motion; "when circulation stops, value disappears and the whole system comes tumbling down" (Harvey 2010: 12). Take as an example, the continent-wide circulation of oil and gas via networks of pipelines, ships, refineries and gas pumps, and the concomitant flow of greenhouse gas emissions from the wellhead to the tail pipe to the atmosphere. These flows are entrenched and precarious, both technologically economically and ecologically (Hesse 2013; (Sassen 2014).

Economic and material flows parallel and entwine with global ecological cycles characterized by flows of energy, nutrients and water, as well as pollution. Ingold reflects on the nature of wind: "Almost always, it is in a state of flux. Sometimes these fluxes are barely perceptible; at other times they are so strong they can uproot trees and bring down buildings. They can power mills and send ships around the world" (2007: S28). Climate change, and other contemporary environmental issues, such as biodiversity loss, ocean plastics and electronic waste disposal epitomize such global transboundary networks (Giddens 2003). Beck refers to "new maps of the world where the key lines are not traditional boundaries between nation-states and social classes, but rather elevation above sea - a whole different way of conceptualizing the world and the 'life' chances, the chances of survival within it" (2015: 76). Salter's (2013) analysis of how surveillance is used to both facilitate and police circulation post-9/11 helps theorize a form of ecological surveillance, whereby through meteorological data collection and climatological projections (e.g. downscaling of global projections to local communities to aid in infrastructure planning), data at increasingly finer grains is desired to provide a sense of security through knowledge in the context of a changing climate and extreme weather events.

Flows, and concomitant turbulences, can be both material (e.g. freight) and structural (e.g. policy networks) in nature, with each co-constructing the other (Spaargaren, Mol and Bruyninckx 2006). The nature of this co-construction is fluid, both metaphorically and, as in the case of hurricanes, literally. I draw on Cresswell and Martin's (2012) turbulence analysis, which is apt for atmospheric and oceanic disturbances characteristic of hurricanes. Turbulence is useful for capturing the intertwining and co-constituted circulations and blockages of social and ecological movement, and particularly the power dynamics therein. Turbulence exposes the inner workings of often smoothly or correctly functioning mobility webs. Cresswell and Martin use the example of the *MSC Napoli* container ship, which broke open off the coast of

England, to argue that turbulence is an integral component of mobility, critical to exposing the inner working of seemingly effortless, or at least unobserved processes, and sparking creative re-orderings. They conclude that “to some, turbulence is a threat and to others an opportunity” (2012: 518). Emancipatory catastrophism falls into the latter category.

The closer one looks, the more order and disorder are co-present. For example, “the internal operation of a hurricane may be seen as illustrative of spontaneous, emergent order, whereas the external consequences (environmental destruction, loss of property, human life, etc.) are clearly disorderly” (Cresswell and Martin 2013: 519). Following the break-up of the *MSC Napoli*, two assessment reports recognized “systemic failings [but] still promote a worldview premised on the potential for smooth laminar flow, and stabilisation,” reflecting a transport resilience emphasis on minimizing economic disruption (Cresswell and Martin 2012: 525). Through my research, I find that under a changing climate, there is need for greater expectation and accommodation of turbulence in the movement of people, goods and services. A paradigmatic shift where smooth mobility is considered the exception and turbulence the rule may be a warranted recalibration of expectations.

There are various elaborations of the mobilities paradigm. Elliott and Urry, for example, outline a global *mobility complex* characterized by speed and integration:

> the contemporary scale of movement around the world; the diversity of especially fast mobility systems now in play; the especial significance of the self-expanding automobility system and its risks; the elaborate interconnections between physical movement and communications; the development of mobility domains that bypass national societies, especially shipping, aeromobilities and future space travel; the significance of movement across borders to

> contemporary governmentality; the development of places of leisure that mostly have to be travelled to from afar; the development of a language of mobility; the capacity to compare, contrast and collect places from around the world; and the increased importance of multiple mobilities for people's social and emotional lives. (2010: 9-10)

The mobilities paradigm recognizes such a mobility complex, but also examines experiences of immobility and interrogates frames that align mobility with desirability and immobility with stagnation. Cresswell (2010) uses the term *mobility constellations* to capture historically and geographically situated mobility dynamics, including the physicality of the movement itself, the representation and meaning ascribed to movement in discourse, and the experience and practice of movement (e.g. as filtered through the lenses of class, gender, race, etc.).

Continuing from Sheller and Urry's uses of *mobilities paradigm*, Elliott and Urry's use of the *mobility complex* and Cresswell's use of *mobility constellations*, and based on my case study findings, I adopt the term *mobility web* to capture both the informal and diverse networks that constitute contemporary mobility and to highlight how mobilities are exposed to, and function within, the context of environmental change.[26] The term references two types of webs. First, drawing on the field of ecology, I reference *ecological food webs* – the interdependent chains of plants, insects and animals that constitute ecosystems – which when faced with a disturbance (i.e. invasive species, forest fire) can adapt or collapse. Second, I draw on the imagery of a spider web as a structure

[26] The concept of *mobility constellations* is an apt alternative to mobility webs, given that the etymology of 'disaster' is derived from Latin for 'ill-starred event.' In the context of the Anthropocene, however, humans actively construct risk rather than simply being the passive recipients of the fates (i.e. what the insurance industry refers to as an Act of God) (see Steinberg 2000 for a discussion of the "unnatural history of natural disaster").

that is simultaneously adaptable and locked-in, sticky and fragile. I use the term *mobility webs* to reflect the environmentally exposed, but also diverse and adaptable dimensions of contemporary transport networks, characteristics emphasized by research participants.

Traditionally, large-scale mobility projects, such as passenger travel across the Atlantic, the Canadian Pacific Railway and the TransCanada Highway were modernizing projects that "took the domination of nature as a necessary condition of human emancipation" (Harvey 1989). Castells summarizes the goal of collapsing the duration of a journey with the term "timeless time," as expressed, for example, in the 'no' time it takes to send an email around the world or to complete a transaction on an international currency market (2009: 35). In contrast to such transient experiences of time, environmentalists propose a "longue durée" or "glacial time" that considers the needs of future generations and non-human species (Castells 2009: 35). Since space is a 'fact' of nature, this meant the "conquest and rational ordering of space became an integral part of the modernizing project" (Harvey 1989: 259). The informal motto of the United States Postal Service epitomizes this mentality: "Neither snow nor rain nor heat nor gloom of night stays these couriers from the swift completion of their appointed rounds." While such dedication to service provision promotes a heroic dependability – a commitment usurped by same day parcel delivery services and lean supply chains – in the face of growing climatic extremes moderated expectations and greater focus on redundancies in terms of both supply and delivery options arise from the dataset as key considerations.[27]

[27] As evidenced by Fed Ex during the 2015 holiday season, when demand for a two-day Christmas delivery service was outmatched by winter weather.

Writing at the intersection of oil, climate change and mobility, Urry develops four hypothetical scenarios, ranging from the familiar – transitioning to a low-carbon-society and virtual societies mediated by digital technology – to reliance on magic bullet technological solutions and regional warlordism resulting from resource conflicts (Urry 2013, 2008; see also Bridge and Le Billon 2013). Transitioning to a low carbon society (i.e. decarbonizing) includes reducing emissions associated with current transport modes, while a focus on digital technology questions the role of mobility in society, asking how much the demand for mobility can be supplanted by virtual interactions. Some scenarios rely on the development of clean technologies for decarbonizing (e.g. as in the case for air travel where compared to other transport modes there are currently few viable prospects for low emission fuels) and post-apocalyptic communities operating under extreme resource stress. These typologies align with Urry's two dystopian scenarios, Hobbesian climate chaos and Orwellian control of carbon pollution (Urry 2008).

My investigation of the social-ecological interactions that underlie the mobilities and immobilities that result when severe weather intersects with mobility webs provides an important contribution in the face of a changing climate by bridging contemporary experiences of everyday mobility with the mobility futures developed by Urry. Further, while transport modes serve to protect humans from the elements, their construction and operation require flows and assemblages of resources in the form of fossil fuels, metal and rubber (see Hawken, Lovins and Lovins 1999).[28] Sheller (2014) juxtaposes the

[28] Informed by the mobilities paradigm and Latour, I use the term 'assemblage' to describe the social, technical and material flows that constitute mobility. I do not formally draw on assemblage theory,

infrastructures of mobility enabled by aluminum and the transnational regimes of immobility resulting from its mining and energy-intensive production. What occurs is an iterative process of the social construction of the technological and the technological construction of the social.

I focus my analysis on the infrastructural and environmental scale, examining the socio-material assemblages that constitute mobility networks and the interface between such assemblages and environmental forces and thresholds, such as hurricanes and climate change. Of particular interest is the capacity of mobility webs to be reconfigured in the short-term, as part of disaster preparation, response and recovery processes, and in the medium to long-term as part of disaster mitigation processes in the face of climatic and resource limits.

Geomorphic/biospheric disaster and mobility

Research is emerging on the impact of biospheric and geomorphic hazards, and by extension disasters, on mobility.[29] Hurricanes, as a form of intense movement through space and time, underscore the power of non-human nature and the frailty of human aspirations for control. While the "human 'mastery' of nature has been most effectively achieved through movement over, under and across it," non-human nature easily exposes the fallibility of such claims (Elliott and Urry 2010: 18-19). An iceberg demonstrated how

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including constellations, as forwarded by Deleuze and Guattari (1987) as this encompasses territorialization which is beyond the scope of this research.

[29] In the disaster literature a distinction is made between a hazard (e.g. a hurricane) and a disaster (e.g. widespread loss of mobility and electricity with adverse societal impacts caused by a hurricane). The former is a potential risk that need not necessarily be realized, the latter is risk that has manifested social impacts.

non-human power sinks human hubris with the *Titanic* disaster (Harvey 1989). A century later, a special issue of *Mobilities* journal was dedicated to exploring the impacts of the 2010 Icelandic volcano eruption that forced the closure of European airspace, resulting in "the cancellation of 108,000 flights, disrupted travel plans of 10.5 million passengers, and cost to the airline industry in excess of $1.7 billion in lost revenue" (Budd et al. 2011: 31). The article titles tellingly include words such as chaos, disruption, uncertainty and stillness (see for example Adey et al. 2011, Jensen 2011).

In the case of Iceland, the extensive socio-technical assemblages that permit global travel were framed as vulnerable to environmental risk and slow to adapt and recover: "Just as the 2008 financial crisis shook the global economy, exposing the fragility of the foundations of global banking and finance, the eruption exposed the weaknesses of European institutions and the governance framework that regulates the free flow of people, labor and cargo by air" (O'Regan 2011). Concepts such as 'mastery' and 'control' echo hollowly.

Empirical research on the ash cloud event had an impromptu quality as a number of academics took advantage of their disrupted mobility to reflect on social-technical assemblages. A spontaneous workshop was organized to further reflection on this unusual atmospheric/aviation event (Birtchnell and Büscher 2011). Jensen (2011), for example, describes his experience of the event from afar as he tried to return to Europe from the United States via air. He focuses on the emotional navigation of disruption – emotional eruptions – ranging from anxiety to joy, and what the experience of 'being stuck' means in contemporary society. He concludes that such experiences have the potential to be tremendously stressful for anyone travelling under added pressures of time commitments (e.g. wedding) or status limitations (e.g. visa). Also using a reflexive approach, Barton (2011) details his overland journey by bus from Norway to Britain. He identifies how travellers who spoke more than one language and who were fluent in social media gravitated to the centre of informal information dissemination networks. He extends his experience to social literacy more broadly, arguing for more complex representations of social navigation in a "fluid, global, mobile, mediated and uncertain" context (2011: 64). Such navigation of social literacy is growing area in disaster research.

Responding in a later issue of *Mobilities*, Lin (2013) highlights the improvised aeromobilities that occurred following the Icelandic eruption in Singapore and Australasia. He emphasizes the human ability to adapt complex mobility networks and cope with disruption. For example, Lin details how the Singapore Airport Authority capitalized on the disruption as a public relations opportunity to demonstrate its hospitality. Further, Lin contrasts the blanket closure of European air space with Australia's laissez-faire approach when it experienced a regional ash event, with governments letting individual air carriers determine what environmental thresholds they could tolerate. In contrast to a focus on transport resilience, Budd et al. (2011) question the mobility status quo. Through analysis of media and policy documents, Budd et al. (2011) find that the framing of the impact of the Icelandic ash cloud event on the aviation sector as a political and administrative "fiasco" diverted attention away from "safety, our over-dependency on aviation and mobility, [and] the impact of aviation on climate change" (2011: 39). In my research I find that during Hurricane Igor a focus on praising individual resilience diverted attention from more critical policy concerns.

Moving from ash clouds to earthquakes, Sheller examines how humanitarian response to the 2010 Haitian earthquake exacerbated uneven mobility access. “Natural disasters,’ she writes, “bring to the fore the astounding interdependence and fragility of the complex mobility systems and infrastructural moorings that make up contemporary transnational geographies” (2013: 87). Sheller finds that issues of mobility justice, already problematic in Haiti, were exacerbated with a militarized American aid response, impacts of which included increased friction at the Dominic Republican border. The result was an *islanding effect* whereby both physical and political barriers further isolated citizens.

Hurricane Katrina, due to issues of mobility justice, namely the failure to evacuate residents leading up to and following the event, is a lightening rod case in terms of the interface of mobilities and hurricanes (Hannam, Sheller and Urry 2006). Stewart and Ray (2007) use the metaphor of “race flood” to describe the intersecting catastrophes of acute flooding on one hand and chronic racism on the other hand. Cresswell (2008) explores the intersection of race, class and mobility, refuting claims that attempt to isolate failure to evacuate to a lack of private car ownership.

Similarly, Haney, Elliot and Fussell (2010) explore the complex intersection of numerous factors, such as race, resources and risk, which influenced the decisions made by families regarding whether to remain or evacuate. Haney, Elliot and Fussell find, for example, that due to the fact that Katrina coincided with the end of the month, a time when the resources of low-income households receiving social support are depleted, the risk of evacuating unnecessarily and losing income was a consideration. Consequently residents of working age were less likely than older residents to evacuate. In the case of Hurricane Juan, the storm hit just after low-income households received social support cheques. As a result, many households lost full fridge and freezer loads of recently purchased groceries contributing to food insecurity. These two scenarios highlight the human dimensions of mobility, illustrating the complex intersection of income and disaster as well as the importance of temporal considerations. Access to socio-technical mobility webs (i.e. means and opportunity to evacuate and lodge elsewhere) is a critical determinant of the experience of a severe weather event. While Haney, Elliott and Fussell (2010) focus on the lived experience of mobility, following Sheller, I situate my research within the emerging area of the social, ecological and technical interface of mobility and disaster.

Mobilities and power

Governmentality

The mobilities paradigm draws on a Foucauldian power analysis, including the concept of governmentality (Manderscheid, Schwanen and Tyfield 2014; Sheller 2016b, 2011). Biopower governmentality refers to the state's 'conduct of conduct,' analyzing how through persuasive, rather than coercive, means the act of governing is achieved (Foucault 1991). Through governmentality the population internalizes of rules of ideal behaviour, governing their own conduct; "human practices have been institutionalized with certain understandings and routines, whereby the population governs itself" (Bærenholdt 2013: 25; Schwanen, Banister and Anable 2011). Critically, the population shifts from passive recipients of sovereign protection to active participants, "defending society against whatever kinds of threats which were defined as anti-social, not only war but also environmental problems, hazards, diseases and antisocial behaviour" (Bærenholdt 2013: 24).

Governmentality takes on particular import during times of disaster, where the calm, helpful, self-disciplining citizen is celebrated (Hage 2009). Gerth and Mills (1958) in their analysis of Weber observe that the state is looked to for security in times of risk and danger. In this vein, Tiryakian argues that 9/11 "produced a massive national solidarity" overcoming, for a period, a particularly divisive phase of relations between Republicans and Democrats (2005: 314). Hage provides a colourful example of governmentality in the context of in-flight safety:

> I go on the plane and I am told that there is always a possibility of a 'crisis' and I need to be prepared, know about the oxygen masks, exits, etc… so that if a crisis comes I am prepared to self-govern myself in such demanding times. Even when possibly facing death I should learn to act in an orderly fashion. (2009: 105)

Such conduct of conduct is a theme in disaster literature.

Rather than static or set, Foucault perceived power generally, and governmentality specifically, as relational, mobile and always in transit, never arriving at a final resting point (Foucault 1991). Such precarity or uncertainty is apt for the study of climate change, which is characterized but uncertainties. And yet, within this tenuous landscape, there are "momentary stabilisations of collective identities as publics" (Sheller 2004: 50), such as in the initial collective calm *after* the storm where the population surveys and processes the scale of damage and takes initial steps to recover.

Bærenholdt (2013) further develops theorizations of governmentality, forwarding the concept of governmobility. He argues that mobility rather than just a subject of governance is a technique or technology of governance. Drawing on network society theory, he defines governmobility as the "self-government of connections, enabled through mobile technologies and the environment" (2013: 31). Governmobility has an addictive, hyper-social quality akin to the compulsion to check social media, whereby "people cannot escape mobilising mobility to live with mobility" (Bærenholdt 2013: 29).

Reflecting on the experience of the Icelandic ash cloud event, Birtchnell and Büscher conclude that "needs and desires to be somewhere else are never sated," consequently mobile society is "eternally stranded in mobility" (2011: 7). Hage (2009) discusses the existential compulsion towards mobility – a social and material sensation of advancing or progressing. Like the positive feedback effects spurred by climate change (e.g. albedo effect, melting permafrost), activating mobility webs perpetuates their use (e.g. if a person travels to a different country and establishes social contacts it is more likely that further travel will be instigated). Therefore the positive feedback loops of fossil-fuelled mobility on one hand and climate change impacts on the other hand are tenaciously interconnected, revealing the challenge of altering mobility and climate trajectories.

Circulation is the lifeblood of governmobility and borders or edges are the source of both guidance and resistance:

> Borders attract and organise mobility around certain routes and regularities … to prevent, regulate, direct or facilitate the mobility of specific assembled groups of humans, materials and information. And borders must be studied along with practices of resistance, with people's tactics and strategies in coping with, transcending, ignoring, overcoming, using and not least building borders. (Bærenholdt 2013: 31)

Usher employs a governmentality analysis of circulation of water in Singapore, leveraging Foucault's interest in the "naturalisation of the urban," that is, circulations of people, resources and waste (2014: 551). Usher traces a shift from the disciplining of water through canalization projects to a focus on water security and working with ecological dynamics to meet human needs (i.e. as promoted by the Next Generation Infrastructure approach). Discipline is characterized by efforts to "concentrate, contain and control" nature, while security "adapts to the reality of natural processes, respects their autonomy and seeks to identify, optimise and work through nature's discernable laws rather than stifle them" (Usher 2014: 558). New Orleans' investment in canalization and dams is a contemporary expression of disciplining water (Freudenburg et al. 2011), while the Netherlands's Room for the River (2015) project marks a recent turn in ecological governance towards accommodating rather than suppressing flood potential.[30] In short, discipline is akin, literally and metaphorically, to a concrete wall, while security is akin to a flood plain.

Similarly, after Hurricane Sandy New York City committed to planting one million trees and growing one billion oysters, among other resilience initiatives, in an effort to realize security by enhancing ecological systems. In fall 2015, the planting of one million trees was celebrated. By increasing the urban forest by 20 per cent, the initiative aims to realize a variety of environmental benefits including storing carbon, retaining stormwater and cooling streets and by extension reducing the use of caron-

[30] Based in the Netherlands, Room for the River (2015) aims to complete engineering interventions (e.g. deepening floodplain, relocating dykes, constructing a bypass channel) at 30 locations that will allow the river to flood safely.

intensive air conditioning (Million Trees NYC 2015). The Billion Oyster Project (2015) eponymously aims to create a living breakwater south of Staten Island in an effort to dissipate wave height and speed during severe weather events. To date, 11 million oysters have been restored to their native habitat through an ecosystem restoration and education project. Illustrating the interface between social, ecological and technical systems, historical oyster populations were degraded by an increase in shipping mobility, while contemporary populations are additionally threatened by ocean acidification (Lewis 2015).[31]

However, a challenge moving forward is that under a changing climate, nature's laws are less discernable and therefore appropriate courses of action more difficult to determine; the rules of the game are changing as the game is in play. Discipline, used in the past to prevent food scarcity, is emerging as a tactic (e.g. in the form of regulation) for managing surplus carbon emissions.[32] Adding an environmental lens, Bærenholdt's (2013) discussion of borders and Usher's (2014) discussion of circulation, may be enlarged to include ecological limits to the circulation of carbon in the atmosphere and oceans (e.g. 2 degree Celsius threshold for dangerous climate change), as well as resulting improvised circulations created by the impacts of severe weather events (e.g. fallen trees, road washouts).

Foucault frames political representatives as responsible for the management of the natural environment upon which the population, as members of the human species, rely:

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[31]Acidification results when the ocean absorbs excess atmospheric carbon, the impacts of which include inhibiting the formation of shells in species such as oysters.

[32] For example, Nova Scotia's *Sustainable Prosperity Act* (2007) requires the province to reduce greenhouse gas emissions by 2020.

“the sovereign deals with a nature, or rather with the perpetual conjunction, the perpetual intrication of a geographical, climatic, and physical milieu with the human species insofar as it has a body and a soul, a physical and moral existence” (Foucault 1991: 23). Governmentality, with its focus on the regulation of (mobile) subjects, is particularly useful in the analysis of liminal states of disruption and emergency that characterize acute events such as hurricanes or chronic climate-related migration (Sheller 2011). Declaring a state of emergency, as was done in the cases of Hurricane Juan and Igor, allows the state to impose coercively exceptional restrictions on the movement of the citizenry, such as enforcing curfews. Foucauldian analysis is useful in identifying and articulating the meanings ascribed to, and responses prescribed for, various states of mobility, such as disruptions caused by hurricanes.

Politics of mobility

I complement the high-level Foucauldian power analysis with Cresswell’s (2010) politics of mobility, which provides a finer grain approach to the description and analysis of mobility beyond the dichotomous mobile and immobile. A politics of mobility, that is an analysis of the power dynamics at play within the mobility paradigm, is premised on recognition of the “entanglement of movement, representation and practice” (Cresswell 2010:17). Physical movement is the ‘raw material’ of mobility. All physical movement is experienced through identity categories such as class, gender and race: “tourists, jet-setters, refugees, illegal immigrants, migrant labourers, academics” (Cresswell 2010: 26). Further, physical movement is represented and attributed with meaning and worth through discourse. For example, in some spheres the act of driving or flying is associated with social status (i.e. a kinetic elite), while in others it is a source of environmental shame (i.e. large carbon footprint). In short, "all forms of mobility have a physical reality, they are encoded culturally and socially, and they are experienced through practice" (Cresswell 2010: 20). Analysis of the co-construction of movement, meaning and practice, permits analysis of the politics inherent in mobility, that is, "in the production of power and relations of domination" (Cresswell 2010: 20). Following from Kwan and Schwanen, a politics of mobility replaces the "cold fact" of movement with a well-rounded sense of mobility that includes experience and representation (2016: 245).

To this theorization I bring an ecological perspective, analyzing how the politics of human mobility intersect with the power of the environment. Hurricanes as a source of intense disruption temporarily revert contemporary mobility, seemingly fixated on immediacy, to an earlier, slower and smaller-scale mobility constellation that exists in the present rather than straining for the future (Benediktsson, Lund and Huijbens 2011; Birtchnell and Büscher 2011). Disruption is a reminder that we can function "without mobility and vast resources" (Birtchnell and Büscher 2011: 7). Further, such an approach asks how the discursive subject positions of "tourists, jet-setters, refugees, illegal immigrants, migrant labourers, academics" (2010: 26) morph when issues of climate change and resource depletion are added to the mix. What counts as "appropriate movement" in a carbon-constrained, and potentially decarbonized, society (Cresswell 2010: 27)?

Informed by Latour (2005), I inflect Cresswell's politics of mobility with a strong socio-material lens. According to Latour's Actor Network Theory, humans do not exist in isolation but are enrolled in "imbroglios of people and things," that result in the co-

construction of humans and non-humans" (Latour 2011: 4). Human mobility is achieved in concert with networks or assemblages of machines, technologies and information, as well as environmental systems and conditions. Latour observes that in the context of climate change, humans are engaged in a real time climate experiment "happening on us, with us, through the action of each of us, on all of us, with all the oceans, the high atmosphere, and even the Gulf Stream" (2011: 3). Given the symmetry that a materialist perspective assigns the human environment, non-human environment, as well as science and technology, such an approach is particularly relevant to the study of climate change.

Latour argues for an overthrow of the hierarchy of human over nature, "a snail can block a dam; the Gulf Stream can turn up missing … Nothing can line up beings any longer by order of importance" (2004: 25). Likewise, Barnes employs a wide-ranging definition of power: "Natural forces and phenomena have it, as when we speak of powerful currents or magnets…animals may have it, or even plants – as when tree-roots undermine buildings" (1988: 1). A hurricane, though it lacks intention – moves but does not act – powerfully influences society. Lockie asks: "What happens if we accept that despite the technological advances of the industrial age, human society has never transcended its ecological roots? If we accept that social change today is as much about ecosystem and climate processes as it is about institutions and power?" (2015: 2). For this research, I define power as the reciprocal, continuous, often invisible and shifting influence and co-construction of the human and non-human environment. In this journey, I focus on social-ecological dynamics and less so differential human experiences of disaster such as lower versus higher income households. This focus is in keeping with my interest in how transport managers and other decision-makers grapple with uncertainty and complexity presented by severe weather events and climate change.

The politics of mobility is a versatile concept. Since Cresswell's (2010a) influential paper in *Environment and Planning D* – it is among the journal's most read papers – authors have applied the idea in diverse contexts. Examples range from the reflections of long-term migrants (Rogaly 2015), to the movement of sex workers (Andrijasevic et al. 2012), to the experience of becoming a mother (Boyer and Spinney 2016). A common thread in such wide-ranging articles is their focus on human mobility. Building on this foundation, I bring an ecological perspective, analyzing how human mobility intersects with the environment. I develop an *eco*politics of mobility focusing on the ecological dynamics inherent in contemporary mobility, identifying resiliencies and vulnerabilities. My contribution is prefigured by Cresswell's (2014) discussion of animal mobilities in the context of (yet another) food quality crisis, Lefebrve's (2004) reflections on rhythmanalysis, including tidal and lunar cycles, as well as Urry's work on climate change and peak oil (2013; 2011). All imply the possibility of an ecologically inclusive approach to the mobilities paradigm, that is, a social-ecological relational ontology (Adey 2006; Cresswell 2010b).

Cresswell's politics of mobility delineates six constituent elements of mobility: motive force, velocity, rhythm, route, experience and friction. Each characteristic expresses dimensions of power. For example, imagine the following fictional scenario of a Philippino citizen, Riza, who travels to Canada to work at a Tim Hortons coffee shop as part of a temporary foreign worker program. The motive force to travel around the world for work is financial. When on the job, closely watched by a manager who wants to get the most value out of her, Riza works at a fast pace and a constant rhythm. Riza lives in a low-income suburban neighbourhood that requires commuting via a convoluted transit route and her experience is a mix of frustrations and opportunities, all coloured by the internal friction she feels between working abroad to support her family and the missed chance to spend time with her family. Another fact of friction might be the difficulty entailed in processing work visas or applying for citizenship. What transpires in this scenario are a myriad of dynamics from the personal to the economic, from local commuting to transnational employment, illustrating the depth and breadth of the politics of mobility.

Building on this foundation and grounded in my case study findings, I develop an *eco*politics of mobility by focusing on the social-ecological dynamics enrolled in mobility webs, and identifying related resiliencies and vulnerabilities. As conceived, *motive force* may be either internally or externally compelled, the former through choice and the latter through necessity. In the context of my research, motive force is most often provided by fossil fuels, and the resulting climatic implications are a central consideration. Motive force may also include curiosity. The movement of water, wind and waves is a form of what I term charismatic mobility, an adaptation of the ecological term charismatic megafauna which refers to species such as polar bears, moose, whales that humans find compelling (see Chapter 4: Hurricane Juan). The concept of charismatic mobility, particularly in reference to ecological mobility, expands Sheller and Urry's (2006) conception of the mobilities paradigm, infusing analysis of social and spatial dynamics with ecological flows. Charismatic mobility has a counterpart of advised (i.e. voluntary) immobility, imposed as officials aim to mitigate risk entailed by movement in an effort to protect the population. Finally, motive force may refer to the movement of wind, rain and waves, tracing a line from Cape Verde, where hurricanes originate, to the North Atlantic and the related uncertainties pertaining to storm track and force that humans forecast with improved, but still limited, accuracy.

Velocity, or speed, can be a marker of power as expressed through jet setting kinaesthetic elites, or powerlessness, as in undocumented migrants in New York delivering fast food via bicycle. The velocity of the economy, the constant push to keep things moving and growing (see Schnaiberg (1980) on the treadmill of production), and the concomitant push to recover from disruption as quickly as possible arises as a central consideration in both case studies. In terms of hurricanes, velocities may range from zero, the no velocity or immobility imposed by calls from emergency and transport officials to 'stay at home and off the roads' to the urgent, frenetic pace of essential workers such as power crews, chain saw teams and disaster managers staffing Emergency Management Offices. Velocity may also be considered in terms of wind and water speeds, again variable and a focus of meteorological forecasts.

Rhythm may range in scale from the gait of a pedestrian to the tempo of an era (Cresswell 2010). Rhythm can be smooth, measured and controlled as in a practiced daily commute, or it can be turbulent as when atmospheric conditions make for bumpy air travel or severe weather events bring massive transport networks to a shuddering halt. In the case of disrupted mobility webs, restoring the dominant rhythm, whether of highway travel or public transit, as quickly as possible is a key focus.

Mobility is channelled via more and less privileged *routes*, as in the geopolitical movement of climate migrants granted or denied entry to host countries, or the shifting track of a hurricane system. Residents improvise routes due to streets blocked by trees and roads washed out by flooding. At a larger scale, such as the aftermath of the Icelandic ash cloud event, travelers "invent new and often inconvenient routes," activating different modes and network/mobility capital (Birtchnell and Büscher 2011). In his framing of governmobility, Bærenholdt (2013) posits that with the powers of mobility, we can imagine societies as routes. Indeed, path dependency or technological lock-in refers to how past decisions – and investments – dictate the range of possible options moving forward; fossil fuel use perpetuates fossil fuel use (Birtchnell and Büscher 2011).

Experience refers to the embodied sensation of movement, ranging from pleasure to pain, from welcomed to resented, or as in the case of hurricanes from excitement to fear. In media coverage of Hurricanes Juan and Igor, a number of references were made to the disturbing sensory experience of the storm: the sound of cracking trees, the noise of streams turned into rushing rivers, the sight of massive tree falls and flooded homes, and the unsettling sensation of being almost swept away by wind or stormwater. Transport and emergency managers alike expressed pride in the response of their teams under trying conditions. People mourned the loss of the beloved trees and, in the worst cases, mourned the loss of community and family members.

And lastly, *friction* refers to the ceasing or resistance of movement, namely is the movement by "choice or is it forced" (Cresswell 2010: 26)? Hurricanes cause a range of frictions, including emotional, physical and financial. Hurricanes cause emotional strain, as one Newfoundland transport manager describes three years after Igor, "I have trouble with hurricane season. I watch the forecast closely." Fallen trees and power poles, as well as washed out roads physically inhibit movement. Hurricanes incur large and unexpected costs, adding strain to limited government and household budgets. Further, climate change, and by extension carbon constraint, are a source of friction that are actively negotiated in response to discrete severe weather events and with a view to long-term climate stability (Birtchnell and Büscher 2011). Climate change is transformative; the process of transition is frictious. Therefore, through these six elements of an *eco*politics of mobility, larger social-ecological power relations are reproduced and challenged.

Disaster sociology

The field of disaster management, as it relates to transport, focuses on the logistics of humanitarian evacuation procedures, supply chain management (including the movement of hazardous materials) and resilience (e.g. of aging infrastructure, to terrorist threats). In transport studies, conceptions of the environment tend to be reduced to greenhouse gas emissions, while in disaster studies the environment is represented as severe weather events. Murphy argues that disaster sociology can teach society "about errors of expectations concerning nature's dynamics, about the material consequence of such errors, and about the social barriers to learning from the prompts of nature" (2004: 255). Social dimensions of disaster – such as perceptions, discourses and structures – are gaining recognition. Concepts of prevention, preparedness, response and recovery, as well as risk, hazard and social-technical dimensions are central considerations in disaster sociology. During extreme weather events, such as hurricanes, the co-constructed relationship between the human and non-human environment, normally taken for granted, is exposed. Freudenburg et al. (2011) distinguish between natural disaster and tragedy: natural disasters are unpreventable, whereas tragedies result from human error or hubris.

However, in an age of anthropogenic climate change (i.e. the Anthropocene), what constitutes a 'natural' hazard is obfuscated.

Disaster sociologists represent diverse perspectives. I am influenced by the work of environmental sociologists who undertake disaster sociology, namely Freudenburg and Murphy. In the case of the 2010 BP oil spill, Gramling and Freudenburg (2012) trace a century of energy policy to illustrate that the Deepwater Horizon oil well blowout was not a one-off accident, but an artefact of cumulative government and industry policy decisions. Gramling and Freudenburg posit that the U.S. government pursued two key diversionary tactics that in combination perpetuated unjust and ineffective energy policies. The first diversion is that of public *access* to resources and related revenues, by facilitating the transfer of offshore energy resources from the public to the private sector. The second diversion is that of *attention*, by framing such a transfer as a means to foster domestic energy production and energy independence. Critically, while American energy independence has been advocated since the 1970s, oil imports increased from approximately 30 per cent to 60 per cent by 2005.[33]

Gramling and Freudenburg (2012) argue that energy independence is an appealing but artificial goal – a myth – that diverts attention from the transfer of public assets to corporate coffers. The diversion of access needs to be paired with the diversion of attention to lend such a wealth transfer the gloss of legitimacy and create a permissive environment for industrial practices, such as deep water drilling and hydraulic fracturing that pose a high ecological risk. Freudenburg and Alario (2007) invoke the metaphor of

[33] Due to widespread development of hydraulic fracking, U.S. energy imports have declined since 2005 reinvigorating aspirations for energy independence (Krauss 2015).

magicianship to describe how public attention is intentionally manipulated. They argue that interrelated rhetorical techniques such as framing, blaming and activating questions are analogous to ‘the flourish, the smoke, the noise, the flash’ employed by magicians to divert audience attention (2007: 155). A central theme in Freudenburg’s disaster sociology is the power of an economic elite to impose environmental risk on the population at large through the mobilization of financial and natural resources.

Murphy’s study of the 1998 North American ice storm foregoes an historical analysis, instead exploring the devastating impact of electrical grid failures:

> Each wave of freezing rain coated trees, power lines, and electrical towers, increasing their surface area and giving the next wave of freezing rain a larger surface to fall upon and cling to. This positive-feedback loop of freezing drizzle exponentially increased the weight on trees, power lines and electrical towers. Trees fell on power lines, or lines fell because of the unbearable weight, and they in turn snapped the supporting hydro poles and towers. (2009: 64)

Murphy posits that rather than detaching us from our reliance upon nature, contemporary social-technological systems produce an intensification of human-environmental relationships. Murphy draws on a *New York Times* (1998) editorial to illustrate his case:

> A storm like this reveals the shallowness of technological civilization – how swiftly the grid collapses. But it also reveals its depth – into how many reaches of ordinary life electricity has penetrated and how high above the fundamental concerns that allows us to float. …The wonder is not that cold is so powerful, but that we are so seldom aware of its power…. (2009: 139)

Humans are more vulnerable given the grafting of technology to the skin of society. Murphy draws on the metaphor of dance to describe such a co-constructed relationship between the human and non-human environment; “human agents dance with the moves of nature's actants to form hybrid constructions" (2004: 254). Importantly, this dance can "be adroitly or ineptly performed" (Murphy 2004: 254). Murphy refers to Latour's use of the term 'actant,' arguing that it leaves "place for the independent actions of non-humans that can be either beneficial or dangerous" (2004: 252). In short, according to Latour, "things strike back" (Murphy 2004: 251).

Murphy (2009) effectively contrasts the devastating state of emergency experienced in Quebec society during the 1998 ice storm, where the majority of residents were struggling without heat and light, with the relative lack of impact in Amish communities in New York State. The Amish "live their daily lives without electricity, and they heat their homes with wood stoves. They spurn telephones, radios, and television and do not own or drive automobiles, relying instead on horse and buggies" (Murphy 2009: 295). While mainstream society struggled with impassable roads and gasoline shortages, the Amish relied on literal horsepower. As a result, their quality of life was less compromised by the ice storm. Murphy (2004) concludes that vulnerability to disaster, rather than inevitable, is socially constructed. In the case of the Quebec ice storm, the adroit performance of the Amish yields lessons for other communities. The human desire to be in control of our environment is easily thwarted. It is this illusion of control and efficacy that Bauman claims humans will "miss most" in a mobility complex run wild (1998: 57). My research, which places weather-impacted mobility networks at its core, furthers our understanding of mobility assemblages.

While Freudenburg (with Gramling 2012; et al. 2011) uses a predominantly historical lens and Murphy an infrastructural lens, disaster sociologist Klinenberg uses a community health lens. The three approaches overlap. Where Murphy examines the hybrid relationship between society and technology, Klinenberg focuses on community and the health of the human body. Klinenberg explores intersections of race, class, gender and neighbourhood as social determinants of health, finding that the elderly and the isolated were hit hardest by Chicago's 1995 heat wave:

> Solitary at the end of life, Laczko [an elderly man who lived by himself] was joined by hundreds of other Chicago residents who died alone during the heat wave and were assisted by two potentially life-saving interventions - attention from state-sponsored service providers and artificial cooling - only after their bodies were delivered to the Cook County Morgue. (2002: 15)

The intersection of time, (air-conditioned) space and mobility was a matter of life and death. Extreme weather events, such as hurricanes, highlight the role one's body plays in determining experience of a disaster and, at an extreme, one's life chances (Klinenberg 2002). Social capital and connectivity is a form of empowerment. What is notable about the 1995 heat wave is that the disaster, that is, isolated and immobile individuals were by definition invisible to those who could offer help, perhaps only being discovered by a neighbour or police after they were deceased for some time. In contrast to the highly visible and aesthetic charisma of hurricane impacts, heat wave impacts are insidious. Klinenberg's recognition that framing, most often undertaken by elites, influences whether or not an event is interpreted, and responded to, as a disaster was a watershed moment in disaster sociology. As a result, it was not until the death toll reached a certain level that the heat wave was recognized as a disaster. Such framing issues are not limited to less perceptible disasters as heat waves. For example, in the lead up to Hurricane Sandy, the Hurricane Centre's use of the phrase 'hurricane force winds' rather than simply 'hurricane' was a source of confusion and delayed government action (Sobel 2014).[34]

Mobility is a common, but backgrounded, dimension in disaster sociology. Freudenburg et al.'s (2011) work on Hurricane Katrina analyzes the interface of infrastructure and economy that led to the disaster, detailing how the local elite channelled investment into the creation of canals in an effort to position New Orleans as a significant port, efforts that in the long-term facilitated flooding and economic devastation. The authors tell how, in response to the flooding, a flotilla of private citizens in cars with boats in tow, travelled to New Orleans to assist those who were stranded – an improvised mobility lifeline. Gramling and Freudenburg's (2012) work on the BP oil spill analyzes the machinations of American policy designed to meet, as well as stimulate, a seemingly insatiable energy demand which includes a massive, carbon intensive transport network. In telling the story of the social-technical entanglement with electricity grids, Murphy simultaneously illustrates the paralysis of transport as residents negotiated treacherous ice-covered roads and sidewalks overhung by ice-covered trees and power lines. He provides insight into the possibility of a mass evacuation of Montreal due to the failure of the municipal water filtration plant when electrical failures prevented processes that filter sediment, with the then Mayor of Montreal stating:

> The top managers…told me the only solution that they foresaw – and I was completely shocked – evacuate a million people, ask people to stockpile water by filling their bathtubs or buying bottled water…. I listened to their strategies and I thought about sicknesses, epidemics, water, the health of the people. I

[34] See 'Chapter 3: Charting Course – Methods' for further discussion and examples of frame analysis.

> thought about the bridges and the people who would flee. I imagined the panic. I saw Montreal upside down. (2009: 194)

Water and transport, sediment and electricity were enmeshed, with blockages of electricity spurring possible flows of people into an ice encrusted mobility web. Fortunately, the evacuation was averted due to a technical fix, but the spectre of evacuation made an impression. At the scale of the individual, Klinenberg explores the range of factors, from social isolation to the ongoing threat of gang violence that deterred senior citizens from venturing out of their homes, from economic decline to urban design, which fostered immobility during the Chicago heat wave. Using a disaster sociology lens, I bring weather-impacted mobility networks to the fore, analyzing the social, ecological and technical turbulence that transpired in hurricane-impacted mobility webs.

Reflexive modernization

Reflexive modernization draws attention to the invisible risks associated with, and perpetuated by, market expansion. Modernization, through the process of forging an existence based on overcoming scarcity, has manufactured risks such as climate change, nuclear threat and ozone depletion, that endanger the ecosystem of which humans are a part; “we live in a world where hazards created by ourselves are as, or more, threatening than those that come from the outside” (Giddens 2003: 35). The anchoring idea for my research epitomizes reflexive modernization: fossil fuel-powered transport contributes to climate change and climate change disrupts mobility webs. The energetic boomerang comes full circle with severe weather events disrupting the complex, weather-exposed transport systems (Beck 1992).

Reflexive modernization is grounded in risk society theory. Beck succinctly defines risk as adversity to a future that is to be "prevented" (1992: 33). With risk comes anxiety: manufactured risks "endanger *all* forms of life on the planet…they outlast generations. The affected even include those not yet alive at the time or in the places where the accident occurred but born years later and long distances away" (emphasis in original) (Beck 1992: 22). For example, Trainor et al. (2009) illustrate the spatial and temporal mobility of risk by describing how climate change impacts and persistent organic pollutants cluster in the Canadian north disproportionately impacting local communities. From an ecosystem perspective, and consequently from social, health and economic perspectives, notions of global and local space are biophysically enmeshed. Giddens observes "very few new-style risks have anything to do with the borders of nations" (2003: 34), a trait held in common with mobility webs.

Risk society theory is characterized by the notion of the end of nature (Beck 1992). The risks posed by human economic development are insidious; there is no aspect of global ecology left unaffected (Beck 1992). Ozone depletion and garbage-filled ocean gyres, persistent organic pollutants and radioactivity illustrate the pervasiveness of anthropogenic environmental impacts, from the outer reaches of the atmosphere to cellular integrity (Beck 1992). Notably, these 'boomerang effects' of modernization are invisible (Beck 1992).[35] This is particularly the case in terms of climate change, where a lag occurs between when greenhouse gas emissions enter the atmosphere and when their

[35] Notably, even the 2010 Icelandic ash cloud event was characterized by invisible volcanic dust, which despite being imperceptible, damaged airplane engines (Birtchnell and Büscher 2011). In a similar way particulate matter from fossil fuel combustion, measured in micrometres, infiltrates human lungs.

warming is felt. Decades of greenhouse emissions have not yet reached their warming potential, making runaway climate change a possibility (Giddens 2003). Further, climate change yields multiple positive feedback effects. The albedo effect hastens the disintegration of polar ice sheets and the melting of the northern permafrost accelerates methane release. Ironically, sciences such as climatology are “more and more *necessary*, but at the same time less and less *sufficient*” to addressing resilience (emphasis in original) (Beck 1992: 156). Risk theory calls on civil society to critically reflect on acceptable levels of risk, questioning risk thresholds identified by government, industry and science (Beck 1992).

