‘Garbage Patch’ e-flows

Exploring on-line plastics in the ocean knowledge politics

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‘Garbage Patch’ e-flows: Exploring on-line plastics in the ocean knowledge politics

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Abstract

Garbage landfills are not generally construed as aesthetically pleasing. Even though the user-landfill relationship is typically mediated in Western societies (through complex institutional arrangements), landfills can still elicit vivid imagery and olfactory sensations with acknowledgement of a user relationship. What of plastics in the ocean, or more precisely, the North Pacific Subtropical Gyre Eastern Garbage Patch (Garbage Patch)? This particular trash problem precludes direct sensory experience and understanding of the link between the ‘user’ (that inadvertently or intentionally introduces plastics in waterways) and plastics in the Garbage Patch. I argue this renders investigation of Garbage Patch knowledge flows on the internet especially pertinent. In this way, the internet can be understood as a social environment for competing knowledge claim flows. From a social constructionist perspective and using empirical data gathered from domain name registration, search engine rankings and the IssueCrawler tool I investigate Garbage Patch knowledge politics on the internet. With this exploratory study I hope to contribute to (1) dialogue on how competing stakeholders produce and reproduce their e-presence and e-networks in an attempt to dominate Garbage Patch e-flows, and (2) gain insights on how the respective e-social networks mirror 'material world’ social networks and issue dynamics.

Introduction

My main goal in this paper is to explore environmental knowledge politics on the Web[1] for the socio-environmental phenomenon of plastics in the ocean. More specifically, the phenomenon is a moving area of marine debris concentration in the North Pacific Subtropical Gyre[2], the Eastern Garbage Patch (Garbage Patch). The

[1] The Web (World Wide Web) is a part of the internet (a network that also includes services such as e-mail, texting, tweeting, file sharing and news groups).

[2] “The North Pacific Subtropical Gyre is the one most notable [of the five major oceanic subtropical oceanic gyres] because of its tendency to collect debris. It is made up of four large, clockwise-rotating

Garbage Patch presents a well-known socio-environmental phenomenon paradox (Yearly 2002:275-276). Contrary to garbage landfills, the Garbage Patch precludes any direct sensory experience (located far in the Pacific Ocean). It also precludes any direct link between the plastic 'user' (that inadvertently or intentionally introduces plastic in waterways) and plastics in the Garbage Patch. In spite of this, there is rising global awareness of the Garbage Patch including in the media (Gaudet 2009), and on the Web (Google™ Search 2009 to 2012; Google™ AdWords 2012). The paradox fuels the main underlying argument in this paper: to understand Garbage Patch knowledge flows is to take electronic networks seriously. I focus on Web network dynamics (e-networks) between competing Garbage Patch knowledge stakeholders and the impact of the e-networks on Web knowledge flows (e-flows). In Canada, an industrialized country bordered by three oceans and with innumerable waterways that can lead to them, plastics in waterways is problematic (Williams et al. 2011). The Garbage Patch, however, is a global environmental phenomenon (re)produced by global material and digital processes and dynamics, which therefore frames the object of study at the global scale. Building on preliminary Garbage Patch research I performed in 2009, in this paper I draw mainly from scholarship on the social construction of environmental issues and problems (Hannigan 1995; Irwin 2001; Hajer [1995]2005; Yearly 2002) and politics of Web space (Rogers 2008; Rogers 2004; McNally 2005) in order to contribute to the burgeoning research area of environmental politics on the internet (Mol 2006:498; Mol 2010:134; wider discussion in Sassen 2006; discussion on method in Law 2008:639, 643).

The Garbage Patch (and plastics in the ocean in general) is an *invisible* socio-environmental phenomenon for most human, but a *visible* one for non-humans in the ocean (i.e., corals and life forms in the oceans such as turtles, fish, and whales). As such, the Garbage Patch socio-environmental phenomenon joins a myriad of similar phenomena resulting from globalized industrialization that tend to be invisible and inaccessible to the human senses (related discussions in Adam 1998; Lidskog 2000:201, 202; Whiteside 2006:35). As is evident with other socio-environmental phenomena,

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currents – North Pacific, California, North Equatorial, and Kuroshio. It is very difficult to measure the exact size of a gyre because it is a fluid system, but the North Pacific Subtropical Gyre is roughly estimated to be approximately 7 to 9 million square miles—not a small area! This, of course, is a ballpark estimate. This is equivalent to approximately three times the area of the continental United States (3 million square miles)" (NOAA 2011).