Beck explores the paradoxical co-development of wealth production and risk production, where in some parts of the world societal concern has transformed from hunger to fear, from a preoccupation with the distribution of goods to the distribution of hazards (Beck 1992). In my research I explore how the distribution or mobility of people, goods and services is managed *within* the context of hazards. Hazards rather than supplanting the distribution of goods, instead further complicate their distribution. I explore the interactions between severe weather and mobility webs, specifically the resultant responses and frames in the context of a reflexive modernity.

Emancipatory catastrophism

In more recent work, Beck (2015) examines the transformative potential for risk. He uses the term *emancipatory catastrophism* to describe the windows of opportunity that occur during ecological, transport and technical disruption. “First,” Beck describes, “the anticipation of global catastrophe violates *sacred* (unwritten) norms of human existence and civilization. Second, thereby it causes an *anthropological shock*, and, third, a *social catharsis*" (2015: 79).[36] While I describe the relationship between climate causation in the transport sector and severe weather disruptions of transport networks as circular, Beck uses the image of a double helix to highlight "the interlocked process of the production and distribution of goods and bads" (2015: 78). While such images are useful, Beck argues that as we are in the midst of profound changes, we are "experiencing that which we do not have the word for, the processes we observe, reflects that reality is still emerging" (2015: 77). Potter and Romano, speaking to the study of recent history, refer to this as a "zone of imperfect visibility" (2012: 3) (See Chapter 6: Zone of Imperfect Visibility). Emancipatory catastrophism, and the related concept of societal metamorphosis, is neither revolutionary nor ideological, but like social-ecological systems theory, describe and constitute an in situ, experimental navigation of a complex and unfolding situation.

However, Murphy (2015) in an analysis of the aftermath of Hurricane Katrina contests the emancipatory potential of disaster. Murphy (2015) cites the work of Freudenburg on the aftermath of various disasters (e.g. BP blowout) as contradicting Beck's theory, stating "denial of climate change has metamorphosized into apathy and profitable adaptation." Due to risk aversion and technological lock-in to fossil fuel dependency, society is in effect largely unresponsive to climate change science and impacts. In contrast, in terms of transport, Mao (2015) analyzes the 2014 crash of

[36] This approach contrasts with Klein's (2007) observations regarding how societal shocks are leveraged in a form of disaster capitalism, exploiting crisis to forward unpopular policies (e.g. the creation of a Department of Homeland Security following 9/11).

Malaysia Airlines Flight 17 in the context of the economic outfall. He describes the discourse around risk that developed in the aftermath of the event as an emancipatory side effect, sparking discussion on improvements in air travel security. These two examples differ in scale from the climate to aviation practices, suggesting that the emancipatory benefits may exist but be diluted as scale increases.

Weaving a theoretical net

To inform my guiding question – *what responses and frames, particularly related to social-ecological interactions, emerge when mobility networks are impacted by hurricanes?* – I ground my research in the mobilities literature, as informed by the disaster literature. Weaving together different threads, I create a new conceptual net. Overall I bridge the mobility and disaster literatures, creating space to explore resilience and vulnerability in climate change-impacted transport systems. I bridge fields: from applied infrastructure resilience to theoretical reflexive modernization. I bridge differing foci: sustainable mobility focuses on environmental protection, while transport resilience focuses on economic protection. I bridge differing futures: the mobilities paradigm includes conceptualizations of resource-constrained transport futures, while emancipatory catastrophism focuses on the collective goods that might emerge out of collective bads. Throughout I weave Cresswell's politics of mobility and Latour's Actor--Network Theory.

Given such a diverse and wide-ranging literatures tensions, complementarities and new theoretical insights abound. Overall, the ontological orientation of my work is premised on the co-construction of social-ecological spheres, including recognition of the

Anthropocene, and the saturation of mobility and related turbulences in both social-ecological systems. Ontologically, the mobilities and risk literatures focus on differing aspects of society. Sustainable mobility, the mobilities paradigm, the politics of mobility, resilience, and Foucault's work on governmentality and social and ecological circulations, all focus on the societal organization of movement. However, the role of power in each literature differs significantly. Analyses of power are peripheral to the study of sustainable mobility as a pragmatic transport planning tool. Similarly, transport and infrastructure resilience focus on managing movement, particularly economic flows in the case of the former, during severe weather events, and are subcategories of climate resilience.

The mobilities paradigm, in contrast, often employs governmentality to describe the techniques and implications of the surveillance, discipline and security of movement from the perspective of how the state manages the responses and frames of citizens, or even more specifically the movement of citizens (i.e. governmobility). Circulations of social and ecological goods are a central consideration in terms of meeting the needs of the population and supporting economic development. The politics of mobility, with its six dimensions, provides a language to articulate and analyze power dynamics in finer grain detail.

The disaster literature, including disaster sociology and emancipatory catastrophism, focuses on the management of risk in society. In contrast to the mobilities literature, the treatment of power is similar for both disaster sociology and emancipatory catastrophism as both focus on social, technical and ecological co-construction and related risks. Disaster sociologists analyze social construction of disaster at the local, regional and/or bioregional scale. Emancipatory catastrophism, as a component of reflexive modernization, examines global, often invisible risks. However, it can be scaled down to explore the emancipatory potential of a specific event or series of events.

Overall, the epistemological orientation of my work is using in-depth case studies and official accounts of extreme events to provide insight into profound ruptures that reveal social-technical-ecological vulnerabilities. Epistemologically, both the mobility and risk literatures draw from diverse knowledge sources. In terms of mobility, sustainable mobility, transport resilience and infrastructure resilience, as dimensions of transport planning, are perhaps most restrictive in terms of potential knowledge sources given their focus on modelling and engineering approaches. In contrast, social-ecological resilience aims to include diverse stakeholder perspectives (e.g. hydrologists, ecologists, industry, recreational users, government officials, etc.) to identify more robust management techniques. The mobilities paradigm and politics of mobility focus on the lived experience of mobility examining the movements, representations and practices entailed in mobility. By contrast, governmentality draws on governmental practices and related representations of governance. In terms of the disaster literature, disaster sociologists embrace diverse sources of knowledge as they piece together complex events, including lived accounts, expert interviews, media accounts, policy documents, photographs and more. Reflexive modernization and emancipatory catastrophism, given their theorization on global issues, tend to be limited to the realm of academics. Bringing together the mobility and disaster literatures yields innovative and valuable synergies given the degree to which severe weather events, of the type expected under a changing climate, impact mobility webs and, in turn, the role mobility plays in disaster prevention, response and recovery

The disaster sociology literature in particular offers diverse methods to describe mobility case studies, while reflexive risk and emancipatory catastrophism offer rich theoretical insights. With the exception of the mobilities paradigm and the politics of mobility, ecological considerations are central to the mobility and risk theories upon which I draw. Sustainable mobility, social-ecological system theory and infrastructure resilience, particularity next generation infrastructure, are overt in their consideration of environmental integrity. Transport resilience aims to accommodate severe weather impacts, but less with a view to accommodating environmental flows and more of a view to facilitating economic flows. Likewise, Foucault’s approach to circulation, which provides useful elaborations of intersections of social and ecological flows, does so from the anthropocentric motive of meeting the needs of a population. Building on a foundation of sustainable mobility, social-ecological system theory and infrastructure resilience, acknowledging the shortcomings of transport resilience, incorporating a circulatory approach, and applying the result to the mobilities paradigm, I develop an ecopolitical approach to mobility. Disaster sociology and reflexive risk inform this approach by providing vocabularies of social, ecological and technical co-construction and social response to disaster (i.e. windows of opportunity and emancipatory catastrophism).

The paths forward posited by each literature are diverse and a key source of tension. At one end of the spectrum are transport and infrastructure resilience, which by design or accident, focus on restoring the status quo. At the other end of the spectrum, Urry imagines potential mobility futures in a carbon and resource-constrained society ranging from utopian to dystopian. Brown raises the possibility of a "future-proof" public works that will withstand climate change impacts (2014: 12). Both reflexive modernization and Urry's mobility futures challenge society to question the levels of risk entailed in contemporary society, while governmentality provides concepts for governing such risk (e.g. surveillance, discipline, security). Likewise, disaster sociology draws attention to the wide-ranging vulnerabilities entailed by tightly integrated social, ecological and technical systems. In sum, by weaving together the mobilities and disaster literatures, I create space to explore what resilience means in terms of mobility webs. To this end, I explore what sources of resilience and vulnerability emerge, as well as consider what transport resilience and larger societal resilience may look like moving forward, providing a bridge between contemporary sustainable mobility efforts and mobility futures as described by Urry.

3 CHARTING COURSE: METHODS

… our pens poised like fishing rods.

When it granted an interview, it refused to talk
about its film credits or its accolades of full moons.

It was more interested in talking about what we thought
it tasted like: fish or tears, it wanted to know.

… When we could
we'd spear a good conversation and carry it, wriggling,

to its mouth. We'd find the bones of what we were trying
to say later, washed up on the shore.

Sue Goyette
Seventeen
2013

Alex Colville
Departure
1962

In a phone booth on the edge of a pier, this woman looks as if she might be engaged in a phone conversation with the ocean itself. It is possible to imagine she holds a pen 'poised like a fishing rod.' However, while the ocean 'granted an interview,' it turns out to be a difficult research participant.

Introduction

To research what responses and frames emerge in terms of mobility webs impacted by hurricanes I used an inductive comparative case study. Given my concentration on issues of complexity and uncertainty in other overlapping spheres of mobility, climate change and severe weather events, I focused on collecting official and expert accounts. For both Hurricanes Juan and Igor, I compiled existing data in the form of media articles, legislative transcripts and policy documents, as well as collected material in the form of interviews with key informants such as transport managers, environmental managers and land use planners. In addition, I attended relevant conferences and training opportunities To strengthen my theoretical understanding and practical experience. I focus on heavily impacted regions within each province, drawing on provincial and to a lesser extent local and national frames and responses. In combination, each method contributes to case construction, with multiple methods increasing the validity of findings (Prior 2003; Snyder 2005). My goal is not to provide a detailed chronological description of the events (such as Murphy's (2009) treatment of the North American ice storm), but to illuminate and explore various facets of mobility experienced in these events.[37]

[37] For popular accounts of Hurricane Juan, see McLeod (2004) and The Chronicle Herald (2003), and for Hurricane Igor see The Telegram (2010a).

I analyzed the resulting data set using content and frame analysis (Neuendorf 2002) guided by the following questions: **1.** What responses were employed prior to, during and following the hurricane in terms of mitigating impacts on mobility networks? **2.** What frames were present and, by extension, absent in the aftermath of the hurricanes generally and in relation to mobility networks specifically? **3.** How do the responses and frames used in the hurricane-impacted regions – which share similarities as well as striking contrasts – compare? **4.** What theoretical insights and practical lessons are yielded in terms of the social-ecological resilience of mobility webs in a changing climate?

Case study selection

Case study approaches provide a thorough understanding of the particular and therefore lend themselves to comparative studies (Van Maanen 2011). I selected two cases: Hurricane Juan which hit Nova Scotia (2003) and Hurricane Igor which hit Newfoundland (2010). Both were record-breaking hurricanes that resulted in significant mobility disruption, exacerbated by coastal and peninsular geography. I focussed on regions that were most heavily impacted by each storm: in Nova Scotia the capital Halifax and in Newfoundland the comparatively rural region of the Bonavista Peninsula.[38] Further, Nova Scotia overall has a more complex mobility web than Newfoundland. Finally, while both regions were impacted by the same type of weather event (category 2 and 1 Hurricanes respectively), the profiles of the storms were notably

[38] This is not to discount the heavy impacts, including transport disruptions, in other parts of each province, including urban Newfoundland (St. John's) and rural Nova Scotia.

different. Nova Scotia was impacted by high winds, while heavy rains impacted Newfoundland. The result is two inductive case studies that are geographically and temporally closely situated, but that offer rich contrasts that yield practical and theoretical insights.

My approach to case study selection and style was informed by the disaster sociology of Murphy (2009) and Klinenberg (2002). Both authors focus on one key event, but include multiple case studies at different scales. In researching the 1998 North American ice storm, Murphy (2009) details the severe infrastructure impacts experienced across several provinces and states, as well as contrasts the impact of the storm on mainstream society with that of Amish communities. In researching the 1995 Chicago heat wave, Klinenberg (2002) details the impact on different Chicago neighbourhoods illustrating how varying levels of community cohesion and social support have discernable impacts on life chances.[39] More recently, Gotham and Greenberg (2014) used a historical comparative case study approach to analyze redevelopment discourses in post-Katrina New Orleans and post-9/11 New York.

In designing my research, based on the particular context in Atlantic Canada, I opted to focus on two hurricanes that impacted two regions. In both cases, I combine a focus on the larger provincial scale with a focus on a region that was particularly impacted: Halifax Regional Municipality in Nova Scotia and Bonavista Peninsula in Newfoundland. These regions were selected in part because of the degree of impact

[39] I opt to focus on extreme events given the social-ecological-technical co-construction they reveal. However, more ‘mundane’ events such as the Halifax-Dartmouth Bridge Commission’s ‘Big Lift’ project (2016), which involves regularly scheduled closures over the course of a year provides a more controlled approach to the study of mobility disruptions (e.g. emergency services).

experienced, and in part, due to the availability and interest of key informants. Writ broadly, the unit of analysis is regional (see Perry and Ommer 2003 for a similar scalar approach). However, drawing on Cresswell's politics of mobility and Foucault's work on circulation permits a versatile non-linear and interscalar approach that can scale between local communities and the atmosphere. I opted for this approach as it captures the interscalar nature of mobility webs, which are often integrated across municipal, provincial/state and national borders. Even disruptions specific to a small geographic region (e.g. a train derailment, a road closure) can cause supply chain and passenger travel disruptions over a broad region as demonstrated by the Icelandic volcanic ash cloud which resulted in disruptions for the Singapore Airport Authority.

In addition to key similarities, namely record-breaking hurricanes making landfall in Atlantic Canada within a decade and the island/peninsular geography of both regions, Hurricanes Juan and Igor also offer important contrasts.[40] Firebaugh (2008) notes that the use of contrasting cases can be a source of telling comparisons. This is exemplified by Murphy's (2009) comparison of the harsh impacts of the 1998 ice storm on large-scale socio-technical entanglements that defined Quebec society versus the relative lack of impact on simpler and smaller assemblages of Amish communities. Likewise, Tompkins, Lemos and Boyd (2008) compare two regions vulnerable to different climate change impacts: hurricane vulnerability in the Cayman Islands and drought vulnerability in Brazil. They find that while disaster risk reduction efforts had an effect in both regions, underlying structural issues that contribute to poverty in Brazil undermine risk reduction

[40] Nova Scotia is a peninsula, and its capital Halifax is located on a peninsula. Newfoundland is the island portion of the province of Newfoundland and Labrador and is characterized by numerous peninsulas.

efforts. Tompkins, Lemos and Boyd conclude that risk reduction and poverty reduction efforts need to be integrated. Comparing the impacts from rural Newfoundland, colloquially known as 'the Bay', to urban Halifax illustrates the diversity and complexity of mobility webs and storm-related disruptions in one region in differing contexts, albeit both within Atlantic Canada. Further, the characteristics of the hurricanes, and their respective impacts on mobility webs, varied: Hurricane Juan was defined predominantly by wind, Igor by rain.

One issue that arises when studying transport networks through the lens of past hurricane events, rather than solely focusing on the contemporary context, is that issues of memory and recall arise (Freund and Thomson 2011). These concerns are particularly relevant in the case of Nova Scotia as Hurricane Juan occurred more than ten years ago. Further complications arise given that, with regard to climate change, humans are in a "zone of imperfect visibility" (Potter and Romano 2012: 3). We are in the midst of climate change and although hurricanes are discrete events, their impacts and implications resonate in the form of tree stumps, unexpected expenses and policy reforms. Further, public consciousness of climate change shifted between 2003 and the 2013/14 (when interviews were conducted), as discussion of climate change and the experience of extreme weather events became more pervasive. A key informant interviewed about Hurricane Juan may be more likely to raise the issue of climate change when interviewed in 2014 than in 2003.[41] It is likely that participants reinterpreted events on an ongoing

[41] Events such as entry into force the *Kyoto Protocol on Climate Change* and the occurrence of Hurricane Katrina, marked 2005 as a turning point in public consciousness on climate change (Lever-Tracy 2008).

basis as new information, particularly related to climate change, came to light. In short, understandings and interpretations of events are historically situated (Prior 2003).

Law argues for the embrace of this ambiguity and the rejection of the notion that reality is “stable, determinate, and therefore knowable and predictable” (2008: 144). Such a methodological approach is apt for a time of post-normal climate, defined as a state where previous climatic trends and patterns are no longer a reliable basis for making future predictions. Flux and uncertainty ironically constitute the ‘order’ of the day – we are learning to live with change (Adger et al. 2005; Ommer 2007). I did not account for differences in participants’ perceptions of the event between the time of the event and present day. However, pairing interviews with the official accounts is a methodological strategy to address potential discordances between memory and written records. Further, with an issue as complex as climate change, it was anticipated that contrapuntal voices might surface, whereby not only key informants from different organizations, but even a single actor, may express conflicting views (Sorsoli and Tolman 2008). For example, a key informant may express concern about climate impacts while soon thereafter expressing the need to maximize fossil fuel-based economic growth. Rather than assuming coherence, this multiple narrative approach anticipates complex discourses that reflect divergent understandings and shifting states of mind (Sorsoli and Tolman 2008).

Notably, Hurricane Juan (2003) took place prior to this shift in awareness, while Hurricane Igor (2010) occurred afterwards.

Data collection

Data for the Juan and Igor case studies was collected between September 2013 and August 2014. Analysis of the media, legislative, policy and interview data occurred on an ongoing basis (Table 3.1).

Table 3.1: Summary of data sources for Hurricanes Juan and Igor

	HURRICANE JUAN	HURRICANE IGOR	REGIONAL (ATLANTIC CANADA)[42]	TOTAL
Media articles	51	53	n/a	104
Legislative transcripts	53	41	n/a	94
Policy documents	3	3	0	6
Interviews	12	11	7	30
TOTAL	121	107	7	

Media

Media analysis is a prevalent method in disaster analysis given its timely, ongoing and easily accessible coverage of episodic events that includes the perspectives of community members, government representatives and service providers. I analyzed print news media articles to determine what responses and frames emerged in terms of mobility webs impacted by hurricanes, as well as to provide a preliminary familiarization with events for which I was not present. I read the articles with an eye to sources of mobility-related

[42] Regional refers to organizations that represent Atlantic Canada as a whole or national organizations that include an Atlantic Canadian chapter or division.

resilience and vulnerability, as well as the frames used by organizations represented in the dataset, such as government and industry, in addition to community members.

For Nova Scotia and Newfoundland, I conducted parallel media scans for each hurricane including local, provincial and national news media articles (Table 3.2). *The Coast* (Halifax, Nova Scotia) and *The Packet* (Clarenville, Newfoundland and Labrador) were selected as they cover regions directly impacted by the hurricanes in question and also have readily available electronic archives. Selection of the provincial and national newsprint media sources was also simplified as each province only has one major newspaper (i.e. *The Chronicle Herald* in Nova Scotia and *The Telegram* in Newfoundland) and Canada two major national papers (i.e. *The National Post* and *The Globe and Mail*).

Given the diversity of media sources, I drew on two databases to obtain the sample. For *The Globe and Mail* and *The National Post*, I used Factiva database; for *The Chronicle Herald*, *The Telegram and The Packet*, I used each paper's in-house online archive as they are not included from the Factiva database. For *The Coast* I scanned hard copy articles available at the Nova Scotia Archives; although many back issues were digitized, the ones I needed were not. A limitation of this approach is that each database may use different criteria for tagging articles, possibly affecting the uniformity of article selection.

Climate change media analyses are commonly longitudinal. For example, the work of Canadian researchers Ahchong and Dodds (2012) and Young and Dugas (2011) using *The Globe and Mail*, *The National Post* and *The Toronto Star* spans decades, from the 1980s to the present, while Stoddart and Tindall's (2015) analyses of *The Globe and*

Mail and *The National Post* focuses on four periods between 1999 and 2010. Boykoff's analyses (e.g. 2007) of American and British coverage focus on the 2000s. Liu, Vedlitz and Alston's (2008) study of news media coverage of climate change in *The Houston Chronicle*, which includes coastal issues such as hurricanes and sea level rise, covers one decade (1992 to 2005).

At the other end of the scale, Driedger et al. (2009) compare ten day and one year analyses of media coverage of two Canadian health disasters, the 2000 *E. coli* breakout in Walkerton, Ontario and the 2003 *Bovine Spongiform Encephalopathy* (*BSE* or Mad Cow) breakout in Alberta. They find that dominant frames are established within ten days of the inciting event. Quigley and Quigley (2013), in a comparative case study that includes Hurricane Juan, used a one-year dataset to compare article volume, rate and content. Given the timeframe for hurricane recovery and my interest in capturing responses, I started the sample one day prior to the hurricane, to include preparation measures, and continued it for one month to incorporate response and recovery measures. This timeframe captures the initial ten days when frames are established, but also captures the arc of preparation, response and immediate recovery practices associated with hurricanes in part.

I searched articles for the keywords (i.e. Hurricane + Juan or Igor, as applicable) in the headlines and leads of articles and editorials. Then I reviewed the preliminary sample, excluding articles that cursorily addressed the hurricane (e.g. announcements), as well duplicates, articles later updated and articles no longer electronically accessible. Finally, I reduced the dataset to a maximum of 20 articles per news outlet, using purposive sampling to identify articles most directly related to the study of mobility and resilience (Table 3.2) (Neuendorf 2002). I selected 20 articles per source as a manageable limit for labour-intensive connotative content analysis, as compared to detonative content analysis (e.g. Young and Dugas 2011) (Neuendorf 2002). However, less than 20 relevant articles were published for each media source (Table 3.2). Letters to the editor, television news coverage, radio news coverage, including phone-in shows, online reader comments and social media are excluded from the archive due to the lack of readily available transcripts and uneven coverage, and photos accompanying the articles were not analyzed, though all may be valuable areas for future research.[43]

Table 3.2: Summary of print media news data archive for Hurricane Juan and Igor

	HURRICANE JUAN	n	HURRICANE IGOR	n
Dates	Sep 27 – Oct 28 2003		Sep 20 – Oct 21 2010	
Local	The Coast	10	The Packet	17
Provincial	The Chronicle Herald	17	The Telegram	18
National	The Globe and Mail	16	The Globe and Mail	11
	The National Post	8	The National Post	7
TOTAL		51		53

[43] See Young (2011) for an analysis of the role of letters to the editor in climate change narratives and DiFrancesco and Young (2010) for an analysis of photos in articles on climate change.

Legislative transcripts

To complement the short-term focus of media coverage, I reviewed legislative transcripts for the year following each hurricane to gain a sense of the issues raised by elected officials and how such issues were framed (Table 3.3). Legislative transcripts, also referred to as Hansard transcripts, are verbatim written records of debates that occur in formal sittings of elected officials. Compared to media analysis, legislative transcript analysis is an uncommon method in climate change and disaster analysis. A search of the academic database Scopus yielded no examples, suggesting that this is an underused and yet readily available data source that may richly complement more traditional methodological approaches.

Table 3.3: Summary of legislative sessions pertaining to Hurricanes Juan and Igor

	NOVA SCOTIA LEGISLATURE	NEWFOUNDLAND AND LABRADOR HOUSE OF ASSEMBLY
First session after hurricane	Sep 30, 2003	Dec 6, 2010
Number of days first sessions held after landfall	1	76
Last session year after hurricane	Sep 29, 2004	May 31, 2011
Number of sessions	53	41
Number (percentage) of sessions referencing hurricane	41 (77%)	20 (50%)
Number (percentage) of sessions that reference hurricane in context of climate change	9 (17%)	1 (<1%)

Transcripts are in the public domain and are available online. I accessed transcripts for the Nova Scotian Legislature and the Newfoundland and Labrador House of Assembly. I entered specific search terms (i.e. Hurricane + Juan or Igor, as applicable), as well as broader terms (i.e. climate, warming, transport and resilience) to flag any relevant topical links. I scanned the articles with an eye to sources of resilience, often highlighted by members of the governing party, and vulnerabilities, conveniently highlighted by members of the opposition parties. Given the public nature of government sittings there was a self-consciously performative element to these texts. I coded the transcripts in terms of the frames used, such as economics, public health and safety, and environment, as well for policy successes acknowledged and policy reforms and proposals initiated by the experience of the hurricane. While beyond the scope of this research, it would be interesting to compare official Hansard transcripts with documents only accessible through Freedom of Information requests, possibly yielding more insight into the 'offstage' political discussion and responses to these events.

Policy documents

I scanned select policy documents produced by key organizations involved in mobility and environmental management to learn if, and how, the experience of a severe hurricane informed policy related to transport and social-ecological resilience. Policy responses to severe weather events are challenging given a range of uncertainties from economic to climatic, as well as political palatability:

> Policy proposals in [response to severe weather events] generally involve drastic infrastructural works and long-term investments. They face the difficult challenge of framing problems and solutions in a publicly acceptable manner in ever changing circumstances. (Vink et al. 2013: 90)

Vink et al.'s (2013) analysis of the framing of three policy proposals forwarded to address flooding safety issues in the Netherlands finds that each document frames climate change differently, varying the emphasis and consequently identifying variable timeframes and governance structures for taking action. By comparison, Jennings' (2011) analysis of policy responses to the 2004 British floods finds that discourse in government policy documents centres on grassroots approaches to climate change adaptation and resilience reflecting a neoliberal tactic of shifting responsibility from government to individuals and communities.

I identified potential documents through a two-stage process. First, through the media scan I flagged any references to policy documents. Second, I asked interview participants to identify policy implications of the hurricanes and related documents. Numerous documents ranging from community to national scales were identified through this process (e.g. climate change action plans, transport sector specific guidelines, infrastructure assessments). To limit the data volume, I opted to focus on provincial government documents produced directly in response to the experience of the hurricane and flagship documents pertaining to mobility in order to maintain focus on the official responses to the hurricanes (Table 3.4). While there are relevant national and municipal documents, given the regional scale I decided to focus on provincial documents paralleling my focus on provincial legislatures. Comparing municipal documents would have been a valuable area for research. Halifax Regional Municipality as a relatively large, wealthy and progressive municipality is active on issues such as climate change adaptation and disaster preparedness. By contrast, the Bonavista Peninsula is made up of relatively small and resource-stretched municipalities with less capacity and traction on such issues. Therefore, provincial policy documents are more comparable. Analyzing local documents and comparing local, provincial and national documents, particularly areas of accordance and discordance, is a valuable area for further study. My goal is not to be comprehensive, but to provide a sense of the range of mobility issues and the types of social-ecological interactions at play. I focus on areas of resilience and vulnerability identified in the policy documents and related frames and policy prescriptions with the goal of determining how the experience of severe weather impacts mobility and reorders social-ecological power dynamics.

The choice of documents is reflective of larger policy orientations and approaches within each province. For example, both provinces have *Climate Change Action Plans*. Nova Scotia required municipalities to undertake climate change adaptation planning in order to receive a portion of federal gas tax revenue, while Newfoundland developed voluntary workbooks to support communities in identifying and evaluating potential adaptation measures. By contrast, Newfoundland tied gas tax funding transfer to a variety of eligible project, including the development of municipal disaster plans (Government of Newfoundland and Labrador 2014c).[44] Nova Scotia has a *Sustainable Transportation Strategy* while Newfoundland and Labrador does not, an absence that reflects a more

[44] Through the *Emergency Management Act*, Nova Scotia requires municipalities to develop emergency preparedness plans (Emergency Management Organization 2015). Likewise, through the *Emergency Services Act* all Newfoundland and Labrador municipalities were required to develop emergency preparedness plans by May 1, 2012 (Government of Newfoundland and Labrador 2009b).

entrenched culture of automobility. Finally, reports on the government's response to the hurricane are publicly available in Nova Scotia, but not Newfoundland and Labrador. However, in Newfoundland provincial and municipal governments did conduct community meetings in the aftermath of Igor.

Table 3.4: Summary of select policy documents relevant to Hurricanes Juan and Igor and/or mobility

	DOCUMENT	ORGANIZATION	YEAR	PAGES
HURRICANE JUAN	Choose How You Move: Sustainable Transport Strategy	Government of Nova Scotia	2013a	48
	Toward a Greener Future: Nova Scotia's Climate Change Action Plan	Government of Nova Scotia	2009	44
	A Report on the Emergency Response to Hurricane Juan	Government of Nova Scotia	2003	13
HURRICANE IGOR	Charting Our Course: Climate Change Action Plan	Government of Newfoundland	2011a	83
	Managing Municipal Infrastructure in a Changing Climate	Government of Newfoundland	No date a	48
	7 Steps to Assess Climate Vulnerability in Your Community	Government of Newfoundland	No date b	~50

Interviews

To complement media articles, legislative transcripts and policy documents, I conducted semi-structured interviews with key informants who, through their work, have specialist knowledge of mobility and climate change in the context of Hurricanes Juan and/or Igor (Payne and Payne 2004). Ranson (2005) in her study of female engineers in Calgary, Alberta debated the merit of researching such a privileged group. In the case of my research, and informed by Murphy's interviews with decision-makers involved with the 1998 North American ice storm, the merit centres on the fact that decisions made by this group affect all others in society. Their choice of responses, as well as their framing of social-ecological dynamics is both pragmatically and intellectually influential. A stronger understanding of the social-ecological orientation of decision-makers and managers provides a basis for others to reflect, intervene and influence areas of climate change mitigation and adaptation, disaster mitigation and response, and transport resilience.

I opted to conduct interviews so that I might query key informants for rationalizations of actions and approaches (Gmelch 2003; Reinharz 1992). I aimed for a more critical stance in interviews attempting to move beyond superficial responses on the part of key informants, delving into agendas and anxieties (Hathway and Atkinson 2005). I used a combination of purposive and snowball sampling to target individuals in diverse functional roles, including transport managers (e.g. provincial transport managers, port authority executives, public transit managers), environmental officials (e.g. climate adaptation specialists, meteorologists, land use planners) and secondary personnel (e.g. emergency services providers, fuel providers, insurance bureau representatives) (Payne and Payne 2004) (Table 3.5) (Appendix A). I interviewed research participants from all three levels of government, with an emphasis on the provincial level. The majority of participants were drawn from government and the private sector, with responsibilities that include directly and indirectly mitigating the impacts of severe weather on transport operations. I also interviewed representatives of non-governmental organizations, including humanitarian organizations, specific transport sector advocacy groups, as well as environmental and infrastructure advocacy organizations. While the experiences of individual travellers (e.g. commuters, seniors, children, etc.) would provide valuable insights (Haney, Elliott and Fussell 2010), I focused on official and expert accounts to highlight areas of social-ecological resilience and vulnerability at the network level. The majority of participants lived and worked in Nova Scotia and Newfoundland, with the exception of representatives of national or regional organizations.

Table 3.5: Summary of interview participants by sector

	NOVA SCOTIA	NEWFOUNDLAND	REGIONAL (ATLANTIC CANADA)[45]
Transport - Private	3	4	2
Transport - Government	3	5	1
Environment - Government	2	1	1
Non-governmental organization	3	1	3
Other - Government	1	1	0
TOTAL	12	11	7

I first contacted potential participants with an introductory email and followed-up by phone if necessary, or vice versa (Appendices B). I attached an *Informed Consent Form* for their review (Appendix C). I communicated with potential participants to clarify any questions or concerns, and if appropriate, to schedule an interview time. Approximately one-half of the interviews were in person and one-half by phone given the broad geographic distribution of research participants. Two joint interviews were conducted whereby two representatives of the same organization were interviewed in tandem. If the interview was conducted in person, I reviewed the *Informed Consent Form* with the participant and requested their signature. If the

[45] Regional refers to organizations that represent Atlantic Canada as a whole or national organizations that include an Atlantic Canadian chapter or division.

interview was conducted over the phone, I reviewed the content and requested their oral consent. I then signed and dated the consent form indicating that ‘I have read and explained this consent form to the participant before receiving the participant’s consent, and the participant has knowledge of its contents and appeared to understand it.’ All participants gave full consent.

The interview consisted of two parts: **1.** the experience of the hurricane; and **2**. policy and practice implications. With regard to the experience of the hurricane, discussion areas addressed include: **a.** hurricane preparedness; **b.** the immediate experience of the hurricane; and **c.** coping and recovery. With regard to policy and practice implications, discussion areas addressed included: **d.** specific policy and practice ramifications and **e.** projections regarding future policy and practice, focusing on links to climate change and mobility. I adapted the interview schedule Murphy (2009) used in his research on how key decision-makers such as politicians, utility operators and senior civil servants navigated the 1998 North American ice storm, to the content of hurricane-impacted Nova Scotia and Newfoundland. I posed questions that addressed matters related to risk perception, work-related responsibilities, coordination, key decisions, and adaptation and transformation in terms of policy and practice (Appendix D). The questions are underpinned by a focus on social-ecological resilience and vulnerability. Interviews averaged 45 minutes in length and were digitally recorded. Interviews were conducted until saturation was reached, the point at which no new themes arose (Charmaz 2010). The recordings were professionally transcribed verbatim with the exception of pauses and hesitations not pertinent to the substance of the interview (Oliver, Serovich and Masson 2005).

Interview materials, including digital audio recordings and typed interview transcripts were stored on two password-protected computers, one belonging to me and one belonging to a professional transcriptionist. Files were transferred from one computer to the other using a password protected data stick. The full name of the participant does not appear on the audio file or interview transcript; a separate password protected file, to which only I have access, links participant names with identification codes. Data will be kept for a minimum of five years, as per the Memorial University policy on Integrity in Scholarly Research.

The validity of the interview findings was managed via participant approval (Neurendorf 2002; Prior 2003). I shared my research in the form of edited transcripts, to give participants the opportunity to review their contributions (Shaffir and Stebbins 1991; van den Hoonaard 2002). One participant made a minor amendment pertaining to technical terminology, a few participants acknowledged receipt of the transcript, while most participants did not respond which I interpreted as tacit confidence in the research process.

Interview considerations

In terms of conducting interviews, I had four concerns: access to key informants, the potential homogeneity of key informants, a potential lack of transparency on the part of key informants and difficulty in maintaining confidentiality. In terms of access to key informants, I anticipated that I might have difficulty identifying and accessing select key informants due to busy work schedules. With regard to the former, I drew on snowball sampling to identify multiple individuals within a sector or organization who have experience relevant to this research. With regard to the latter, I began scheduling interviews early in the project to allow time for repeat requests if necessary. In cases where key informants were no longer with the organization, I spoke with the current representative. In the case of Newfoundland, accessing the relevant contacts proved somewhat challenging, possibly reflecting a less developed relationship between academia and the private/government sectors and/or interviewer fatigue as other scholars have conducted research on Igor in recent years (e.g. Courage 2013; Masson 2014). In addition certain transport sectors, notably the trucking sector, proved less interested in participating (see Fleming (2014) for a similar experience).

My second concern related to the lack of diversity among key informants. The demographic profile of the people whom I interviewed was largely homogenous (e.g. older white professional males). Women were more likely to work for non-governmental organizations. This was the case with both case study sites. The embodied and classed experience of these key informants shapes their perspectives (Fontana and Prokos 2007; Hawkesworth 2006). Just as Haney, Elliott and Fussell (2010) conduct a gender analysis of decision-making during disaster at the household level, it would be valuable to compare approaches to decision-making undertaken by demographically overrepresented versus underrepresented policy makers and transport managers. In addition, the conspicuous absence of women in leadership roles in the transport sector is worthy of research and policy intervention. For example, would the inclusion of women in decision-making result in qualitatively and/or quantitatively different outcomes, or does the professional training (e.g. civil engineering) dilute such difference?

My third concern related to the degree to which candidates would be forthright. I interviewed key informants who were conscious of how they represent the organizations by which they are employed, and often have agendas that they are trying to advance. Borins (2011) observes that management stories presented to the public are "almost invariably upbeat and heroic, thus failing to recognize complexity and ambiguity" (2011: 17). Likewise, Hathway and Atkinson refer to the challenge of "penetrating the public performance" of key informants (2005: 68). Murphy (2009), for example, opted to discard one key informant interview in the course of his research on the North American ice storm as the individual's preoccupation with the image of his/her organization precluded thoughtful reflection of how the event was actually managed. I was conscious of the potential for superficial responses on the part of key informants during interviews and probed for rationalizations of actions and approaches (Hathway and Atkinson 2005; Reinharz 1992). To this end, I included grounded questions regarding actual work experiences, comparing the nature of work before and after the hurricane.

My fourth concern related to issues of confidentiality given the relatively small and regionally-based professional community that is the focus of my research. Certain key informants occupy unique, identifiable positions and/or are individuals with a public profile, such as transport managers and corporate leaders (Payne and Payne 2004). For example, to refer to a bridge manager in the Nova Scotia case study would for some immediately flag likely research participants. Therefore, when obtaining consent I included the following clause to alert research participants to this risk:

> … because the participants for this research project will be selected from a small community of professionals in a specific geographic region it is possible

> that you may be identifiable to other people (i.e. colleagues) on the basis of what you have said. Please keep this in mind during the course of your responses, should you agree to participate.

Research participants did not express concern. I used pseudonyms combined with broad professional categories (e.g. Robert, municipal transport manager) to identify research participants.

Content and frame analysis

I used qualitative data analysis programs to analyze the content and frames identified in the media articles, legislative transcripts, policy documents and interview transcripts.[46] I began with a preliminary coding tree based on key concepts (e.g. mobilities, climate change, weather events). I first coded the media articles, expanding the parent (e.g. mobility) and child nodes (e.g. mobility as essential service) as needed. I sorted data into emergent themes and frames using an iterative process (Neuendorf 2002; Tashakkori and Teddlie 1998). I analyzed content based on themes (e.g. mobility, weather events and climate change) and claims (i.e. related to resilience and vulnerability; related to the relationship between the human and non-human environment) (Neuendorf 2002). I incorporated a component of emergent qualitative document analysis in the exploratory phase, transitioning between documents, coding and preliminary analysis to flesh out key terms, themes and frames (Altheide et al. 2008: 137).

[46] I used NVivo10 software for coding the legislative transcripts, policy documents and interviews transcripts. I used Dedoose software for coding the print media articles as NVivo10 software for Mac was unavailable during the early stages of data collection and analysis.

I reorganized and consolidated the coding tree on an ongoing basis. The final coding tree included 18 parent nodes and 207 child nodes. I first analyzed each dataset quantitatively, by comparing the relative prevalence and absence of nodes. I flagged major themes (i.e. those that are referenced in half or more of the data set) and compared these across the case studies. The content analysis provided an overall picture of the saturation (or lack thereof) and nature of themes related to mobility webs and resilience in media, legislative and policy documents, as well as among key informants.

Building on the foundation of the content analysis, I analyzed themes and frames to examine in greater depth the framing of issues related to social-ecological resilience and vulnerability in mobility webs (Neuendorf 2002; Prior 2008). Frame analysis is an “analytical tool for sorting out many viewpoints and stances” (Creed, Langstraat and Scully 2002: 38). I define a frame as an interpretative lens or conceptual scheme for making sense of events that have occurred and the resultant prescriptive lens that shapes the practices adopted in response. Each frame is defined by a “universe of words” that constitutes and flags the presence of a given frame (Chong and Druckman 2007: 108). I define frame analysis as the identification and comparison of frames, as well as the examination of how certain frames become dominant and perceived as common sense. Frame analysis is often used in the context of polarizing debates and can be associated with identifying a strategic elite employing frames to influence public opinion (Chong and Druckman 2007). While there are elements of this in the Hurricane Juan and Igor case studies, there are also more spontaneous reactions or unconscious tactics or reflexes that constitute a history and culture of social response to the impact of severe weather events on mobility webs in Atlantic Canada (Norgaard 2011). For example, climate change emerges as a theme and different frames includes scientific uncertainty, economic impacts and motivation to change the status quo.

I inflect my use of frame analysis with Norgaard's more informal analysis of the "culture of talk" (2006: 375). Norgaard identifies *tools of innocence*, which are stories that a community tells itself that shape a collective identity that fosters non-response to climate change. One such theme is 'Norway is a little land,' and refers to the country's relatively small contribution to global greenhouse gas emissions. Another is 'We have suffered,' which refers to the hardship experienced during WWII and prior to the rise of the oil economy. Norgaard (2006) argues that such tactics buffer citizens from the discomfiting emotions associated with climate change, such as guilt, fear and helplessness.[47] Tierney, Bevc and Kuligowski (2006) focus not on national myths, but on disaster myths perpetuated by media, for example, that affected communities are at high risk for looting and lawlessness, observing that such frames both reflect and prompt the militarization of government responses.

I identified thematic corroborations and synergies, as well as contradictions, discontinuities and silences (Denzin 1997; Young and Dugas 2011). I focused the analysis on frames (i.e. beliefs, values, actions, justifications, predictions) within the context of the resilience of mobility webs in order to identify and compare practices and frames for both case studies (Borins 2011; Jones 2012). Of particular relevance to my research, Budd et al. through an analysis of media and policy documents, find that the

[47] This said, Norway is not inactive in terms of climate policy, aiming for a 30 per cent reduction in emissions below 1990 levels by 2020 with a further goal of carbon neutrality by 2050 (Government of Norway 2014). By comparison, Nova Scotia and Newfoundland share a target of ten per cent 1990 emissions by 2020.

framing of the impact of the Icelandic ash cloud event on the aviation sector as a political and administrative “fiasco” diverted attention away from “safety, our over-dependency on aviation and mobility, [and] the impact of aviation on climate change” (2011: 39). Young and Dugas’ (2011) analysis of Canadian media coverage of climate change identifies numerous frames: economic growth, green capitalism, political conflict, justice and equity, moral obligation, faith in innovation and fatalism.

From data to narrative

I synthesized the data from the media articles, legislative transcripts, policy documents and interviews using a combination of qualitative and content (i.e. counts of theme prevalence) comparison tables (Stoddart 2013). I developed tables that summarize the content analysis from each data source by hurricane, comparing coverage, including gaps, within and between data sources. These tables were useful in managing and analyzing data. Analysis carried on through the writing process, as the process of writing, inquiring and synthesizing sparked greater engagement with the data and research question (Richardson and Adams St. Pierre 2001).

In sum, I draw on four data sources, including available documents in the form of media, legislative transcripts and policy documents, and new documents in the form of interviews with key informants. The strengths of this approach are the robustness offered by the range of data sets and the balancing of documented and remembered accounts for events that occurred up to thirteen years ago. Limitations of this approach include the exclusion of lived accounts of mobility and immobility by individuals, a valuable area for future research, and the gender bias inherent when researching a male-dominated sector.

Issues of case study comparability also arise when addressing regions of rural Newfoundland to urban Nova Scotia, however, the advantage is that such an approach illuminates the range and modal complexity that characterize mobility webs in Atlantic Canada.

4 PORT OF CALL I: RESULTS
HURRICANE JUAN: CASCADING TREES, POLES AND EVENTS

We realized then that we lived on a peninsula and the rocking
for water surrounding us was actually the ocean

slurping.

Sue Goyette
Fifteen
2013

Life, we voted, would be easier
if we knew what was going to happen. This was the biggest

flaw and became the complaint that motored
many meetings. Exactly who was in charge?

And why weren't they letting us prepare?

Sue Goyette
Nineteen
2013

Alex Colville
Berlin Bus
1978

Halifax, as a peninsula, is surrounded by water, a fact that feels more apparent and precarious in stormy conditions: 'the rocking for water surrounding us was actually the ocean slurping.' Just as the woman sprints for the bus, there is an unsettling awareness that society is running behind in terms of climate change mitigation and adaptation: 'Exactly who was in charge? And why weren't they letting us prepare?'

Introduction

The first port of call on our journey is Nova Scotia where Hurricane Juan hit on September 29, 2003. In anticipation of the storm, transport operators cognizant of the impact of weather on infrastructure, employed a '*batten down the hatches*' frame. Simultaneously, some residents were drawn to feel the force of nature in a frame I term '*charismatic mobility*,' illustrating both mobilization in terms of preparation as well as movement for the purpose of getting closer to the storm. After the storm made landfall, there was a complementary pull to explore the immobility caused by entanglements of fallen trees and power poles that highlight the intensification of human, natural and technical systems in contemporary society – a frame I term '*charismatic immobility*.' Participants framed the boreal and electrical tangle simply as a '*big mess*.' In response to the risks of navigating such a disrupted mobility web, officials declared a state of emergency, which theoretically requires residents to stay off the roads but was actively negotiated by residents in a form of governmobility. The restoration of transit service indicated a pragmatic and symbolic '*return to normal'* mobility. Using an *eco*politics of mobility lens, I analyze the motive force, speed, rhythm, route, experience and friction of mobility webs, observing how they contract, expand and rebound from disturbance.

Counterbalancing a push for a return to normality was a cognizance of an accumulation of extreme events that occurred during the same period, involving numerous and complex flows and mobilities, including natural (e.g. spring flooding, brown spruce longhorn beetle), technical (i.e. Swissair crash), intentional (i.e. 9/11), political (e.g. Kosovo refugees) and health-related (i.e. BSE, SARS). Such an inundation of events increased the profile of disaster preparedness measures and accelerated a shift in thinking about climate change mitigation and adaptation. I highlight how mobility is a common theme among these diverse events and explore the implications for resilience and vulnerability. Between the ecopolitical experience of mobility during Hurricane Juan specifically and other extreme events generally an adaptive and modestly transformative frame emerges, resulting in a shift to a new social-ecological relationship in the context of a changing climate through disciplining the circulation of greenhouse gas emissions and tempering automobility.

Nova Scotia's mobility web

Nova Scotia is connected by road and rail, ferry and freight (Figure 4.1). The province benefits from multiple modes and multiple routes. Ferries connect Nova Scotia to New Brunswick, Newfoundland and Prince Edward Island, as well as, seasonally to Maine. The Trans-Canada Highway runs both northward to Cape Breton and eastward to Halifax. In addition, multiple roads circumscribe as well as transect the province. There are in fact so many roads that fragmentation of wildlife habitat is a concern (see Beazley et al. 2004). Via Rail offers an increasingly limited passenger service, with trains arriving from Montreal three times per week. Freight trains start and complete journeys in Halifax, supporting an active freight sector. Halifax supports a full-scale transit system that includes buses, ferries, bus rapid transit and dial-a-ride services. There are four other regional transit services, numerous dial-a-ride and private van shuttle companies, as well as one major private coach service, Maritime Bus (see Groszko 2010).

The transport sector accounts for 26 per cent of greenhouse gas emissions, a figure that has held steady since the early 2000s (Government of Nova Scotia 2013b, Genuine

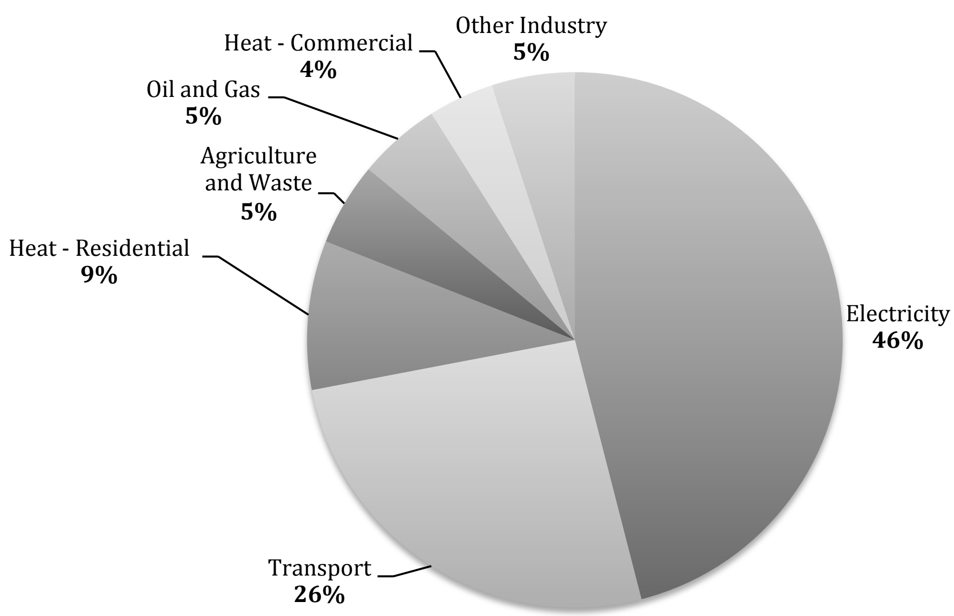
Progress Index Atlantic 2001). Road transport, including passenger light vehicles and heavy-duty vehicles (e.g. tractor trailers), accounts for 71 per cent of transport-related emissions (Figures 4.2 and 4.3). Total absolute emissions decreased between 2005 and 2011, from 23 to 20 megatonnes of carbon emission equivalents (25 to 22 tonnes per capita) (Environment Canada 2013a).

Circa 2003, the journey to work provincially was dominated by the car (85 per cent) (Statistics Canada 2001). However, Halifax as the major urban centre, enjoyed a more varied commuting modal split.[48] In 2001, 78 per cent of commuting occurred by car (68 per cent drivers, 10 per cent passengers), 10 per cent via public transit, 10 per cent via walking and one per cent via cycling (Figure 4.4) (Statistics Canada 2001). Halifax's modal split was on par with the Canadian metropolitan average, though with lower levels of private vehicle use (-6.0 per cent), transit use (-0.6 per cent) and cycling (-0.3 per cent), and higher levels of walking (+4.0 per cent), it enjoyed a more environmentally sustainable profile (Statistics Canada 2001). As of 2011, Nova Scotia and Halifax both experienced a slight decrease in car use (-1.0 per cent and -2.0 respectively), indicating the rigidity (i.e. infrastructural, behavioural, financial lock-in) of modal splits and the difficulty of instigating substantive modal shifts despite (modest) efforts at both the provincial and municipal levels (Government of Nova Scotia 2013b).

[48] Modal split refers to the breakdown of transport by mode used (e.g. public transit, walking, cycling) and is used to compare the transport profiles between regions and over time.

Figure 4.1: Nova Scotia's road and ferry network
(Community Futures Network of Canada 2015)

Figure 4.2: Greenhouse gas emissions by sector, Nova Scotia, 2010
(Government of Nova Scotia 2013a)[49]



[49] The raw data for figures 4.1 and 4.2 was generated through Environment Canada's national greenhouse gas inventory report (1990-2009). However, the full report has been archived with only the executive summary still available. Therefore, I credit the images to the secondary report in which they appear (Government of Nova Scotia 2013a).

Figure 4.3: Energy consumption within the transport sector, Nova Scotia, 2010
(Government of Nova Scotia 2013a)[50]

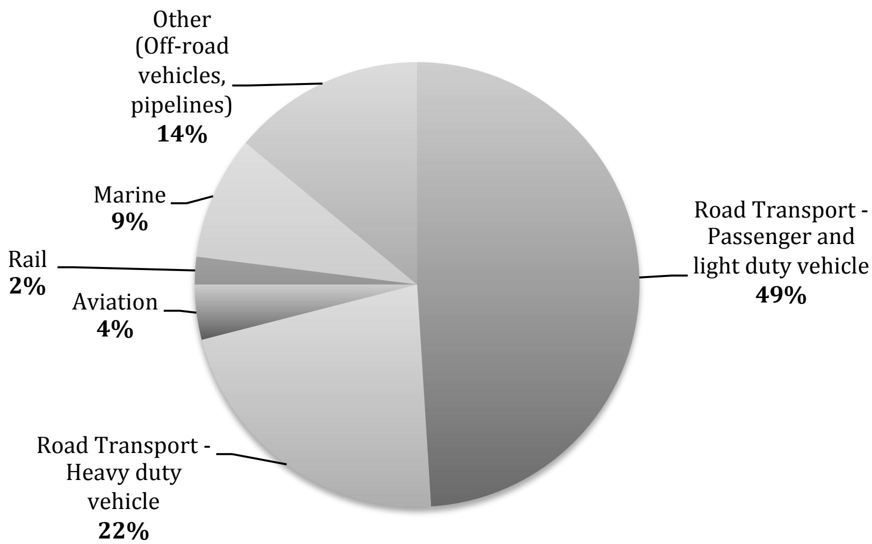
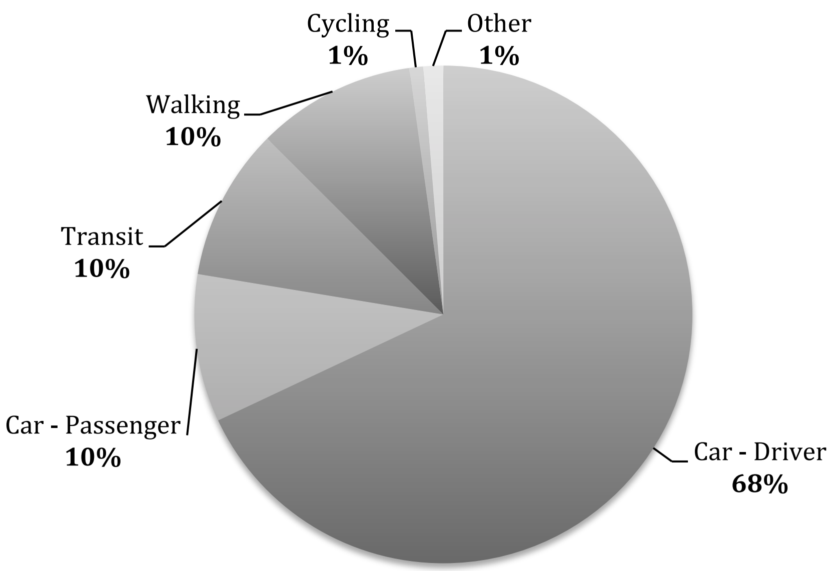


Figure 4.4: Commuting modal split, Halifax Regional Municipality, 2001
(Statistics Canada 2001)



[50] Due to greenhouse gas accounting methods, aviation and marine sectors account for only domestic emissions.

The Halifax International Airport Authority (2015a) aims to increase passenger and freight traffic, as well as the number of passenger and freight traffic destinations. Since 2008, the number of passengers at the Halifax International Airport Authority has grown from just under 3.5 million to just over 3.6 million (of which approximately 80 per cent is domestic and 20 per cent international). Notably, the Authority attributes “extreme winter weather conditions” to a decline in passengers in early 2014 (2015a: 9). The metric tonnage of air freight traffic grew from approximately 27,000 metric tonnes in 2008 to 30,000 in 2013 (Halifax Airport Authority 2015a). The Authority has a number of site-specific environmental initiatives (e.g. solid waste management, public transit promotion and stormwater management), but the high emission intensity per passenger/freight kilometre for aviation relative to other transport modes is not addressed.

The Halifax Port Authority cultivates a cruise ship industry, as well as promotes the shipping of freight. The Authority reported 134 cruise ship dockings in 2013 (Halifax Port Authority 2015). A nine per cent decrease recorded in 2014 was attributed to the implementation of a North American-wide low-sulphur fuel standard (Canadian Broadcasting Corporation 2014d).[51,52] In terms of freight movement, the Port (2015) reported an increase in container traffic of 14 per cent between 2008 and 2013, though traffic decreased ten per cent in 2015 (Canadian Broadcasting Corporation 2015d). In

[51] Sulphur dioxide contributes to smog formation as well as acid precipitation, to which Nova Scotia is vulnerable given its soil composition.

[52] Environment Canada established *Sulphur in Diesel Fuel Regulations*, specifying limits for marine, rail, heavy-duty road vehicles and stationary sources that went into effect June 1, 2014 (Environment Canada 2015a).

2014, the Port invested in technology to permit docked ships to run on electricity rather than diesel (Canadian Broadcasting Corporation 2014).

In terms of freight mobility, the Atlantic Gateway, a federal-provincial initiative to facilitate global trade, is made up of the Port of Halifax, the Halifax International Airport, CN Rail and the provincial highway system. It positions Halifax as a hub integrated in the global freight sector. The Gateway is designed to facilitate the movement of goods:

> Strategically located on North America's east coast, the Halifax Gateway can save you time, money and frustration when moving goods and people between North America and the globe. Built for speed and volume, the Halifax Gateway offers a winning combination of multimodal transportation and logistics services, modern infrastructure, exceptional service, and global reach that will make your experience hassle free. (Halifax Gateway 2015)

The Gateway concept relies on the integration of truck, rail and shipping modes (see Hesse (2013) for a discussion of the interaction of flows and place in urban ports). With an emphasis on modal integration comes recognition of the economic risks if one component of the transport chain is disrupted. A port manager observes that:

> ports are critical connectivity points. But you have to be moving the goods and cargoes, etc., to and from locations. So that means your arterial connections - your roads, your rail - are very important. So if those are damaged in any substantive way by weather perturbations, then you've got a problem. Then your port becomes immediately congested. You do not have the ability to get that product moving. (NS Transport 115)

In terms of managing the logistics of multi-part journeys – whether for freight or passengers – seamless connections are the industry ideal.

Through trade agreements such as the *Comprehensive Economic and Trade Agreement* (2014) between Canada and Europe, projected to increase bilateral trade by 20 per cent, and the Canada-Korea Free Trade Agreement (2014), projected to increase exports by 32 per cent, as well as other ongoing trade partnerships, such as with China, the movement of goods is positioned to further increase (Halifax International Airport Authority 2015a). The Atlantic Gateway facilitates market expansion through the movement of more goods to more markets. Like Freudenburg et al.'s analysis (2011) of the growth machine mentality that spurred investment in extensive canal infrastructure in New Orleans, the Atlantic Gateway is positioned as a high-return, low risk initiative. Just as the New Orleans industrial elite promoted the movement of goods via canals as common sense, so too the Halifax Port Authority and the Governments of Canada and Nova Scotia promote the movement of goods via rail, road and water.

For Marx, the mechanisms of capitalism are always in process and in motion; "when circulation stops, value disappears and the whole system comes tumbling down" (Harvey 2010: 12). This was exemplified for Harvey by the experience of 9/11,

> …everything came to a standstill. Planes stopped flying, bridges and roads closed. After about three days, everybody realized that capitalism would collapse if things didn't get moving again. So suddenly, Mayor Giuliani and President Bush are pleading with the public to get out their credit cards and go shopping, go back to Broadway, patronize restaurants. Bush even appeared in a TV ad for the airline industry encouraging Americans to start flying again. (2010: 12)

This resumption of service was advocated "even when the open, networked character of civil aviation, airports, and border security radically failed" (Salter 2013: 10). The economic and symbolic benefits of circulations were perceived as outweighing the risks of immobility. Urry (2010), citing Marx and Engels, refers to precarious state of capitalism as a phenomenon, much like the climate, that is within human influence but beyond human control.

More recently, in 2012 the New York Stock Exchange closed for two days due to Hurricane Sandy and, in 2010 air travel was halted for ten days in Europe when the Eyjafjallajökull volcano erupted. In sum, “capitalism is nothing if it is not on the move” (Harvey 2010: 12). Hurricane Katrina disrupted oil processing plants with continent-wide ramifications for fuel distribution and pricing (Brown 2014). With an international logistics supply chain, delays in one region can cause back-ups on a global scale (Birtchnell, Savitzky and Urry 2015; Cowen 2014). Just-in-time delivery means that regions do not store goods but bring them in as needed. Disruption results in shortages.

However, just as mobility paralyzes capitalism, capitalism also has a tendency towards hypermobility. Bauman depicts capital as highly mobile,

> [it is an] unanchored power, able to move at short notice or without warning, is free to exploit and abandon to the consequences of that exploitation. Shedding the responsibility for the consequences is the most coveted and cherished gain which the new mobility brings to free-floating, locally unbound capital. (1998: 9)

Such vulnerability to immobility and such an inclination to hectic mobility speak to the crisis-ridden nature of capitalism. Weber addresses the “irresistible force” of industrialization: “perhaps it will so determine them until the last ton of fossilized coal is burnt.” Capitalism moves forward, periodically lurching under the self-induced crises of recessions and depressions, labour strife and environmental harm (Weber 1958: 181). In Nova Scotia, this is expressed as ongoing competition from other North American ports for a share of the passenger and freight markets.

This complex and varied mobility web – some parts thriving and others fledgling – exists in the context of overall economic decline in Nova Scotia. In 2014 a provincial commission released a report assessing Nova Scotia's economy. The basis for the report is sobering:

> As we explored current economic and population trends we became more and more alarmed. The evidence is convincing that Nova Scotia hovers now on the brink of an extended period of decline. Two interdependent factors — an aging and shrinking population and very low rates of economic growth — mean that our economy today is barely able to support our current standards of living and public services, and will be much less so going forward unless we can reverse current trends. (Ivany Commission 2014: vi)

The Commission speaks generally to the need for improved transportation infrastructure and the role of expanding trade in bolstering the economy: "free trade with Europe and expanding markets in Asia offer exciting opportunities to leverage our advantages as a global trader if we can shift to higher value products and build stronger trade linkages" (Ivany Commission 2014: 18). Nova Scotia's mobility web is positioned to grow both within and beyond provincial borders. There is a tension, if not contradiction, between economic goals of expanding market share and environmental goals of reducing greenhouse gas emissions. As a discursive tactic, this separation works to maintain an image that mobility is unproblematic in relation to parallel, but separate, discourses about climate change (Sodero and Stoddart 2015).

Hurricane Juan

Battening down the hatches

Hurricane Juan formed off the coast of Africa on September 14th, traveled across the Atlantic Ocean hitting Bermuda on September 23rd, and then tracked up the Eastern seaboard where it made landfall in Nova Scotia at 12:10am on Monday September 29, 2003 (Government of Nova Scotia 2003). The Canadian Hurricane Centre started issuing statements regarding the severity of the storm on Thursday, September 25 and the provincial Emergency Management Office (EMO) initiated preparations on Friday, September 26 (Government of Nova Scotia 2003). '*Batten down the hatches*' emerged as a frame in the data set, a nautical expression that refers to closing the entry holes used by sailors to access a ship's hold to prevent the vessel from swamping during a storm.

An article in Nova Scotia's provincial newspaper, *The Chronicle Herald*, describes the retraction of mobility webs in light of the pending storm:

> People on the Halifax waterfront were preparing for the storm Sunday morning. Leading Seaman T.J. Peric and Ordinary Seaman Alex Zaslavskiy, taking care of HMCS Sackville, had to call for help to slacken the vessel's moorings. Already stretched tight by the morning's high tide, they needed to be looser for the surge. Peter Murphy of Murphy's on the Water cancelled all harbour tours and had *Theodore Too* and the *Mar II* moved to more sheltered wharves. The Halifax-Dartmouth Bridge Commission was preparing to restrict access to the bridges when winds hit 75 km/h and shut them completely when they reached 100 km/h. By late Sunday afternoon, all flights in and out of Halifax International Airport had been grounded. … Workers with the airport and airlines were busy Sunday afternoon securing equipment to prevent items from flying around in the high winds that were on the way …. (Gillis, September 29, 2003)

The Halifax-Dartmouth Bridge Commission, responsible for two major connective links in the regional mobility web, followed the guidelines set out in its then new wind threshold policy, closing bridges that in turn prompted the transit authority to wind down its operations:

> Once the winds came up to the point where the hurricane hadn't quite struck Nova Scotia, we were getting reports back from Bridge Commission that the bridges were going to close and that the winds were sustained at X amount of kilometres. And at that point in time on Saturday night we began bringing our equipment back into the garage. Again, for the most part the authorities here were telling people to stay off the roads, batten down the hatches, and all that kind of stuff. We pulled it all in, we had the equipment safely off the road, with the exception of our service staff (they were out there doing their thing), and strategic areas, trying to stay out of the weather (NS Transport 128).

A Port Authority representative highlights the decision-making acumen needed to assess how to best respond to severe weather:

> Most vessels are capable of putting out extra lines, particularly heavy lines that are intended specifically to withstand these abnormal weather conditions, such as hurricane-force winds. The real question for the master of the vessel to determine is: is it safer for that vessel to remain alongside? Or should it ride at anchor or in the outer harbour? Or should it proceed to sea and do a slow loop around? And taking advance time, before the extreme weather hits, to safely navigate the harbour and then ride out the storm. Again, professional mariners have to make judgments on this. (NS Transport 115)

Amending and/or cancelling service as in the case of the Halifax International Airport and the Halifax-Dartmouth Bridge Commission, as well as preventing damage to infrastructure by mooring naval ships and storing or tying down loose objects are all strategies for managing both mobility webs and unintentional mobilities of stationary objects, during severe weather events. In response to weather warnings, the mobility web contracts as needed to prevent injury and infrastructure damage. At a certain threshold, the normal rhythm of mobility is abandoned. Both formal mechanisms such as the

Halifax-Dartmouth Bridge Commission's wind threshold policy, as well as informal practices, such as observing the tautness of mooring lines, are employed.

A Government of Nova Scotia report states:

> the fishing industry, well aware of its need to take weather warnings seriously, battened down the hatches and was generally "very well prepared." And while there was extensive infrastructure damage to wharves and other facilities during the storm, the fact that there was no loss of life is significant. (2003: 4)

However, two fishermen were lost at sea near the Anticosti Islands, Quebec. Due to the timing of the storm, arriving just after midnight, most people were home – a circumstance to which lower rates of fatality and injury is attributed (Government of Nova Scotia 2003: 1). However, six people in Nova Scotia died during the storm: two direct and four indirect. A paramedic died when a falling tree struck his parked ambulance and a motorist died when debris his vehicle. In the aftermath of the storm a mother and two children died in a house fire. Critically, the electricity-powered smoke detectors in their public housing did not function during the power outage (The Chronicle Herald 2003). One man died while assisting with relief work (Environment Canada 2003c).

Charismatic mobility

The movement of water, wind and waves is a form of what I term '*charismatic mobility*,' an adaptation of the ecological term charismatic megafauna, which refers to species such as polar bears, moose, whales that humans find compelling. In the case of Juan, people were drawn to watch and feel the approaching storm, as well as to explore its aftermath. Ingold, reflecting on the interface of humans and weather, observes:

> To feel the wind is not to make external, tactile contact with our surroundings but to mingle with them. In this mingling, as we live and breathe, the wind, light, and moisture of the sky bind with the substances of the earth in the continual forging of a way through the tangle of life-lines that compromise the land. (2007: S19)

For example, a fisherman describes being able to taste the salt in the air (The Chronicle Herald 2003). Humans navigate a world continuously 'in-formation,' rather than simply traversing a static surface, and for some the opportunity to feel the power of the weather – perhaps held in contrast to more static environment of the office or the ubiquitous screen – holds appeal (Ingold 2007: S32). Such uncertainty or newness is even more resonant in the context of an anthropogenic post-normal climate.

The frame '*charismatic mobility*,' particularly in reference to ecological mobility, expands Sheller and Urry's (2006) conception of the mobilities paradigm, infusing analysis of social and spatial dynamics with ecological flows. Storm watching illustrates how humans are both drawn to observe unusual mobility and to undertake mobility to this end. One *Chronicle Herald* article records impressions of the approaching storm, from the sombre reflection of an adult to the enthusiasm of a child:

> Farther down the coast, Marina Fregeau stood watching the turbulent sea in Broad Cove. "It's so powerful. . . . It makes you feel pretty small," she said as waves pounded the rocks. Dozens of people spent much of the afternoon at Crescent Beach, many of them bodysurfing. "It's great," said 10-year-old Luke Rosborough of Hebbville. (Gillis and Grevatt 2003)

For one person the storm is humbling, for the other it is a playground. The slogan on Nova Scotian licence plates is 'Canada's Ocean Playground.' Surfers, for example, anticipate big storms and the waves and adrenaline rush that they promise. In terms of both purposeful and recreational mobility, there is a fine line to be negotiated between safety and precarity, exhilaration and hazard (see Benediktsson, Lund and Huijbens 2011 for a discussion of how Iceland leveraged the volcanic risks as an opportunity for tourists to play). The ocean playground in the context of climate change takes on a more ominous tenor.

'*Charismatic mobility*,' while it centres on the appeal of movement, also has a counterpart of managing this movement especially when it involves risk. On the night of Hurricane Juan, the municipal Emergency Management Organization (EMO) issued an advisory to stay indoors, but the charismatic experience of the storm prevailed and a small but visible number of people were drawn to coastal areas like the Halifax waterfront to experience the force of the storm. The atmosphere was like a "carnival" (The Chronicle Herald 2003 n.p.). As the hurricane approached, there was:

> almost a celebratory mood in the city on Sunday, even as Juan was picking up speed over the Atlantic on a collision course with the Nova Scotia capital. People flocked to the beaches to watch the huge waves pushed ashore by the pressure of the approaching storm. Even in the minutes before the height of the storm at 1 a.m. Monday, cars, pedestrians and even the occasional cyclist could be seen pelting through the wind and rain. (McLeod 2003)

One transport manager recalls the precarious movement of residents:

> … the public generally had a lack of knowledge of what to expect. It was just a nice windy night for people. We all saw the images of ... young adults down on the waterfront with their shirts flapping open and the water breaking over them. That's not safe to do. We shake our heads, at the same time we see people standing on the waves down at Peggy's Cove [a scenic coastal area known for large waves that sweep people into ocean]. People die that way. (NS Transport 125)

A pedestrian describes his precarious navigation of a Halifax street in the hours before Juan made landfall:

> Out on Barrington [Street], the top of a street lamp rattles down the street. Venus Envy's sign breaks free from its chains and crashes onto the pavement. As I run out to recover it, the wind rips my glasses off my face. Passers-by stop to help me search for them. Suddenly there's an awful noise and a hail of debris. As we dive into an ATM [automatic teller machine] for cover, fragments of the Green Lantern building's roof slam into the Plexiglas. (Ferguson 2003)

(see de Certeau (1984) on the tactics of walking). Emergency officials endeavoured not only to manage the movement caused by the storm (e.g. tree blow downs; fallen electrical lines), but also the mobility of humans drawn to experience the approaching storm and observe its aftermath via a form of neighbourhood disaster sightseeing or citizen surveillance that combines "a feeling of mortal danger with a certainty of being safe and having things under control" (Benedikktsson, Lund and Huijbens 2011: 81) (see Silver and Conrad (2010) on public perception of and response to storm warnings). Just as the expectations of transport and emergency professionals were exceeded by the force of the storm, so too was were the expectations of this pedestrian as the experience of the storm quickly shifted from novelty to hazard.

Making landfall

The storm tracked over the Halifax Regional Municipality on the eastern edge of Nova Scotia, traveled through the centre of the province and continued to Prince Edward Island (Figure 4.5). A transport manger recalls:

> It hit Halifax, … it took most of the trees down in Point Pleasant Park, and then it went right straight through the peninsula, knocking down several trees…, and then over to Dartmouth causing crazy havoc along Dartmouth area, which is across the Harbour from Halifax, and then out through some of the suburban areas. (NS Transport 128)

The storm ranked a Category 2 on the Saffir-Simpson Hurricane Wind Scale with sustained wind speeds of 151 kilometres per hour and wind gusts reaching 176 kilometres per hour.

A meteorologist recounts the storm forecast, indicating friction between experience and expectations of the storm:

> Neither me, nor my colleagues, envisioned the full-strength Category 2 at landfall. We were thinking a pretty well intact hurricane at landfall with trees coming down (we mentioned the trees in our bulletins, power outages pretty much guaranteed). So we predicted things quite definitively and were confident with that. Definitely some impacts, but we certainly [weren't] expecting the massive tree blow-down that occurred. There was just – the extent of the tree damage, right? We didn't expect [that]. (Regional Government 108)

Many research participants shared this observation. One representative of the provincial government states:

> Oh, it was by far worse than we ever imagined. I mean, I don't think anybody had planned for – we get a lot of heavy wind and everything here in Halifax and throughout Nova Scotia. But no one planned for that. No one knew that was coming. And it was absolutely astounding what damage it caused. (NS Government 122)

It is estimated that 100 million trees were felled across the province (Canadian Hurricane Centre no date). The electricity system was severely damaged: "devastating winds brought down 27 main transmission lines, several 120-foot transmission towers, 117 distribution feeders, and 31 major… substations" (Government of Nova Scotia 2003: 1).

As one utility official states: “The hurricane tracked along the “backbone of the… transmission system from Halifax to Truro,” a distance of 100 kilometres, disrupting service to 70 per cent of customers (Government of Nova Scotia 2003: 6). The president of Nova Scotia Power reflected that it was like the storm “was designed to come straight up the harbour (and) attack the major populations and the transmission system in its entirety” (The Chronicle Herald 2003: 69).

Due to fallen trees and electrical poles, as well as a coastal storm surge, roads were severely impacted. More than one kilometre of rail tracks, another form of static infrastructure, were washed out in several locations along Halifax Harbour by a 1.5 metre storm surge and a record-breaking total storm tide of 2.9 metres (Environment Canada 2003c, The Chronicle Herald 2003) (Photo 4.1).[53] Ten train cars were derailed (The Chronicle Herald 2003). Ships were taken to sea to avoid the damage caused when vessels are buffeted against terminal infrastructure. However, one boat sunk, several yachts were swept onto land, and other vessels moored in harbour broke their lines damaging both the vessels and nearby infrastructure. While air travel was disrupted during the hurricane, the lack of infrastructure damage meant that service could resume quickly. However, given that marine and air services are integrated with the road network, the extent of road washouts meant that accessing the air and marine facilities was a challenge.

[53] Hurricane Juan hit when these forces aligned to produce high water levels, though had the storm hit two hours earlier or ten hours later the storm surge could have been as much as one metre greater (i.e. 3.9 metres) (Environment Canada 2003c).

Figure 4.5: Hurricane Juan storm track (The Guardian 2013)

Photo 4.1: Rail cars and tracks washed out by Hurricane Juan storm surge (Environment Canada 2015b)

The impact on the road network in particular complicated all transportation, including, critically, health-related transport. The risks were tragically illustrated when a falling tree killed an ambulance driver. The provision of care to home-based patients, as well as access to hospital-based care, was disrupted, exacerbated by damage to the roof of the Victoria General Hospital, which was partially evacuated during the storm (see Fink (2013) for an account of a hospital evacuation during Hurricane Katrina).

As a result, "Hurricane Juan left the entire health care system, in affected areas, with a backlog of hundreds of surgeries and clinic appointments," exacerbating a system already grappling with long wait times (Government of Nova Scotia 2003: 5) (see Fulmore and Russell (2005) on how Halifax hospitals coped in the storm's aftermath). The impact of the hurricane on health services was a theme in legislative discussions related to Hurricane Juan. Minister of Health, Angus MacIssac, conceded:

> We know that weeks and months after the trees and bushes are picked off the streets, and after windows and roofs are fixed, the effect of Juan will still be felt on the health care system. This impact reminds us just how much our health care workers do every day. Yet, while their extraordinary efforts continue, for those patients and their families who are waiting, I know that this is not an easy time for them. (NS Hansard Oct 3 2003)

Further, loss of power hindered the safe storage of vaccines and other medical supplies that require refrigeration (Government of Nova Scotia 2003: 5).

The immobility of electrical currents also affected food storage. As social support cheques were issued just before the hurricane, many households lost recently purchased groceries when the power went out. Approximately $780,000 in food vouchers was distributed to low-income households. The Red Cross, in coordination with Community

Services Nova Scotia, managed shelters and assisted 30,000 people by providing water and meals (Government of Nova Scotia 2003).

Charismatic immobility

Just as I describe the movement of water, wind and waves '*charismatic mobility*,' an adaptation of the ecological term charismatic megafauna which refers to species such as polar bears, moose, whales that humans find compelling, I use the term '*charismatic immobility*' to refer to blockages of flows caused by tree falls and flooded rivers. These blockages of flows work in an analogous way to attract spectators. Just as emergency managers, transport officials and politicians focused on surveying the damage, referred to in disaster management as situational awareness, so too did community members for both practical and inquisitive purposes.

A *Chronicle Herald* reporter observed:

> Halifax was made up of two main groups Monday: those who walked the streets to see what they could see, and those who stayed at home to see what they could saw. In the heavily treed west and south ends, camera-toting gawkers exchanged tips on where to take in the most spectacular damage. "Have you seen Vernon Street?" asked one. "You've got to go over there." (Spurr 2003a)

Residents travelled by foot and by car to observe and assess the damage in their neighbourhoods and local parks and, where possible, travelled to other hard hit neighbourhoods with activities that ranged, according to media accounts, from mourning to offering assistance to a form of sightseeing, not unlike disaster tourists who travelled to New Orleans to view the damage after Hurricane Katrina (see Pezzullo 2009). In one

Chronicle Herald article a police officer expresses frustration at having not only to manage the impacts of the storm, but having to assist people who put themselves at risk by venturing into unsafe conditions:

> "Traffic was a major issue after people started going out . . . especially after they started to go sightseeing." … The problem of people ignoring the entreaties of law enforcement agencies to stay home and stay out of the way was an issue for police in both urban and rural areas. "That was the case despite the many warnings we put out through the media to stay home, stay off the streets unless absolutely necessary," Fraser said. "You're still going to get those that are going to challenge that and come out." (Spurr 2003b)

The management of mobility, whether of the storm or of people motivated to observe the storm and storm damage, materialized as a source of friction.

A confounding issue was that with the fallen trees came fallen power lines and concerns about electrocution. A non-governmental representative recalls the tension between the messages conveyed by emergency officials to stay off the roads to permit clearing, and the real life reaction, which was to assess, explore, connect, access goods and services as well as offer assistance:

> … there were so many downed trees, and there were so many downed power wires. Whether or not the streets were passable or not, definitely the message from the provincial authorities and EMO was "people stay home so we can clear this," and urging people not to walk around and not to bike around, so as not to run into live wires. *No one really listened to that*. … And then there were places, even in HRM, where because of downed trees and power wires, sections were impassable. ... It's the messages you get about where you can go, what's open, what you should be doing and not doing. And so there were definitely people rushing out to try to look at damage…. And other people that were told to stay home (don't clog the system). I think there certainly was a perception that transportation was undesirable, whether or not that was actually true or not. (emphasis added) (NS Non-governmental organization 112)

A reporter further describes with pride how community members governed their own mobility:

> At times like this, we find what we are made of. … We find that people will drive carefully and patiently through intersections that don't have [functioning] traffic lights. We find that young men will clear tangled brush in the rain without being asked. … We find that people will put up warning signs and hang reflector tape from dangerous wires. … We find that we are made of something good. (The Chronicle Herald 2003)

Official calls for immobility or limited mobility appeared not to reflect the needs and instincts of the population, though they perhaps set an appropriate tenor of caution. Further, a successful governmobility comes to light.

There were, of course, exceptions. The owner of a taxi company reflects on the distinction between the essential mobility of health care workers and the compulsion for nonessential mobility:

> We've started catering mostly to the health care nurses that go to the home and hospital employees that are trying to get to work, or someone that just got stuck somewhere and has to get home. … You would be amazed when you have a disaster or a really bad storm how many people all of a sudden decide they want to go out shopping. [chuckles] … It's unbelievable. … Yeah, they figure [places like the mall] won't be very busy and they want to go out. But a lot of people that take cabs, they don't own their own vehicles because they don't know what it's like to be out there driving during that kind of stuff. (NS Transport 126)

This example indicates a disjuncture between strategic mobility, that is, taking advantage of quiet periods to undertake travel and an awareness or appreciation of the impact of environmental conditions of mobility webs. The impacts of Hurricane Juan repressed circulation, in the form of streets blocked by fallen trees and power poles, as well as produced it, by prompting an instinct to explore the changed landscape and access goods and services.

Declaring a state of emergency

Preceding the storm, at 9:25pm the Mayor of the Halifax Regional Municipality declared a State of Emergency (Jeffrey and Pugsley Fraser 2003). A state of emergency has several practical implications related to mobility including imposing curfews and travel bans. As one provincial risk manager details:

> The powers that the declaration gives you are fairly extensive. … You don't enter into it lightly…. For starters, we can order an evacuation of an area, which we may not be able to without the declaration. Now, the fire department, in the [*Municipal*] *Government Act*, can order an evacuation (because of a fire or explosion or an emergency) of an area, but they're the only agency within Nova Scotia that can do that. But if you've declared a state of local emergency then you can, through your control group or through your mayor, you can order an area evacuated. … you can [also] control or prohibit travel to an area. So we can say, for instance, you can't go there. Or you can't go there in certain hours of the day or night. So similar to what you would consider a curfew. (NS Government 118)

Such '*voluntary immobility*' contrasts with the '*charismatic mobility*' of the approaching storm or the '*charismatic immobility*' of the storm impacts. A mass evacuation was not considered in the case of Halifax, as it was briefly in the case of Montreal during the ice storm (Murphy 2009). However, given its peninsular geography a large-scale evacuation poses a logistical challenge with the natural characteristics of the landscapes creating bottlenecks (Grieve and Turnbull 2013). As well, declaring a state of emergency allows the municipality or province, as the case may be, to go on land without a warrant, recruit qualified workers and implement pricing controls to prevent gouging. Financially, declaring a state of emergency is a necessary step in the process of claiming federal disaster relief funds through the Disaster Financial Assistance Agreement (DFAA) (Grieve and Turnbull 2013).

From a Foucauldian perspective, declaring a state of emergency is a direct disciplinary technique focused on ensuring the safety of citizens by expediently reconnecting transport and electrical networks. In contrast to the art of governmentality, which aims to conduct the conduct of citizens from afar, declaring a state of emergency positions the government centrally and authoritatively. Officials however opted to issue voluntary warnings, rather than compulsory curfews and mobility restrictions. Though in advance of the storm, targeted evacuations were ordered for residents living in coastal areas from urban Halifax Harbour to rural Sambro and Clam Harbour (Jeffrey and Pugsley Fraser 2003). As well, residents of an apartment building damaged during the storm were evacuated.

Evacuation is an extreme measure that is used sparingly by officials, because while voluntary movement motivated by a desire to observe the storm and its damage is charismatic, forced mobility or immobility spurred by necessity is stressful and undesired (Birtchnell and Büscher 2011). Motive force matters. However, in the absence of permanent retreat from coastal and other flood prone areas, skill in organizing temporary retreats in the form of evacuations will likely become more necessary as extreme weather events increase in frequency. For example, a non-governmental organization representative reflects on the need for adequate shelters:

> One of the learned lessons around that was to ensure that in the future the pre-positioned, pre-designated shelters would be on generated power. Because how

> can you even feed people if they're in the dark, and you've got … volunteers with flashlights? So then now you're creating more crisis for the people that were in the shelter, which puts more stress on the … volunteers that were managing the shelter with these people. (NS Non-governmental organization 117)

Managing charismatic movement, restrictions on travel (i.e. ranging from voluntary to compulsory) and mandatory evacuations promises to be features of increasingly frequent storm events. Official attempts to repress circulation were countered by governmobility on the part of the population, where residents appeared to assess – largely successfully according to injury and mortality rates – the appropriate level and type of mobility based on their direct experiences of friction, route, motive force – that is, overall experience of turbulence.

Electrical and boreal entanglements

The storm hit early enough in the fall that trees still had leaves – in effect, millions of sails – that were buffeted by the gale force winds. One citizen states:

> "We've had some great storms in the past, but the trees were full of leaves and were like big sails," said Darin Sweet, a landlord who spent the day hacking away at a huge elm that fell on one of his buildings. "The gusts did the damage. The devastation is incredible." (McLeod 2003)

A municipal planner observes that if the storm had occurred later in the fall when there were fewer leaves "there wouldn't have been near that amount of damage" (NS Government 114). The damage to the urban forest canopy and provincial forestlands was extensive. Trees were mobile, uprooted and blown down; torn branches were projectiles.

Mobile trees rendered transport immobile. Trees fell on vehicles – causing two fatalities – and across roads (Photos 4.2 and 4.3). One emergency manager states:

> The number of trees that were pulled down was almost unimaginable. We had lost most of the power to the central part of the province. I think there was 220,000 user accounts in HRM [Halifax Regional Municipality] alone that were without power for various periods. So we're dealing with lost power. We're dealing with loss of critical infrastructure in this sense, because the trees were down you couldn't get fire trucks or police cars or ambulances down certain streets. This is during the night itself. We had a death of a paramedic, unfortunately. A tree fell on his ambulance. We were dealing with all those things. (NS Government 118)

The hurricane force winds brought down trees and electrical poles, creating a fibrous and electrified entanglement blocking routes. The orderly assemblage of the everyday was rendered chaotic.

Following Murphy's (2004) work on socially-constructed disaster, what comes to light is not isolated technical systems (e.g. transport networks, electrical grids) that raise humans above ecological concerns, but rather an intensification and interweaving of technological and ecological systems. Technological systems literally wend among ecological systems (e.g. roads shaded by the urban tree canopy, rail infrastructure built along coastal zones), illustrated by the toppling of trees and power poles on roads (Photo 4.2). The case of Juan, as well as Igor (Chapter 5: Port of Call II: Results - Hurricane Igor), allow me to bring to the fore how mobility webs are implicated in the social construction of disaster, a focus that is often backgrounded in disaster sociology (e.g. Freudenburg (2012, 2009) on economic development, Klinenberg (2002) on community health, Murphy (2004) on electrical infrastructure).

Photo 4.2: Fallen trees and power lines block a residential Halifax street
(Halifax Regional School Board 2003)

Photo 4.3: Fallen tree on truck on a residential Halifax street
(Halifax Regional Municipality 2015)

The frame ‘*big mess*’ was used to describe the resulting mix of leaves, branches, tree trunks, electrical wires and poles. A transit manager recalls the sight of:

> power lines, fallen trees, cables, I mean it was just a mess. … I was in EOC [Emergency Operations Centre], but we were looking at video and pictures … that were going around and transmitting photos back to us, so we knew where to focus our attention. It was just chaos all over the place. There’s trees uprooted. … So it left quite a trail of mess all through the area. And that impacted a lot of the infrastructure that we would travel on the streets and roads. (NS Transport 128)

Likewise, a meteorologist states: “If you’ve got trees and power lines together, that’s a hell of a mess [and that’s] what happened with Hurricane Juan here. A big, big mess” (Regional Government 108). What materializes is the intersection of static human infrastructure (e.g. roads and power poles) and with both dynamic and compromised ecological processes. For example, forests naturally regenerate over time, with storms and fires creating space for new growth (i.e. disturbance ecology). The urban forest canopy is particularly susceptible to blow downs, as confounding issues such as shallow root systems, even age and non-native species increase vulnerability.

The scale of the damage was starkly apparent in Point Pleasant Park, a popular recreational space for walking, jogging and biking (Photo 4.4). A local author describes the scale of the damage:

> Point Pleasant Park, a heavily wooded area on the city's southern tip, looks tattered and torn as if picked up by a giant and vigorously shaken. Throughout the city Tuesday, the sputter of chainsaws rang over streets choked with fallen trees and tangles of dead power lines as people continued to marvel at the hurricane's ferocity. (McLeod 2003)

The Park was vulnerable not only because of its location in relation to the storm, but due to other human and natural factors. A park since 1866, the urban forest has been protected from natural regenerative processes. A municipal planner notes that:

> I had worked on the Point Pleasant Park plan peripherally, and I think if you look at resilience, if you look at the urban forest and susceptibility – certainly what you don't want is an even-aged stand with low biodiversity. What you want is something with a range of ages of trees, and also trees that are structurally sound. Most – well, I would say most, but a lot of the failures that we saw (especially on the peninsula) were the result of poor pruning practices, or lack of pruning over the years. (NS Government 114)[54]

Further, a brown spruce longhorn beetle epidemic that began in 2000 was a source of contention over management practices. The beetle epidemic is attributed to the importation of wood through the Halifax Port Authority that neighbours the Park (Photo 4.4).