competing stakeholders are engaged in claims-making processes (Hannigan 1995:66; Yearly 2002:275-276) in relation to the Garbage Patch. One of two main competing groups socially constructs Garbage Patch scientific knowledge as credible and plastics as problematic and requiring reduced plastics production and use. It was unofficially 'launched' by Charles Moore, a sea captain who first 'discovered' the Garbage Patch in 1997 (Moore 2011). For the second stakeholder group, the interwoven social constructions are of contested Garbage Patch scientific knowledge and a lack of garbage control (i.e., plastics recycling), linked to inadequate education for the plastic user. It is led by the plastics industry, and more specifically by the American Chemistry Council. Prominent arenas of discourse where competing stakeholders attempt to dominate and secure legitimacy for their claims are digital, including the Web. These virtual arenas give stakeholders "…their own representational and reality-producing techniques" (Law 2008:639). In order to try to make Web dynamics visible, I harness domain name registration information to peer into who holds power on knowledge dissemination, Google™ search engine tools to shed light on the salience of the Garbage Patch issue, and the IssueCrawler tool (Rogers 2004) to visualize e-network maps.

I propose an exploratory approach to yield preliminary insights in response to two questions: (1) How do competing stakeholders (re)produce their e-networks in an attempt to dominate Garbage Patch e-flows?, and (2) How do the respective e-networks mirror 'material world' social networks and issue dynamics? First, I frame the Garbage Patch socio-environmental phenomenon. Second, I develop the theoretical model through which I will engage with Garbage Patch e-networks and e-flows. Third, I address methodological considerations. Finally, I explore competing stakeholder Garbage Patch e-knowledge (re)production and e-networks. I conclude with remarks on the potential and limitations of the proposed approach and avenues for further discussion and research.

The Garbage Patch Socio-Environmental Phenomenon

Garbage landfills are not generally construed as aesthetically pleasing. Even though complex institutional arrangements typically mediate the user-landfill relationship in Western societies, landfills can still elicit vivid imagery and olfactory sensations with acknowledgement of a user relationship. What of plastics in the ocean, or more precisely,

the Garbage Patch? Few people had heard of the concentration of ocean debris (formerly wood, synthetics starting in the 1950s (Pichel et al. 2007)) trapped in the North Pacific Subtropical Gyre until American sea captain Charles Moore sailed across the area in 1997 (Moore 2011:3). Moore subsequently co-produced scientific knowledge on the topic and published his findings on the 6 to 1 mass ratio of plastic to plankton in the Garbage Patch (Moore et al. 2001). Curtis C. Ebbesmeyer, an oceanographer, is believed to have coined the term Garbage Patch with James Ingraham (NOAA 2008: 2), the naming being one of the first steps in its social construction (Hannigan 1995:67). Scientists have also been actively producing Garbage Patch knowledge in relation to its size, current flows, quantity of plastics, potential for clean-up and the impact on birds, wildlife and in the food chain (small sampling, Pichel et al. 2007; Ebbesmeyer and Scigliano 2009; NOAA 2011; Blight and Burger 1997; Day et al. 1990; Center for Microbial Oceanography (C-MORE): Research and Education 2009).

In 2009, I identified two main competing Garbage Patch stakeholders (Gaudet 2009), and investigation for this paper revealed the two stakeholder groups are still competing. The first loosely strings together environmental activists, scientists and all levels of government (municipal, state/provincial and federal). They tend to socially construct (1) Garbage Patch scientific knowledge, including non-scientist Moore's co-produced scientific knowledge, as credible, and (2) plastics as problematic for the environment, which typically leads them to promote reduced plastics production and use (including bans on plastic bags, for example). It was unofficially 'launched' and is still unofficially spearheaded by Charles Moore, the sea captain who purports to have first *discovered* the Garbage Patch in 1997 (Moore 2011). From this point forward, I designate this group as the *pro* stakeholder group. For the second stakeholder group, the interwoven social constructions are (1) of contested Garbage Patch scientific knowledge (especially concerning its size and the quantity of plastics, but not denying the problem of plastics in the ocean more generally), and (2) the lack of control over plastic garbage (i.e., plastics recycling), that they link to inadequate plastic user education. The American Chemistry Council plastics division (I will also refer to the Council), on behalf of the plastics industry, primarily and unofficially leads the second group. In this paper, I will refer to the second as the *counter* stakeholder group.