What was viewed as a '*big mess*' from an emergency management and operational standpoint, was viewed with grief by community members. A strong sense of a loss surfaced as residents observed the damage to trees on their properties and in public green spaces. In a *Chronicle Herald* article, a city councillor shares her reaction to the damage to the Public Gardens, a popular Victorian style park in the city centre:

> The sight of the Gardens' uprooted century-old trees was hard to take, Coun. Dawn Sloane (Halifax Downtown) said. "I was saddened when I saw the park gates and then those large trees downed inside them," she said. "It just seemed like all the greenery was gone." Apparently, many passersby felt the same way. By late Monday afternoon, hundreds of people stood gazing in at the destruction from outside the historic park gates. … "It's a traumatic experience we went through," Coun. Sloane said of the damage. (Pugsley Fraser 2003)

[54] In contrast, Wiersma et al. (2012) found that after no particular tree type was more susceptible to Hurricane Igor.

One transport manager reflects: “if you look at the scarring left from Hurricane Juan on things like Point Pleasant Park, that was so sad” (NS Transport 115). A citizen who lives close to Point Pleasant Park recalled the sound of the storm: "It sounded terrible…. It sounded like lumber cracking" (Pugsley Fraser 2003).

Photo 4.4: Damage to Point Pleasant Park post-Hurricane Juan, with Halifax Port Authority in background (Guscott 2003)

Trees, like power poles and roads are static, unable to skirt direct hits. Another transport manager recalls the changed landscape:

> And it just looked like a bomb hit down there off of the harbour. It was unbelievable. All those big old trees down covering the whole road and stuff, and we had to detour around another way. Some places there was just no way you were getting through. The whole scape looks different now because that whole street used to be covered in trees. (NS Transport 126)

The response to the loss of trees reveals the emotional connection between humans and the environment, just as does the charismatic mobility of storms. Normal relations between the social and the environmental are disrupted, with the active social sphere suddenly rendered vulnerable to environmental factors. The metaphors used are illustrative, from a giant shaking the city as if it were a snow globe to war imagery such as the destruction wrought by a bomb, scarring the landscape and traumatizing community members.

Power lines fell due to the force of winds and falling trees. The result was the blockage of streets with entangled masses of fallen trees and power lines (Photos 4.1 and 4.2). Simultaneously, the tightly-coupled road and electrical networks were compromised. In the media archive, the focus on restoring electrical service was framed as the primary goal, with clearing roads as a secondary measure to support that goal. Three hundred power crews from Nova Scotia, New Brunswick and Maine worked to reconnect the electrical grid. They were supported by 2,000 members of the Canadian Forces tasked with clearing roads (Government of Nova Scotia 2003). One line worker compared his experience of Hurricane Juan to that of 1998 ice storm: “The weather has been good – at least it's not 45 below and people dying” (Cox 2003).

However, through interviews, details of road network restoration efforts surfaced:

> We were dealing with, like I said, downed power lines, downed trees. There was a lot of clean-up that we had to do. … But I know the clean-up went on, and, like I said, we had representatives from Nova Scotia Power, the Emergency Operations Centre, … we had police, we had RCMP [Royal Canadian Mounted Police], we had military, conventional emergency operations, federal emergency operations. So we’re all working together from one room down there [in the Emergency Operations Centre located in nearby

> Dartmouth] and trying to pull together to clean it up as quickly as possible. (NS Transport 128)

Likewise, a transport manager likens the recovery process to triage, a metaphor that is a natural extension of an encounter with storm likened to a giant or war:

> …the first thing that we would look at is obviously the public safety issues. And attached to that would be the requirement to, attempts to keep as many or all the main roads or the main arterial routes from police stations, fire stations, hospitals, those types of things. We would have to, I guess, ultimately triage those things from more of the non-essential type services (i.e., a school or a shopping centre). So we would look at maintaining those networks, just so that we can keep ambulances rolling around and fire trucks going and police, and of course our crews as well. (NS Transport 130)

Murphy (2004) describes humans dancing, either adroitly or ineptly, with the moves of nature's actants to create hybrid social-material assemblages. What transpires in the aftermath of Juan is a painstaking disentanglement of the ecological and technical, tree-by-tree, line-by-line (see Kochanoff 2004 on tree/line tensions that emerged between utility providers and home owners following Hurricane Juan).[55]

While damage to the Park was severe, damage to the neighbouring Port's hard infrastructure was relatively minimal:

> There was damage to the shed roofs, for example, with the velocity of the winds that had to be secured and repaired, and cargo that was weather sensitive and those had to be shifted around so it wasn't damaged. The seawall at Pier C, the south end of the Halterm container terminal, was badly damaged. … There

[55] Given the damage to the electrical grid during Hurricane Juan, it is notable that discussion of burying power lines was not prevalent in the dataset. Nova Scotia Power (2015) notes that burying power lines costs ten times more than above ground infrastructure and requires disruption to streets for installation. However, with more frequent severe weather events the economics may change. Further, safety concerns surrounding service provision following severe weather may instigate regulatory requirements for underground power lines.

> was a lot of water surge on top of this terminal during the storm, but that drained off properly in the storm sewer systems…. We did have one ship departed its lines and pilots responded in a very timely fashion to re-secure that vessel. Some containers were lost overboard on the ship when it surged off the dock. Those were recovered. And any other structural damage around the port was rectified in a good, orderly process. (NS Transport 115)

The Port was functional within 24 hours of Hurricane Juan hitting, though blockage of roads caused disruptions in terms of intermodal connectivity. By contrast, Point Pleasant Park remained closed to the public for eight months. The juxtaposition of the damage to the treed Park and relative lack of impact to the hardened coastal port infrastructure is notable. The experience of damage was highly variable and not proportionate to the contribution of a sector or space to climate change.

Influenced in part by the experience of Hurricane Juan, the Halifax Regional Municipality (2013) developed an *Urban Forest Master Plan* to manage the 709,000 trees on public property and fill 94,000 vacant spots to achieve an average 40 per cent forest canopy across the city. The Plan takes a green infrastructure approach, including measures such as using trees to decrease stormwater in highly impervious areas, with priority given to conifers where conditions permit.

Transit as essential

As the mobility web was gradually disentangled from the electrical grid, there was a focus on restoring public transit as an essential service. Transit service emerged as both a source of innovation and adaptability, as well as a symbol of a '*return to normal'* functioning that characterizes passive engineering resilience – the tendency for a system to retain the status quo. Critically, transitioning from the status quo into an alternate state and back again, is frictious.

At full functioning Halifax Transit has, according to Chad a transit manager, a service area of "about 263 square kilometres. We have about 340 buses and three ferries. We operate about 22 hours a day" (NS Transport 128).[56] The impacts on public transit, given its reliance on a functioning road network, were notable:

> And of course the priority was to try to get things rolling, get the city operational. And so we were trying to open up all the priority routes: priority 1 infrastructure, repair what damages we could. I mean you're making remedial, just basic repairs to what you need to get you going again. And of course one of the main focuses was getting transit re-established, so that we could actually have people start moving around again. … But we were dealing with power outages. (NS Transport 128)

There was relatively little physical damage to buses and ferries, however, one of the terminals was damaged: "we sustained a lot of damage to our Halifax Ferry Terminal, which kind of took the brunt of it. The [ramp] to the ferry was smashed up quite badly, so we had a lot of repairs there" (NS Transport 128).

However, while Juan did not damage buses, problems arose because a lack of electricity, which meant that the gas pumps located in the main bus terminal, were not functioning. Chad recalls:

> At the garage, we didn't have a backup generator. … the fuel pumps that pump the diesel into the buses, they weren't pumping at the time… At the same time we were looking at if the power was down, if we didn't have the ability to refuel our buses, we wouldn't be able to put our service out and get the city moving again. … I was being pushed to find areas to fuel the buses, because

[56] Formerly called Metro Transit, the name Halifax Transit was adopted in 2014.

> our fuelling stations weren't working. So I had some contingency set up for that. But ... the power was restored quite quickly. (NS Transport 128).

The failure of the electrical grid and lack of generator power was a barrier to transit service delivery, just as it complicated the operation of evacuation shelters.[57,58]

During, and immediately after, the storm, transit buses were themselves used for evacuation and temporary shelters. For example, 251 residents of one apartment building found themselves homeless the night of the storm and buses were used as temporary shelter (Government of Nova Scotia 2003). One emergency manager recalls:

> We actually used buses that night to evacuate the people up in the apartment building that had the roof blown off. ... Went out in the storm to evacuate these people – in a windstorm, in a hurricane – because these people were hiding behind fire trucks because there was no safe place to be because the wind was that strong. It was blowing leaves off the trees, and the leaves they were actually wadding up like little mini bullets. There were garbage cans flying everywhere. People were huddled behind fire trucks for protection. Bus drivers came out and put them in buses, and … the buses backed up the road because there was no place to turn around. (NS Government 118)

War zone imagery is used: leaves like bullets, residents taking shelter and buses retreating as if from a front line.

Buses were also used to transport clean-up crews:

> We were moving some folks around to various areas to assist with the clean-up. We couldn't put our service out, but we got a few buses on the road, just to

[57] In the city at large, access to gas was also an issue due to power outages. At one point only one gas station was open; the Lower Sackville station was inundated. Sales tripled and police resources were needed to manage extensive traffic backups (Mcleod 2004)

[58] In late summer 2015, Nova Scotia was impacted by a 'fuel drought' that lasted for five days due to supply chain issues, additive requirements and panic buying. This raises fuel resilience as a component of transport resilience. Fuel resilience could include both transport fuels, as well as cooking fuel (i.e. propane) (Canadian Broadcasting Corporation 2015e). See MacNeil and Keefe (2015) for an independent review of the fuel shortage.

> move some people around to areas where – like we could be moving a crew at one point to another ... And for the most part the main component was to clear the roads and try to restore power at the same time. So we had crews that were going around with [Nova Scotia] Power [boom trucks] to try to get the trees and branches off the road. We would be focused on trying to move those folks around. We did that quite effectively. (NS Transport 128)

Transit materialized as a versatile and central component of the hurricane response and recovery efforts.[59] The motive force of public transit shifted from moving the public to sheltering the public and transporting workers, to once again moving the public.

In the aftermath of the storm, the focus was on clearing main arterial routes and major transit routes so as to resume transit service as quickly as possible.

> Of course, the transit component is one of the key components to making the city move again. And after any storm like that there's some trauma. We had established, through some of our situation reports, that getting transit on the road was a priority because people would have some feeling of normalcy. So we were quite focused on getting some of these areas cleaned up, where we could get some degree of the operation back on the road again. And that way people would be a little bit more relieved to the fact that, "Oh, well transit is running again, we're good. We're going to start coming back, right?" … And most people, I think, in an urban area, once the buses start coming back out again, people start saying, 'Ah, well, gee we can get out and around.' And I think that's something we were quite focused on at the time. (NS Transport 128)

Restoration of transit routes is symbolic of the city being on the 'move again' and 'getting things rolling' was a core consideration. The provision of transit is considered an essential service, as well as a symbol of normalcy. The movement and circulation of buses and

[59] See the New York Transit Museum's (2016) online exhibit, *Bringing Back the City: Mass Transit Responds to Crisis*, for accounts of how mass transit providers prepare for and respond to extreme events including 9/11, the 2003 Blackout and Hurricane Sandy. See Douglas, Koslov and Klinenberg (2015) for a discussion of the impacts of Hurricane Sandy on New York's transit system.

ferries are part of the visual and practical rhythm of city life (see Lefebrve (2004) on interval rhythms):

> It was high priority because getting people to be able to move around again is one of the things we need – to both bring commerce back, to bring people back to their sense of comfort, and also be an indication that if transit is running, then the primary roads are clear, which means public safety vehicles can get down them as well, and they're working from there on to your secondary roads. (NS Government 118)

First, a limited schedule holiday service was restored on main routes within approximately 24 hours. Demonstrating passive resilience, full transit service was restored about four days later. Provincially, all major roads were cleared and passable by October 3, with a goal set of clearing minor roads by October 31 (Government of Nova Scotia 2003: 6). The clearing of roads and the restoring of electricity occurred in tandem, with 95 per cent of utility customers reconnected by October 3 and the remaining five per cent restored by October 12 (Government of Nova Scotia 2003: 7).

Inundating events

In the years leading up to and following Hurricane Juan, Nova Scotia experienced a diverse range of extreme events, from natural to technical to intentional (Table 4.1).[60] The experiences highlighted Nova Scotia's exposure to a range of risks, as well as aspects of resilience and vulnerability when facing such risks, particularly in terms of mobility. Many of the risks are in line with the risks associated with reflexive modernization in that they are transboundary and insidious, and most of which are facilitated in some capacity

[60] Most recently, Nova Scotia experienced a record-breaking series of winter storms that resulted in significant damage and disruption (see MacIntyre 2015 for an account).

by global mobility webs. Budd et al. speak to the increasing “awareness of the inherent ‘riskiness’ of air travel…identifying the threat posed by terrorism, human failings and emerging infectious diseases” (2011: 38). However, in the case of Hurricane Juan, as well as other extreme events, the risk and vulnerability of a range of transport modes came to light. In the case of Juan, the static infrastructure of roads and rail in particular is vulnerable to mobilities of wind and storm surges.

The experience of Hurricane Juan lent further weight to *The Globe and Mail’s* framing of 2003 as Canada’s “year of affliction,” citing events such as the British Columbia forest fires, the North American black out, the Iraq War, *BSE* and *SARS* (Little 2003). Likewise, *The Chronicle Herald* remarks on the number of severe events that Nova Scotians managed between 1998 and 2003 and the competency they are developing for “coolly coping in the face of adversity” (Spurr 2003b).

A provincial risk manager comments on the frequency of events and Nova Scotia’s relative success in managing the unexpected:

> It’s not just Hurricane Juan. We were involved in Swissair [1998 plane crash] for months. We were involved in Hurricane Juan. We were involved in White Juan. We have one, I always say, every 18 months. … I would go out on a limb and say that one of the things that makes us a success in Nova Scotia is that we have full empowerment to make decisions and create activities to move a disaster, a remediation of a disaster, forward. That’s really the big thing that we have. (NS Government 122)

The overall effect was both a heightened awareness of Nova Scotia’s vulnerability to a range of disasters, as well as an increased familiarity in, and competence with, dealing with disaster:

> “If you think back, Nova Scotia for the last - well, certainly since Swissair - we've dealt with multiple tragedies, so it's fortunate and unfortunate that it's second nature now to kick into emergency mode,” said Supt. Vern Fraser of Halifax RCMP. “It's fortunate that we have that ability, it's unfortunate the way we acquired it.” (Spurr 2003a)

Nova Scotians are developing a necessary, albeit undesired, skill set. The need for such disaster preparedness skill sets will only increase as the climate changes and will be exacerbated by interrelated issues of conflict, terrorism and disease amplified by intensive global mobility webs. Hage reflects that, “Crisis today is no longer felt as an unusual state of affairs which invites citizens to question the given order. Rather, it is perceived more as a normalcy… a permanent state of exception” (2009: 8). What transpires is a new normal, both in terms of climate and of expectations of mobility disruption.

The cumulative impact of such diverse disasters was a major theme within the Legislative Assembly in the year following Juan. The Conservatives were in power, with the New Democratic Party (NDP) in Official Opposition. John MacDonell, NDP Member of the Legislative Assembly for Hants East, spoke to the cumulative effects of extreme events in the agricultural sector:

> Whereas the farmers in Nova Scotia are struggling to survive in the wake of spring floods and the BSE crisis; and Whereas damage by Hurricane Juan is yet another blow to Nova Scotia's agricultural sector; and Whereas farmers in Nova Scotia simply cannot handle any more financial challenges this year; Therefore be it resolved that this government commit to including the agricultural sector in any plans for disaster relief related to Hurricane Juan. (NS Hansard September 30 2003)

Likewise, Member of the Opposition, Howard Epstein, speaks to novel risks identified by the Emergency Management Organization:

> The EMO identified new risks and challenges in this year's business plan. What EMO is expecting is more forest fires, more flooding, more tidal surges and severe winter weather thanks to climate change. EMO has also predicted that Nova Scotia will experience a flu pandemic in the next few years. The agency is also concerned over security issues. (NS Hansard May 4 2004)

From a Foucauldian perspective, physical security of the population arose as a governance concern.

There is a historical dimension to Nova Scotia's experience. In 1917, Halifax was the site of the largest human-made explosion prior to Hiroshima and Nagasaki when two ships, a French ammunition ship (*Mont-Blanc*) and a Norwegian relief ship (*Imo*) collided in Halifax Harbour. Approximately 2,000 people died and 9,000 were injured, and much of the city destroyed (Photo 4.5). A municipal staff person likens the damage caused to trees to that experienced a century earlier: "This is quite possibly the worst damage to our urban canopy since the Halifax Explosion. It's that significant and that order of magnitude" (Pugsley Fraser 2003).[61] Similarly, a report on the provincial government's response to Juan states that the "Joint Emergency Operations Centre (EOC) group – in coordination with the Halifax Regional Municipality (HRM) EOC – mounted the greatest emergency response effort in Nova Scotia since the Halifax Explosion of 1917" (Government of Nova Scotia: 2003: 2). Grieve and Turnbull note: "officials continue to look back [on the Halifax Explosion] for lessons in the challenges of sound emergency preparation. In particular, the city must prepare for the hazards associated with port, rail and road transport" (2013: 77) (see Remes (2016) for an account the Halifax Explosion through the

[61] The Halifax Explosion was an 'emancipatory' catastrophe in two ways. First, it led to transformations in disaster preparedness, response and recovery efforts. Second, due to the death of numerous tramline operators, women were hired as operators for the first time (Remes 2016).

lens of disaster citizenship). Knowledge and memory of disaster, even in the absence of direct experience, leave an impression.[62]

Photo 4.5: Damage caused by Halifax Explosion (*Imo* on far side of Harbour) (Wikipedia 2015)

Relative to Juan, the series of extreme events began five years prior. All of the events have a mobility linkage, whether direct or indirect. On September 2, 1998, Swissair Flight 111, out of New York crashed eight kilometres off the coast of Nova Scotia near the village of Peggy's Cove, with a loss of 229 passengers and crew. The crash was ultimately attributed to a technical failure – fire causing the malfunction of the electrical system and consequently spatial disorientation. Just four years later, planes

[62] Notably, some senior citizens experienced both events (see *The Chronicle Herald* 2003 for one such profile).

emerged again at the centre of disaster. On September 11, 2001, passenger planes were hijacked and employed as weapons. North American airspace was closed and 225 planes bound for the United States were diverted to Canadian airports, including Halifax International Airport. A large-scale response was mobilized to provide food and shelter for passengers. In 1999, another form of movement under duress, facilitated by planes, occurred as refugees fleeing war-torn Kosovo landed in Canada, including Nova Scotia. As one non-governmental organization representative states:

> Who would think 8,000 people [from] 44 planes [would arrive] in Halifax because of 9/11? Who would think that would even affect us, you know? Who would even think that Canada would say we would agree to receive 5,000 [Kosovo] refugees, and that Nova Scotia would take 2,500? And then after these events saying, "Well, that's once in a lifetime. That's never going to happen again." And then you see events like the Superstorm Sandy and then you see events like the tsunami in Japan. ... So what it says is this is more and more possible, and that Superstorm Sandy could have been easily Halifax instead of New York and New Jersey. (NS Non-governmental organization 117) [63]

Due to the succession of diverse extreme events, the sense of such events being unique or 'one-offs' quickly eroded, discernably changing the disaster response culture in Nova Scotia.

During the same time period as these transport-related disasters, the transmission of disease was also a pressing concern. In 2003 an outbreak of *BSE* threatened human health and the beef industry (see Davidson and Bogdan 2010). While the Canadian epicentre of the crisis was Alberta, the ramifications were felt across the country,

[63]The Halifax International Airport Authority (2015b) states that approximately 7,000 passengers on 40 to 50 planes landed in Halifax. In Newfoundland, 78 planes carrying 13,000 passengers landed at five airports (Morrison 2003) (see DeFede (2003) for an account of impact of 9/11 flight diversions on Gander, Newfoundland and Labrador).

including Nova Scotia, as beef exports declined. In 2000, there was an outbreak of the brown spruce longhorn beetle, an insect that attacks healthy trees by preventing the transport of food to tree roots. The invasive species was likely introduced to the province though wooden packing crates offloaded at the Halifax Port Authority. As a result, Point Pleasant Park which is adjacent to the Port, as well as forestry lands were quarantined with ecological and economic impacts further exacerbated by Hurricane Juan. Just as curfews are used to limit mobility of humans, quarantines are used to limit the movement of insects and viruses. Among humans, there was an outbreak of *SARS* in 2002/03. The outbreak originated in China, spreading to 37 countries. In Canada, there were 231 cases and 44 deaths (18 per cent fatality rate). The outbreak was a source of concern for the general population, as well as for frontline health care workers.

In addition to transport, refugee and disease-related events, natural events posed challenges. Hurricane Hortense hit in 1996 incurring $3 million in damage. Significant flooding occurred in the spring of 2003. The Town of Truro declared a state of emergency, closing roads, schools and businesses (Grieve and Turnbull 2003). The flooding resulted in two fatalities and damaged 47 bridges and 200 roads. Approximately $10 million in damage was incurred (Dunn 2003).[64] In winter 2004, just six months after Hurricane Juan, a record-breaking blizzard dubbed White Juan hit causing the province (as compared to municipalities in the case of Hurricane Juan) to declare its first ever state of emergency (Grieve and Turnbull 2013). Following the impacts of Hurricane Juan and White Juan two citizen coalitions focused on the special needs, particularly related to mobility, of

[64] At the same time, flooding isolated Corner Brook, Newfoundland and Labrador for four days.

community members who are elderly and/or who have physical challenges (Grieve and Turnbull 2013). For example, McLeod (2004) writes of how one woman who used a wheelchair required the assistance of two strangers to carry her six floors to her apartment as the elevator was not functioning. In response to such cases, the Special Care Emergency Preparedness Association of Nova Scotia collaborated with Nova Scotia Community Services to create an educational brochure on how individuals with limited mobility can prepare for, and be supported during, extreme events. While such cases of individual mobility are beyond the scope of this project, it is a valuable area for future research.

Mobility figures differently in each of these events. The Swissair crash relates most directly to conventional notions of mobility as human transport, while in the case of 9/11 airplanes were a tool of terrorism. For refugees from Kosovo, it is easy to imagine that movement was a welcome escape from adversity combined with the stress of migration. In terms of BSE and SARS, spread of disease from animal to animal, human to human or from animal to human, arose as matter of concern. In the case of the beetle epidemic, the focus was on containing the spread through quarantines, while in the case of the spring floods water was the focus of discipline (i.e. containment). During Hurricane Juan, restricting the movement of humans was the focus of a strongly advised albeit voluntary immobility.

Table 4.1: Natural, technical and intentional extreme events impacting Nova Scotia, 1996-2004

YEAR	EVENT
1996	Hurricane Hortense
1998	Swissair crash
1999	Kosovo refugee arrival
2000	Brown spruce longhorn beetle
2001	9/11 flight diversions
2002	Severe acute respiratory syndrome (SARS)
2003	Spring floods
2003	Bovine Spongiform Encephalopathy (BSE or Mad Cow Disease)
2003	Hurricane Juan
2004	White Juan (blizzard)

It is worth noting the disasters that were averted either by human or ecological forces. For example, with the extensive and prolonged loss of power following Hurricane Juan, officials "anticipated an increase in food-borne illness… that did not occur" in part because of the proactive measures such as setting up a food safety hotline and providing food vouchers (Government of Nova Scotia 2003: 4). The movement of harmful bacteria through humans was successfully prevented. At the same time as officials were managing the response to Juan another hurricane was being tracked (Government of Nova Scotia 2003). Fortunately, the hurricane did not make landfall but the quick succession of extreme events is not unheard of. For example, the day after the 1917 explosion, Halifax was hit by a blizzard compounding the disaster and hindering relief and recovery efforts.

Long-term planning

Longer term planning was also influenced by these events. Given the diversity of events, an adaptable all-hazards approach is employed by emergency management officials. An all-hazards approach means that the same protocols are used regardless of the nature of the incident. For example, "emergency managers regard terrorist emergencies as they do any other hazard, yielding the same demands for shelter, food, and communications as weather or accident-related emergencies" (Grieve and Turnbull 2013: 69). Reflecting on Hurricane Juan, an emergency manager states:

> It reinforced how we do things. … the process hasn't changed. The actual how we get information, how we make decisions, and how we catalogue that – that hasn't changed because it was sound to begin with. I started using that back in Swissair days. (NS Government 118)

The management process remains the same regardless of the type of event, and both interview participants and policy documents convey a sense that the approach is effective. Through iterative learning, the process is fine-tuned with each event (Grieve and Turnbull 2013). In their study of emergency planning in Nova Scotia, Grieve and Turnbull find that stakeholders deem the process "adequate and moving forward" (2013: 62). One aspect of the emergency planning system in Nova Scotia that is credited with its efficacy is the location of federal, provincial and municipal (i.e. Halifax Regional Municipality) emergency officials in one building, facilitating informal connections and quick consultations (Grieve and Turnbull 2013). The physical co-presence, to use Urry's term, reduces friction in, and increases speed of, decision-making.

A review of EMO responses conducted after Juan identified three broad lessons: improving the use of resources and people (e.g. leverage skills of Department of Justice staff who have experience transporting people), improving operational protocols (e.g. identify back-up sites for emergency operations centres) and improving communications (e.g. provide callers to emergency hotlines with hold time estimates) (Government of Nova Scotia 2003). However, Grieve and Turnbull find that the "sporadic and event-driven nature" of these events results in a focus on refining the emergency response process, rather than a focus on disaster prevention – demonstrating passive rather than transformative resilience (2013: 64). Likewise, the framing of the impact of the Icelandic ash cloud event on the aviation sector as a political and administrative "fiasco" diverted attention away from "safety, our over-dependency on aviation and mobility, [and] the impact of aviation on climate change" (Budd et al. 2011: 39). Additionally, in Canada since 2001, the federal government has directed its attention towards border and international security issues, downloading responsibility for extreme weather-related events to provinces and municipalities (Grieve and Turnbull 2013).

Social-ecological mobility webs

From an ecosystem perspective, and consequently from social, health and economic perspectives, global and local space are biophysically enmeshed. Giddens observes "very few new-style risks have anything to do with the borders of nations" (2003: 34), a trait held in common with mobility webs. What emerges are multiple complex and intersecting mobilities (i.e. natural, technical, political) that continually shape each other. Humans do not exist in isolation but are enrolled in materialist assemblages, "imbroglios of people and things," that result in the co-construction of humans and non-humans (Latour 2011: 4). This is particularly the case with the natural environment on which humanity depends. "Nature, contrary to appearances," Latour argues, "is a political animal. It is what is used to define the world we have in common, the obvious existence we share, the sphere to which we all pertain equally; it is what connects us" (2011: 8). Disciplining or securitizing such diverse, complex and multiscalar mobilities appears challenging at best, highlighting a more diffuse distribution of power between the social, ecological and technical, contrasting with modernistic images of humans conquering time and space.

The swaths of felled trees can arguably be construed as an ecological vernacular, a legibility imposed by the non-human environment on humans. Nova Scotia's landscape, was rewritten by Hurricane Juan (Sodero 2014c). Hurricanes leave a temporary geomorphic signature characterized by slope erosion, fluvial outwash deposits and stream bank erosion (see, for example, Catto and Tomblin 2013). Such an extreme event lays bare not only the tenacious and tenuous nature of the human relationship with the non-human environment, but reveals the artificiality of the human/non-human dichotomy. Just as bacteria populate an elbow crook, humans populate ecosystems (Bennett 2010). Notions of scale and hierarchy are easily disrupted. The events experienced by Nova Scotia over the course of a decade illustrate the inseparability of humans and non-humans, that is, the indivisibility of the planetary ecosystem. With climate change, the co-constructed networks of human and non-humans "come out of hiding" (Latour 1996: 139). Greenhouse gases, hurricanes and humans are engaged in a real-time climate experiment where ecological and policy responses are entwined (Latour 2011).

It is valuable to consider a nexus of climate change interactions made up of both climate change causation and human and ecological impacts. Whereas government, industry and community members may be seen to exert power and adversely affect the climate through a fossil-fuelled mobile society, severe weather events such as Hurricane Juan, turn the table. Climate change-related events are disrupting mobility, intersecting with other natural, technical and intentional disruptions. Deep structural shifts in the global carbon cycle are disturbing surface continuities in the mobility complex. The aspiration of 'seamless' connectivity needs to be reconsidered (Cowen 2013).

Climate change

In policy documents, legislative transcripts and interviews, links are made between Hurricane Juan and climate change. A report summarizing a provincial emergency response debriefing session on Hurricane Juan states:

> Many people [in attendance at the debriefing] suggested Hurricane Juan was a "hundred-year storm" in name only – that with a changing global climate and warming ocean currents, a repeat was possible, if not likely. An official from the Department of National Defences put it most directly: "…Only a fool would act on the supposition that it would not happen again." (Government of Nova Scotia 2003: 8)

Likewise, one environmental manager states:

> Professionally, I think it was an opportunity for reflection on the impacts of the severe weather. It was on the radar already. It was already something that we were looking at in terms of the goals and objectives of the [*Climate Change Action] Plan*. It was fairly clear, even at that point, that we would look at the climate change, but also look at emergency events, sort of unexpected in terms of the weather, as part of our planning. (NS Government 114)

The influence of Hurricane Juan on future policies and responses was immediately apparent.

In the Legislature, Member of the Opposition Joan Massey drew links between Hurricane Juan and climate change, challenging the government's response:

> Mr. Speaker, we have been told that climate change could lead to an increasing severity in these storms. In expectation, we should be working with Nova Scotia Power to safeguard our infrastructure. In response to 1998's massive ice storm, both Quebec and Manitoba developed environmental targets. Manitoba took steps to upgrade its transmission systems. Mr. Minister, has your department assessed how we can be better environmentally protected in case of another storm? (NS Hansard October 7 2003)

The Minster of Environment responded by stating the government's intentions to work with Nova Scotia Power. However, while improvements may have been made, ongoing issues persist (Grieve and Turnbull 2013).[65] Links between Hurricane Juan and climate change were less common in the media coverage, perhaps due to a focus on more immediate issues of recovery.

Hurricane Juan is referenced on the first page of the provincial *Climate Change Action Plan* (CCAP), released six years after the event:

> When it comes to climate change, Nova Scotia faces a triple threat:
> - Because most of the energy we use comes from fossil fuels, we have an unusually long way to go in curbing the emissions that cause climate change.
> - We're at the northern end of the Atlantic hurricane track, where more storms similar to Hurricane Juan could hit us as the planet warms.
> - With 7600 km of coastline, we are exceptionally vulnerable to rising sea levels caused by climate change. (Government of Nova Scotia 2009: 3)

[65] Notably, however, power failures are a regular feature of severe weather events in Nova Scotia, such as occurred during post-tropical storm Noel (2007) (Grieve and Turnbull 2013).

The CCAP addresses the transport sector, focusing on increasing vehicle efficiency, promoting sustainable modes of transport and designing communities to reduce the need for transport. The report asks fundamental questions that strike at the heart of transport by probing societal reliance on mobility: "Are Nova Scotians willing to move closer to work or public transportation? … How can we redesign communities to minimize the need for transportation? Can more efficient urban layouts for our towns and cities be encouraged by rezoning?" (2009: 20). These are bold questions given the reliance on fossil-fuelled automobility in Nova Scotia. However, such transformative questions are not reflected in the nine action items listed in the CCAP. Six actions pertain to vehicle efficiency (e.g. maximum speeds for semi-trailers) and three to sustainable transportation (e.g. expand innovative sustainable transportation projects), with none focusing on land-use planning. Translating intention to practice is challenging, especially in the context of goals that involve several provincial departments, as well as municipalities.

One of the actions included in the CCAP was developing a *Sustainable Transportation Strategy*, released in 2013. The Strategy does not reference Hurricane Juan specifically, but takes an integrated approach that addresses climate change, energy costs and health. In terms of climate change, the strategy states:

> the impacts of climate change will affect Nova Scotians in a number of different ways that include more frequent extreme weather events, rising sea levels, and warmer average temperatures (Intergovernmental Panel on Climate Change 2007; Climate Change Action Plan 2009). This will put further strain on our current transportation system as more roads and other infrastructure are washed out by storms and floods. We are already starting to see the impacts of climate change in Nova Scotia. Adaptation to climate change will be an important component of the provincial government's approach to all activities. Our transportation system will also have to be resilient to the impacts of climate change, which should be part of all our transportation-related decisions. (Government of Nova Scotia 2013b: 9)

The Strategy focuses on passenger transport and forwards 28 actions pertaining to leadership, collaboration, community engagement, transport networks (i.e. active transportation, public and community transit), urban and rural planning, vehicles and fuels, and monitoring and evaluation. The guiding principles of the Strategy include increasing vehicle efficiency, but also to “drive less distance” and “provide access to employment and essential services” and to “engage with our communities to create locally designed, regionally integrated solutions” (2009: 17-18). The report focuses on personal journeys, such as commuting, while the modal distribution of freight and the role of air and rail travel are not addressed in the Strategy, signalling significant gaps in terms of decarbonizing transport and promoting transport resilience in the context of disaster.

Towards an ecopolitics of mobility

Hurricane Juan brought mobility to the fore in multiple ways, from the charismatic mobility of the storm itself to the immobilities caused by entanglements of trees and power lines and the immobilities promoted by a state of emergency. At the local scale, public transit service, both pragmatically and symbolically, was an important means and measure of mobility. At the regional scale and beyond, the inundation of multiple, diverse and complex events, from the terrestrial movements of beetles to the atmospheric movement of planes, created challenges for Nova Scotia, rapidly developing capacity in an undesired ‘all-hazards’ skill set.

The six elements of an ecopolitics of mobility – motive force, speed, rhythm, route, experience and friction within Nova Scotia’s mobility web – prove adept at describing flows related to Hurricane Juan. The charismatic mobility of the hurricane motivates people to takes risks to experience the force of the environment. Managing both charismatic movement and mandatory evacuations promise to be a feature of increasingly frequent storm events throughout Atlantic Canada and beyond. While just a slice of what can be included under ‘experience’ of the *eco*politics of mobility, it indicates one concrete dimension of issues that arise when communities are impacted by severe weather. The hurricane’s speed is notable, as is the speed with which it caused a fully functioning mobility web to contract and immobilize. In terms of rhythm, the contracting mobility web disrupted daily transport rhythms and replaced them on the one hand with immobility by the many, as communicated by messages to stay off the roads both for safety purposes and to allow clean-up to occur, and on the other hand, the urgent mobilities of a relatively small group of skilled workers, such as emergency management officials, line crews and tree clearing crews. Route pertains to the uncertainty related to the storm path, which made landfall in the most densely populated region of Atlantic Canada. As one non-governmental representative noted the path of Hurricane Sandy could easily have reached Nova Scotia. Route also pertains to the disrupted roads in Halifax and the friction caused by fallen trees and power poles, and the concomitant adaptations. Friction also occurs in the dissonance between the expectation of the hurricane force and the actual experience of the event, illustrating the tensions that appear as human grapple with a changing climate and new parameters for what constitutes normality. Finally, experience varies from the thrill and fear associated with watching and hearing the storm, to the social connections facilitated by upheaval to grief for a transformed treescape, and in worst cases, mourning for community members.

Key sources of resilience include maritime cultural knowledge of the need to prepare for severe weather events (i.e. batten down the hatches), the creative use of public transit as both emergency transport and shelter as well as a symbol of a reinstatement of the mobility web, and the coordinated and collaborative all-hazards approach to disaster management in Nova Scotia facilitated by both formal as well as informal relationships and physical co-presence in the same facility. Key sources of vulnerability include the precarious co-presence of the urban forest canopy and the electrical grid, susceptibility of hard static infrastructure (i.e. roads, rail) to storm impacts, reliance on electricity to access fossil fuels (i.e. gas pumps) and the lack of generators given this reliance, as well as the reliance on finite and carbon intensive energy sources for fuel. Further, disruptions to mobility exacerbate pre-existing vulnerabilities such as the (im)mobility of physically challenged community members and flows of patients through hospitals as measured by wait times.

In the face of multiple extreme events that relate directly to and impact mobility, governance morphs from art to triage. Community members actively negotiate their own mobility. The governmobility of citizens and the mobility limitations imposed by a state of emergency are both a source of resilience and vulnerability. Residents, while enticed by the charismatic mobility of the storm and charismatic immobility of the storm’s impacts, as well as motivated to meet basic daily needs and assist with recovery, appeared to successfully navigate the disrupted mobility landscape as measured by the lack of fatalities (by contrast, see Murphy (2009) for a discussion of the fatality and injury rates that resulted from the North American ice storm). Simultaneously, municipalities and the provincial government can, and in the case of the former, did enact states of emergency that permit limitations on mobility. One vulnerability lie in selecting the appropriate mix of persuasive and coercive measures within a state of emergency, permitting governmobility where possible while also ensuring the protection of citizens. Another vulnerability for officials and citizens alike, is the level of discretion used by officials in enforcing voluntary immobility (i.e. might a group of white teenagers exploring damage after the storm in the south end receive differential treatment than a group of black teenagers in the north end?). Numerous complaints were received about youth "smashing windows, harassing outside workers and setting brush fires" (The Chronicle Herald 2003" 73). Though no incidents of discrimination emerged in the dataset in the contexts of Hurricanes Juan (nor Igor), given the racialized dimensions of both crisis mobilities (e.g. Hurricane Katrina) and the non-crisis mobilities (e.g. New York's stop-and-frisk policy), it bears flagging as a potential issue.

The development of a *Climate Change Action Plan* and a *Sustainable Transportation Strategy* are efforts to secure the population from the effects of climate change and the adverse impacts of fuel price volatility and sedentary lifestyles associated with automobility, as well as to discipline anthropogenic greenhouse gas emissions. An unfortunate source of resilience is the lack of change in the provincial and municipal modal split profile. The experience of Hurricane Juan combined with other extreme and ongoing events (e.g. decreasing health, increasing fuel prices) has led the province to consider the need for transformative resilience characterized by questioning societal reliance on both fossil fuels and automobility, as well as taking steps to discipline, restrain and redirect the *eco*politics of mobility. While these steps are incremental (i.e. by focusing on increasing the energy efficiency of automobility and trucking), given the scale of change required, they in a modest way recognize the need for change and resist a wholly passive resilience. The fact that these documents, particularly the *Sustainable Transportation Strategy*, question the status quo of mobility is notable and a valuable area to build upon, for example through the development of a resilience strategy that brings together the field of transport, disaster management and climate change mitigation and adaptation, as well by drawing questions of transport resilience writ broadly into discussions of economic development such as raised in the Ivany Commission report (See Chapter 7: Navigating Transition). Nova Scotia has started the wheels moving on an important policy conversation. The next step is to gain traction.

5 PORT OF CALL II: RESULTS
HURRICANE IGOR: THE (PASSIVELY) RESILIENT NEWFOUNDLANDER

We had only just begun

to put leashes on things that had resisted
being caught. In this way, we muzzled

our concerns and decided to turn on lights
before it got dark.

Sue Goyette
Six
2013

Alex Colville
Truck Stop
1966

A man blends into the background amidst the transport truck and gas pump. His broken arm hints at the vulnerability of humans in tightly coupled social-technical assemblages. His other hand rests on the pump, as if tethered: "leashes on things that had resisted being caught."

Introduction

Chronologically, our second port of call is Hurricane Igor. Two key examples of resilience were lauded during Igor, that of individual through the frame the '*resilient Newfoundlander*' and that of community coming together: '*getting things back to normal as quickly as possible*.' In terms of responses, a variety of resiliencies and vulnerabilities related to social-ecological interactions materialized. A robust form of passive resilience characterized the response of both communities and the government, where the priority was returning things to normal with limited reflection on how to proceed given past and prospective severe weather events.

In terms of frames, there is emphasis on a '*ten-day recovery*' narrative, referring to the time it took to reconnect the road network, albeit partially and with temporary repairs. There is a parallel frame praising the resilience of residents and expressing pride in the community in both grappling with the impacts and affecting a prompt return to normal, but a notable absence of a transformative frame proposing a new social-ecological relationship with limited references to climate change in all data sources. Throughout this Port of Call I highlight how an *eco*politics of mobility – drawing on Cresswell's six elements of motive force, velocity, rhythm, routes, experience and friction – and Foucault's theorization of circulation are well suited to detailing the interface and power dynamics inherent between the environment and contemporary social-technical mobility assemblages.

Newfoundland's mobility web

Since the 1992 cod fishing moratorium, two prominent strategies were pursued to diversify Newfoundland's economy: *attractive* development in the form of tourism and *extractive* development in the form of the oil (Luke 2002).[66] Newfoundland aims to double its tourism revenue by 2020 and maximize oil revenue (Government of Newfoundland Labrador 2009a). Both sectors are central to the provincial economy and both are embedded in a petrocapitalist mobility complex that centres on the 'production, exchange, and consumption' of fossil fuels (Valdivia 2001: 312; also see Altvater 2007, Urry 2013). The tourism sector is linked to petrocapitalism via a global, fossil-fuel dependent mobility network that includes airplane, cruise ship, ferry and car travel, while the oil sector is bound to petrocapitalism through fossil fuel extraction, employment and royalties (Urry 2013).

The petrocapitalist profile of Newfoundland's economy is apparent when analyzing Gross Domestic Product (GDP), employment and greenhouse gas emission statistics. The oil sector contributes significantly to the provincial GDP, 31 per cent, compared to less than five per cent for the tourism sector.[67] However, the tourism

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[66] The province of Newfoundland and Labrador consists of an island in the North Atlantic (Newfoundland) and a portion of the continent land that borders the province of Quebec (Labrador). Both have limited transport options due to their remoteness. However, I focus on the island portion, Newfoundland, as this received the brunt of Hurricane Igor's impact.

[67] With the fall of oil prices in 2014/15, the contribution of the oil sector to provincial GDP is on a downward trend (Canadian Broadcasting Corporation 2015b).

industry is an employment engine, engaging 13,000 people, compared to approximately 3,000 in the oil sector (Government of Newfoundland and Labrador 2014a; Higgins 2011).[68] The fossil fuel intensive transport and oil sectors account for approximately seventy per cent of provincial greenhouse gas emissions (Government of Newfoundland and Labrador 2011a).[69] Such carbon intensive development is at odds with the provincial emission reduction target of ten percent below 1990 levels by 2020 (Government of Newfoundland and Labrador 2011).[70]

I use the term mobility webs to refer to the environmentally exposed, but also diverse and adaptable dimensions of contemporary mobility systems. Newfoundland's mobility web lacks redundancy, defined by vast spaces and limited transport options and routes. A road manager, Phil, observes: "one of the problems we faced was the fact that some places there was no other route: the Trans Canada, for instance. There's ways that you just can't get around the Burin Peninsula Highway" (NL Government 106). In terms of mobility, redundancy can be defined as having more than one way to get to a destination, or being able to meet needs independent of mobility (e.g. local provisions of food, medicine, fuel). Limited routes render Newfoundland more vulnerable to severe weather impacts. A reliance on ferries and one highway means that disruptions are "reflected almost instantly in empty shelves" as the average five-day food supply dwindles (Catto and Tomblin 2013: 96). Further, a declining and ageing population has

[68] Employment figures in the tourism sector include seasonal and part-time employment; employment figures in the oil sector increase temporarily during the construction phase of a given project.
[69] Based on greenhouse gas inventory data, this calculation includes oil production (e.g. oil and gas extraction and related fugitive sources, as well as mining) and transport (e.g. gas- and diesel-powered road, off road, marine and domestic air travel). The calculation is approximate as oil and gas data includes mining, and transport data excludes international aviation and marine transport.
[70] For anticipated regional climate impacts see Catto (2010) and Finnis (2013).

led to the centralization of provincial services such as hospitals and schools (Catto and Tomblin 2013).