What is more, in the ocean, fungi and bacteria are "…powerless to absorb" plastic fragments (McLaughlin 2008) or put another way, plastics "…do not readily enter into the degradation cycles of the biosphere" (NOAA 2008: 2). The Garbage Patch with its small plastic fragments is thus an invisible socio-environmental phenomenon for most humans, but can be visible and sensory for non-humans. The latter can be impacted by debris (i.e., corals), can ingest plastic debris (or ingest prey that has itself ingested debris) or get entangled in debris (i.e., turtles, fish, dolphins, and whales) (Davison and Asch 2011; NOAA 2008; Williams et al. 2011; Blight and Burger 1997; Browne et al. 2008; Derraik 2002). As such, the Garbage Patch socio-environmental phenomenon joins a myriad of similar phenomena resulting from globalized industrialization that tend to be invisible and inaccessible to the human senses[3] (related discussions in Lidskog 2000:201, 202; Whiteside 2006:35). The phenomenon is invisible to humans in at least two ways. First, humans inadvertently or intentionally introduce plastics in waterways that are remote from oceans and therefore individuals cannot typically perceive a causal link with the plastic making its way to the Garbage Patch (or the ocean). Second, plastics in the Garbage Patch are generally invisible to the senses as they are broken down in small fragments and the Gyre's inhospitable waters attract little marine traffic (Kostigen 2008:146; Weisman 2007:121; Moore 2011). There are two exceptions to the latter however, visual and auditory accessibility through photos and videos on the Web and via the media. This observation links to the next section where I develop a theoretical model to investigate Garbage Patch e-networks and e-flows.

Politics of Webspace, e-Networks and Social Constructionism

In his investigation of information politics on the Web, Rogers (2004) captured a fundamental characteristic shared by websites that website owners and search engines (and other actors) vie for: "[o]n the Web (as elsewhere) sources are in constant competition with each other for the privilege of providing information" (2004:1). How can these *invisible* dynamics be rendered *visible*? Law (2008) framed the challenge slightly differently, "So the question arises: how well are sociologists currently able to

[3] See related discussion of socio-environmental hazards (e.g., nuclear power, damage to the ozone layer and genetically modified organisms) that escape sensory perception and framed as timescapes linking past, present and future by Adam (1998).

track and trace the realities" (2008:639) being created such as on the Web and on the internet? Rogers developed the IssueCrawler tool (discussion and use below) as he sought to capture Web dynamics and information politics[4] practiced by search engines and website owners. At the centre of the dynamics are hyperlinks (linking *beyond* the original) that create relationships between Web resources. Uniform resource locators[5] (URLs), hyperlink webpages to other webpages and resources (i.e., document, video or image) that ultimately shape e-networks on a global scale (2004:25). The e-network maps generated by IssueCrawler are thus social networks. The *inter*-links between Garbage Patch actors (the hyperlinks between pages or resources) can be understood as e-network social relations. The size of each respective actor node on *in*links maps is an indication of the number of *in*links each has received from other Garbage Patch e-network actors. This can convey actor standing (status) in the network (McNally 2005:3013). Centrality, on the other hand, reflects e-network actor power (where central actors hold more knowledge e-flow power) as measured on e-network maps featuring both *in*links (*from* other actors in the network) and *out*links (*to* other actors in the network).

Power over the presence of, or silence of links, *de facto* becomes in and of itself a political e-network shaping tool[6]. The digitized object (webpage, document, video or image), once linked, gains hypermobility (ability to move through the internet) and is subject to dematerialization (loses its material links) (Sassen 2006:26).

Sassen warned (2006), however, that hypermobility and dematerialization do not exclude the nondigital, material world. Rogers (2008) also depicted e-networks as not being mere representations in a virtual world (2008:12). These observations bolster my socially situated, social constructionist approach. In sum, the "…digital world is embedded in the larger societal, cultural, subjective, economic, and imaginary structurations of lived experience and the systems which we exist and operate" (Sassen 2006:26).

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[4] Although Rogers refers to information politics, I refer to knowledge politics where I define knowledge as a justified belief that is connected to purpose or use and is generally associated with intentionality (inspired by Gross 2007:742, 749, 751).

[5] A URL is a unique address assigned to each resource on the Web, i.e., http://www.uottawa.ca/photo.jpg is a URL linking to an image named 'photo' on the University of Ottawa website.

[6] Rogers gives the example of Shell linking to Greenpeace, but Greenpeace not linking back to Shell (Rogers 2004:vii).

Understood in this way, e-networks of multiple place-based activism with politics of the local (e.g., groups engaged in beach cleaning activities) connecting globally to garner political support (2006:34) exhibit hybrid material/digital political dynamics. This leads, in essence, to place-based knowledge participating in 'cross-border political activism' (beyond locality and nation-states) that contributes to global political clout (if not power *per se*) (2006:25, 34, 39-40). The e-networks can be used not only to render knowledge hypermobile, but also to deploy engagement (2006:34) or, I advance, counter-engagement strategies by competing stakeholders. These insight point to an interesting question with respect to Garbage Patch e-networks, How do the respective e-networks mirror 'material life' social networks and issue dynamics? A first place to look is interconnectedness between competing e-networks. The dynamics of environmental knowledge politics regulating borders between 'material world' stakeholder groups would typically preclude permeability of e-networks. The Shell to Greenpeace Web unidirectional link (see footnote) demonstrates potential for partial permeability however.

Furthermore, Sassen argued that the three main properties of e-networks, "…decentralized access/distributed outcomes, simultaneity and interconnectivity" (2006:21) do not necessarily lead to the same outcome for all e-networks (2006:22, 43). Assumptions that e-networks ultimately lead to democratization and increased participation are false starting points, the author warned, and social scientists should rather focus on better understanding the "…imbrications between digitization and politico-economic processes" as embedded dynamics, not only technological processes (2006:22). In the social construction of a socio-environmental phenomenon, networks are one strategy for success that stakeholders can deploy to mobilize resources in an effort to impact policy and political arenas (Hannigan 1995:68, 73). By extension, e-networks can likewise be part of a strategy for the success of socio-environmental phenomena social constructions. In the case of an activist e-network, for example, the main properties of e-networks contributed to distributive outcomes including local organizations participating in global e-networks (Sassen 2006:21). The e-network dynamics were "…constituting elementary forms of transboundary public spheres or forms of globality centered in multiple localized types of struggles and agency" (2006:21). Absent in Sassen's model

however, was consideration for competing stakeholders – excluding the state – vying for e-network hegemony over an issue (in this case a socio-environmental phenomenon).

This discussion points to the second main question in this paper, How do competing stakeholders (re)produce their e-networks in an attempt to dominate Garbage Patch e-flows? Here, I pay particular attention to engagement and counter-engagement strategies and their impact on knowledge e-flows. I advance that the respective stakeholders' goals and the embeddedness of their e-networks in the material world will help (re)produce e-network dynamics. Based on Sassen (2006), the e-network dynamics of an essentially *pro* stakeholder group (with a goal to engage citizens democratically) would generate transboundary public spheres where local organizations participate in global e-networks. Conversely, I advance that the e-network dynamics of an essentially *counter* stakeholder group led by an industry (not place-based activism) (with a goal to re-educate and counter knowledge-claims) would generally lead to counter-engagement in the transboundary public spheres generated *by* the pro stakeholder group (not in new spheres, in order to meet re-education goals). *Counter* stakeholder dynamics would therefore remain at least partially invisible in the *counter* e-network. In contrast, a socio-environmental phenomenon such as climate change with competing place-based activists would theoretically generate parallel transboundary public spheres with local organizations participating in global e-networks. To investigate these empirically implies both material world and e-network dynamics.

Finally, I advance that social constructionism is the binding element to understanding e-networks. Similar to industrial emissions before the social construction of acid rain (Hajer [1995]2005:64), the hegemonic social construction of plastic was framed primarily in terms of progress and modernity until very recently. As plastics-related environmental and health issues continued to emerge however, environmental activists and scientists questioned its potential detrimental health effects, safe use, and proper disposal. The Garbage Patch served as a rallying socio-environmental phenomenon for plastics in the ocean more generally. As a social construction, it is not understood as "…ris[ing] and fall[ing] according to some fixed, asocial, self-evident set of criteria" but rather as a "…direct response to successful 'claims-making' by a cast of social actors" (Hannigan 1995:63). This lends further credence to investigating e-

networks on the Web, a prominent claims-making arena in modernity. Social actors that purchase multiple website URLs (that become e-network actors) can amplify their e-network claims making and power, for example.