Travellers access the island by air or ferry. There are three hub airports, including the St. John's International Airport in the capital city on the east, Gander airport, a formerly significant hub in transatlantic passenger travel and military transport in central Newfoundland, and Deer Lake on the west coast (Figure 5.1). Two ferries are operated by the Crown corporation Marine Atlantic, a year round ferry that travels between North Sydney, Nova Scotia and Port-aux-Basques on the western side of the island and a seasonal ferry that runs between North Sydney, Nova Scotia and Argentia on the southeastern side of the island. Marine Atlantic ferries also transport freight, as do private sector companies.

The vast majority of goods – from food, to the refrigerators that hold food, to the materials needed to build homes that hold refrigerators – are shipped. A marine operator speaks to the lack of self-sufficiency:

> We're not self-sufficient. So if it's a trend that weather conditions are going to be more severe in the future, I guess – and I hate to say that we've just to live with it, but that's probably-, we've done it for hundreds of years. We've made our life around the water all along the coast of Newfoundland. And we we're so dependent on the ocean to maintain, I suppose, to develop the lifestyle that we have. But even now as things change, as the economy changes, look at the offshore oil, the oil industry. It's huge, and it keeps growing. But we've got to be able to supply their needs. So there is a huge impact. (NL Transport 110)

The marine operator continues, "If the trend is that there's going to be more impact from weather or we're going to see more severity in weather systems, I think as an island we have to expect that there's going to be an impact to supplying the island" (NL Transport

110). On one hand, these statements indicate an appreciation for the environmental exposure of Newfoundland as a coastal region, with communities reliant upon the ocean, for transport. On the other hand, these statements reveal a disjuncture or, to adopt Cresswell's term, friction, between the experience of climate change impacts in the form of severe weather and anthropogenic contributions to climate change in the form of shipping and the oil industry.

Once on the island the dominant form of transport is by car and truck. The Trans-Canada Highway reaches from Port-aux-Basques on the west coast to St. John's on the east coast; it is the only highway that transects the province. There is a private bus service that offers a daily trip across the island – notably travelling across the island by bus takes approximately the same amount of time as it takes to cross Canada by air. St. John's offers a modest public transit service, while taxis operate in both the capital and smaller communities. In addition, 14 provincially funded ferries operate, connecting communities within Newfoundland.

The transport sector, including passenger and freight transport, accounts for 29 per cent of provincial emissions – the second largest emissions source after large industry (44 per cent) which includes the oil sector (Figure 5.2).[71] The volume of transport is on the rise. The St. John's International Airport projects reaching two million passengers by 2020 (compared to 1.6 million in 2014), and is in the process of installing technology that will allow flights to land even in foggy conditions (Broadcasting Corporation 2015c). One marine shipper comments on recently adding a new ship to his fleet, while another

[71] This figure is on par with Nova Scotia where the transport sector also accounts for 26 per cent of emissions and is the second largest source of provincial emissions (Government of Nova Scotia 2013b).

Figure 5.1: Newfoundland and Labrador transport map (Nelleman 2016)

marine shipper projects an annual increase in commercial shipping of 1.5 per cent per year (NL Transport 110, 113). In terms of commuting, travelling by car or truck is the dominant mode, accounting for just under 90 per cent of the modal share between 2006 and 2011 (Statistics Canada 2011). Within the transport sector, 64 per cent of energy is consumed by road transport, 23 per cent by the marine transport and 13 per cent by aviation (Government of Newfoundland and Labrador 2011a) (Figure 5.3).

Figure 5.2: Greenhouse gas emissions by sector, Newfoundland and Labrador, 2010 (Government of Newfoundland and Labrador 2015)

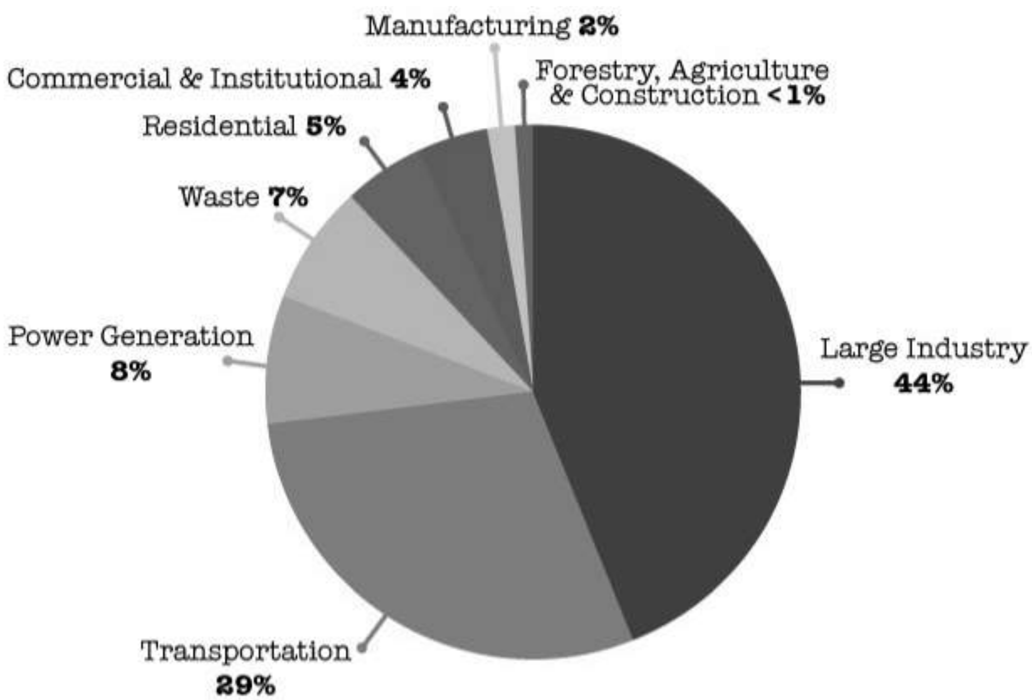
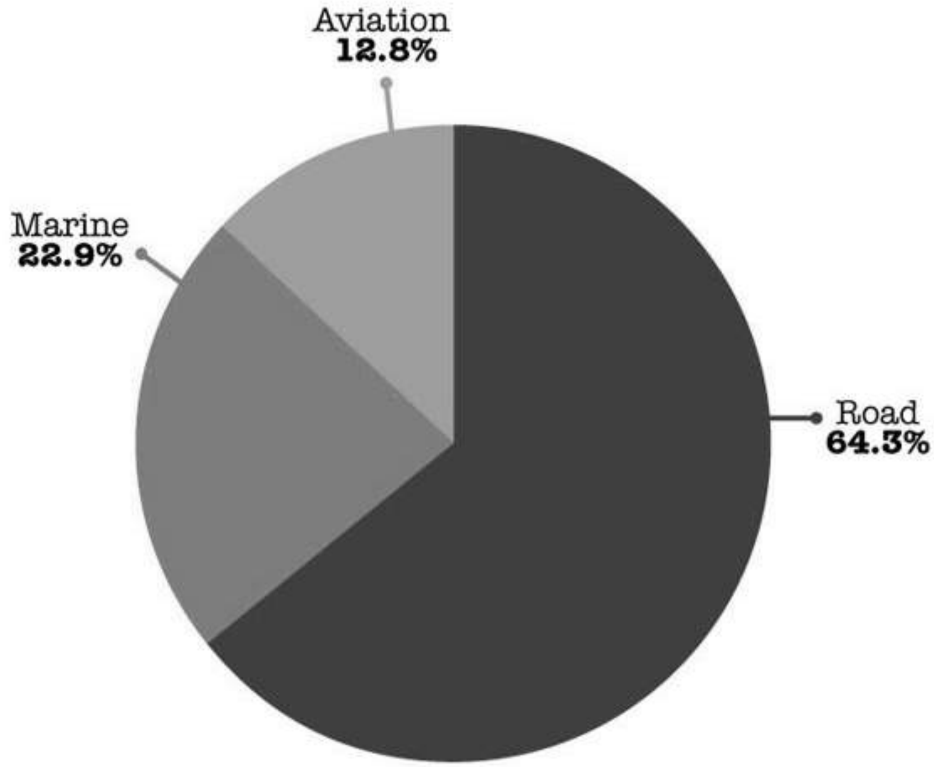


Figure 5.3: Energy consumption within the transport sector, Newfoundland and Labrador, 2010 (Government of Newfoundland and Labrador 2015)



Hurricane Igor

Hurricane Igor formed off the coast of Africa on September 8th, traveled across the Atlantic Ocean reaching Bermuda on September 20th and intensified as it tracked up the Eastern seaboard. As it approached Newfoundland, it combined with a moving storm front, Hurricane Julia and a trough of low pressure making landfall in Newfoundland on September 21st (Environment Canada 2011). Fire and Emergency Services Newfoundland and Labrador, the provincial body responsible for emergency response, monitored the storm a week in advance of its arrival (Courage 2013). With contemporary storm tracking technology, the track or route of hurricanes is closely monitored – or from a Foucauldian perspective, surveilled – as minor shifts in the storms trajectory can mean the difference between making landfall or heading into open ocean.

Preliminary data indicated the storm would track over the ocean, however the day before the hurricane hit the Canadian Hurricane Centre issued warnings that the storm could track over land: “even during the day of the event, the position and track forecast had to be continually adjusted closer to land as the details of the upper-level trough influence were evolving” (Environment Canada 2011). Likewise, hurricane speed is a matter of concern. As Igor passed over Newfoundland it was in the process of transitioning to an extratropical hurricane. Such transitions are typical in the North Atlantic and characterized by a “larger rain and wind field” (Masson 2014: 631). Though Igor was large, it was not fast. While hurricanes distinguished by stronger winds rank higher on the Saffir-Simpson Wind Scale, slower moving storms can yield greater damage from precipitation, as there is more time for the rainfall to inundate a given region (Masson 2014). This was the case with Igor.

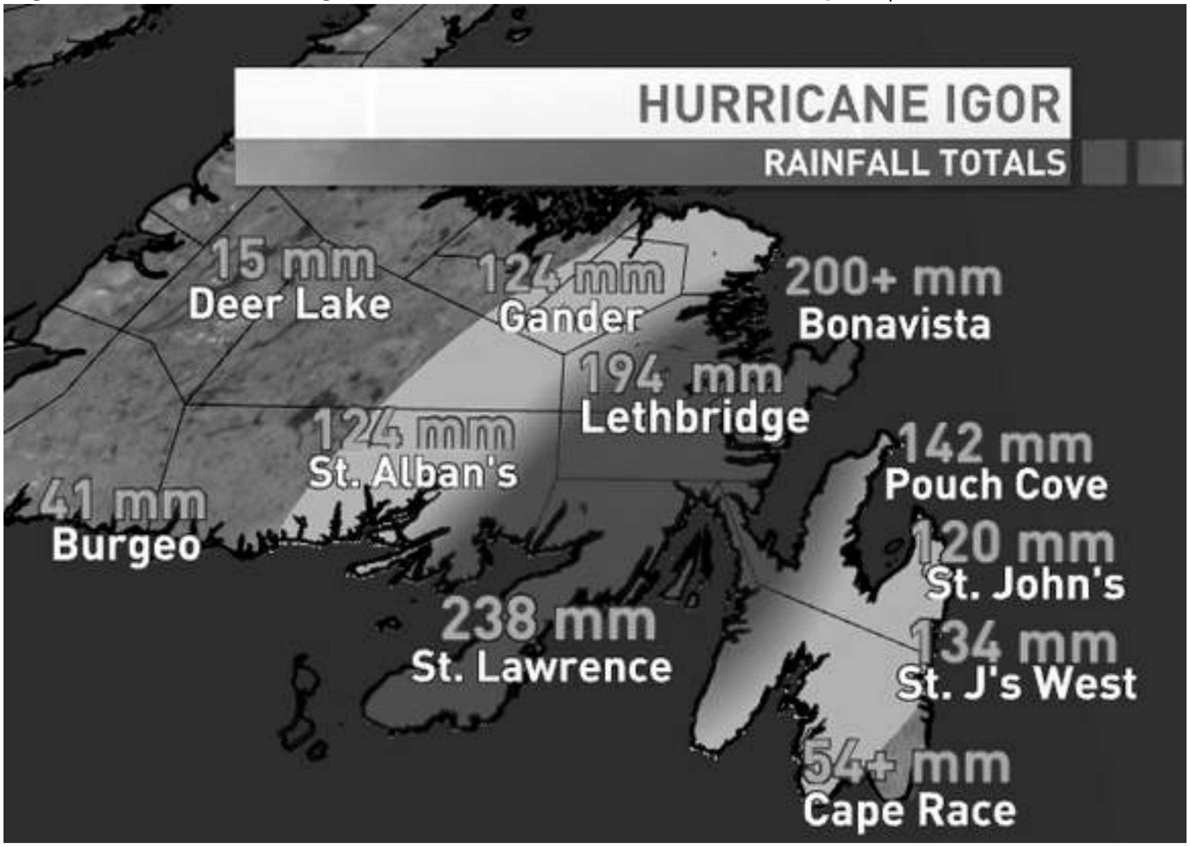
In early September, storm warnings were issued for Hurricane Earl, which was forecast to track over land. The anticipated storm received media coverage, but the impacts were mild compared to Hurricane Igor. By contrast, Hurricane Igor, which was projected to track offshore received less media attention prior to landfall. Igor’s change in direction caught the region off guard. Acting pre-emptively, the Eastern District School Board closed schools preventing the movement of dozens of schools buses (Courage 2013) (see Fothergill and Peek (2015) for a discussion of the impacts of disaster on children, including long-term absence from school). Oil companies evacuated approximately 200 workers from offshore oilrigs (Canadian Broadcasting Corporation

2010a). Eastern Health set up shelters, however no evacuations were ordered (Masson 2014). Proactive measures were also taken by a non-governmental organization: “we preposition supplies on the island and in Labrador, because if it’s foggy we don’t get flights in. If it’s windy we don’t get flights or boats in” reflecting familiarity with the difficulties that develop when mobility webs are disrupted by weather (NL Non-governmental organization 116).

Igor was a record breaker. Spanning 1,480 kilometres in diameter, it was the largest recorded storm in the Atlantic Basin until Hurricane Sandy (Government of Newfoundland and Labrador 2010a). [72] Sustained winds reached 130 kilometres per hour, with gusts of 170 kilometres per hour, ranking it a category one hurricane on the Saffir-Simpson Wind Scale. It was the third wettest hurricane in Canadian history, deluging the Bonavista and Burin Peninsulas with up to 250 millimetres of rain, or approximately 20 per cent of annual precipitation for the region (Current Results 2015; Environment Canada 2011) (see Figure 5.4).

[72] Hurricane Sandy (2012) had a diameter of 1,600 kilometres (National Oceanic and Atmospheric Administration 2013).

Figure 5.4: Hurricane Igor rainfall total (Canadian Broadcasting Corporation 2010b)



Newfoundland is colloquially known as The Rock due to its geologic makeup – when such intense precipitation hits the province's thin soil it was quickly saturated (Catto and Tomblin 2013). Stream flow increased from a mean of 10 cubic metres per second to 600 cubic metres per second (Masson 2014). One community member draws on a transport metaphor to describe the scale of impact: "It sounded like a roar, like an airplane was going to land in the backyard, but it was the brook" (The Telegram 2010). Floyd Prince recounts the inundation of his store and post office:

> … In a matter of minutes the store faced destruction as the waters rose in a nearby pond, overflowing its banks. "I went to secure the gasoline storage facility (in the parking lot)," Prince says, "and by the time I got back to the store, I had to fight the current to get back inside."… Water surged from the back of the building

> through the loading door. Deep freezers floated. The community's mailboxes and Prince's office became saturated beyond salvation. Fearing his store would fill to the ceiling, Prince left the front door open to let the water "pour out like a waterfall." …"You can't stop nature at that point," says Prince. (Borja 2010)

Prince concludes that the experience left him "heartsick" (Borja 2010).

States of emergency were declared in 30 communities (CTV News 2010a). The storm caused dramatic upheaval to Newfoundland's mobility web, particularly the road network, resulting in extensive and prolonged road and bridge washouts that isolated more than 100 communities. In a photo book commemorating the event, journalist Barbara Dean-Simmons reflects:

> I never imagined life without a highway, no connection between communities. … Huge chunks of pavement had disintegrated, leaving gaping holes and sheer drops. Streams and rivers had changed their courses; water flowed in areas where water had never flowed before…. The 35-km route that I took everyday to get to work was practically obliterated. Guardrails hung like slack clotheslines across huge gaps. Asphalt was ripped apart like paper. (The Telegram 2010)

In addition, vehicles were damaged and air and marine transport were interrupted.

The failure of the road system resulted in the blockage of diverse flows of people and goods, from the utility crews required to reconnect electrical services to the flows of oxygen to people with home ventilation systems. Transport to work and school, and the movement of goods such as food, water and fuel, as well as access to medications and treatments such as insulin, dialysis and methadone was challenging. In addition, approximately 70,000 households lost power. The Canadian Forces were brought in to assist with recovery. Costs estimates for infrastructure and property damage range between $100 to 200 million.[73] As with Hurricane Juan, Hurricane Igor's arrival at night was attributed with lower rates of injury and mortality. However, one life was lost when the driveway upon which a man was standing washed out.

Photo 5.1: Typical example of type of damage to roadway caused by Hurricane Igor - Little Barasway, Avalon Peninsula (Rose 2010)

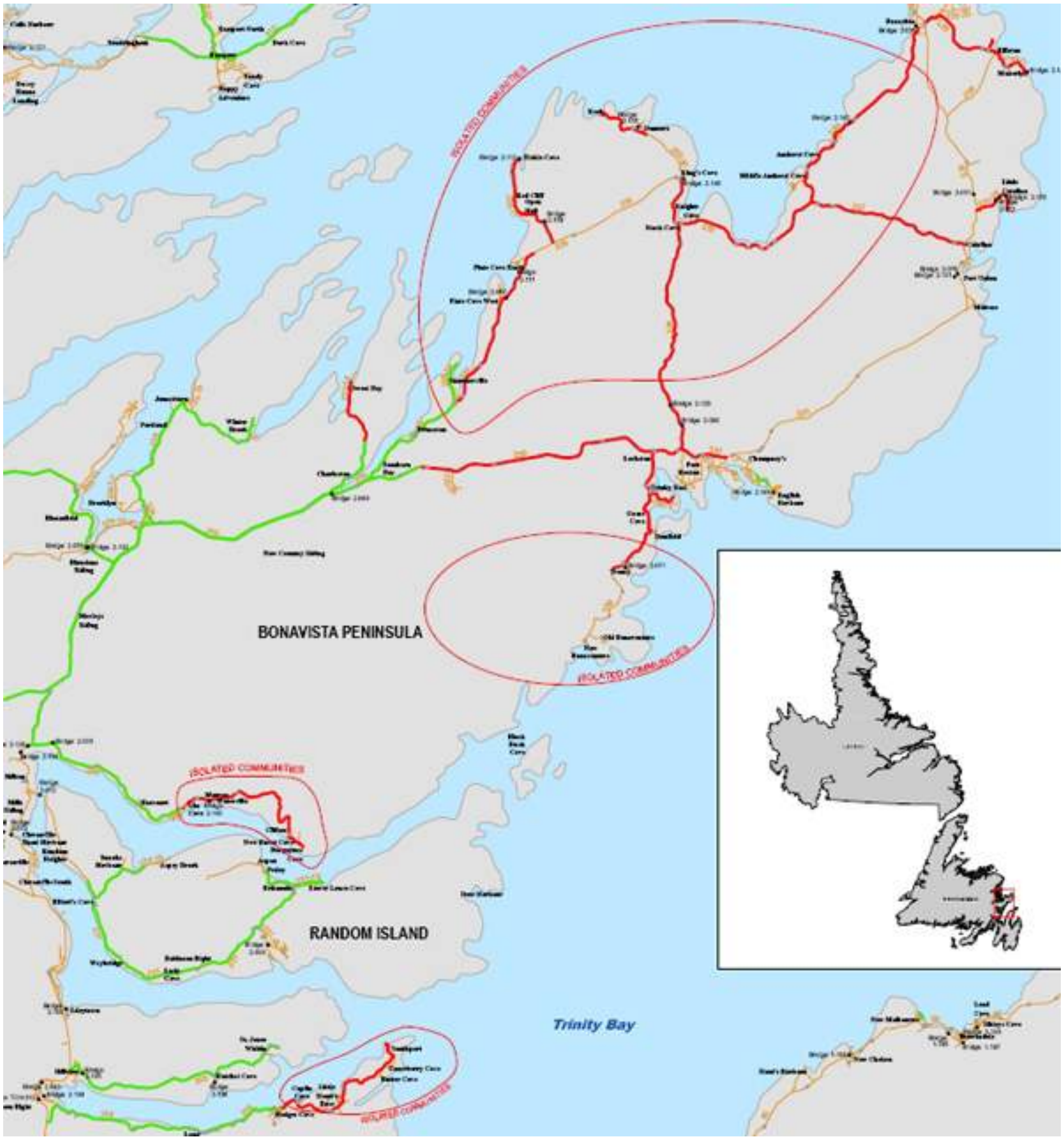
[73] Costs for Hurricanes Juan and Igor are estimates that include insurable costs and costs recovered under the Federal Disaster Financial Assistance Arrangement (DFAA). They do not include uninsured costs, indirect costs, nor ecological and social costs not reflected in the market. Critically, overland flooding was not an insurable cost. At the time an Insurance Bureau of Canada representative stated: "There's no policy available to homeowners in Canada that would cover that kind of damage," though recently overland insurance is available on the market (Aviva 2015; The Telegram 2010 np).

Mobile roads

Once the storm passed, the first step was assessing damage: determining what routes were intact and what routes had structural failures (Figure 5.5). Roads transmuted from the realm of fixity to the world of fluidity. A politician recalls: “We went down to Random Island and it hit us. Total destruction over there. … [It] wasn’t gaps – there were just roads just sort of gone, right? My thoughts were, “My god, we’re going to be years putting this place back together”” (NL Government 107). The order of the road network was supplanted by hydrological mobility: “The turbulent movement of a fast-flowing river for example, may be formed of intricate orders, when the liquid reaches a certain speed or ‘critical point’ the random flow of a moving liquid gives way to the intricately ordered patterns of turbulence” (Bryant 2007; Cresswell and Martin 2012: 519). To use a driving analogy, human mobility yielded as water took the right of way.

Society had to reorient itself and navigate a dramatically changed mobility landscape. Road manager, Phil, recalls gathering information from the ground and via word of mouth: “we were getting calls coming in from everywhere, and our staff couldn’t get out to check on a lot of it because the roads were–. Once they got to the first washout, that’s as far as they got” (NL Government 106). Phil describes the process of piecing together the impacts of Hurricane Igor on the mobility web:

Figure 5.5: Map of Bonavista Peninsula road closures (red indicates road closure) (CTV News 2010b)



> [Fire and Emergency Services] set up a command centre and they had different government agencies at that centre, and we would feed that centre with information. … The first day, none of that was in place. It got better as a couple days went ahead. But the first day … you couldn't get a chopper or fly because the winds were too high. And it was still raining, so you couldn't get out and really assess the damages. … [But after] that first day we had a pretty good idea. We might have missed some smaller ones, like a side road in a community, that kind of thing, but we had a pretty good idea that all our major routes were compromised. (NL Government 106)

The first step of navigating disruption, that is, identifying the scale and range of impacts on routes, is fraught with difficulty. Given the weather conditions and infrastructure damage, even conducting a basic impact assessment of the damage to the road network proved challenging. While some officials had access to helicopters and were able to get a bird's eye view of the situation, most transport managers relied on first-hand experience and second-hand accounts. Looking forward, one town manager imagines that in future events, drones will be an important tool for mobile disaster surveillance, permitting aerial mobility without risk to human life (NL Government 104).[74]

Of the damage, one road manager describes the stretch of highway for which he is responsible "it runs … pretty much the path that Igor took" (NL Transport 106). In terms of the impact on the mobility web the road manger draws on a war metaphor "It looked like a war zone. It looked like strategically dropped bombs on bridges and crossings" (NL Transport 106). Likewise, an editorialist for the provincial newspaper *The Telegram* recalls, "It's the closest I've ever felt to being involved in a battle, except the enemy was the weather and it had far more in its arsenal than we did" (Frampton 2010). The

[74] This interview was conducted in 2013. In 2016, the use of drones in disaster contexts is commonplace illustrating the speed of technological uptake.

hurricane’s track traced the path of the road network, an unfortunate alignment of ecological and human transport routes (Photo 5.1).

Given that many regions in Newfoundland only have one primary road, Igor hit where it hurt, exacerbating a pre-existing vulnerability of a fragile mobility web that lacks redundancy. Fire and Emergency Services lamented the lack of “overland re-routing options” (Masson 2014: 63). A fuel provider comments on the variable state of road maintenance across the province where sparsely populated areas may be less likely to attract provincial investment in maintenance but may still experience relatively high drive-through traffic volumes. He observes that “there’s a lot of roads that were in a lot worse shape than those areas that got washed out, that probably didn’t get as much wind and rain, so they were lucky” (NL Transport 123). The prospect that the damage to Newfoundland’s road system could have been even worse if the storm track shifted slightly raises a new specter for both climate and disaster mitigation. Road infrastructure is particularly vulnerable precisely because it is intended to be immobile.

This contrasts with marine and air routes, which are malleable. A marine operator speaking to the flexibility of shipping, observing the intimate relationship between routing and motive force, that is, fossil fuel:

> … we always listen to the forecast, take advantage of the weather. We’re paying for our own fuel. …We have all the right incentives in place, if you will. We can be stupid, but it’ll cost us. … So every time we’d … take advantage of the currents that were predictable and the weather. So we’ll weather route to allow us to maintain the maximum speed with the minimum amount of energy. (NL Transport 113)

Weather routing refers to altering a ship's course to take maximum advantage of tidal, current and wind conditions to reduce physical resistance, that is friction, of the ship moving through water. He expands, describing the inextricable relationship between the socio-technical assemblage of shipping and the marine environment: "So we have to do work-arounds and work with the environment that we live in. If you're at that all the time, you're naturally doing a lot of stuff without realizing it. … It's something that we do all the time. It's not an exception" (NL Transport 113). Through the optimization of weather and technology, speed is a central consideration in the "distributive space of capitalism" (Cresswell and Martin 2012: 254). Drawing on the example of the *MSC Napoli*, Cresswell and Martin (2012) detail how, taken to an extreme, a focus on profit resulted in overloading vessels and traveling too fast, overwhelming the capacity of the vessel to navigate. The result was a turbulent and ultimately failed mobility.

In the context of Hurricane Igor, while the roads were in shambles, airports and marine services (i.e. shipping, ferries) were relatively unharmed. Ferries were taken to sea to avoid damage to terminal infrastructure. As with Halifax International Airport, air travel was disrupted during the hurricane, but a lack of infrastructure damage meant that service could quickly resume.[75] However, given that marine and air services are integrated with the road network, the extent of road washouts meant that accessing the air and marine facilities was a challenge.

The road washouts caused by Igor were not disruptive to the Marine Atlantic ferry service as the seasonal ferry that operates on the southeastern side of the island was no

[75] Blizzards are far more disruptive to airports than hurricanes, given the time needed to remove snow and deice planes.

longer in operation. However, previous weather events, such as Tropical Storm Chantal (August 2007) were disruptive. A marine operator recalls: “we had to turn the vessel around – now, not because of the weather event. It was because of the damage to the road network that occurred overnight in Argentia. We wouldn’t be able to get the passengers out … because the roads were washed out” (NL Transport 110). Consequently, 600 passengers were detoured.

An airport manager states: “the airport being accessible by air, but probably not accessible by road, because the road infrastructure is at risk. So that’s something that I guess could be a potential weakness is that the road network, the access routes to the airport” (NL Transport 109). A transport manager states, “we would have got impacted a bit by [Igor] with the road washouts because we have a big trucking fleet as well. We’re just not a shipping company. We have about 500 trucks on the road everyday as well” (NL Transport 113). Passenger and freight transport is intermodally integrated, with one journey made up of multiple routes that are subject to differing environmental vulnerabilities (see Fleming 2014 for a discussion of the environmental adaptive capacity of truckers in Newfoundland).

Fuel as fixity

While roads became mobile, fuel morphed into fixity. Flows of fuels into the province, gas stations and vehicles were disrupted. Just as hurricane damage to roads was a primary source of mobility friction, the inaccessibility of fuel was a secondary or resultant source of friction. The mundane task of obtaining fuel, critical in the achievement or accomplishment of automobility, became a pressing matter of concern for both public and private transport operators and community members (Normark 2006). One regional fuel provider, Stuart, recalls his interactions with gas retailers in the aftermath of Igor:

> [They were asking:] 'When can you get us gas? When can you get us gas?' And we're like, 'Guys, the road is washed out. It's not like we can just go and drive down through that big hole and get a tractor-trailer over to the other side.' So they understood, but everybody was kind of really anxious, I guess, to have that taken care of ASAP. (NL Transport 123)

Stuart continues, "the road was cut off, the residents down there panicked and started buying gas like it was going to be made no more" (NL Transport 123). In Newfoundland, the average gas station carries about 15,000 litres of fuel with a turnover of two to three days.[76] Stuart describes the aftermath of the storm:

> Well, they were selling everything they've got in one day. And then some of them even actually rationed gas. When they realized they were going to run out, they would stop letting people take whatever they wanted. Some sites actually stopped it and said, "If I sell out everything I've got, then how is the ambulance and the fire truck going to move if there's an emergency? … They're going to sell the litres anyway, so it's just as well that they make sure a lot of people get some instead of only a few people getting that and everybody else doesn't get any. (NL Transport 123)

This raises valuable areas for future research, including the fuel procurement strategies of emergency services.[77]

Due to the scarcity of fuel, both actual and technical, a number of research participants observed the tendency for community members to stock up. Even long after the storm, residents were sensitive – on "high alert" – to the possibility of fuel shortages

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[76] In Atlantic Canada, oil is processed by North Atlantic Refining at Come-by-Chance, Newfoundland (115,000 barrel-per-day capacity) and by Irving in Saint John, New Brunswick (320,000 barrel-per-day capacity) (MacNeil and Keefe 2015).
[77] This issue also emerged during the 2015 fuel shortage Nova Scotia experienced where, for example, ambulance drivers took measures to conserve fuel.

(Masson 2014: 629). Phil recalls a 2012 storm, “The eye went right through [town] and we didn’t have hardly any damage – 20 millimetres of rain, no high winds – but people were at the gas station, lined up at the gas station. Water was sold out” (NL Government 106). The experience of scarcity made an impression on community members, modifying their storm preparation measures. Notably, the fuel shortages were not raised in the Legislative Assembly. By contrast, fuel shortages experienced in New York after Hurricane Sandy resulted in the imposition of short-term, government-imposed rationing reminiscent of the 1970s OPEC (Organization of the Petroleum Exporting Countries) oil crisis. In the longer term, legislation required key gas stations to install generators (New York State Energy Research and Development Authority 2015).

While flows of fuel were blocked due to the failure of the road network, ferries were forwarded as a substitute transport mode, reconfiguring the mobility web spontaneously to deliver fuel. One ferry operator recounts loading fuel trucks and diverting ferries to the south coast (NL Transport 110). Movement of fuel, usually taken for granted – akin to our expectation that water will flow when we turn on a tap – surfaced as a pressing concern. Following Lin’s (2013) work on the reconfiguration of airspace during ash cloud events, Newfoundland worked quickly to adapt and respond, but at the same time reinforced fossil fuel dependence. From a social-ecological systems perspective, it was easier to retain the status quo (i.e. rigidity trap) than to transform to an alternate state.

Access to fuel, however, was only one example of tightly-coupled systems (Brown 2014). With the failure of electricity system, even available fuel stores became stranded assets as gas pumps run on electricity. Stranded assets refer to geological stores of oil and gas that, due to technological and/or financial barriers, cannot be extracted; they are observable but inaccessible. This parallels contemporary environmental campaigns that advocate for conscientiously refraining from resource extraction (i.e. keeping fossil fuels in the ground) (Canadian Broadcasting Corporation 2015a). Such campaigns argue that to avert disastrous climate change, two-thirds of known fossil fuel reserves must remain unused. Rather than mitigating emissions, the campaign argues for preventing emissions in the first place. While ideally such a transition would be phased in gradually, stranded or depleted gas stores give an abrupt sense of resource scarcity, evoking the strain anticipated by Urry (2011) under a regional warlordism scenario.

Stuart notes that loss of electricity and consequently the ability to pump fuel is not limited to hurricane-scale events: “It happens a lot, even now, when we had the power outage … in January [2014]. … Some small places do carry generators where they can get a pump running, a single pump. This is very uncommon though. It should be more common, given our climate” (NL Transport 123).[78] The lack of a back-up system for gas pump failures is remarkable given the reliance on fossil fuels for day-to-day functioning in the automobility culture of Newfoundland. Echoing experiences during Hurricane Juan, this qualifies fuel resilience as a sub-issue within the field of transport resilience.

Further, it is notable that fossil fuels are required even for back-up equipment such as generators and equipment used in recovery efforts, such as chain saws. There are

[78] From January 2 to 8, 2014, Newfoundland experienced rolling blackouts. Planned temporary power outages were scheduled to allow for utility upgrades. However, unplanned outages resulted from a fire at the Sunnyside substation and a failure at the oil-powered Holyrood generating station. As a result, almost 300,000 Newfoundland Power customers lost service. Newfoundlanders lacked heat and electricity at a time when temperatures reached lows of -18˚ Celsius with wind chill making it feel like -35ºC. To complement my doctoral research, I collected sampling of public response at the St. John’s Art Marathon (darknl.tumblr.com).

limited efforts to address issues such as the distribution and pumping of gas, nonetheless the problematic reliance on one fuel type. Stuart concedes: "I think if there was another Igor … maybe we'd have the same thing happen again and we'd just have to suffer through it like we did last time. Hopefully, the road holds up this time" (NL Transport 123). Hope, rather than action, is a precarious strategy.

The official response to the various sources of friction (e.g. safety, financial, emotional) that occurred in Newfoundland's mobility web were limited to restoring the road network, albeit with upgraded infrastructure and improved practices. From a Foucauldian perspective, the security of the population was framed in the narrow terms of reconnecting the mobility web in the short-term, rather than broader considerations of how to mitigate future road washouts through infrastructure maintenance, generator distribution, development of alternate mobility webs, and/or addressing potential food, water and medicine shortages.

Engineering passive resilience

Engineering or passive resilience is defined as '*getting things back to normal as quickly as possible*,' and it characterized the response to Hurricane Igor; it was a response at which the government excelled. A prominent frame that emerged in the dataset was a '*ten-day recovery*' narrative; this frame is characterized by an urgent pace or rhythm. For example, politician Chris recounts:

> so over the next few days (and it was ten days really), we had our goals set. We wanted to make sure that we connected every community in as short a possible time. And everybody stepped up. I mean we had our workers working 18-20 hours a day. (NL Government 107)

He recalls: “we hauled [contractors] off the west coast, we hauled them off the east coast. They all came together… but it went like clockwork, bang, bang, bang. We knew all the gaps. It was quantitative in the sense that we knew how many communities were out” (Figure 5.5). Chris provided ongoing updates to the media on the status of the road network, counting down the repairs so the public “had some sense that all through this … that we were getting ahead, not falling behind.” In Newfoundland a count down approach focused on reconnecting roads, while in Nova Scotia a count down approach focused on reconnecting the electrical grid, illustrating different infrastructure focal points. Hage observes how the practice of lining up, as in the case of Igor for gas and road repairs, is a form of governmentality that “valorizes self-control even in times of crisis” (2009: 9). Focusing on a countdown approach, mobilizing workers from across the province and long work hours define the frenetic rhythm of recovery.

Phil, a road manager, reflects “the estimation was weeks, if not months, to put it all back together and we did it in ten days. Now, I mean, let’s face it, it’s three years later before we got it all straightened out” (NL Transport 106). In the span of ten days, some form of physical connection was made with the more than 100 communities that were isolated by road and bridge washouts. The Canadian Forces assisted with the installation of temporary bridges that, when the original structures washed out, isolated the Bonavista (Barbour Bridge) and Burin (Long Pond and Rattlebrook bridges) peninsulas (Government of Newfoundland and Labrador 2010b). Roads were reduced to one lane and weight restrictions were imposed (Masson 2014). Over the course of the following years, permanent measures replaced the temporary repairs. One reason for the slower pace of recovery was that asphalt and tar plants required for road rebuilding are seasonal, shutting down in winter (Masson 2014).

While things were restored to normal, they were not the same: “knowledge was gained regarding road stability and necessary construction in the face of rainfall and peak stream flow” (Masson 2014: 629). Based on continual learning from previous events improvements were made, such as installing larger culverts, installing concrete abutments to keep culverts in place, monitoring weather more closely, getting work crews out in advance of storms to clear culverts and catch basins, coordinating with other organizations and practicing disaster simulation exercises.[79] As a consequence of Igor, the Water Resources Management Division of the Newfoundland and Labrador Department of Environment and Conservation recommended using intensity-duration frequency curves, which are useful in determining how rare a given event is, combined with flood mapping to adapt to climate change (Government of Newfoundland and Labrador 2014b).

In some places, such as Marystown, culverts were replaced rather than upgraded and were subsequently washed out again during post-tropical storm Ophelia (Canadian Broadcasting Corporation 2011, Mason 2014). Mayor Sam Synard asserts: “I'm just stating the obvious. If a hurricane blows through and knocks out culverts that are some four feet in diameter, it might be a better idea to put them back six feet in diameter, or something [with] increased capacity” (Canadian Broadcasting Corporation 2011). Then

[79] In 2006, prior to Hurricane Igor, an emergency preparedness exercise, Operation Dolphin, was held at Channel-Port-aux-Basques and focused on hurricane preparedness (see McMillan (2006) and Senguin (2006) for accounts and assessments). Based on the experience of Hurricane Igor, such exercises could be amended in future. For example, Operation Dolphin focused on one smaller coastal community, Channel-Port-au-Basques, compared to the regional impact of Hurricane Igor. Further, though the scenarios included cancelled ferry service, blocked roads and collapsed bridges, the recommendations do not overtly reference transport (though, for example, communication redundancies are referenced) (Verge 2008).

Minister of Transportation, Tom Hedderson, responded to the concern stating, “when you get a significant flow as we've got [Monday], we do expect that there will be some damage, and hopefully damage that we can mitigate very quickly” (Canadian Broadcasting Corporation 2011). This exchange reflects a larger tension in the data set between upgrading infrastructure construction standards incurring guaranteed upfront costs versus simply allowing infrastructure to wash out and incur replacement costs if, and when, needed.

In terms of maintaining mobility webs, the former is more in line with a transport resilience approach. The difference in approaches suggests differing perceptions of risk (Catto and Tomblin 2013). Further, it highlights that Igor was framed largely in terms of passive, engineering resilience: “the difficulties were seen as the result of inadequate preparation (the failure to install larger culverts, lack of maintenance), and it was assumed that better pre-storm management would have resolved most issues” (Catto and Tomblin 2013: 101). Passive resilience was embraced, rather than provoking more fundamental questions related to climate change mitigation and social-ecological adaptation measures characteristic of transformative resilience.

Research participants expressed pride in the collective experience and efforts of various levels of governments, the military, contractors and communities to restore the road network, often praising employees who went above and beyond the call of duty. Just as there was a sense of loss for the transformed landscape, there was almost nostalgia for the cooperation that occurred under Igor. The Chief Administrative Officer of one community recalls, “our fire department and our [public] works are excellent examples of this. … They were out trying to save other people’s properties when their own homes were home getting flooded out. It was a really amazing – I was proud to be associated with them. I really was" (NL Government 104). What emerges in the '*ten-day recovery*' narrative is a form of community resilience where stakeholders were able to pull together with an all-hands-on-deck mentality, uniting behind a concrete common goal of reconnecting the road network, or in other terms, restoring the mobility web (NL Government 119). However, the road network itself proved catastrophically vulnerable and therefore the merits of re-establishing it to 'normal,' while understandable, are simultaneously questionable. Anecdotally, it was mentioned that for some companies road building contracts are a lucrative source of income indicating that there may be economic resistance to increasing road resilience.

While the road rebuilding effort was impressive, it raises concerns about the resilience of the road network moving forward. One issue is rebuilding policies and practices. Phil reflects: "We have a very strict Public Tendering Act for our hiring contracts. All bets were off. I was told by my executive, do whatever you got to do" (NL Transport 106). This included waiving environmental assessment processes and hiring less experienced machine operators. Phil continues: "we had [contractors] digging holes in the side of the road and everything trying to get enough fill to fill in a washout." Depending on how and where fill was removed it might actually promote further erosion and flooding. The use of heavy equipment near rivers could compact the natural riverbanks and bed, making it more conducive to flooding. Another issue that arose was with regard to public perception of how best to prevent flooding. Debris, such as trees, blocked some culverts impairing their flow, contributing to the road washout (Photo 5.2). In response, public sentiment was that "you go back in the country and clean all the brooks out so that the debris doesn't come down again" (NL Transport 106). However, withdrawing biomass could potentially disrupt natural flooding buffers.

The frame '*getting back to normal as quickly as possible*' is in tension with another dominant frame, '*never seen anything like it*.' This conceptual gap mirrors the literal gaps that occurred in road network during Igor (Photo 5.2). An editorial in the Clarenville *Packet* reads, "in this province, we're used to being at the mercy of the weather, but rarely has the weather been so merciless" (Frampton 2010). Likewise, a town manager states, "I'd never seen anything like it that severe. … I realized how forceful nature could be, but I'd never seen it" (NL Government 104). He continues: "we've been through wind and rain …but nothing like this … *we didn't anticipate the seriousness of it because we'd never seen anything like this before*" (emphasis added).

Photo 5.2: Gap in road network as mirroring conceptual gap between a 'return to normal quickly' and 'never seen anything like it'
(Chance Cove Road, Avalon Peninsula, Newfoundland) (Care2 2010)

One resident wryly captures the dissonance between expectation and reality: "Tied my barbecue down. Forgot to tie the house down" (The Telegram 2010). Igor was unique in Newfoundland's storm history in terms of the geographical extent of the storm, impacting numerous communities simultaneously and straining response and recovery resources (Masson 2014). As reflected in all data sources, the scale of Igor was beyond previous experience, giving Newfoundlanders a new and sobering appreciation for the power of the environment. Just as infrastructure was under stress, so too were residents (Masson 2014).

Inundating events

However, though the severity was new, such flooding events in Newfoundland were not. Flooding has occurred almost every year in Newfoundland since 2001, from tropical storms like Gabrielle (2001) and Chantal (2007) to the Stephenville floods (2005) and the Northern Peninsula storm surge (2007): "a plethora of meteorological and geological events since 2000 has necessitated intense activity by first responders and government agencies" (Catto and Tomblin 2013: 96) (Table 5.1). Costs incurred, as measured in terms of Federal Disaster Assistance provided, range from a low of $1.3 million for the Burin Flood to a high of $28.3 million for the Stephenville floods, putting the $100 to 200 million cost of Hurricane Igor in perspective.[80]

In media coverage of Igor, as well as legislative transcripts, policy documents and interviews, references to past weather events were surprisingly sparse given their frequency and compared to the frequency of references in media coverage of Hurricane Juan. The most common reference, mentioned three times, was to Tropical Storm Chantal and its related costs. Catto and Tomblin suggest that such flooding events are "perceived by residents as a feature of the local environment to be endured, rather than a hazard to be combatted," perhaps accounting for the textual silence (2013: 100). There is a disconnection between past severe weather events – they appear to be treated in media accounts as isolated incidents rather than as components of a larger integrated frame of

[80] Founded in 1970, the Federal Disaster Financial Assistance Arrangement (DFAA) program compensates provinces for expenses that are incurred while managing disasters. Expenses are eligible when the cost of the disaster exceeds three dollars per capita. A state of emergency must be declared to enact the DFAA. The DFAA is notoriously slow in administering compensation. For example, as of 2013 costs incurred during Tropical Storm Gabrielle (2001) has not fully been repaid (Catto and Tomblin 2013; Grieve and Turnbull 2013).

severe events as is the case in Nova Scotia. This echoes a larger disconnection in Newfoundland between emissions and climate change impacts.

By contrast, provincial departments such as Fire and Emergency Services, the Office of Climate Change, Municipal Affairs, and Municipalities Newfoundland and Labrador are cognizant of, and concerned about, extreme weather trends. A climate change workbook designed for municipal managers states:

> Globally, the number of severe damage-causing storms gas increased from an average of 150 per year in the early 1980s to between 250 and 300 per year in the period from 2000 to 2004. In Canada, scientific models show shorter return periods of extreme weather events (the estimated interval of time between occurrences). (Government of Newfoundland and Labrador No date a)

The workbook outlines five extreme weather events that occurred between 2007 and 2010, including the Daniel's Harbour landslides (2007), the Middle Cove rogue wave (2008), storm damage to the St. John's Battery (2009), the Ferryland road washout (2009) and Hurricane Igor (2010). The concepts of reactive versus anticipatory adaptation are introduced. Reactive adaptation refers to examples such as the permanent relocation of residents in the aftermath of the Stephenville floods, while anticipatory adaptation planning refers to projects such as including sea level rise projections in the construction of the Confederation Bridge that connects New Brunswick and Prince Edward Island (Government of Newfoundland and Labrador No date a). The workbook promotes anticipatory adaptation as ultimately more cost-effective and structurally effective than reactive adaptation.

Table 5.1: Weather events in Newfoundland and Labrador that triggered the Federal Disaster Financial Assistance Arrangement Program, 2001-2010
(Fire and Emergency Services-Newfoundland and Labrador 2014)

YEAR	EVENT	FEDERAL ASSISTANCE ($M)
2001	Tropical Storm Gabrielle[81]	6.1
2003	Badger Flood	8.2
2003	West Coast Flood	9.6
2005	Stephenville Flood	28.3
2006	North East Coast Flood	4.6
2006	Burin Flood	1.3
2007	Northern Peninsula Storm Surge	2.9
2007	Daniel's Harbour Landslides	2.7
2007	Tropical Storm Chantal	24.5
2008	North East Coast Flood	1.8
2010	Hurricane Igor	95.0
	TOTAL	$185M

Links with climate change

The expertise of transport operators, given intimate experience of weather, constitutes a valuable data source. A number of the transport managers interviewed occupy senior positions with decades of experience in their field. A Newfoundland road manager observes changes in storm frequency: "I've been here 26 years now. I've got to say, it seems like it's more frequent. And that certainly impacts what we do because one of these storms certainly sets you back a long ways" in terms of damage to infrastructure (NL

[81] Tropical Storm Gabrielle hit on September 18-19, arriving just as the last passengers diverted by the events of 9/11 left, illustrating the potential for compound extreme events (Catto and Tomblin 2013).

Transport 104). A Newfoundland marine operator speaks to changes in wind conditions at sea:

> … bad storms are worse than they used to be, it seems. Like we had a period one time last year. I remember one of our ships was in the Corner Brook area, and for six hours straight it had, I think it was 180 kilometres plus [wind speeds on par with a Category 3 hurricane]. It was totally unheard of, right? I mean, I never! The periods of bad weather are definitely different. They're more extreme. So obviously over time that will degrade everything at some stage. Is that going to continue? Well, who knows? I mean they had 380 kilometres in Asia recently [referring to Category 5 Typhoon Haiyan]. So maybe it could come here too. (NL Transport 113)

Another marine operator speaks to the impacts of service delivery:

> I think last year we had in the vicinity of 30 days that we actually had to cancel. That was last year. … That's increased [over past years]. There were probably more impacts, but they wouldn't have necessarily meant cancellations. So there would have been delays probably arriving in port because of wind conditions, but actually cancellations would be about 30 days. … In this month alone, yesterday we lost all [sailings] yesterday. Last week we lost two days that we were out. (NL Transport 110)

Transport operators' first-hand experience involves managing and monitoring the inextricable interface of the environment and mobility webs.

The concept of an one hundred year storm as an historical measure for severe storm recurrence intervals was mentioned frequently – most often in terms of the out-datedness of such measures. One Newfoundland transport manager quotes a peer who exaggerates for effect: "He says we're having a 100-year storm every two months" (NL Transport 113). Phil observes that

> …we've come through [Igor] relatively good. So some people are saying it's the storm of the century; we'll never have another one. But all you've got to do is watch the news in other parts of the world. Climate change is here, for sure. So

> that was one opportunity, I guess. But we haven't [taken advantage of it]. (NL Transport 106)

A thematic through line – captured in the frame '*never seen anything like it'* – in the interview dataset is a sense that we are entering new territory where severe weather events are common and a recognition that the climate is changing.

However, while convinced that the climate is changing, not all participants were convinced that the cause is anthropogenic, which has important implications for both disaster and climate change mitigation. Finnis, Sarkar and Stoddart (2015), for example, find that conflation of climate change and natural climate variability in western Newfoundland may undermine climate action efforts during period of natural, cooling climate variability. While in the dataset as a whole there was consensus that the climate is changing and is caused largely by humans, there were a few exceptions in Newfoundland.

A town manager reflects:

> And everybody keeps blaming all the stuff we're putting into the atmosphere. I wonder if that's true or not. I just wonder, like we've had climate change throughout our history, ice ages and receding. I just wonder if we're not part of that bigger cycle. I don't know. I'm convinced that there is a change, but I don't know if we're part of the bigger million-year transition or it is something that we're doing. (NL Transport 104)

Similarly, a Newfoundland marine operator reflects:

> I read an interesting article a few weeks ago about sunspots, and some guy made a lot of sense that it's really tied to sunspots, and in actual fact the earth is going to start cooling down. It's not getting warmer at all. And that's not hard to understand. I just came back from Florida, and a couple of mornings I got up it was warmer here than there. (NL Transport 113)

While climate change is related but peripheral to the occupations of both of these research participants, it is interesting to note their engagement with the issue and efforts to reconcile their experience and the information to which they are exposed. Differing understandings arise as a form of friction in terms of linking the experience of severe and changing weather events with the contribution of the transport sector to climate change.

This context sheds light on the apparent internal tension between the perception of the event and the response to it. Stakeholders are grappling with this tension, uncertain of how to proceed given that storm events are forcing and surpassing the upper edges of infrastructure design limits, while also cognizant that building to higher standards, nonetheless maintaining current infrastructure, is difficult to achieve financially. A road manager aptly illustrates this struggle:

> One of the things that we've noticed - and we've discussed this a lot since Igor - is that when it comes to storm systems, we don't design for hurricanes. We design for 50- to maybe 100-year maximums. To design for a hurricane is financially unfeasible. But what we're finding is that extreme weather events seem to be happening more often, and when they do they're more severe. So it looks to me there may have to be some work done in that area, but I certainly can't see... I mean, we just can't afford to design and build for something that's going to happen for 200 millimetres of rain. We just can't. (NL Transport 106)

Such uncertainty, related to storm recurrence rates, was a common source of friction in terms of limiting action. In the interviews a sense of discomfort surfaced akin to being stuck between a rock and hard place – the experience of changing weather conditions and limited resources and knowledge to act. Constructively, Phil suggests the creation of a "provincial think tank on this or some kind of committee" to provide practical direction on how to move forward (NL Transport 106). Transport resilience, though not articulated as such, is a matter of concern at both municipal and provincial levels of government, in the private sector and among residents. Igor in particular sparked a conversation that now needs more formal means, whether in the form of a task force, committee, review or other process, to articulate and reflect on more fully. It would be interesting to learn if a stronger connection were made between extreme weather events and Newfoundland's contribution to climate change, whether mitigation and adaption measures might gain more traction.

The resilient Newfoundlander

Shadow mobility webs

In the media, legislative and interview datasets, a central theme is '*community spirit*,' that is, the tendency for neighbours and families to help each other get back on their feet. Particular to Newfoundland, the sub-theme of the '*resilient Newfoundlander*' emerged when political leaders laud the ability of communities to respond to crisis. There appear to be corollary concepts in other disaster-impacted regions, such as the 'neighbourly Nova Scotian' (i.e. neighbours helping neighbours in the aftermath of Hurricane Juan) or the 'connected Calgarian' (i.e. use of Twitter during 2013 Calgary floods). The historical concept of '*resilient Newfoundlander*' has connotations of being hearty, strong, resourceful and competent in dealing with hardship and stems from a tradition of isolated communities, independent of government, dealing with emergencies through informal means (Catto and Tomblin 2013). For example, in Clarenville a local grocery store manager and community members organized the transport by boat of food and water to communities isolated by the Hurricane Igor (NL Other 105) (Photo 5.3).

This is emblematic of a shadow mobility web that came to the fore in the absence of the dominant road network. Phil states: “What I find with Newfoundland[ers] is that they’re very diversified. …. A lot of them have quads and Ski-Doos and boats and generators. .... They coped very well” (NL Transport 106). [82] He continues, “Newfoundlanders are very diverse. Yeah, the bridge was washed out, but they get down there with a quad to make it over to the other side” (NL Transport 106) (Photo 5.4). The term ‘diversified,’ another word for which is ‘redundancy,’ is a key element of resilience. Here residents demonstrate transport resilience through substitute modes (e.g. off-highway vehicles, boats and, in winter, ski-doos), as well as back-up energy sources such as generators, though notably stores of personal back-up fuel are not referenced in the dataset.

Provincial and local governments also practiced transport resilience by activating both alternate modes and routes. Chris, the politician, states: “people were cut off, but we started immediately to look at how can we get to them by sea. Could we use our provincial ferry system? Our helicopters?” (NL Government 107). Just as a forest fire clears room for new growth revitalizing biodiversity in a process of disturbance ecology, so too did the hurricane, through a social-ecological-technical disturbance, create space for alternate forms of mobility. Ferries, ships, helicopters and off-highway vehicles filled the gap left by cars and trucks – though critically these modes are all fossil-fuelled (see Fardink (2011) for a discussion on the role of helicopters in Hurricane Katrina). A

[82] Quad is a regional term for Off-Highway Vehicles or All Terrain Vehicles.

government news release issued three days after the storm provided an update illustrating the shadow mobility web:

> The Department of Transportation and Works has established marine and air support for communities isolated as a result of Hurricane Igor. A ferry vessel stationed at Clarenville will be dedicated to moving supplies to isolated communities on the Bonavista Peninsula. A second ferry vessel is also positioned at Portugal Cove, awaiting shipments of gasoline to be taken to Marystown. As well, two helicopters are stationed at Clarenville to be dedicated exclusively to addressing any essential transportation requirements to and from isolated communities. (Government of Newfoundland Labrador 2010b)

In this description, for example, Clarenville morphs into a multimodal transport hub.

In addition to different modes, different routes were used. One road manager recalls, "we used some alternate routes that were, like old cabin roads. We got some fill on them, and we used gravel roads. We used some old bridges that hadn't been used in the last 20 or 30 years" (NL Transport 106). The central ties of the road network (i.e. automobility) were supplanted by peripheral ties within the road network, as well as by the peripheral ties of ferries (i.e. aquamobility) and helicopters (i.e. aeromobility) (Barton 2011).

Following Igor, other measures were taken to further improve redundancies such as distributing emergency Bailey bridges across the island, rather than just storing them on the west coast, as done previously.[83] As well, measures such as storing extra road fill, (baseball-sized rocks used to create a roadbed) are used as low cost measures to expedite responses to future road washouts. The shadow mobility webs forged new routes and modes – as well as activating old routes and modes – that have their own often slower

[83] Prefabricated Bailey bridges were first used in World War I to advance troops and equipment.

speeds and urgent but more idiosyncratic rhythms that contrast with the rhythms of commuting (whether locally or via the fly-in, fly-out that characterizes out-of-province work in the oil sector) and just-in-time delivery. Hurricanes as a source of intense disruption temporarily revert contemporary mobility, seemingly fixated on immediacy, to an earlier and slower and smaller-scale mobility constellations that exist in the present rather than straining for the future. Such disruption was for some initially welcomed, as described in a *Telegram* editorial:

> Of how being without phone and electricity meant enjoying the uncharacteristic quiet, giving us even more excuse to have romantic candlelight dinners, and seeing the brightness of the stars, undiminished by light pollution. How, sometimes, it's in the midst of swirling confusion that we can see things most clearly (Frampton 2010).

However, after an initial 'honeymoon' period, residents are generally anxious for services to be restored and for normal life to resume.

Photo 5.3: A grocery store manager and community members organize the transport of food and water by boat to Random Island (Co-op Atlantic 2010)

Photo 5.4: Off-highway vehicles (quads) emerged in the shadow mobility web (Ayer 2010)

Directing attention from House to homes

Political and public figures recognized the diversity and resilience of individuals and communities. In the provincial *Telegram* then Premier, Danny Williams, states:

> It was a truly humbling experience to see people, faced by their own hardship, putting others before themselves and going above and beyond to assist in any way humanly possible. … Newfoundlanders and Labradorians have a reputation for being some of the kindest and most *resilient* people in the world, and this past week was certainly a testament to this claim (emphasis added). (Bartlett 2010)

Williams reflected on one scene: "there were at least 20 people on their knees in the mud, cleaning up so these elderly people could get back in their home.... You know, we turned this around. We turned this around because we're resilient, we're tough." Likewise, Prime Minister Harper stated that residents "are facing the aftermath of the storm with their characteristic resilience and determination" (The Telegram 2010a). Speaking to the Canadian Forces contribution to relief efforts, the Minister of Defence states, "Newfoundland-Labradorians have great resilience. They're getting on with sorting themselves out and helping their own situation" (The Telegram 2010b). What emerges is a normalizing frame, the '*resilient Newfoundlander*,' which from a Foucauldian perspective, serves as a tool of governmentality, simultaneously celebrating the individual's response and diverting attention from government responsibility. The capability of individuals and communities to cope is highlighted, while discussion of larger issues that require government action, such as climate change mitigation and adaption (e.g. road construction), is absent.

Such praise, while deserved, risks focusing attention on the domestic and lived experience of individuals, directing attention away from the House of Assembly. Just as blame can stall the generation of “alternative imaginaries” as in the case of the response to the Icelandic ash cloud event in the United Kingdom, so too can praise (Birtchnell and Butchener 2011: 2). The first sitting of House of Assembly, governed by the Conservatives with the Liberals in Official Opposition, was in December more than two months after Hurricane Igor. The storm was mentioned in half of the House sittings the following year, for example, acknowledging the role of volunteers and discussing the closure of Port Union fish processing plant damaged by the hurricane. By comparison, Nova Scotia’s Legislature, governed by Progressive Conservatives with New Democratic Party in Opposition, met two days after Hurricane Juan, and the storm was discussed in three-quarters of sessions the following year. The discussions were more substantive in Nova Scotia, including links with climate change, impacts on workers and landowners, and the status of emergency preparedness.

Discussion pertaining to mobility webs was limited largely to the issue of infrastructure maintenance and economic development. In terms of maintenance, Kelvin Parsons, Liberal Member of the House of Assembly for the District of Burgeo-La Poile in southwest Newfoundland, expresses concern about the outsourcing of highway maintenance jobs:

> …in this Province we have a tremendous amount of highway maintenance and repair work needed in communities, particularly in the aftermath of Igor. Government has surpluses, major maintenance work is required, they are laying off these [highway] depot workers when, at the same time - in my District of Burgeo, for example, on the Burgeo Road - we are seeing government contract out work to put signs up. Can the Minister of Transportation and Works explain

> the logic of us closing down depots, laying off workers, and contracting the work out to others? (NL Hansard April 7 2011)

Later the same month, in the Budget Speech the Minister of Finance, Tom Marshall, outlines how the economic benefits of the offshore oil and gas industry, will be invested in road infrastructure including repair of damage incurred by Igor illustrating disjuncture between climate change causation and impacts:

> In many ways, including a multi-year infrastructure strategy currently valued in excess of $5 billion, we have reinvested those revenues in communities throughout Newfoundland and Labrador, laying a solid foundation for investment attraction and new economic growth…. In 2011-12, the Province of Newfoundland and Labrador will invest $216.4 million in roads and bridges for a total federal-provincial investment this year of $251.6 million. Initiatives will include: Funding to repair roads damaged by Hurricane Igor, a portion of which is recoverable from the Federal Disaster Financial Assistance Program. (NL Hansard April 19 2011)

Likewise Yvonne Jones, Liberal Member of Parliament, questions the lack of financial support for community members who lost work due to Igor, speaking to the oil economy but not drawing a linkage to climate change. She implies that the resilient Newfoundlander is being worn down by challenges such as Hurricane Igor and fisheries decline:

> These are the people who pay in their hard-earned money to the government every day … that you are using to drill holes in the ground for oil, that you are using to buy shares in oil companies, and that you are using for all of these things. That is their money, and today a lot of them down in the Port Union and Bonavista area are out of a job, have damages to their homes, and are not getting any help from the government [following Igor]. Mr. Speaker, you can understand why people would be frustrated. There is a complete dependency as well in that area around the fishery. (NL Hansard May 10 2011)

Following Igor, the fish processing plant in Port Union was closed due to structural damage resulting in 170 workers losing their jobs.

The lack of discussion in Newfoundland's House of Assembly about larger and fractious issues, such the integrity of road infrastructure, disaster preparedness and climate change implies the perception, or at least promulgation of the perception, of an unproblematic status quo. A focus on smaller scale questions of engineering and maintenance diverted attention from bigger picture issues such as safety, "over-dependency" on mobility and climate change mitigation and adaptation (Budd et al. 2011: 39). The focus on the purified lived experience of individuals serves to nullify, rather than address, frictions between the environment, mobility and society lending weight to Borins' (2011) observation that official narratives tend to focus on the upbeat and heroic.

Jennings (2011) similarly notes that neoliberal governance tactics were employed in response to the 2004 flooding in England, where responsibility for environmental impacts was diverted from government to the individual through a discourse centred on bottom-up adaptation measures. In the case of Newfoundland, praise is a form of persuasion. Such admiration is deserved and genuine. However, when there is a concomitant lack of discussion, whether intentionally or unintentionally, about macrosocial issues such as the resilience of transport or electrical systems, the result is a naturalization of the status quo. As used by political figures and media, the '*resilient Newfoundlander*' frame illustrates the risks of resilience terminology which, just as with the term sustainability, can be used so broadly that it gives rise to reinterpretation and appropriation (see Adkin (2009) and Luke (2006) on the erosion of the concept of sustainability).

The Government's, and equally the Opposition's, handling of Hurricane Igor contributes to non-problematicity. Compared to the blaming tactics identified by Freudenburg and Alario (2007), high-level figures use praise as a diversionary tactic. Such flattery diverts attention away from macrosocial questions about the resilience of infrastructure (including tourism and oil infrastructure), disaster preparedness or climate change mitigation, to a microsocial focus on the role of individuals, possibly pre-empting more critical assessments of infrastructure design and maintenance, as well as disaster response. Blaming shifts questions about legitimacy and competency from one social actor or organization to others. Rather than responding to questions about an organization's own practices, representatives divert attention to a real or constructed opponent. Two related tools used in blaming are asking questions and raising doubts. However, the case of Newfoundland illustrates how praising and an absence of critical questions likewise serve to legitimize a problematic status quo.

Gramling and Freudenburg (2012) elaborate on the role of distraction with the concept of *double diversion*, where the first diversion is that of public *access* to resources and related revenues and the second diversion is that of *attention*, by framing such a transfer as a means to foster domestic energy production and energy independence. In the case of Newfoundland, a double diversion occurs in the form of a disjuncture or friction between the development of oil and tourism sectors on one hand and the experience of extreme weather events of the type expected under a changing climate on the other hand. Following Norgaard's tools of innocence, the story of Newfoundland enjoying an economic traction after decades of hardship facilitates this disconnection.

Social-ecological mobility webs

Efforts are being made in Newfoundland to mitigate and adapt to climate change including, central to this discussion, the development of two voluntary workbooks designed to assist communities with adapting to climate change: *7 Steps to Assess Climate Vulnerability in Your Community* and *Managing Municipal Infrastructure in a Changing Climate*. As politician Chris states: “[Igor] really fed into our Climate Change Office because it was only, I think, about less than a year ago [two years after Igor] that we released a document with regard to infrastructure and predicting storms and what’s going to happen” (NL Government 107). Other measures include producing climate change impact projections to give decision-makers a sense of local impacts (e.g. change in local annual precipitation) (see Finnis 2013), raising public awareness via the public education campaign called *Turn Back the Tide*, and encouraging a green economy via measures such as renewable energy and energy efficiency.

Under the federal-provincial Atlantic Climate Adaptation Solutions project, a federal-provincial initiative, several Newfoundland municipalities undertook climate change vulnerability assessments (Atlantic Climate Adaptation Solutions 2013). Communities can voluntarily complete a 400-page workbook (*7 Steps to Assess Climate Vulnerability in Your Community*) that assesses seven issues related to climate change adaptation: flooding, slope movement, coastal vulnerability, drinking water, winter issues and wildfire, based on the criteria of location, infrastructure, society, economy, environment and options. The findings are intended to inform the development of a range of municipal plans (i.e. emergency, land use, transport, etc.) and are to be updated regularly to reflect changing conditions (Atlantic Climate Adaptation Solutions 2013).

Though not formally a social-ecological systems initiative, this project echoes a social-ecological systems approach as it centres on adaptation and resilience in local contexts and has the potential to contribute to transformations at the regional scale.

The *Managing Municipal Infrastructure in a Changing Climate* is a 40-page workbook designed to be completed in three hours. It includes a primer on climate change, severe weather and infrastructure and provides instructions for three breakout sessions related to identifying municipal infrastructure assets, identifying local climate change impacts and identifying measures to protect municipal infrastructure. Further, it provides infrastructure-costing charts (e.g. cost per metre of culvert) to assist in concrete calculating and planning. Transportation is addressed in both workbooks though both assessing past and potential impacts on transport infrastructure. While valuable tools, the voluntary approach raises questions about creating and supporting adequate momentum in the face of low financial and human resource capacity and the likelihood and timeliness of larger adaptive and transformational resilience. In addition, these activities (i.e. voluntary workbooks) and actions (i.e. greening of government vehicle fleets) are happening in the shadow of an oil industry that accounts for approximately one-third of provincial revenue.

Discussing the status of emergency measures in Newfoundland and Labrador, Catto and Tomblin identify barriers to reform that are transferable to, though not wholly explanatory of, barriers to climate action:

> Renewing governance and transformation are influenced by the levels of perceived crisis but also by the power of inherited processes and mechanisms when compared with new paradigms or visions. In small NL communities, without the expertise, personnel, financial resources, and institutional support

> required to effect major reforms, promote integration, construct a viable alternative, or even to cope with events as they unfold, any reform will be slower than in places where the prospects for change are better. (2013: 93)

Igor, while a major event, appeared insufficient to contribute significantly to an emancipatory catastrophism. In lieu of substantive policy action, incremental change is being fostered through community engagement such as the community workbooks (Catto and Tomblin 2013).

The *Climate Change Action Plan* (CCAP), references the impact of severe storm events such as Igor, particularly on infrastructure:

> Climate change is an important issue for Newfoundland and Labrador. As a large coastal province with over 90 per cent of the population living near the sea, Newfoundland and Labrador is exposed to many long-term impacts of climate change including sea-level rise, more storm surges, greater coastal erosion and volatile changes in seasonal weather patterns. These have important social and economic implications:
>
> - Storm surges and flooding can affect infrastructure, services, and business activity, as seen with Hurricane Igor.
> - Coastal erosion and sea-level rise can impact community development and place homes, businesses and coastal infrastructure at risk, such as wharves and causeways.… (2011: 7)

The CCAP addresses the transport sector, which it identifies as a limited source of greenhouse gas emission reductions:

> These are unique challenges in Newfoundland and Labrador with respect to the transportation sector. Newfoundland and Labrador is the most rural province in Canada, with 50 per cent of the population living in rural locations. Its largest centres do not have sufficient population to support mass transit options such as rail and the provincial population is too small to support unique vehicle efficiency standards. In addition, biofuels are not readily available in sufficiently large quantities to power the province’s vehicles. As a result, GHG savings in the transportation sector will largely depend on individual decisions concerning means of transportation, vehicle purchases, driving habits and distance traveled, for the foreseeable future. (2009a: 51)

The fact that the Government of Newfoundland and Labrador does not have a sustainable transport strategy is likely due to the cultural-techno lock-in of automobility.[84] This reflects a powerful path dependency considering that road transport is relatively new to Newfoundland and Labrador, a region where travel by boat was until recent decades commonplace.

As with Hurricane Juan, the static infrastructure of roads in Newfoundland is particularly vulnerable to wind and storm surge. A sense of new and disconcerting normal materializes, both in terms of climate and of expectations of mobility disruption. However, perhaps due to the more rural composition of the province, combined with the relatively new but pervasive automobility, minimal consideration is given to emissions mitigation in a growing transport sector. According to Catto and Tomblin "effecting change requires a sense of problem (or crisis), a new vision that reflects core values and objectives, a coalition in support of new reforms, and institutions capable of getting the problem onto the radar screen and implemented" (2013: 94). The impacts of Igor were insufficient to spark a sense of transformative crisis. This may, in part, be due to the combination of the praising discourse employed by officials, as well as the genuine sense of pride and feeling of accomplishment in effectively managing the crisis and restoring the road network within ten days.

[84] The Government of Newfoundland and Labrador (2006) developed a sustainable transportation discussion paper pertaining to Labrador, however it focuses solely on transportation infrastructure investment and economic development. The document does not reference climate change, notable given the impact of extreme weather and melting permafrost in northern regions (see Andrey, Kertland and Warren 2014).

Disciplining emissions in the transport sector is viewed as almost futile at the provincial scale, however the disciplining of water though flood management practices is an active area of focus. The circulation of water (i.e. dihydrogen monoxide) rather than emissions (i.e. carbon dioxide) is leveraged as a means to secure the circulation of people, goods and services. Through mapping of flood prone areas, as well as modelling and forecasting of potential flood events, the movement of water is the focus of government surveillance, echoing Usher's (2014) analysis of the management of circulations of water in Singapore. Notably, homes in Stephenville were permanently relocated after the 2005 floods, though such relocations are limited compared to the more comprehensive and transformative approach taken in the Netherlands' Room for the River (2015) project. While discipline is characterized by efforts to "concentrate, contain and control" nature, and security "adapts to the reality of natural processes, respects their autonomy and seeks to identify, optimise and work through nature's discernable laws rather than stifle them," Newfoundland and Labrador is engaged more at the level of surveillance, monitoring and forecasting flood events, with forays into the disciplining of water (Government of Newfoundland and Labrador 2014; Usher 2014: 558).

While flood management is moving in a promising direction, it is important to note that significant attention is simultaneously paid to circulations of oil. For example, the Premier of Newfoundland Labrador, Paul Davis, recently stated:[85]

> Based on the work that has been done and what we know about potential oil reserves off our shores, we know that there is a long-term future for oil and gas

[85] Dwight Ball replaced Paul Davis as premier in December 2015. With three premiers in two years, there is also fluidity of political leadership.

> business in Newfoundland and Labrador. … Of course it would depend on markets, and I don't think the oil and gas markets are going to end in the next decade or two. …We'll have markets for many years to come; the reserves are significant. (Brake 2015)

Efforts to facilitate circulations of oil to markets (but not to intervene beyond) and to manage circulations of water, particularly storm and flood waters, illustrates a disjuncture between the production of greenhouse gas emissions and adaptation to the impacts of climate change.

Towards an ecopolitics of mobility

Courtesy of Hurricane Igor, Newfoundland experienced two types of resilience, community and engineering, both of which have merits and both of which are necessary. The community spirit and resourcefulness embodied by the '*resilient Newfoundlander*' are critical, but need to be paired with larger policy conversations in the House of Assembly. Likewise, Newfoundland demonstrated capability in terms of engineering resilience, but the absence of discussion regarding more transformative forms of resilience is a notable source of vulnerability.

By applying Cresswell's six elements of mobility – motive force, velocity, rhythm, route, experience and friction – I elaborate an *eco*politics of mobility, detailing the interface and power dynamics inherent between the environment and contemporary social-technical mobility assemblages. The route of Hurricane Igor was erratic, changing course as it approached Newfoundland and making an unanticipated turn landward. Upon continuing in its path, the track of the storm traced critical road infrastructure for an unfortunate alignment of natural and human mobility. Further, the combination of one fuel and one main road is at the crux of Newfoundland's mobility vulnerability. The lack of redundant routes renders Newfoundland's mobility web brittle.

In terms of motive force, the utter reliance on fossil fuels for both the dominant and shadow mobility webs, is simultaneously startling and taken for granted. The experience of fuel scarcity, due to the failure of electricity, the lack of generators and depleted fuel reserves, left an impression on residents shaping their preparation in subsequent events. In the marine sector, the keen sensitivity to weather routing, that is, the practice of optimizing the interface of routing and fossil fuel use to maximize profit, offers lessons that if transferred to a consciousness of emissions could transform the field of transport resilience as currently understood and practiced (see Chapter 7: Navigating Transition).

The shadow mobility webs – demonstrating a depth of both community and engineering resilience – are characterized by differing speeds and distinctive rhythms that contrast starkly with the dominant inclination for speed and connectivity. Rhythm was expressed in the urgent, flat-out pace of the ten-day recovery effort. The speed of workers and coordination of organizations contrasts with the slower pace and idiosyncratic rhythm of the shadow mobility web, a temporary reversion to an older style and experience of mobility that was simultaneously a source of interpersonal community-building and frustration. The pressure for speed channelled into efforts to restore the pre-storm mobility web defined a '*ten-day recovery*' frame.

The frame '*getting things back to normal as quickly as possible*' was in tension with another dominant frame that emerged in the dataset of having '*never seen anything like it before.*' The scale of Hurricane Igor took all by surprise, giving a taste of a new and disconcerting normal. Uncertainty regarding return periods of severe weather events and the sense that measures such as 1-in-100 year events have entered the realm of fiction, render infrastructure investment, planning and management more precarious. While there is agreement on the fact that the climate is changing, the reasons behind the change are a source of friction. The disconnection between anthropogenic climate change and the experience of severe weather at the individual level mirror a larger disconnection between the contributions of Newfoundland to climate change. For example, fossil-fuelled transport generally, the costs and losses associated with Hurricane Igor specifically, and the experience of increasingly severe and frequent weather by transport operators generally are largely disconnected from climate change. There is friction between efforts to develop the carbon-intensive oil and tourism industries and intentions to reduce greenhouse gas emissions. Similarly, there is friction in terms of intermodal connectivity as disruptions to one transport mode (i.e. roads) hinder seamless exchanges with other modes (i.e. marine, air).

The community and engineering resilience demonstrated in the aftermath of Igor, beg the question: What if the energy, finances and cooperation channelled into reconnecting the road network as quickly as possible was redirected to climate change mitigation and adaptation and/or to reimagining mobility webs that reduce social-ecological contention, increase resilience and question the role of mobility? Ironically, the conditions permitted in times of crisis – intense focus on one common goal, interdepartmental cooperation, regulatory support and liberal financial resources – would benefit climate change mitigation and adaptation, as well as transport resilience, overcoming long time lines, voluntary measures, interdepartmental cross-purposes and limited time and resource allocation.

6 ZONE OF IMPERFECT VISIBILTY: ANALYSIS

We unearthed fear that day, our first act of real
archaeology. Understand, at that point, maps charted roads

and the humble footpaths between rumours crooked
with love. The ocean took up the most room

with its tidal pull and tentacled beasts inventing
their own recipes. Some days we knew we were nothing

but ingredients, other days we felt like honoured guests.
But the day we brushed the dirt from fear's forehead

and got a look at its hands, well, our maps changed
and the ocean got bigger, our nights, a great deal beastier.

Sue Goyette
Four
2013

Alex Colville
To Prince Edward Island
1965

The woman looks into the distance, but at the same time the binoculars obscure her eyes, reflecting the imperfect visibility of the Anthropocene. The position of humans relative to the environment is shifting: "Some days we knew we were nothing but ingredients, other days we felt like honoured guests."

Introduction

Having journeyed to two ports of call – Hurricane Juan in Nova Scotia and Hurricane Igor in Newfoundland – I first compare the impacts of these severe weather events on mobility webs. I detail the responses and frames employed by transport operators, emergency managers and other key informants as they align with the four stages of disaster response cycle (i.e. prevention, preparation, response and mitigation). From this largely pragmatic description, I shift to a theoretical discussion of the ecopolitics of mobility, elaborating upon Cresswell's work and incorporating a Foucauldian analysis of governmentality (including governmobility) and the circulation of societies and ecologies. I integrate theorizations from various approaches to resilience (e.g. transport, infrastructure social-ecological), disaster sociology and reflexive modernization, moving towards a more sophisticated conception of navigating disruption in mobility webs caused by severe weather events (Table 6.1).

Mobility webs and hurricanes

Disruptions and changes in mobility are "challenging, exciting, stressful, and sometimes deeply troubling" and consequently instigate a multiplicity of social responses (Harvey 1989: 240). I use the term mobility webs – drawing on the metaphors of food and spider webs to reflect the environmentally-exposed, but also diverse and adaptable dimensions of contemporary mobility networks – arguing for an approach that cooperates with, rather than dominates, the environment. This ecopolitical approach to mobility extends past and current approaches transport planning, namely conventional transport engineering and sustainable mobility (Table 6.2).

Table 6.1: Analytical framework combining mobility and disaster literatures to create an ecopolitical approach to mobility

THEORY	THEORISTS/PRACTITIONERS
MOBILITY	
Mobilities paradigm Politics of mobility	Sheller and Urry Cresswell
Sustainable mobility	Banister, Schwanen, Anable
Resilience (with a mobility focus) Transport Infrastructure Social-ecological	 Transport Canada;UK Department of Transport Brown Folke/Adger/Berkes/Holling
Governmentality Social and ecological circulations	Foucault
+ DISASTER	
Disaster sociology	Freudenburg/Klinenberg/Murphy
Reflexive modernization Emancipatory catastrophism	Beck
= ECOPOLITICAL APPROACH TO MOBILITY	

Table 6.2: Contrasting approaches to transport planning
(Adapted from Banister 2008 and Marshall 2001)

TRAFFIC PLANNING (MARSHALL 2001)	SUSTAINABLE MOBILITY (BANISTER 2008)	ECOPOLITICS OF MOBILITY (SODERO 2016)
Physical dimensions	Social dimensions	Ecological, social and physical dimensions
Mobility	Accessibility	Human accessibility and non-human mobility
Traffic/ car focus	People focus, either in (or on) a vehicle or on foot	People as part of larger ecosystem
Large scale	Local scale	Interscalar
Street as road	Street as space	Street as ecological corridor
Motorized transport	All transport modes in carbon-intensity hierarchy	Ecological flows included within considerations of all modes of human mobility
Forecasting traffic	Visioning cities	Transforming social-ecological relationship
Modelling	Developing scenarios and modelling	Imagining futures (e.g. utopian, dystopian)
Evaluating economic criteria	Analyzing multiple criteria, including environmental and social	Analyzing multiple criteria, including environmental (e.g. carbon budgeting), social, safety (e.g. disaster relief), economic (e.g. infrastructure maintenance)
Travelling as derived demand	Travelling as derived demand as well as a valued activity	Travelling as derived demand, valued (in)activity and environmentally contingent
Demand-based	Management-based	Ecologically-constrained
Speeding up traffic	Slowing down movement	Accommodating fast and slow social, ecological and technical movements (e.g. tipping points, turbulence)
Minimizing travel time	Aiming for reasonable travel times and travel time reliability	Recognizing timeless time including "longue durée" or "glacial time (Castells 2009)
Segregating people and traffic	Integrating people and traffic	Incorporating ecological flows and turbulences with flows of people and traffic

The cases of Hurricanes Juan and Igor demonstrate the simultaneous rigidity and adaptability of mobility webs. Hurricanes vary, with different conditions exposing different resiliencies and vulnerabilities (Table 6.3). However, broadly, in the face of Hurricane Juan and Igor, human mobility contracts like a snail curling into its shell or a spider retracting its legs. The dominant transport modes, particularly static ribbons of infrastructure such as roads, demonstrate the social-ecological principle of highly optimized tolerance, whereby they are functional and flexible within a daily range of experience, but may falter and fail under less frequent and more extreme events.

Just as in disturbance ecology (e.g. forest regeneration), the removal or absence of the dominant species (e.g. mature trees) allows other species – that is alternate transport modes and networks – to develop. I describe these as *shadow mobility webs*. In each case study, there is a simultaneous celebration of the capacity to innovate in the face of adversity and pressure to return to the status quo as quickly as possible. The former reflects a fledgling form of transformative resilience, whereas the later reflects passive resilience; the latter benefits from not only cultural familiarity, but significant social, political and economic path dependency (i.e. lock-in). A window of opportunity is opened but not passed through; the breeze felt, but then the window shut. This may be in part due to an uncertainty as to whether the event is a "portent of things to come or merely a fleeting immobility" (Birtchnell and Büscher 2011: 8).

This both reinforces and contradicts Beck's (2015) argument that climate change, though catastrophic, can have an emancipatory effect, shocking society into what Schwanen, Banister and Anable (2011) refer to as a durable reconfiguration. The experience of transformation while lauded is also uncomfortable and challenging.

Table 6.3: Comparison of mobility web resiliencies and vulnerabilities in Hurricanes Juan and Igor

	HURRICANE JUAN	HURRICANE IGOR
RESILIENCE		
Mobility web	Versatility of public transit	Emergence of multi-modal shadow mobility web
	Diversity of dominant mobility web	Diversity of transport modes and operating skills at individual level
Preparation	Familiarity with need to batten down hatches	Familiarity with need to batten down hatches
Response	Cooperation between levels of government and other sectors	Cooperation between levels of government and other sectors
	Integrated Emergency Management Organization, especially within one building	
	Experience with a range of hazards and an 'all hazards' approach	
Recovery	Coordination of recovery effort (~5 days for urban transport)	Coordination of recovery effort (e.g. ten road connection)
Mitigation	Recognition of the frequency and diversity of extreme events and the relationship with climate change	Development of disaster management plans (local)
	Development of *Climate Change Adaptation Plan* (provincial and municipal) and *Sustainable Transport Strategy*	Development of climate change adaptation workbooks, albeit on voluntary basis
VULNERABILITY		
Mobility web	Reliance on static road infrastructure (trees)	Reliance on static road infrastructure (water)
	Reliance on fossil fuels	Reliance on fossil fuels
		Lack of redundancy in terms of dominant mobility web (i.e. cars, trucks)
Preparation	Reliance on forecasting (i.e. underestimation of storm force)	Reliance on forecasting (i.e. inaccuracy of storm track)
Response	Reliance on electricity to access gas	Reliance on electricity to access gas
Recovery	Discrepancy between recommended mobility and actual mobility on part of residents	Emphasis on re-establishing mobility web as it was prior to storm event
Mitigation	Reliance on fossil fuels	Reliance on fossil fuels
	Focus on vehicle efficiency (personal and freight) rather than shifting modal split or reducing demand	Lack of recognition of connection between greenhouse gas emissions and climate change

A reactive almost panicked reflex of returning to normal appears to supplant considered reflection of longer-term innovations and reimagined futures. This is understandable given the need to restore services. However, given the prospect of future such events, pre-planning activities could leverage the emancipatory potential created by extreme events to facilitate a mobility metamorphosis (Beck 2015). Such an approach echoes social-ecological systems theory, which advocates selective experimentation and intervention at smaller scales to precipitate transformational change at larger scales (Folke et al. 2010).

In the case of Nova Scotia, winds brought down trees and power poles blocking roads in a fibrous and electrical entanglement. The experience of Halifax was defined by the persistence of mobility even in the face of disrupted mobility webs, as illustrated by residents drawn to the coast to experience the oncoming storm, '*charismatic mobility*,' and examples of disaster sightseeing in the aftermath of the storm, '*charismatic immobility*.' With the blockage of streets, many forms of mobility – bus and ferry, car and ambulance, walking and cycling – proved challenging, if not impossible. Despite requests from emergency services to stay clear of the roads to prevent injury and allow clean-up crews to carry out their work, what occurred was a persistent, albeit perhaps more localized mobility. Mobility also took on poignancy as community members reflected on the changed urban treescape.

Public transit in particular had a central functional and symbolic role, morphing from transport mode to shelter to recovery mobilization and back to public transport mode. However, the reliance on public transit directly on fuel and indirectly on electricity to pump fuel embeds vulnerability within this modal resilience. In the case of Nova Scotia a key source of vulnerability in the context of Hurricane Juan was the '*big mess*' of trees and power lines, leading to attention to and investment in the urban forest canopy as a resilience measure. More prominently, the experience of successive intentional, technical and ecological adversities fostered a culture of all-hazards disaster readiness. Key sources of resilience include the cultural instinct to '*batten down the hatches*,' the adaptable role of transit, the coordination of emergency services, as well as the recognition of the frequency and diversity of extreme events. Further, residents appeared to successfully, if somewhat precariously, govern their own mobility (i.e. governmobility). In the aftermath, the experience of Hurricane Juan shaped both thinking on climate change and emergency preparedness.

In Newfoundland, water, more so than trees, defined the experience of Hurricane Igor. Vast volumes of water overwhelmed the absorptive capacity of the landscape and rendered asphalt roads and bridges mobile, calving the road network like a disintegrating iceberg. Unlike the varied transport modes and road networks of urban Halifax, the washout of limited roads combined with limited modes (e.g. car, truck) and limited fuel sources and stores rendering Newfoundland communities even more vulnerable to disruption. In many cases, the dominant network allowed for only one route to access a community. However, the literal absence of the dominant network permitted a shadow network made up of quads and helicopters, boats and ferries to develop.

Just as Lin (2013) analyzes the improvised aeromobilities that occurred in the aftermath of an ash cloud event, improvised mobilities emerged in the aftermath of Igor. All levels of government, as well as the private sector and private citizens activated the shadow mobility web. Pride was taken in quickly adapting to ensure basic needs were met. A key source of resilience was coordination and cooperation among different levels of government, the private sector and communities. Further, Newfoundland demonstrated high capacity for passive resilience restoring the road network to a basic form of functionality within ten days. Indeed, in terms of frames, restoration of the status quo and reliance on the resilience of Newfoundlanders characterized media accounts immediately following the storm. In weeks following, a '*ten-day recovery*' frame developed and was a source of pride for politicians and managers. However, the '*ten-day recovery'* frame also had the effect of curbing more critical, longer-term assessments related to climate change mitigation and adaptation.

To a greater extent than in Nova Scotia, the experience of Igor was conducive to passive/adaptive resilience rather than transformation. A key concern was the economic cost of rebuilding roads and contention over what standard to build roads in light of restricted budgets and uncertainty regarding the return period of future severe weather events. While Igor informed discussions on climate change, most notably through the creation of voluntary community workbooks and the development of downscaled climate models, communication on climate change overall has less prominence in the social and political realms than in Nova Scotia, relying more on peripheral voluntary measures than a changing culture spurred by regulatory measures and/or more proactive government approaches. Further, while Newfoundland has experienced numerous flooding events since 2000, only in policy documents and certain interviews were these events framed as part of a larger vulnerability to climate change. Particularly in the media archive, Igor was positioned as an isolated event with minimal acknowledgement of the possibility of future such events. The greatest area of certainty with regard to climate change in Newfoundland is the steadfast commitment to developing oil and gas resources and to expanding the tourism industry, both of which are greenhouse gas intensive activities that contribute to long-term climatic precariousness. This is echoed in Nova Scotia where there is also a focus on expanding export and tourism markets. The degree to which "business models in manufacturing and leisure/tourism based on current global production chains and aviation networks [will] remain feasible," is far from the purview of consideration (Schwanen, Banister and Anable 2011: 1004).