Of relevance for the Garbage Patch, and for socio-environmental phenomena more generally, is the role of scientists (1995:63, 94-107; Yearly 2002:279-281) in socially constructing the phenomena. In this investigation, the American Chemistry Council, itself within the institution of science, holds legitimacy in chemistry and industrial activity, but not in oceanography (including the study of ocean flows). This insight will be useful in understanding some of the *counter* stakeholder group e-network dynamics. Finally, stakeholder groups vying to command attention for their claims can exploit an inherent feature of the Web by using "…evocative verbal and visual imagery" (Hannigan 1995:70) to visually socially construct their claims and counter claims. This element of social construction is critical for the Garbage Patch that precludes any direct sensory experience for humans. Next, I tend to methodological considerations.

Methodological Considerations

To generate e-network maps for *pro* and *counter* stakeholder groups, I used the IssueCrawler software by the Govcom.org Foundation, Amsterdam (Rogers 2004). Fundamentally, the software is a scientometric citation tool for co-link analysis. Before I explain co-link analysis, I first present the starting URLs for each respective e-network in table 1. The starting URLs reflect a core set of websites for each stakeholder group that features the Garbage Patch. Co-link analysis means that to be included in the respective e-networks, websites must receive a link (an *in*link) from at least two of the initiating URLs. As discussed above, e-network URLs (as organizational nodes) are actors engaging with other actors (re)producing Garbage Patch knowledge e-flows. I performed three iterations in IssueCrawler using: (1) all *pro* and *counter* stakeholder group URLs (to investigate interconnectedness between competing e-networks), (2) only *pro* stakeholder group URLs, and (3) only *counter* stakeholder group URLs. I generated the e-network maps on October 5 and 6, 2011 (maps and discussion below). In the conclusion, I address the limitation of the small number of starting points for the *counter* stakeholder group.

Table 1: Starting URLs for *pro* and *counter* stakeholder groups

Starting URLs for *pro* stakeholder group	**Starting URLs for *counter* stakeholder group**
http://marinedebris.noaa.gov/projects/partners.html http://www.5gyres.org http://www.algalita.org/about-us/links.html http://www.greatgarbagepatch.org http://www.gyrecleanup.org/problem-summary http://www.oceanconservancy.org/our-work/marine-debris/international-coastal-cleanup-11.html http://www.plasticdebris.org http://www.plasticsoup.org/en http://www.theplasticocean.blogspot.com http://www.waterwitch.com/ Excluded en.wikipdia.org/wiki/Takaful	http://plastics.americanchemistry.com/education-resources/links.html http://plasticsinfo.org http://www.plasticsmythbuster.org/main-menu/mythbusting-resources-and-links

Taking a step back, who 'owns' the e-network URLs? The Web offers a multitude of free hosting opportunities (free URLs, such as www.theplasticocean.blogspot.com) which means that "…even small, resource-poor organizations and individuals can become participants in electronic networks" (Sassen 2006:25). Organizations or individuals can also purchase domain names (the root of a URL is its 'domain' with extensions such as .com, .org, .ca) for a nominal fee. Cost of the domain name therefore has little impact in the knowledge e-flow power equation, but ownership, does. How? As discussed above, social actors can purchase multiple domain names. A website URL does not reveal ownership however. This material world dynamic is managed globally in a database called WHOIS that lists a URL ownership and administration (although ownership can be *masked*, again for a nominal fee). I harnessed domain name registration information to peer into *who* holds power on knowledge e-flows from 2001 to 2012.

What is more, how can I empirically study if and how Garbage Patch e-networks matter? I drew on Google™ Insights, search engine, and AdWords tools to shed light on the salience of the Garbage Patch issue on the Web. Google™ Insights data spanned from 2004 to April 25, 2012. Data (number of searches on Google™ for "Garbage Patch") is first normalized (search term divided by total number of searches on Google), and is then scaled (highest search becomes 100%, and all other searches are scaled against highest peak). Insights also revealed temporal-spatial dynamics with global maps. Next, I collected Google™ search engine data for the term "Garbage Patch" (resources on the Web indexed by Google™ that use this term) from March 27, 2009 to April 22, 2012.