Hurricanes Juan and Igor were different in key respects: Juan was defined by an urban epicenter subjected to high winds, while Igor was defined by extensive flooding of more rural areas. However, despite these differences important parallels occur suggesting a commonality of social response to the type of events expected under a changing climate. In both Nova Scotia and Newfoundland the impacts of the hurricanes were perceived as devastating, with analogies of war (e.g. bombs, battles, arsenal) used to describe the effects. In both cases it was felt that the storms tracked over key infrastructure: the backbone of the electrical transmission system in Nova Scotia and the road network in Newfoundland. The overlap was so uncanny that it was almost perceived to be intentional, effectively illustrating the inseparability of technological and ecological systems.

Static ribbons of road, as well as electrical infrastructure, were particularly susceptible to storm impacts. By contrast, mobile infrastructure, such as cars, ferries and airplanes were often successfully sheltered, diverted or repositioned to avoid impact. However, while such modes were flexible their fuel sources were not. The mobility of fuel, whether from supplier to market or from holding tanks to gas tanks, was a theme in both case studies. Particularly for cars, buses and emergency vehicles, concerns about accessing fossil fuel were top of mind. Regardless of the diversity of modes, the majority of transport energy is derived from fossil fuels. At an extreme, even pedestrians and cyclists often rely on food derived from fossil fuel intensive agriculture methods and markets. Further, the reliance on electricity, which in both provinces is derived in large part from fossil fuels, to pump liquid fuel highlights the tight coupling of fossil fuel and electricity whereby the provision of one relies on the other and, by extension, the absence of one prevents the provision of the other (Brown 2014). What comes to light is an energetic monoculture subject to cascading collapses. With the failure of electricity after each storm even available fuel stores became stranded assets.

While vulnerabilities were identified, there are limited efforts to address issues such as the distribution and pumping of gas, nonetheless societal reliance on one fuel. A regional fuel provider concedes: “I think if there was another Igor (by a different name of course) maybe we’d have the same thing happen again and we’d just have to suffer through it like we did last time. Hopefully, the road holds up this time” (NL Transport 123). This is a precarious system on which to base the majority of societal movement, particularly in the context of observations in both regions about the frequency of recent extreme weather events, the general sense that traditional measure of return period (e.g. 1-in-100 year events) are now the stuff of lore (i.e. references to a disaster return periods being on the scale of months, not years), and the ominous sense that with just slight alterations in storm tracks and intensity Atlantic Canada could be exposed to events with the force of Hurricane Sandy.

And yet both regions worked laudably and efficiently, coordinating multiple levels of government, the Canadian Forces, non-profit organizations and communities, to restore the system as quickly as possible, illustrating a robust passive resilience and mild adaptive resilience that foregoes transformative resilience, which may in fact foster longer-term vulnerability. The emancipatory potential of catastrophes appears, at best, to be gradual. It is in the months and years after the event that it is processed and incorporated into incremental processes of policy renewal.

Navigating disruption

A myriad of strategies used by transport managers and other officials to navigate weather-related mobility disruptions appeared in the dataset. These can be broadly categorized as managing mobility before the disaster (e.g. battening down the hatches, fuelling generators), adjusting mobility during and after the storm (e.g. rescheduling flights, rerouting cars, rebuilding roads) and building resilience of mobility webs for potential future disasters (e.g. building in redundancies, implementing operating standards). These loosely align with the disaster response cycle which includes preparation prior to the impact of the storm, emergency response during and immediately following the event, recovery in the form of restoration and reconstruction, and in the longer term building mitigation capacity (Figure 6.1). There is an iterative relationship between the phases, characterized by ongoing learning, with past experiences shaping preparation and response measures in later events.

Figure 6.1: Disaster response cycle (Osmania University 2013)

Thorough but not exhaustive, the following table provides a sense of the diversity and multitude of strategies employed in Nova Scotia and Newfoundland that relate directly and indirectly to mobility webs (Table 6.4). Both regions implemented these measures to varying degrees, in varying combinations and/or based on the experience of the storm, revised practices for future events. The similarity of approaches is notable given the geographic and modal diversity of the case regions, as well as the differing composition of the storms indicating a high level of transferability. While my research focuses on hurricanes, the lessons learned and analytical framework (e.g. *eco*politics of mobility) are transferable to diverse fast onset weather events in diverse regions (e.g. 2016 Fort MacMurray wildfires), as well as to slow onset crises (e.g. the role drought played in contributing to the Syrian refugee crisis) and more infrastructural events (e.g. the 2015 Nova Scotia fuel shortage; 2016 Ottawa sink hole). My research is of value to transport practitioners, climate change managers, emergency managers, humanitarian organizations and politicians. Further, through my elaboration of an ecopolitics of mobility, inspired by Cresswell's politics of mobility, I forward an approach that considers both social and ecological flows of value to mobilities scholars and disaster sociologists.

Table 6.4: Examples of measures for managing mobility before, during and after hurricanes (alphabetical)

BEFORE THE STORM: PREVENTING UNDESIRABLE MOBILITY	AFTER THE STORM: RESTORING MOBILITY	FUTURE STORMS: BUILDING MOBILITY WEB RESILIENCE
PREPARATION	RESTORATION[86]	MITIGATION
Activating emergency plans	Assessing situation (i.e. situational awareness)	Analyzing risk
Advocating caution (e.g. stay indoors, stay off roads)	Containing/allowing flooding	Building in redundancies (e.g. back up equipment, alternate routes)
Battening down hatches (i.e. tying down loose objects, tying up boats)	Coordinating with other organizations	Conducting research (e.g. generating data and statistics)
Barricading roads	Dealing with political tensions (e.g. urban/rural, federal/provincial)	Coordinating with other organizations
Charging cell phones	Distributing relief (i.e. food, water)	Creating new departments/expanding existing departments[87]
Cleaning out catch basins	Using temporary structures (i.e. Bailey bridges)	Developing Early Warning Systems
Coordinating with other organizations	Prioritizing responses (i.e. triaging restoration of mobility infrastructure)	Evaluating responses
Creating berms	Providing shelter	Implementing operating standards (e.g. wind threshold policy)
Declaring state of emergency	Reconnecting roads and transit	Investing in equipment and technology (e.g. radios)
Evacuating residents	Repurposing transport (i.e. buses as shelters)	Maintaining infrastructure and equipment
Fuelling generators	Rerouting, guiding, detouring (i.e. physical adaptation)	Managing retreat of development from zones prone to flooding
Monitoring weather	Resuming, continuing, carrying on	Managing stormwater (e.g. *Urban Forestry Strategy*)
Prepositioning personnel and goods (i.e. cots)	Searching and rescuing	Promoting living shorelines
Putting up signage	Waiving normal approval processes (e.g. tendering, environmental assessments)	Regulating fuel and mobility
Rescheduling, postponing, closing, cancelling		Updating construction standards (e.g. culvert diameter)

[86] The restoration category includes the response and recovery phases of the disaster cycle given the similarities of the measures.
[87] For example, Newfoundland and Labrador Fire and Emergency Services grew from five to 27 positions between 2008 and 2012 (Catto and Tomblin 2013).

However, each measure needs to be tailored to local context (e.g. climate change projections, culture). Though beyond the scope of this research, there is potential to develop a resilience toolkit, including case study examples, photos, budget estimates, for Canadian transport, land use and emergency management practitioners. This toolkit could complement existing workbooks, for example, *7 Steps to Assess Climate Vulnerability in Your Community and 12 Steps to Developing an Effective Emergency Management Plan* (Government of Newfoundland and Labrador no date b, c), while highlighting how to meet longer-term community needs in the face of a compromised dominant mobility web. The toolkit would extend existing tools by introducing more systemic rethinking of our societal reliance on fossil-fuelled mobility (e.g. beyond infrastructure fixes) and beyond short-term disaster response. Such a toolkit could be informed by stakeholder consultations (e.g. creative and interactive workshops with visioning components) focusing particularly on the potential to spur adaptability and transformability, not just passive, resilience. C*ommunity Resilience Techniques: A Compilation of Approaches Used to Increase Resilience,* a toolkit developed by the State of New York (2013) in the aftermath of Hurricane Sandy provides a practitioner-friendly template.

Ecopolitics of mobility

Based on the empirical cases of Hurricanes Juan and Igor, I develop an *ecopolitics of mobility* attuned to the interface of the social, ecological and technical. I adopt Cresswell's six elements of the politics of mobility – motive force, velocity, rhythm, route, experience and friction. The result is fresh theoretical insights into mobility in the context of a changing climate. I reframe mobility as ecologically-situated, both in terms of the impact of the transport sector on the environment and in terms of the impact of the environment on the transport sector. Mobility – socially, ecologically and technically – is a source of achievement and risk. For Cresswell, all mobility is political in that it is "implicated in the production of power and relations of domination" (Cresswell 2010: 20). This ecopolitical approach builds upon conventional transport planning and sustainable mobility (Banister 2008).

Motive force is compelled internally, such as physically through fossil fuels or behaviourally through practices of charismatic mobility, and externally, such as through pressures for economic expansion or the desire to see storm damage. In the context of my research, the prominence of fossil fuels as the means of movement is striking not only for the climatic implications of a greenhouse intensive fuel source, but due to the lack of redundancy in mobility webs both normally and during disaster. The fact that generators and chainsaws, key tools of disaster response and recovery, are fossil- fuelled illustrates the precariousness of such tight coupling (Brown 2014). Motive force arises as a key problem within the field of transport resilience. A reflexive risk analysis illustrates how mobility webs contribute to climate change and, in turn, are impacted by climate change. This raises questions regarding not only how to mitigate the reciprocal impacts, but also how mobility webs can play an active role in societal adaptation to climate change. At this point, the reciprocal impacts are largely unacknowledged with governments aiming to expand mobility webs and simultaneously decrease emissions.

Velocity is characterized by extremes. At one end of the spectrum, the vast majority of the affected population is immobilized, at least in the immediate term, encouraged – but not necessarily persuaded – via safety bulletins and more coercively by mandatory evacuations permitted under a state of emergency, to stay at home and off the roads. At the other end of the spectrum, essential workers such as emergency management officials and work crews (e.g. power, road) are thrown into a state of intensive mobility, travelling to and/or between impacted sites and working long hours under strenuous conditions. Extreme weather contributes extremes in the velocity of mobility. Further, pressure to keep the market economy moving is a central consideration. In both cases, there is a push to keep things moving and growing, and to recover from disruption as quickly as possible. The economy is afforded consideration, both in the immediate aftermath of the event and on an ongoing basis; consideration which the climate is only beginning to be afforded in practice. This prompts consideration of what a more climate-centric mobility web might look like (see Chapter 7: Navigating Transition). Under a changing climate, hurricanes may be more severe, potentially intensifying impacts generally and on mobility webs specifically (Intergovernmental Panel on Climate Change 2012a, 2012b). Movement may become more fractured as more complex mobility webs operating at greater speeds and shorter timelines are subject to more frequent weather-related disruptions.

Similar to velocity, the concept of *rhythm* can be applied to the functioning of mobility webs. In the face of severe weather events, mobility webs morph, perhaps expanding briefly as residents make preparations, travel home in response to work and school closures or even are drawn to coastal regions to experience the force of the oncoming storm. Mobility webs contract for the duration of the storm, with the exception of a small essential workforce, and then gradually as recovery occurs, expand with a return to the normal rhythm celebrated. Hurricanes illustrate their power by wreaking havoc on the multitude of rhythms that constitute daily social functioning, from journeys to school to global supply chains, from surgical schedules to food deliveries. Further, hurricanes as a meteorological phenomenon have a rhythm that begins with their formation off the Cape Verde coast and their dissipation in the North Atlantic. However, a given hurricane may be arrhythmic or sporadic, erratically gaining and losing strength as it progresses northward and possibly changing course. This was the case in Newfoundland where 24 hours prior to making landfall Hurricane Igor turned landwards; forecasters and emergency officials struggled to adapt human rhythms to the arrhythmia of the hurricane. Overall, there is a sense among research participants that traditional measures of storm return periods (i.e. 1-in-100 years), that is temporal rhythms, are changing.

The track or *route* of the storm is a matter of concern, with forecasters and residents alike closely monitoring whether the storm will turn landward. In the case of both Hurricanes Juan and Igor, the storms made landfall with the storm tracking over key infrastructure. In Halifax, residents learned to navigate urban streets blocked by fallen trees and power lines, for example, by climbing over or around trees, or opting to use alternate streets. In Newfoundland, new routes across water and air were forged to replace the routes of asphalt highways washed out by rivers carving new routes. Experienced mariners practice weather routing, using tidal, current and wind conditions to reduce the physical resistance of vessels moving through water. The practice of selecting and undertaking (or not) a route, particularly during and following stormy conditions, is a skill.

Routing is closely related to *friction*, in that most routing, whether human or non-human is focused on minimizing friction. Like the Canadian fishing and racing schooners that characterized marine activity in the 1930s, ships carve a course to maximize the efficiency of their route. Hurricanes are disruptive precisely because they add multiple layers of friction: environmentally in the form of water and wind; infrastructurally in the form of fallen power lines and washed out roads; and legally in the form of states of emergency. Emotional friction is also experienced during and following a storm, ranging from the frustration of cancelled travel plans to financial concerns over missed work, from the grief of an altered landscape to the strain of rescheduling a long-awaited medical procedure. These frictions are complemented by a range of emotions related to Hurricanes Juan and Igor, including disbelief at the scale of impact, pride in the recovery effort, anxiety about how to proceed with infrastructure projects given uncertain return periods and certain costs, and a desire to return to normal as soon as possible.

Friction also emerges in the bigger picture, with a range of uncertainties from the course and intensity of current and future storms, sea level rise projections, decisions on whether and how best to rebuild infrastructure in the face of such events and the uncertainties associated with future events, as well as for some, uncertainty about anthropogenic contributions to climate change. Friction arises between recognition by some of the need for transformation and resistance to significant change. There is larger financial friction as the costs of cumulative events are incurred. Severe weather events, of the type expected more under a changing climate, could be perceived as a form of carbon taxation, where the externalized costs associated with a fossil fuel-reliant mobility web are incurred eventually.[88] Critically, switching from mobility from the status quo into an alternate state (e.g. adaptive or transformative) is frictious.

The overall pictures that materializes, based on the six elements of an *eco*politics of mobility, is a fossil-fuelled mobility web that is geared towards speed and volume and connectivity between modes that, like a finely-tuned race car, is vulnerable when exposed to less than optimal conditions. Mobility is perceived as desirable, with disruptions viewed as an inconvenience to be overcome as quickly as possible. While innovations and teamwork are lauded in the process of returning to normal, the overall short-term tendency is towards a passive engineering resilience.

Circulation, surveillance, discipline and security

I complement an ecopolitics of mobility with a Foucauldian analysis of circulation of societies and ecologies, exploring related issues of discipline and security. Foucault argues that power is "never localised here or there, never in anybody's hands," rather it circulates in networks (1980: 98). Castells (2009) describes contemporary society as a network society, characterized by the logic of self-organization and transience. Similarly, Latour employs the concept of actor networks, whereby society is continuously made and remade through interactions of human and non-humans actants. While there are dominant players in such webs, the power is not held in isolation nor permanently.

[88] Hurricane Juan incurred an approximate per capita cost of $107 ($100 million divided by the 2003 provincial population of 936,000) and Hurricane Igor an approximate per capita cost of $192 to $383 ($100-200 million divided by the 2010 provincial population of 522,000).

Ecological circulation

A circulatory approach is useful in analyzing the intersecting mobilities of societies and ecologies. In addition to capturing the movement intrinsic to both spheres, they also highlight resiliencies and vulnerabilities that characterize these flows. The flows of molecules of oil, carbon dioxide and water provide a lens with which to track these movements. The earth is continually changing: fossil fuel formation occurs in the order of millennia, hurricanes seasonally and weather hourly. Sedimentary substances formed through bio-chemical processes of compressed ancient wetlands are the source of fossil fuels that now power the vast majority of transport energy. Glacial retreat carved our current landscape and annually icebergs break off the Greenland ice sheet and migrate as far south as Newfoundland. Carbon circulates through the geosphere, biosphere and atmosphere, combining with water, nitrogen and sunlight to support life on the planet.

Through complex interactions of wind, currents and temperature Hurricanes Juan and Igor originated off the coast of Cape Verde in Africa and dissipated in the North Atlantic. Such storms often sweep tropical birds and fish along with them. Through wind and rain, hurricanes erode land and transport massive amounts of sediment to the ocean where it is circulated by global currents. Hurricanes transfer massive volumes of heat from warmer to cooler regions and water from the ocean to land. Storm surges leave salt in soil, creating habitat for salt-tolerant plants and related insects, birds and animals, fostering biodiversity.

When humans are added to the mix complications arise. Seismic testing used in oil exploration to tap ancient reservoirs disrupts the communication and migration patterns of marine mammals. Schedules of global tourists intersect with the migration patterns of whales and seabirds. Icebergs are tugged out of the path of fixed platform oilrigs (Photo 6.1). Globally- and locally-sourced workers are flown by helicopter to oil platforms where oil is extracted from the sea bed, carried in fossil-fuel powered ships for refining and then shipped to new destinations, where it fuels further flows. The flows of wind and water that constitute hurricanes disrupt the flows of humans, and related goods and services.

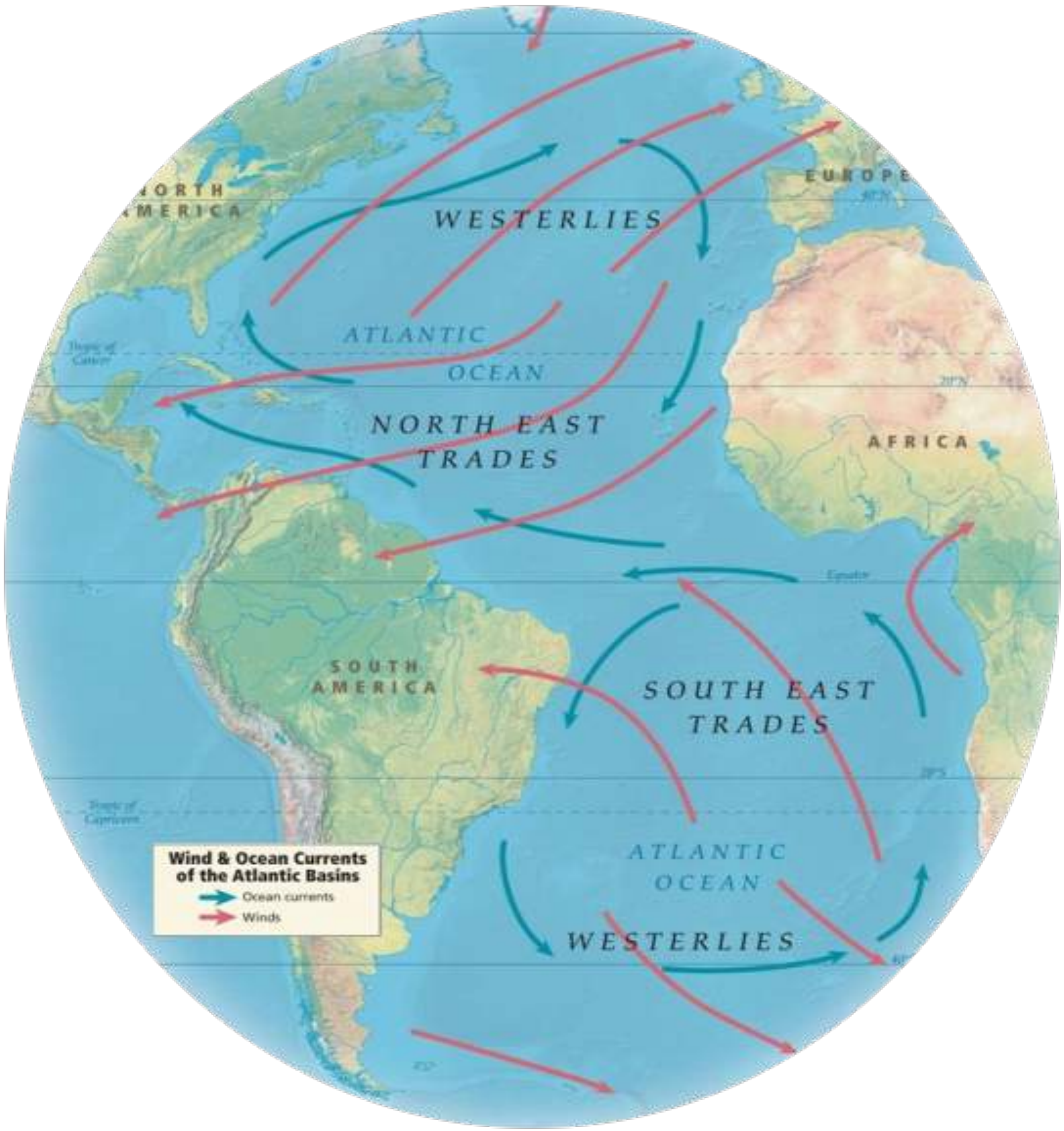
Photo 6.1: Intersecting social and ecological flows: Oil workers tow an iceberg, Newfoundland and Labrador (Reuters/STR News No date)

Capital circulations

Environmental flows can be viewed as disrupting capital flows. Contemporary mariners use technology to optimize navigation and reduce fuel use and travel time – as one Newfoundland mariner stated, "we'll weather route to allow us to maintain the maximum speed with the minimum amount of energy" (NL Transport 113). Historically, mariners took advantage of trade winds, dominant easterly winds that cross the Atlantic, which facilitated European exploration and trade of the Americas (Figure 6.2). Hurricanes follow the trade winds. The ecological interface of marine mobility with local economies has a storied history (see Peréz (2001) on the economic impacts of hurricanes in Cuba).

Control of time and space are integral to power in capitalistic systems, "the incentive to create the world market, to reduce spatial barriers to annihilate space through time is omnipresent, as is the incentive to rationalize spatial organization into efficient configurations of production…circulation networks… and consumption" (Harvey 1998: 232). Time is equally as prominent in Weber's (1958) analysis of how the Protestant work ethic shaped capitalism. The ascetic value of work prompted the productive use of time; "waste of time is thus the first and in principle the deadliest of sins" (Weber 1958: 157). At an extreme, the minute movements of workers are analyzed in Tayloristic time management studies to both maximize efficiency and control alienated labour (Braverman 1974). In short, "time is money" (Harvey 1989: 227). Given the centrality of interrelated concerns of speed, volume and intermodality to contemporary mobility practices, it was unsurprising that they surfaced as considerations, particularly on the part of interview participants. Movement, growth and distance are lauded, with different concessions made for extenuating circumstances such as weather.

Figure 6.2: Dominant trade winds and ocean currents in the Atlantic Ocean
(Seven Seas 2012)

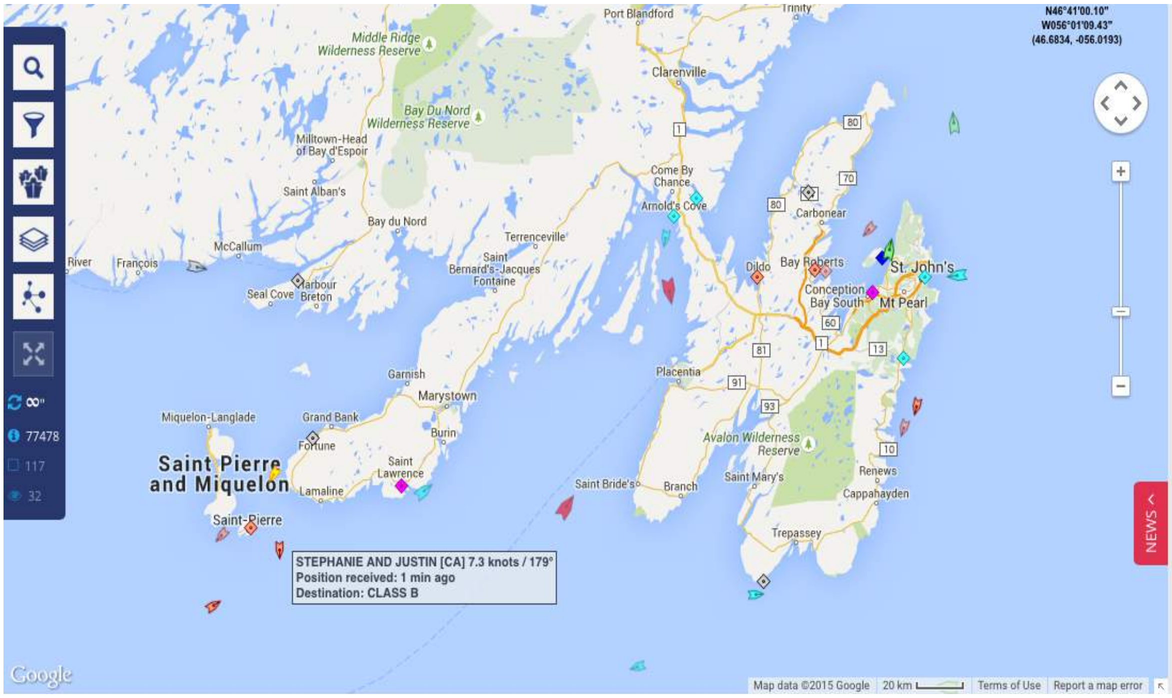


In both Nova Scotia and Newfoundland there is a tension between expanding mobility networks through resource extraction and tourism on one hand and reducing greenhouse gas emissions on the other hand. Both governments and the private sector in Nova Scotia and Newfoundland aim to expand passenger and freight markets. For example, Nova Scotia is positioning itself as Atlantic Gateway in an integrated and intermodal global supply chain. Newfoundland aims to double its tourism revenue by 2020.

Surveillance

Surveillance of mobility is increasingly prevalent. The movement of passengers, particularly post-9/11, is the subject of scrutiny. With cyber surveillance, virtual travel is tracked. Likewise, freight and the system of containerization means that movement of goods can be monitored en route. For example, marine operators use Geographic Positioning Systems (GPS) to track the location and movement of their fleet and other vessels (Figure 6.3). Ecologically, from a climate change mitigation perspective, greenhouse gas emissions are now tracked and accounted for in regular audits (Schwanen, Banister and Anable 2011). In terms of climate change impacts, sea level rise and stream flow volume are monitored.

Figure 6.3: GPS tracking of vessels in eastern Newfoundland (August 19, 2015) (marinetraffic.com 2015)



Just as hydrology is closely monitored, so too is meteorology. Humans are drawing on increasingly sophisticated meteorological techniques and technologies to reduce the uncertainty associated with hurricane events. Knowledge, obtained through surveillance, surfaces as a form of control over the environment. Monitoring the weather involves a complex socio-technical assemblage, including meteorologists, satellite images and weather buoy data. Data is collected passively via remote sources such as satellites and buoys, as well as actively by flying airplanes with scientific crews into hurricanes to take readings (Photo 6.2).

Individual transport operators often employ meteorologists to prepare forecasts tailored to their sector and operations. Intimate familiarity with, and forecasting of, weather conditions are viewed as invaluable information in the transport sector. A number of research participants observed the improvement in the accuracy and range of weather forecasts in recent decades. Just as Global Positioning Systems can provide real time information on transport movements, forecasting provides real-time data and forecasts on the movement of weather systems, with both transport managers and meteorologists anticipating the intersection of heavy traffic and heavy weather. With the manifestation of climate change and the socio-economic centrality of mobility, meteorological data will only grow in import.

Notably, due to the force of the Hurricane Juan, a weather buoy at the mouth of Halifax Harbour actually snapped its moorings, illustrating human power in the form of surveillance relative to the physical power of the marine environment. In part due to the experience of Juan, the Halifax Port Authority, Dalhousie University, Environment Canada, among other organizations, partnered to fund the installation of a weather buoy (Photos 6.2 and 6.3).[89] More buoys means more information and therefore more power to adequately prepare for storms. However, cost is a limiting factor. Knowledge of the environment, in the form of meteorological and climatic data, emerges as power. Whereas previously knowledge was associated with power in the form of control or strength (as epitomized by the Titanic), due to shifting social-ecological dynamics, power may now be equated with identifying and preparing for hazards such that they do not transpire into disasters.

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[89] Funded through the federal Networks of Centres of Excellence, the Marine Environmental Observation, Prediction and Response Network (MEOPAR) develops disaster and risk reduction tools and proposes positive adaptation measures allowing Canada to be better positioned to manage all forms of ocean hazards.

Photo 6.2: Hurricane Juan research flight conducted by National Research Council and Environment Canada (Environment Canada 2013b)

Photo 6.3: Deployment of first inshore weather buoy in Halifax Harbour (Marine Environmental Observation, Prediction and Response Network 2013)

Discipline

Governmentality, with its focus on the self-regulation of (mobile) subjects, is useful in the analysis of liminal states of disruption and emergency that characterize hurricane events (Sheller 2011). More specifically, a form of governmobility occurred with residents in Nova Scotia treating states of emergency as suggestions tempered by their own needs and contexts. In Newfoundland, the activation of a shadow mobility web by residents creatively met community needs. Governmobility was complemented in both regions by declaring a state of emergency, allowing officials, if needed, to impose exceptional restrictions on the movement of the citizenry, such as curfews and evacuations. In the overlap between the extremes of reliance on the common sense of residents on one hand and extraordinary regulatory measures on the other, a form of disaster mobility was negotiated and practiced.

Another aspect of discipline relates to the mobility of greenhouse gas emissions (see Paterson (2014) on the mobilization of carbon markets). The creation of regulatory emission reduction targets in Nova Scotia and Newfoundland is a form of aspirational societal discipline. Notably, the shared emissions reduction target of ten per cent below 1990 levels by 2020 are insufficiently disciplined compared to the suggested targets of 80 per cent reductions by 2050. Nova Scotia does include a long-term target in its *Climate Change Action Plan*: "By 2050, the province will reduce GHG emissions from human sources by up to 80 per cent below current levels, guided by the most up-to-date scientific consensus on required reduction" (Government of Nova Scotia 2009). However, as an initial target, though ecologically inadequate, it speaks to the process of learning how to discipline emissions (e.g. auditing, target setting, reporting).

Security

From a Foucauldian perspective, decision-makers are responsible for the management of the natural environment and resources upon which the population relies. Gerth and Mills (1958) in their analysis of Weber, observe that the state is looked to for security in times of risk and danger. In this vein, Tiryakian argues that 9/11 "produced a massive national solidarity" overcoming, for a period, a particularly divisive phase of relations between Republicans and Democrats (2005: 314). In the management of crises such as hurricanes, heat waves and ice storms, governance entails an ensemble of institutions, procedures, analyses and reflections, calculations and tactics, that is mechanisms of power, employed by government, ranging from the non-action of the wait-and-see approaches, to voluntary energy and water conservation measures, to more authoritarian measures requiring police and military intervention such as declaring states of emergency and organizing mass evacuations (Burchell et al. 1991).

Manufactured risk and the resulting fear poses specific governance challenges: "there is a new moral climate of politics, marked by a push and pull between accusations of scaremongering on the one hand, and of cover-up on the other" (Giddens 2003: 29). When managing unknown, non-linear risks, providing advice and direction to the public is fraught with risk and challenge (Giddens 2003). In his analysis of the 1998 North American ice storm, Murphy (2004) details the deliberations undertaken by Hydro-Québec officials, the Premier and the Mayor of Montreal in the face of a pending water shortage. Deciding that openness could exacerbate the problem by leading to hoarding, they opted for secrecy. One option considered by this powerful and burdened elite was the evacuation of Montreal, "a drastic measure for a large population when transportation had broken down and there was nowhere to go” (Murphy 2004: 258). In the management of unknown, non-linear risks “we cannot know beforehand when we are actually scaremongering and when we are not” (Giddens 2003: 30). In this scenario, time, space and mobility intersect: time in the form of hours before the water supply runs out, space in the form of water and population distribution and mobility in the form of a potential full-scale evacuation of an urban population. By contrast, the mass evacuation of Fort McMurray due to forest fire (May 2016) were immediate, leaving residents with minutes to connect with loved one, collect belongings and physically evacuate.

In the case of Atlantic Canada, security was incentivized, leveraging the financial benefits of the federal gas tax agreement that allocates a portion of tax revenue to municipalities via provinces. In Nova Scotia, access to the funds was stipulated on the development of municipal climate change action plans, while in Newfoundland development of community disaster management plans was one of several eligible investments. Given competing demands and limited resources, both provinces shaped the local agenda towards a specific security agenda, longer-term in the case of Nova Scotia and shorter-term in the case of Newfoundland, reflecting the overall tenor of response to Hurricanes Juan and Igor respectively.

Conclusion

Through this exploration of Hurricanes Juan and Igor, a fundamental shift in power from the human to the non-human emerge as dominant themes. The case studies show power to be diffuse and enrolled in complex, polycentric assemblages which include, but are not limited to: humans, non-human nature, transportation, meteorology, communication technologies, fossil fuels and weather (Latour 2005). Power continually shifts in these networks, flickers like streetlights subject to variable fluctuations in the voltage of the power supply, but is not actually 'held' – or necessarily expressed – contrasting with classical and more static notions of power. Power is mobile though it sits in particular locales for periods of time.

Applying an *eco*politics of mobility framework illustrates how the six elements of mobility – motive force, velocity, rhythm, route, experience and friction – are readily and richly amenable to the ecological dynamics upon which passenger and freight mobility is contingent and in turns shapes. An ecopolitical approach to mobility offers a valuable elaboration of past and current approaches to transport planning, namely traffic engineering and sustainable mobility (Banister 2008). A Foucauldian analysis of ecological and capital circulations, as well as surveillance, discipline and security as they relate to co-constructed mobilities of societies and ecologies, is useful in identifying and articulating the meaning ascribed to, and responses prescribed for, various states of mobility (or immobility), such as disruptions caused by hurricanes. Combining the ecopolitics of mobility with a Foucauldian approach results in an effective elaboration of social-ecological power inherent in contemporary mobility, illuminating dynamics that are suggested but not elaborated in literatures such as resilience (e.g. transport, infrastructure, social-ecological systems), disaster sociology and reflexive modernization.

In sum, this empirical research combined with original theorization, generates potentially profound shifts for the emerging field of transport resilience. In the context of the Anthropocene, humans are in a "zone of imperfect visibility" (Potter and Romano 2012: 3). We are "experiencing that which we do not have the word for," observes Beck, “the processes we observe, reflects that reality is still emerging (2015: 77). The cases of Hurricanes Juan and Igor provide a vantage point to explore the impact of severe weather events on mobility webs, and the concept of an ecopolitics of mobility provides theoretical leverage to discuss the human and ecological circulations that constitute contemporary society. What comes to light is a far more all-encompassing view of transport resilience than currently employed, bringing together threads of climate change causation, mitigation and adaptation more fruitfully.

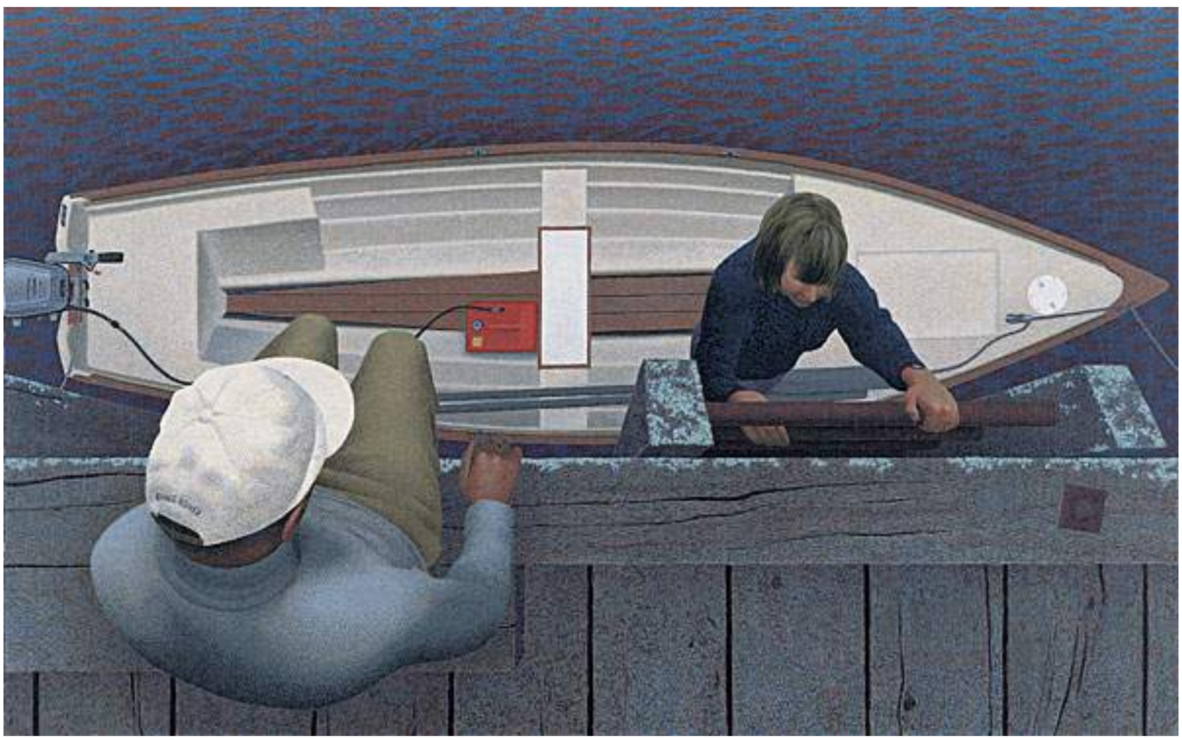
7 NAVIGATING TRANSITION: CONCLUSION

Children were given crayons
and instructed to make welcome banners. Boats panted

on their ropes. Spoons were silent propellers geared up
to start a current. We had become the new tide: leaning in

to call the ocean then leaning back to watch it come.

Sue Goyette
Fifty-Three



Alex Colville
Embarkation
1993

Here, decades later, we revisit the couple we met on the beach at the outset of our journey. The ocean is even more central, emphasized by a bird's eye view. A humble gas tank acts as a focal point. Just as the couple has matured, so too has society's relationship with the environment: "We had become the new tide."

Travelogue reflections

At this, the end of our journey, I conclude by considering the research process and proposing future research directions. First, I contemplate the overall state of mobility in storm-impacted Atlantic Canada in the Anthropocene, followed by reflections on the theoretical and methodological contributions of my research. I forward a socially-ecologically enriched concept of transport resilience and elaborate potential components of a climate routing framework, including creating a transport resilience task force, deliberating decentralization, internalizing externalities, planning for green and blue flows, rebranding redundancies and thinking flex. Finally, I suggest future research projects and outline past and potential knowledge mobilization, before disembarking.

Having traced the ports of call of Hurricane Juan and Hurricane Igor, what transpires is a sense that mobility webs are increasingly precarious. Just as the carbon cycle has tipped with the excessive combustion of fossil fuels, the balance of power is tipping from the human to the non-human in mobility. Uncertainty and loss of control are the 'order' of the day. Urry's description of a "massive out-of-control 'juggernaut' lurching onwards but with no driver at the wheel" is fitting (2003: 2). Bauman observes simply: "no one seems to be in control" (1998: 58). Precisely by exercising control over, and disregard for, the natural environment, humans are sowing the seeds of manufactured risk, the impacts of which through climate change are already being experienced. The field of transport resilience came into being directly in response to shifting social-ecological dynamics. By combining a Foucauldian analysis with Cresswell's politics of mobility, I supplant traditional traffic planning and expand sustainable mobility, forwarding an ecopolitical approach that illuminates power shared by assemblages of human, technical and environmental elements and that questions the centrality and volume of mobility.

Murphy states that "the significant question is, will risk be perceived and acknowledged, expectations about nature's dynamics improved, foresight developed, and mistakes diminished?" (2009: 27). Through a comparative case study approach I explore theoretical insights that surface when the mobilities paradigm, including the politics of mobility, is informed by resilience literatures, disaster sociology and reflexive modernization. I employ a definition of power that accounts for the reciprocal, continuous, often invisible and shifting influence and co-construction of the human and non-human environment. What emerges in this zone of imperfect visibility is that risks are only partially perceived and acknowledged, expectations about nature's dynamics are improved and foresight developed but not at the speed or scale needed to diminish negative impacts. The vulnerabilities inherent in Newfoundland's road network and Nova Scotia's electricity grid largely still exist; if storms on par with Hurricane Juan or Igor were to make landfall tomorrow the scale of impact would be similar.

Through analysis of the dynamics of mobility webs, which I define as the integration of mobility via nodes in complex and adaptable social, ecological and material constellations, I explore how mobility webs are impacted by, and respond to, the interface of the social, ecological and technical, identifying areas of resilience and vulnerability. I adopt Cresswell's politics of mobility to further elaborate an ecopolitics of mobility – motive force, velocity, rhythm, route, experience and friction – describing the texture of the interface between the environment and contemporary social-technical assemblages of mobility. Foucault's work on circulation, as well as surveillance, discipline and security permit further elaboration on social-ecological power dynamics in the realm of mobility.

In the cases of Nova Scotia and Newfoundland, I learned through expert and official accounts how transport providers and others interpret and respond to the risk posed by severe weather. I identified a suite of responses and frames employed prior to, during and in the aftermath of severe weather events to explore and elaborate a socially and ecologically informed transport resilience. Further, I identify sources of resilience and vulnerability, and in combination with theoretical insights, explore how greater social and ecological resilience can be achieved with respect to mobility webs. Key sources of resilience include cultural awareness of the need to batten down the hatches in the face of oncoming storms, administrative and cultural contexts that are conducive to cooperation and communication, and the creative leveraging of shadow mobility webs. Key sources of vulnerability include reliance on single modes, routes and fuels that constitute a dominant and precarious automobility, incremental and partial approaches to climate change mitigation and adaptation, and a lack of critical reflection on society's reliance on mobility.

Given these areas of resilience and vulnerability, greater social and ecological resilience with respect to mobility webs can be facilitated through a clearer and more profound articulation of the reciprocal impacts of the transport sector on the climate and, in turn, climate change on the transport sector. The ecopolitics of mobility and

Foucauldian attention to the power dynamics of circulation are pivotal to this task, creating a language and conceptual space to reflect on the interface of the social, ecological and technical.

The cases of Hurricanes Juan and Igor beg questions for consideration. Given a changing climate, what is the prospect of returning to normal? As one participant stated: "It's like we are having a 100 year storm every two months." Storms like Igor and Juan, Sandy and Katrina, are surpassing engineering design limits. Do we continue as is and rebuild if needed? Do we build to higher design standards in communities already experiencing infrastructure deficits? Do we question our societal reliance on mobility? Different contexts require different approaches. Profound shifts in the global carbon cycle are disturbing surface continuities in the global mobility complex. Humans are experiencing fear and anxiety, and governments are faced with states of emergency where significant decisions regarding the welfare of the population must be made in a timely manner. Governmentality morphs from art to triage.

Analytical contribution

My research is grounded within the mobilities literature and informed by the disaster literature to elaborate an *eco*politics of mobility. I complement the applied areas of sustainable mobility (i.e. climate change mitigation) (Banister 2008) and resilience (i.e. transport, infrastructure, social-ecological) (Brown 2014; Folke 2010), with the theoretically oriented mobilities paradigm (Sheller and Urry 2006), including the politics of mobility (Cresswell 2010). Further, I inflect the politics of mobility, which provides a nuanced approach to the analysis of power within mobility systems, with Foucault's work on governmentality and circulation of societies and ecologies. Each literature offers analytical insights that when combined illuminate mobility in the context of climate change.