Finally, I collected Google™ AdWords (tool that conveys global monthly searches for keywords averaged over 12 months) on April 25, 2012. My concentrated use of Google™ to perform webmetrics on salience is a potential limitation. For my exploratory study, the (1) the multi-tool approach, and the (2) hegemony of Google™ as a search engine tool globally are sufficient I believe to reveal *trends* in e-network salience. Having addressed methodological considerations, next I delve into the heart of the matter, Garbage Patch knowledge e-flows, and e-networks.

Garbage Patch Knowledge e-flow and e-Network

In this section, I attempt to render Garbage Patch knowledge politics on the Web *visible*. To analyze knowledge e-flows and e-networks, first I look at e-flow power through domain name registration. Second, I investigate the salience of the Garbage Patch using Google™ Insights, search engine, and AdWords tools. Finally, I explore the *pro* and *counter* stakeholder group e-network maps generated with the IssueCrawler tool.

Who holds ownership of domain names in the respective e-networks? By extension, who exerts control and power over the availability (number of websites) and e-visibility (potential for e-network linking) of claims and counter-claims? In table 2, I present a select list of *pro* and *counter* stakeholder e-networks domain name registrations from 2001 to 2012. I included historical reference points to situate the reader. In the *pro* stakeholder e-network, there were few instances of multi-domain name ownership (i.e., Moore's Algalita Marine Research Foundation owns two domain names out of 70 nodes in the map). In contrast, the American Chemistry Council controls ten of the 14 actor domain names in the *counter* stakeholder e-network. The Council therefore exerts power over 70% of potential knowledge e-flow nodes in the *counter* stakeholder e-network. This means that a Web user, starting from a page within this e-network, and who only uses links to access further Web resources, will very likely be exposed to claims exclusively socially constructed by the American Chemistry Council. The Council's domain ownership politics on the Web are decidedly self-referential and monopolistic. These domain ownership dynamics resonate with Mode 1 science knowledge flows – *a*contextual and *a*social scientific knowledge that is objective and universal produced in self-referential processes that preclude reflexivity and co-production of knowledge.

Table 2: Select Garbage Patch *pro* and *counter* stakeholder e-networks domain name registrations from 2001 to 2012 (with historical reference points)*

Date (day, month, year)	**Domain Name (Event)**	**Ownership**
1997	Moore *discovers* the garbage patch	n/a
30/03/1999	plasticsinfo.org	American Chemistry Council
2001	Moore's first publication on the Garbage Patch (Moore et al. 2001)	n/a
24/06/2001	coastalcleanup.org	The Ocean Conservancy
20/07/2001	biosphenol-a.org	American Chemistry Council
29/03/2003	plasticbagrecycling.org	American Chemistry Council**
04/10/2004	plasticdebris.org	Algalita Marine Research Foundation (Founded 1994)
23/10/2004	algalita.org	Algalita Marine Research Foundation
04/01/2005	plasticsmythbuster.org and .com	American Chemistry Council
10/04/2008	gyrecleanup.org	Environmental Cleanup Coalition and The Gyre Cleanup Project
11/04/2008	factsonplastic.com	American Chemistry Council
14/04/2008	greatgarbagepatch.org	the Sea Studios Foundation
22/01/2009	plasticbagfacts.org	American Chemistry Council
06/05/2009	marinedebrissolutions.com	American Chemistry Council
16/10/2009	factsaboutbpa.org	the American Chemistry Council

*I highlight a selection of domain names from *pro* and *counter* stakeholder e-networks in keeping with the goal to render visible the *invisible* multiple domain name sole-ownership. The domain name data source is the WHOIS database. Domain name registration dates indicated do not necessarily coincide with the date at which a website is launched.

** The plasticbagrecycling.org website is registered to a recycling company, but the website is © 2009 American Chemistry Council and the Terms and Conditions for its use link to the Council website at americanchemistry.com.

The growth in the number of internet resources (e.g., websites, blogs, photos, and videos) from March 27, 2009 to April 22, 2012 depicted in Table 3 reflects growth in Garbage Patch *mobile* digitized resources from approximately 66,300 to 1,29 million (see discussion on hypermobility in Sassen 2006:26). The constant increase in Garbage Patch

digitized resources has created the dynamics for increased knowledge e-flows. From a Web user 'pull' perspective, this increases access to (e-networked or none-networked) Garbage Patch digitized resources. I return to this with Google™ search and Insights below. Finally, I advance that the increase also reflects the rise in success of the social construction of the Garbage Patch as a socio-environmental phenomenon.