These diverse and interrelated literatures, when applied to the empirical case studies of Hurricanes Juan and Igor, contributes to creating a social-ecological theorization of mobility, including concepts of *mobility webs,* the *ecopolitics of mobility* and *climate routing*. This analytical framework is transferable to other regions and other types of extreme events, including diverse fast onset weather events in diverse regions (e.g. 2016 Fort MacMurray wildfires), as well as to slow onset crises (e.g. the role drought played in contributing to the Syrian refugee crisis) and more infrastructural events (e.g. the 2015 Nova Scotia fuel shortage; 2016 Ottawa sink hole).

Overall, I develop an ecopolitical approach to transport planning that evolves out of past transport planning approaches including traffic management and sustainable mobility. In an *eco*political approach to mobility, focus shifts from navigating disruption to navigating transition. Power shifts from the discipline of control to security created through knowledge of social-ecological dynamics. In sum, my research offers innovative contributions by orienting mobilities research to social-ecological considerations – extending previous work on sustainable mobility even further – and orienting disaster sociology to mobility and related transport considerations.

Methodological contribution

In addition to diverse literatures, I draw on diverse data sources. Through media articles, legislative transcripts and policy documents, in addition to semi-structured interviews with key informants, I identified and analyzed the resulting responses and frames as they pertain to social-ecological resilience and vulnerability. For the media scan, I selected a sample of national, provincial and local print media articles for one month following each event. While useful in gaining a sense of the events across scales, for the purposes of this research I largely drew on provincial coverage as it focused on regional mobility webs. If I were to conduct a similar study might opt to focus solely on provincial media and draw a sample for the year following the event in order to capture coverage related to policy in addition to recovery. Further, the Canadian Broadcasting Corporation online reporting was a valuable data source that I would use more centrally in future research. Legislative transcripts analysis is a surprisingly underused data source in the fields of climate change and disaster. These documents highlighted heroic narratives, acknowledged vulnerabilities and offered important policy critiques.

Analysis of policy documents was valuable in identifying how the severe weather events of Hurricanes Juan and Igor permeated the longer-term policy agenda. Given the range of possible documents I focussed on provincial government documents produced directly in response to the experience of the hurricane and flagship documents pertaining to mobility so as to maintain attention on the official responses to the hurricanes. Incorporating municipal documents, particularly in the case of Halifax, which is active on the issue of transport and climate change, would augment this research. However, due to both limits of capacity and a focus on a provincial scale, I opted to exclude these documents. This speaks to the challenge of defining a research scale given the interscalar nature of mobility and climate change. Analyzing local documents and comparing local, provincial and national documents, particularly areas of accordance and discordance, is a valuable area for further study.

In both Nova Scotia and Newfoundland, interview participants expressed pride in cooperation that tended toward more, though not entirely, heroic narratives in terms of disaster response and recovery (Borins 2011). Murphy (2009) explores how leaders, such as politicians and senior civil servants, navigated the 1998 ice storm. On one hand, Murphy finds that officials embraced a policy of "transparency and openness" in communicating with residents (2004: 258), and on the other hand, Murphy determines that "nature's prompts were used politically" to frame the federal and Quebec governments, as well as the Canadian Forces, as competent (2004: 255). For example, the Canadian Forces, recently disgraced by the Somalia affair, were volunteered by the Prime Minister to provide highly visible ground relief (Murphy 2004).[90] In both Nova Scotia and Newfoundland, though more so in the latter, a similar approach was taken. Frames of community resilience and cooperation dominate, which is understandable and even desirable (so long as it reflects reality) during a state of emergency. The storms were framed as shared experiences. However, as my dataset encompasses only the month following the precipitating event more critical narratives may have arisen at later periods. By contrast, when interview participants reflect on the future instead of the past, more

[90] In 1993, members of the Canadian Airborne Regiment engaged in humanitarian efforts in Somalia were found responsible for the torture and murder of a Somali teenager.

modest narratives arose, characterized by uncomfortable uncertainty with regard to climate change impacts, storm tracks and budgets.

In terms of case study selection, comparing Hurricanes Juan and Igor offered surprising contrasts given their physical proximity, with Juan defined by wind and Igor by water. Likewise, comparing the epicenters of both storms, Halifax in Nova Scotia and the Bonavista Peninsula in Newfoundland, highlighted the impact of hurricanes on urban versus more rural mobility webs. Despite these differences, common considerations of resilience and vulnerability arose, suggesting transferable practices. Exploratory research I conducted on the impacts of Hurricane Sandy on mobility webs in New York suggest commonalities across scale and context, such as aging infrastructure, disruptions to gas distribution and the emergence of shadow mobility webs, such as the use of bicycles in relief efforts. Further such research would yield insights into the similarities and differences between the impacts of severe weather events across scales, from rural Newfoundland to urban America.

Social-ecological transport resilience

Social-ecological systems theory forwards resilience, adaptability and transformability as potential trajectories. What emerges in my research is the necessity of all three in the context of severe weather events: with resilience needed to regain basic functioning, adaptability needed to respond to changing climate dynamics and transformability needed in terms of transitioning to post-carbon mobility and questioning the status quo in terms of mobility volume and acceleration. However, in the cases of Hurricanes Juan and Igor, transport resilience dominates, with adaptation and transformability as more peripheral considerations. Transport resilience, as implemented in the United Kingdom and Canada, focuses on engineering approaches that retain the status quo, or restoring the status quo promptly if disrupted (e.g. installing larger culverts). There is a movement in the disaster risk reduction field to incorporate an ecological lens in all four phases of the disaster response cycle (e.g. preparedness, response, recovery, mitigation) (i.e. eco-DRR). What happens when an ecological lens is added to the concept of transport resilience generally and in light of extreme weather events such as hurricanes specifically?

Ecologies fluctuate and change. Disturbance ecology studies natural adaptive cycles and reorganizational processes. For example, hurricanes, through intense wind and rain erode land and transport massive amounts of sediment to the ocean where it is circulated by global currents. In addition, hurricanes transfer massive volumes of heat from warmer to cooler regions and water from ocean to land. Storm surges salinate soil, creating habitat for salt-tolerant plants and related insects, birds and animals, fostering biodiversity. In ecosystems, disruption is natural and healthy. This contrasts with societal perceptions of, and responses, to turbulence, where the economy and infrastructure are less amenable to disruption. Equilibrium conditions are perceived as ideal and society aims to minimize disruption and practice seamless intermodal movement. The question then arises as how to best reconcile dynamic and variable ecologies with more rigid structures of the human built environment and strictures of society and economy. How can an ecological lens inform and strengthen the resilience of mobility webs? How do we allow necessary natural disturbances and maintain or adapt human connectivity and social structures?

There is already a strong awareness of the weather-exposed nature of transport modes, especially among transport managers and the general travelling public. Rain, snow, wind, fog, cold and heat are routine considerations for transport managers and commuters alike. Hefty snowfalls and fog paralyze the St. John's International Airport. Extreme heat causes rail tracks to expand, kinking lines and delaying travel. High winds restrict truck travel on the Halifax Harbour and Confederation Bridges, as well as in western Newfoundland. Intense rainfall washes out bridges and roads such as experienced in Meat Cove, Nova Scotia. Cargo ships constantly weather route, adjusting their course to accommodate conditions at sea. And cyclists and pedestrians face the elements head on, dressing and adjusting their practices of movement. However, while at the operational level weather considerations are routine, there is greater scope for consideration of the social-ecological interface of mobility webs in a changing climate, a suite of approaches I term climate routing that may facilitate a transition to a transformative, social-ecologically informed transport resilience.

Climate routing

In the marine sector, the keen sensitivity to weather routing, that is, the practice of optimizing the interface of routing and fossil fuel use to maximize profit, offers lessons that if transferred to a consciousness of emissions could transform the field of transport resilience as currently understood and practiced. Brown notes that while there are examples of next generation infrastructure, there lacks a "policy and development framework" to systematically transform infrastructure design (2014: 3). Under the umbrella concept of climate routing, I explore a framework for moving towards transformative transport resilience via a spectrum of measures – creating a transport resilience task force, deliberating decentralization, internalizing externalities, planning for green and blue flows, rebranding redundancy and thinking flex – where primary considerations are reducing social-ecological contention, increasing resilience, questioning the role of mobility in contemporary society and improving quality of life.

How can mobility transition into a post-carbon era characterized by a post-normal climate? Mobility webs must both be decarbonized (or at least lower carbon) as well as adaptable to extreme events, such as the movement of 50 to 350 million climate migrants anticipated by 2050 due to climate change impacts, including desertification, disease and hurricanes. How can turbulence, rather than assumptions of laminar flow, be accommodated (Cresswell and Martin 2013)? A paradigmatic shift, such that smooth mobility is considered the exception and turbulence the rule may be a warranted recalibration of expectations.

There is a well-established suite of common sustainable transportation initiatives such as increasing vehicle efficiency, reducing the carbon content of fuels, shifting to more sustainable modes and land use planning that promotes compact, mixed use development that reduces the needs for car transport (Schwanen, Banister and Anable 2011). These initiatives can be promoted through infrastructure investments, zoning by-laws, financial measures (e.g. carbon tax, insurance rates), education and regulation.

The State of New York, for example, developed a broad community resilience framework that provides seven focal areas: conserve, enhance, restore natural protective features; resilient construction; structural defences; land use planning and regulation; market-based methods; awareness, information and preparedness; and systemic resilience.

Further, there is an emerging suite of transport resilience measures (e.g. passive and adaptive) that include initiatives such as investing in ongoing infrastructure maintenance, flood-proofing infrastructure and related electrical systems, and identifying critical routes to be prioritized during times of crisis (UK Department of Transport 2014). However, transport and infrastructure resilience, as currently practiced, tend towards "predict-and-provide" emphasizing infrastructure provision in contrast to questioning the mobility status quo (Schwanen, Banister and Anable 2011: 997). Given the fact that both the climate and transport technologies are rapidly changing, I recommend broader principles and structures to complement such initiatives. The following measures – creating a transport resilience task force deliberate decentralization, internalize externalities, planning for green and blue flows, rebrand redundancy and think flex – are intended to build upon and augment passive transport resilience facilitating a paradigm shift to transformative transport resilience (Table 7.1).[91] Elements of Urry's (2013, 2008) potential futures, including transitioning to a locally based, low-carbon-society and virtual interactions mediated by digital technology, inform my approach.

Table 7.1: Potential climate routing measures

MEASURE	ACTION
CREATE	Create provincial interdepartmental transport resilience body (e.g.

[91] See Banister (2008) for a discussion of seven elements for promoting sustainable mobility that complement climate routing: providing information, involving and communicating with stakeholders, packaging push and pull measures in policy bundles, selling the benefits, adopting controversial politics in stages, and ensuring consistency between different measures and policy sectors.

TRANSPORT RESILIENCE TASK FORCE	committee, office, commission), including a focus on fuel resilience Create university-based transport resilience research lab Develop a transport resilience strategy that brings together the field of transport, disaster management and climate change mitigation and adaptation, as well as drawing economic development into discussions of transport resilience
DELIBERATE DECENTRALIZATION	Incorporate potential disruptions due to extreme weather events into calculations regarding the centralization of schools, hospitals and other critical infrastructure
INTERNALIZE EXTERNALITIES	Implement provincial carbon tax with portion of revenue dedicated to climate change mitigation, climate change adaptation and/or disaster prevention, preparedness and recovery
PLAN FOR GREEN AND BLUE FLOWS	Incorporate consideration of environmental flows, including disruption ecology, in transport planning
REBRAND REDUNDANCY	Build redundancy (e.g. modal, technical, material) into mobility webs at multiple scales from infrastructure to individual
THINK FLEX	Incorporate flexibility into mobility webs in terms of fuels, modes, routes and infrastructure Explore communication (e.g. Skype), printing (e.g. 3-D) and alternative vehicle (e.g. UAVs) technologies as a means to render mobility webs more flexible

Create transport resilience task force

The substantive spheres of sustainable transport, climate change mitigation and adaptation, and disaster preparedness, as well as economic development, all intersect under the umbrella of transport resilience. A sense of trepidation was apparent among transport managers in particular as they aimed to meet their primary mandates (e.g. delivery, and often growth, of transport services) with more peripheral but also pressing concerns about infrastructure investment, emissions management and disaster preparedness. One Newfoundland transport manager constructively suggested the creation of a "provincial think tank on this or some kind of committee" to provide practical direction on how to move forward (NL Transport 106). Such a body (e.g. task force, think tank, working group, commission, lab, clearing house) would create space for interdisciplinary consideration and experimentation with proactive adaptive and transformational approaches to transport, extending beyond reactive passive resilience. Dalhousie University in Nova Scotia (which includes Faculties of Planning and the College of Sustainability) and Memorial University in Newfoundland (the province's only university) could have parallel research bodies that focus on theoretical and pragmatic aspects of transport resilience, asking what counts as "appropriate movement" in a carbon-constrained and potentially decarbonized society (Cresswell 2010: 27)?

Big picture questions such as safety, "over-dependency" on mobility and climate change mitigation and adaptation could augment ongoing conversations pertaining to engineering and maintenance (e.g. culvert sizing) (Budd et al. 2011: 39). The "interplay of disturbance and organization" – or flow and turbulence – could be a guiding theme (Brand and Jax 2007: 27). Such big picture questions could leverage the emancipatory potential of events such as Hurricanes Juan and Igor and other transport disruptions. An interdisciplinary approach, including meteorologists, coastal biologists, forest conservationists, in addition to transport providers, infrastructure experts and risk managers and policy and governance experts, would help create a larger brain trust in which to learn "about errors of expectations concerning nature's dynamics, about the material consequence of such errors, and about the social barriers to learning from the prompts of nature" (Murphy 2004: 255).

Rather than focusing on maintaining carbon intensive mobility webs, how can we mitigate their climatological impact (Cowen 2014)? How can extensive mobility webs be decarbonized? While the aspirations of a lower carbon transport system are stated (especially in Nova Scotia), a task force would create time and space to consider how to navigate a mobility transition, as well as could play a role in facilitating public discussion of such issues. A task force could be a forum to consider and address questions raised by Schwanen, Banister and Anable:

> - What is the kind of world that we would like to live in and find desirable and how should mobility be configured in that world?...
> - Will business models in manufacturing and leisure/tourism based on current global production chains and aviation networks remain feasible?
> - Is mobility in principle a right to which people are entitled? (2011: 1004)

In addition, more specific questions regarding budget allocations and design practices could be discussed.

A related area in need of attention is that of the resilience of fuel supplies. Fuel resilience emerged as an issue during both hurricanes as well as during other events (i.e. the 2014 rolling blackouts in Newfoundland, the 2015 fuel drought in Nova Scotia). While sustaining fuel supplies may appear at odds with a transition away from fossil fuels in the transport sector, the experience of Hurricane Juan and Igor revealed the vulnerability created by relying on one fuel source. Diversifying the fuel supply to include lower carbon products and decreasing demand for fuel may also benefit societal resilience during disasters.

The ideal time to create such a task force may be in the aftermath of an extreme weather event in order to garner political will and momentum. A time-limited format such as a commission or independent review might facilitate the transfer of conditions permitted in times of crisis – intense focus on one common goal, interdepartmental cooperation, regulatory support and liberal financial resources – to emerge and be leveraged during a period of non-crisis (e.g. the Ivany Commission structure). Potential outputs might include developing a vision for transport resilience, facilitating province-wide consultations (in-person and virtual), and developing a transport resilience, adaptation and transformation discussion paper and/or toolkit (see Cresswell et al. 2015 for an ongoing study of mobility transitions in 14 countries).

Deliberate decentralization

There are constant downward financial pressures to streamline government and businesses. Moves to centralize schools and health care services mean that transport is built into our education and health care systems. Disruptions to transport can therefore translate to disruptions in the lives of students and patients. Hurricane Juan led to the disruption of surgical schedules, exacerbating already lengthy wait times. This past winter in Nova Scotia, the issue of how to make up for days of school cancelled due to snow was raised (The Chronicle Herald 2015) (see Fothergill and Peek (2015) for a discussion of the impacts of disaster on children, including school closure). One controversial strategy proposed offsetting lost curriculum time was by holding classes on Saturdays. Strategic decentralization – both of services as well as electrical grids – may allow for a quicker resumption of services in the face of severe weather. Likewise, more creative and flexible means of delivering key services, such as education and health (e.g. e-consultations) may warrant exploration.

Internalize externalities

Extreme weather events are expensive. It is estimated that Hurricane Juan's direct costs were $100 million, while a decade later the Alberta floods incurred $5 billion in damages – the most expensive disaster in Canadian history. Severe weather events can be thought of as a form of indirect carbon tax. For example, Hurricane Juan incurred an approximate per capita cost of $107 and Hurricane Igor an approximate per capita cost of $192 to $383.[92] By pricing carbon emissions, institutions, industry and individuals, may be prompted, depending on the price point and availability of low-carbon options, to reduce their carbon emissions.[93]

Importantly, the actual effectiveness of any given carbon tax is determined by its design and the implementation of complementary policies. In 2013/14, British Columbia's carbon tax raised $1.2 billion dollars, all of which was returned to residents

[92] Nova Scotia: $100 million divided by the 2003 provincial population of 936,000. Newfoundland and Labrador: $100-200 million divided by the 2010 provincial population of 522,000.

[93] Labour costs are also externalized. See McLean (forthcoming) for a discussion of how hours of service regulations in the Canadian long haul trucking industry artificially lower the cost of trucking (i.e. labour costs), and by extension, consumer goods.

and businesses via a myriad of tax reductions, such as for home renovations and skills training, and was attributed with a 16 per cent reduction in emissions (Pembina Institute 2014). The revenue generated by a tax can be offset via tax reductions in other areas (e.g. income), as is done in British Columbia, or directed to sustainability initiatives, such as public transit. A further option that will help underline the connection between severe weather events and fossil fuel use is to direct funds to disaster prevention, preparedness and response initiatives – an option that may be more politically palatable in some jurisdictions, such as Newfoundland.

Plan for green and blue flows

Tightly coupled social, ecological and technical systems are complex and dynamic. Increasing attention is being paid to how to accommodate environmental flows by explicitly including ecological considerations (e.g. blue flows of water, green flows of trees) into mobility management.[94] While discipline is characterized by efforts to "concentrate, contain and control" nature, security "adapts to the reality of natural processes, respects their autonomy and seeks to identify, optimise and work through nature's discernable laws rather than stifle them" (Usher 2014: 558). Green or next-generation infrastructure (e.g. creating more flood tolerant and water permeable urban environments) is a term used to describe efforts to build with, rather than dominate, the natural environment (Brown 2014). Brown identifies five guiding principles to reimagine society's approach to infrastructure:

[94] Blue urbanism (Beatley 2014) is a similar approach that proposes a more meaningful relationship between coastal cities and the ocean.

> 1. Systems should be multipurpose, interconnected, and synergistic.
> 2. Infrastructure should contribute few or no carbon emissions.
> 3. Infrastructure should work with natural processes.
> 4. Infrastructure should improve social contexts and serve local constituencies.
> 5. Infrastructure should be resilient and adapt to predicted changes brought along by an unstable climate. (2014: 11)

Likewise, the related field of ecosystem-based disaster risk reduction advocates for the restoration of natural environments to prevent and mitigate against hazards (e.g. reforesting a slope to prevent flooding; restoring wetland habitat to buffer the impact of storm surges). The elegance of such solutions is that they mitigate disaster through softer and less expensive ecological measures rather than, solely, harder and costlier engineering approaches (United Nations Environment Program 2013).

Following Hurricane Juan one urban planner reflects on how to manage a stretch of coastal highway:

> One of my areas of key concern is sections of Highway 107 along the eastern shore .… I think there's all sorts of saltmarsh complexes in through there, and the highway has no room to move. And so that's more of a question for provincial transport planners. There's no sense of retreat there. I guess it would have to be putting in a causeway or a bridge or I don't know. (NS Government 114)

With sea level rise, such spatial pressures will only increase. One response implemented in the Netherlands was to prioritize the spatial needs of the non-human environment over those of society. The Room for the River (2015) project is a nation-wide, multicomponent initiative to allow rivers greater latitude. It is guided by questions such as what does nature need to do and how does nature need to circulate? The project is scheduled to complete ecological-engineering interventions (e.g. deepening floodplain, relocating dykes, constructing a bypass channel) at 30 locations that will allow the river to flood safely. Accommodation replaces older approaches of confinement. An ecopolitical approach to mobility is a logical evolution of traditional transport planning and sustainable mobility. Mobility infrastructure, in addition to the electrical grid as a tightly coupled system, will increasingly need to be designed around a changing climate.

Rebrand redundancy

Redundancy gained a bad reputation in recent decades, synonymous with bureaucratic inefficiency. Another way to think of redundancy is having a back-up plan – what social-ecological systems theorists refer to as functional redundancy. Redundancy is needed at multiple scales. At the infrastructure level, the use of old cabin roads and retired bridges during Hurricane Igor proved useful. Ideally there would be greater redundancy of routes, modes and fuels in the regular mobility web, so that communities are not reliant upon one road to meet all of their supply and emergency needs. Back-up equipment such as generators, chainsaws and radios are also necessary redundancies, as are contingency and continuity plans. Redundancy is further supported by distributing disaster recovery infrastructure (e.g. Bailey bridges) and materials (e.g. cots, fill) throughout a region. At the household and individual level, the availability of alternate transport modes, as well as the skill to use them, are a source of redundancy that proved particularly valuable in the aftermath of Igor.[95] Skills such as boating, snowmobiling and off-roading, as well as

[95] With the decline of the fisheries in outport communities, shadow mobility web infrastructure such as boats may less readily available.

biking, canoeing, cross-country skiing, swimming and snowshoeing – in both urban and rural environments – may characterize post-disaster mobility webs in future.

Think flex

Through my research, a greater expectation for and accommodation of turbulence in the movement of people, goods and services surfaced. A paradigmatic shift, such that smooth mobility is considered the exception and turbulence the rule may be warranted. Hage reflects that, “Crisis today is no longer felt as an unusual state of affairs which invites citizens to question the given order. Rather, it is perceived more as a normalcy… a permanent state of exception” (2009: 8). Managing both charismatic movement and mandatory evacuations promises to be a feature of increasingly frequent storm events. Official attempts to repress circulation were countered by governmobility on the part of the population where residents appeared to assess – largely successfully according to injury and mortality rates – the appropriate level and type of mobility based on their direct experiences of friction, route, motive force – or overall experience of turbulence. What emerges is a new normal, both in terms of climate and of expectations of mobility disruption.

Personal vehicle infrastructure “changes the environment or fitness landscape for all other existing and future users…. Automobility adapts as it spreads along the paths and roads of each society, it draws in many aspects of the environment which are then reconstituted as components of the system” (Urry 2007: 134). Hurricanes Juan and particularly Igor reveal an overreliance on automobility that increases vulnerability. There is a need to reduce the rigidity of automobility by introducing flexibility in terms of fuels, modes, routes and infrastructure, as well as through technologies, such as communication (e.g. Skype), printing (e.g. 3-D) and alternative vehicles (e.g. driverless cars and trucks, drones).[96] While the concept of the driverless car is gaining traction, given the impact of Hurricane Juan and Igor on static infrastructure, it is worth considering the possibility of roadless transport. Could helicopters provide flexibility in the face of severe weather events? What role can drones play in disaster assessment and response? Each mode has its vulnerabilities – helicopters and drones are susceptible to wind and fog conditions – however Juan and Igor demonstrate the need to diversify beyond the dominant automobility network.

Future research

My research offers theoretical generalizations and policy lessons that are applicable to the North American contexts and to other extreme weather events, such as blizzards, rain storms and forest fires. Further, this research yields possibilities for future comparative case studies, including between Atlantic Canadian communities and other communities along and extending beyond the Eastern seaboard (e.g. Boston, New York, Miami, Bermuda and Cuba), as well as between Atlantic Canada and other hurricane-exposed locales in the North Atlantic (e.g. Reykjavik, Iceland; Oslo, Norway).

Methodologically, there are interesting avenues for future research that were beyond the scope of this project. The majority of interview participants were male, representative of the gender bias in the transport sector and senior governmental and

[96] See Birtchnell et al. (2013) for a discussion of the impact of 3-D printing on the freight sector.

political positions. It would be valuable to compare approaches to decision-making and policy directions undertaken by demographically dominant versus minority decision-makers. In addition, the conspicuous absence of women in leadership roles in the transport sector is worthy of reflection and policy intervention. Would the inclusion of women in decision-making result in qualitatively and/or quantitatively different outcomes, or does the professional training (e.g. civil engineering) dilute such difference?

Just as the lived experience of policy makers and transport operators would benefit from further research, the lived experience of disrupted mobility is a peripheral aspect of my research that would be an intriguing area for future research. Examples of such dynamics that emerged in the cases of Hurricane Juan and Igor include tensions involving youth, frictions between urban and rural communities, and adverse impacts on lower-income households and individuals who are precariously employed. Research into these issues, as well as issues of longer-term recovery, is valuable and necessary. How is turbulence navigated? What social, technical and ecological networks are leveraged to achieve or replace mobility? What steps can be taken to assist those individuals and communities particularly vulnerable to mobility disruptions? The intersection of mobility and states of emergency is of particular interest. In the context of Hurricane Juan, the state of emergency resulted in a strongly advised but ultimately voluntary immobility. Community members appeared to largely disregard official advice, governing their own mobility to meet their needs, whether material, informational or interpersonal. The communication, navigation and enforcement of voluntary, as well as compulsory, states of immobility (including evacuations) during severe weather events is ripe for further research.

There are also potentially interesting visual aspects of this research, for example, analyzing photos and images included in media coverage, weather forecasts/warnings and social media threads. Other possibilities include creating a dynamic visual representation of the six elements of the ecopolitics of mobility and mapping the turbulent journey of one person, good (i.e. supply chain resilience) or service in a form of mobile method and/or institutional ethnography.

Knowledge mobilization

Findings from this paper were published in the inaugural issue of *Environmental Sociology* (Sodero and Stoddart 2015). I submitted a paper on the ecopolitics of mobility to *Environment and Planning D,* where Cresswell's (2010) politics of mobility was originally published. Future papers include: a submission to *Transport Policy* forwarding an *eco*politics of mobility as an extension of Banister's (2008) discussion in the same publication of sustainable mobility; a review of transport resilience academic and applied literatures for *Applied Mobilities* and a case analysis of disaster-specific employment-related geographical mobility for *Mobilities*. I have also published preliminary findings in non-academic venues such as the *Newfoundland Quarterly*, *The Independent* and *Between the Issues*.

I shared my research findings with academics and practitioners in fields of transport management, disaster preparedness and climate change mitigation and adaptation, both in Canada and internationally. I presented my findings at a Transport Canada webinar on transport resilience that included an audience of provincial, municipal and private sector transport planners and managers across Canada. I also presented in a

Department of National Defence Domestic Operations Military Professional Education Session attended by senior and non-commissioned officers. I presented to the Canadian Risk and Hazards Network (dedicated to sharing knowledge and innovative approaches that reduce disaster vulnerability) and the Harris Centre of Regional Policy and Development, (dedicated to stimulating informed discussion on important provincial issues and the key facilitator of conservations between academics, policy makers and communities in Newfoundland and Labrador). Through the Harris Centre, I delivered a synergy session, which was an opportunity for government officials, representatives of non-governmental organizations and academics to come together to discuss public policy issues, and a pecha kucha talk designed to share current academic research with the public.[97]

In addition, I am affiliated with two relevant projects that will provide opportunities to further disseminate my research findings: On the Move: Employment-Related Geographical Mobility in the Canadian Context Partnership and the Marine Environmental Observation Prediction and Response Network (MEOPAR). On the Move, established in 2012 and funded by the Social Science and Humanities Research Council, is composed of social scientists exploring the intersection between employment and mobility (On the Move Partnership 2014). MEOPAR, established in 2012 and funded through the Government of Canada's Networks of Excellence program, is composed of Canadian natural and social scientists who are researching how to reduce coastal

[97] A pecha kucha talk specifies a structured and brief format (a six minute talk with 20 slides shown for 20 seconds each).

vulnerability to marine hazards such as hurricanes (Marine Environmental Observation Prediction and Response Network 2013).

Though beyond the scope of this research, there is potential to develop a resilience toolkit, including case study examples, photos, budget estimates for Canadian transport, land use and emergency management practitioners. Such a toolkit could be informed by stakeholder consultations (e.g. creative and interactive workshops with visioning components), focusing particularly on the potential to spur transformative, not just passive, resilience. The State of New York *Community Resilience Techniques: A Compilation of Approaches Used to Increase Resilience* provides a pragmatic example.

Disembarking

Two intersecting trends help define our times: an intensification of transport mobility and an upsurge in severe weather events. Movement is central to our society and mobility disruptions are "challenging, exciting, stressful, and sometimes deeply troubling," consequently instigating a multiplicity of social responses (Harvey 1989: 240). The concepts of *mobility webs*, the *eco*politics of mobility and *climate routing*, as explored through the example of two record-breaking hurricanes in Atlantic Canada, provide a fresh perspective on how to navigate disruptions in mobile society. What comes into focus through the cases of Hurricanes Juan and Igor is a picture of robust capacity for passive transport resilience and a nascent recognition (at least among some actors), prompted by tensions in current responses and frames related to mobility and extreme weather, of the need for transformative resilience.

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Appendix A
List of potential research participants
Key informants were drawn from this list of mobility managers, environmental managers, and secondary personnel.

Mobility managers
Mode

Active
- Cycling network planners
- Pedestrian network planners

Air
- Freight air managers
- Helicopter managers
- Passenger air managers

Bus
- Access-a-bus managers
- Intercity bus managers
- Public transit managers

General
- Road engineers
- Transportation planners
- Transportation demand managers

Marine
- Coast Guard navigation managers
- Harbour masters
- Port authority managers

Personal vehicles
- Car rental company managers
- Off road vehicles association representatives
- Taxi company managers

Rail
- Freight rail managers
- Passenger rail managers

Truck
- Trucking association representatives

Environmental managers

- Climate change adaptation specialists
- Flood managers
- Hydrographers
- Hurricane prediction and preparedness specialists
- Land use planners
- Urban foresters

Secondary personnel

- Community volunteers
- Environmental advocacy organizations
- Emergency management organizations
- Fuel providers
- Insurance sector representatives
- Mobility advocacy organizations
- Political representatives (e.g. municipal, provincial, federal)
- Utility providers

Appendix B: Introductory email

Dear [Name],

You are invited to take part in a research project entitled "*The social-ecological resilience of transport mobility networks: Lessons from Hurricanes Juan and Igor.*" This project examines the relationship between transport systems, hurricanes, and resilience. Given your experience with [transport, environmental, secondary sector], I am interested in learning your perspective on this topic.

You are invited to participate in a research interview that will take approximately 40-60 minutes.

This research project is funded by the Social Sciences and Humanities Research Council of Canada and has been approved by Memorial University's Interdisciplinary Committee on Ethics in Human Research.

In order to decide whether you wish to participate in this research study, you should understand enough about its risks and benefits to be able to make an informed decision. Please take time to read the attached *Informed Consent Form* that provides further details regarding your involvement.

Should you agree to participate, please let me know if there is time and place that is convenient for you to be interviewed. I will be in [province] during [month].

Please contact me with any questions of concerns.

Sincerely,

Stephanie Sodero
PhD Candidate
Department of Sociology
Memorial University
sbs105@mun.ca
709-730-9274

Appendix C: Informed consent form

MEMORIAL UNIVERSITY

Faculty of Arts

Department of Sociology
St. John's, NL, Canada A1C 5S7
Tel: 709.864.8862 Fax: 709.864.2075

Informed Consent Form

Title:	The social-ecological resilience of transport mobility networks: Lessons from Hurricanes Juan and Igor
Researcher:	Stephanie Sodero PhD Candidate Department of Sociology Memorial University Email: sbs105@mun.ca Phone: 709-730-9274
Supervisor:	Dr. Mark C.J. Stoddart Department of Sociology Memorial University Email: mstoddart@mun.ca Phone: 709-864-8862

You are invited to take part in a research project entitled *"The social-ecological resilience of transport mobility networks: Lessons from Hurricanes Juan and Igor."*

This project examines the relationship between transport, hurricanes, and social-ecological resilience. You are asked to participate in a research interview that will take approximately 40-60 minutes.

In order to decide whether you wish to participate in this research study, you should understand enough about its risks and benefits to be able to make an informed decision. Please take the time to read this carefully and to understand the information given to you. Please contact the researcher, **Stephanie Sodero**, if you have any questions about the study before you consent.

It is entirely up to you to decide whether to take part in this research. If you choose not to take part in this research or if you decide to withdraw from the research once it has started, there will be no negative consequences for you, now or in the future.

Introduction
I am a PhD candidate in the Department of Sociology at Memorial University. In order to better understand the relationship between transport, hurricanes, and social-ecological resilience, I am conducting interviews with transport managers, environmental managers, and others (e.g. emergency responders, insurance representatives). This research project is funded by the Social Sciences and Humanities Research Council of Canada (SSHRC).

Purpose
This research project is guided by the question: *How do disruptions to transport mobility networks caused by hurricanes highlight areas of social-ecological resilience and vulnerability?*

Participation
As a participant in this research, you will be asked a series of interview questions about your experience of Hurricane Juan and/or Hurricane Igor in terms of mobility and related issues of risk perception, work responsibilities, management approaches, coping mechanism, policy coordination, key decisions, and adaptation and transformation in the policy context. The interview will be conducted by Stephanie Sodero. The interview will be scheduled at a location and time that is convenient to you. The interview may be conducted over phone.

Duration
The interview will last approximately 40-60 minutes.

Withdrawal
You may withdraw from the study at any time, up to the point where data are included in the final report (i.e. three months from day of interview). If you choose to withdraw from the project, your interview recordings, transcripts, and related data will be removed from the project.

Possible benefits
Research respondents will not receive any direct benefits from their participation in the research. Indirect benefits may include the opportunity to discuss the timely and professionally relevant issues of social-ecological resilience, severe weather events, and climate change adaptation.

This project will contribute to our knowledge about how to manage transport mobility networks in the context of a changing climate. Fossil fuel-powered mobility contributes to climate change and climate change disrupts mobility. The atmospheric accumulation of greenhouse gas emissions released in the course of fossil-fuel based transport exacerbates climate change. Under changing climatic conditions, the frequency of severe weather events is projected to increase. In Atlantic Canada, for example, hurricanes are projected to become more active as ocean waters warm. Hurricane Juan (2003) and Hurricane Igor (2010) are examples of the type of severe weather events projected to become more frequent under climate change. Such events disrupt the movement of people, goods, and services central to our society and economy. This research aims to shed light on the interactions between mobility and climate change, and possibilities for fostering social-ecological resilience.

Possible risks

The interview questions, which centre on risk perception, work-related responsibilities, management approaches, coping mechanisms, policy coordination, key decisions, and adaptation and transformation in the policy context, do not deal with overtly sensitive topics. However, the experience of the hurricane was for many a stressful period, both professionally and personally. Should you experience unanticipated emotional distress you may skip the question, as well you may stop the interview at any time, or withdraw from the project, without penalty.

As participants for this research project will be selected from a small community of professionals in a specific geographic region (ie Atlantic Canada, New York), it is possible that you may be identifiable to other people (ie colleagues) on the basis of what you have said. Please keep this in mind during the course of your responses, should you agree to participate.

Confidentiality and data storage

Interview materials, including digital audio recordings of the interviews, and typed interview transcripts, will be kept on two password-protected computers, one belonging to Stephanie Sodero and one belonging to a professional transcriber. Your name will not appear on the audio file or interview transcript. A separate password protected file will link participant names with identification numbers. Only Stephanie Sodero will have access to this file. Once this information is entered, the original interview schedule will be shredded and disposed. Only this identification number will appear on interview transcripts or in data analysis files. Only Stephanie Sodero and the professional transcriber will have access to the interview data; the transcriber will sign a confidentiality agreement. Names and other identifying information will be removed from interview and transcripts prior to data analysis. Data will be kept for a minimum of five years, as per the Memorial University policy on Integrity in Scholarly Research.

A legal “duty to disclose” details of criminal actions may override participants’ confidentiality. Participants’ confidentiality will be breached only if legally obligated to do so.

Data recording

Interview data will be collected using a digital audio recorder.

Member checking

The researcher will provide you with an electronic copy of the edited transcript for your review. After the interview, and before final data analysis (three months after interview date), participants will be able to review interview transcript and to add, change, or delete information from the transcripts.

Reporting results
Every reasonable effort will be made to ensure confidentiality in the reporting of research results. Data from this research project will be published and presented at academic and non-academic settings; however, the identity of participants will be kept confidential. Names will not be attached to quotations, rather pseudonym and/or descriptors such as ‘transport manager’ or ‘climate adaptation specialist’ will be used. In addition, quotations will be edited to remove details that could be used to identify participants. However, because the participants for this research project are selected from a small community of professionals in a specific geographic region (ie Atlantic Canada), it is possible that participants may be identifiable to other people (ie colleagues) on the basis of what they have said. Please keep this consideration in mind during the course of the interview, should you choose to participate. In the unlikely case of a confidentiality breach (e.g. data loss), such precautions will minimize social risk to participants.

Sharing of results
If you would like to receive a summary of the research findings and/or academic and non-academic publications resulting from the research, you will be asked to provide your contact information which will be stored in a password protected electronic file on a password-protected computer. After the data collection and analysis are completed, a summary of results will be sent to you by e-mail or by mail. The research report will describe aggregated results from all participants, rather than individual results.

Questions
You are welcome to ask questions at any time during your participation in this research. If you would like more information about this study, please contact:

Stephanie Sodero
PhD Candidate
Department of Sociology
Memorial University
Email: sbs105@mun.ca
Phone: 709-730-9274

Ethical concerns
The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with the ethics policy of Memorial University. If you have ethical concerns about the research (e.g. the way you have been treated or your rights as a participant), please contact:

Chairperson
Interdisciplinary Committee on Ethics in Human Research
Memorial University
Email: icehr@mun.ca
Phone: 709-864-2861

Consent
Your signature on this form means that you:

- have read the information about the research;
- have been able to ask questions about this study;
- are satisfied with the answers to all your questions;
- understand what the study is about and what you will be doing;
- understand that you are free to withdraw from the study up to the point of final data analysis, without having to give a reason, and that doing so will not affect you now or in the future;
- understand that any data collected from you up to the point of your withdrawal will be destroyed.

If you sign this form, you do not give up your legal rights and do not release the researchers from their professional responsibilities.

Signatures
I have read and understood what this study is about and appreciate the risks and benefits. I have had adequate time to think about this and had the opportunity to ask questions and my questions have been answered.

☐ I agree to participate in the research project understanding the risks and contributions of my participation, that my participation is voluntary, and that I may end my participation at any time, up to three months after the interview date.
☐ I agree to be audio-recorded during the interview.
☐ I agree to the use of quotations with the understanding that my name will not be identified in any publications resulting from this study.

A copy of this *Informed Consent Form* has been given to me for my records.

______________________________ __________________________
Signature of participant **Date**

I have explained this study to the best of my ability. I invited questions and gave answers. I believe that the participant fully understands what is involved in being in the study, any potential risks of the study and that he or she has freely chosen to be in the study.

______________________________ __________________________
Signature of researcher **Date**

Oral Consent *(if applicable)*
I have read and explained this consent form to the participant before receiving the participant's consent, and the participant has knowledge of its contents and appeared to understand it.

______________________________ __________________________
Signature of researcher **Date**

Appendix D: Interview schedule

Interview #:
Participant's name:
Participant's sex:
Sector: _Mobility _Environment _Secondary
Date:
Time:
Scripted introduction used: _Yes _No
Participant consents?: _Yes _No _Qualifications:

Introduction/Consent

- You consent to participate in an interview as part of the research project, "The social-ecological resilience of transport mobility networks: Lessons from Hurricanes Juan and Igor." This project explores how to increase the resilience of transport networks at a time when severe weather events are occurring more frequently.
- I will ask you a series of questions about the short-term coping mechanisms and long-term policy implications in terms of Hurricane Juan/Igor and its impact on transport networks. The interview will take approximately 40-60 minutes, and will be recorded on a digital audio recorder.
- The interview questions do not deal with sensitive topics. However, individual participants may have unanticipated emotional distress. If this is the case, you may skip any questions you do not want to answer.
- You may withdraw from the study at any time, up to the point where data are included in the final report (ie three months from interview date). If you choose to withdraw from the project, your interview recordings, transcripts and related data will be removed from the project.
- Interview materials will be kept on a password-protected computer. Your name will not appear on the audio file or interview transcript. A separate password protected file will link participant names with identification numbers. Only the principal researcher will have access to this file.
- Every reasonable effort will be made to assure confidentiality in the reporting of research results. Quotations from interview transcripts may be used in conference papers, journal articles, books, research reports, or other communication material resulting from this research, such as podcasts or videos. Your name will not be attached to these quotations. Pseudonyms will be used for all quotations and quotations will be edited to remove identifying details.
- However, because the participants for this research project will be selected from a small community of professionals in a specific geographic region (ie Atlantic Canada), it is possible that you may be identifiable to other people (ie colleagues) on the basis of what you have said. Please keep this in mind during the course of your responses, should you agree to participate.

- You are welcome to ask questions at any time during your participation in this research. If you have any questions about this study, please contact Stephanie Sodero (sbs105@mun.ca; 709-738-9274).
- The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and is found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research (such as the way you have been treated or your rights as a participant), you may contact the Chairperson of the ICEHR (icehr@mun.ca; 709-864-2861).
- Do you consent to participate in this research interview?

Introduction

1. a. What is your current position?
   b. What responsibilities does your position entail?
2. a. What position did you hold during the time of the hurricane?
   b. [If different than above] What responsibilities did this position entail?

PART 1

a. Hurricane preparedness

3. Thinking back to the days preceding the hurricane, what were your expectations of the severity of the storm?
4. Did you make any special preparations in light of the pending hurricane? If so, what? If not, why not?

b. Immediate experience

5. a. What was your experience of the hurricane?
   b. How did your experience of the hurricane compare with your expectations?

c. Coping/Recovery

6. In what ways were transport networks were strong? Weak? Please expand. Prompt: Geographic, structural, services (e.g. emergency services, food supplies, commuters, etc.)
7. What strengths and weaknesses emerged in terms organizational coordination? Prompt: With which other organizations were you in contact? What was nature of your coordination with other organizations?
8. a. Did you have an emergency plan in place?
   b. If so, to what degree was this followed?
   c. In what ways did you need to improvise?

PART 2

d. Policy implications

9. a. Since the hurricane, what has changed with regard to how your organization does its work? Prompt: Climate change mitigation, climate change adaptation
   b. How has the nature of your work changed since the hurricane? Prompt: Responsibilities before versus after the hurricane
10. Has your organization experimented with different approaches to managing extreme weather events? If so, how? If not, why not?
11. In your organizations, has the emphasis placed on system redundancies and back-up plans changed since the hurricane? Please describe.
12. a. Such severe events are viewed by some as “windows of opportunity” to pursue alternate development trajectories or implement systemic changes. To what degree do you feel the hurricane provided such as opportunity?
    b. To what degree was this opportunity acted upon?

e. Projections

13. Thinking forward, what is your perception of how hurricanes may impact transport networks in the future?

14. a. What are you reactions to other severe weather events that have occurred in recent years (e.g. Hurricane Sandy, Alberta floods, etc.)?
    b. What lessons, if any, are important to take away from such events?
15. In what ways do you anticipate your work changing in future?
16. a. Where do you learn about how to prevent and cope with such extreme weather events? (e.g. media, professional networks, Federation of Canadian Municipalities, etc).
    b. What barriers exist in terms of preventing and coping with extreme weather events?
17. What might the implications be if weather events of this severity occurred more frequently (e.g. every ten years)?

Wrap-up

18. Is there anything you would like to mention that we have not addressed?
19. Who else would you recommend that I speak to on this topic?