Table 3: Number of results* generated by the Google™ search engine for query search "Garbage Patch" from March 27, 2009 to April 22, 2012 (Google™ Search 2009 to 2012)

Date	March 27, 2009	April 11, 2009	Sept. 10, 2009	Jan. 5, 2010	April 22, 2012
Results*	~66,300	~94,700	~351,000	~463,000	~1,29 million

*Results are the number on-line resources (e.g., websites, photos, and video) that the Google™ search engine generated in response to the text query "Garbage Patch". The '~' symbol in front of results denotes the approximate number of results as the Google™ search engine does not always yield identical search results (due to variations in available search engine servers to produce a list of results for any given query).

Table 4 depicts the dynamics of internet user knowledge 'pull' from the Google™ search engine for three socio-environmental phenomena that I deemed globally relevant: the Garbage Patch, the ozone hole, and climate change. I proxy socio-environmental phenomenon salience with user queries: the higher the number of monthly user queries, the more internet users are 'pulling' on knowledge related to that given socio-environmental phenomenon (related discussion on problems of salience in Mellon 2011). Monthly user query numbers are of the same scale for the Garbage Patch and the

Table 4: Google™ Monthly User Queries for Three Socio-Environmental Phenomena Globally and in Canada*

Environmental Issue	**Global searches/month**	**Searches in Canada/month**
Garbage Patch	74,000	8,100
Ozone Hole	90,500	4,400
Climate Change	2,24 million	110,000

* An approximate 12-month average of user queries for each environmental issue keywords on Google search, globally and in Canada (Google™ AdWords 2012).

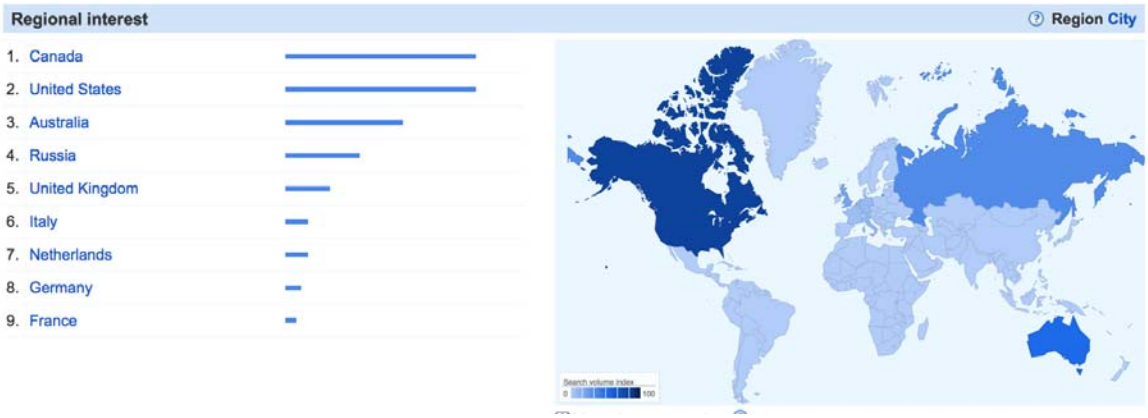
Ozone Hole socio-environmental phenomena (74,000 global searches per month to 90,500 searches per month respectively), but are eclipsed by Climate Change (monthly

global queries ranging around 2,24 million). A discussion on the use of such a proxy is beyond the scope of this paper and I acknowledge its limitations, especially that individuals who already actively participate in one or the other of the opposing stakeholders might not use search engine tools to access internet e-network resources.

To validate the data on salience further, I drew on Google™ Insights. With this tool, figure 1 shows the number of searches performed in Google™ for Garbage Patch from 2004 to April 25, 2012, relative to the total number of searches done on Google™. The numbers are not absolute search volume numbers, as Google™ has normalized and scaled the data, with a vertical scale from 0-100. Trends vary in Web user pull of Garbage Patch resources from 2004 to 2012, but tend to rise from 2007 onward. On the right-hand side of figure 1, a short listing of media releases coincides with some of the increases in knowledge pull (including interest in Japanese Tsunami debris and the garbage patch). Furthermore, figure 2 illustrates global regional interest in Garbage Patch searches with knowledge pull from Canada sharing top spot with the United States.

Figure 1: Google™ Insights for Garbage Patch search from 2004 to April 25, 2012

Figure 2: Google™ Insights Regional Interest for Garbage Patch search from 2004 to April 25, 2012



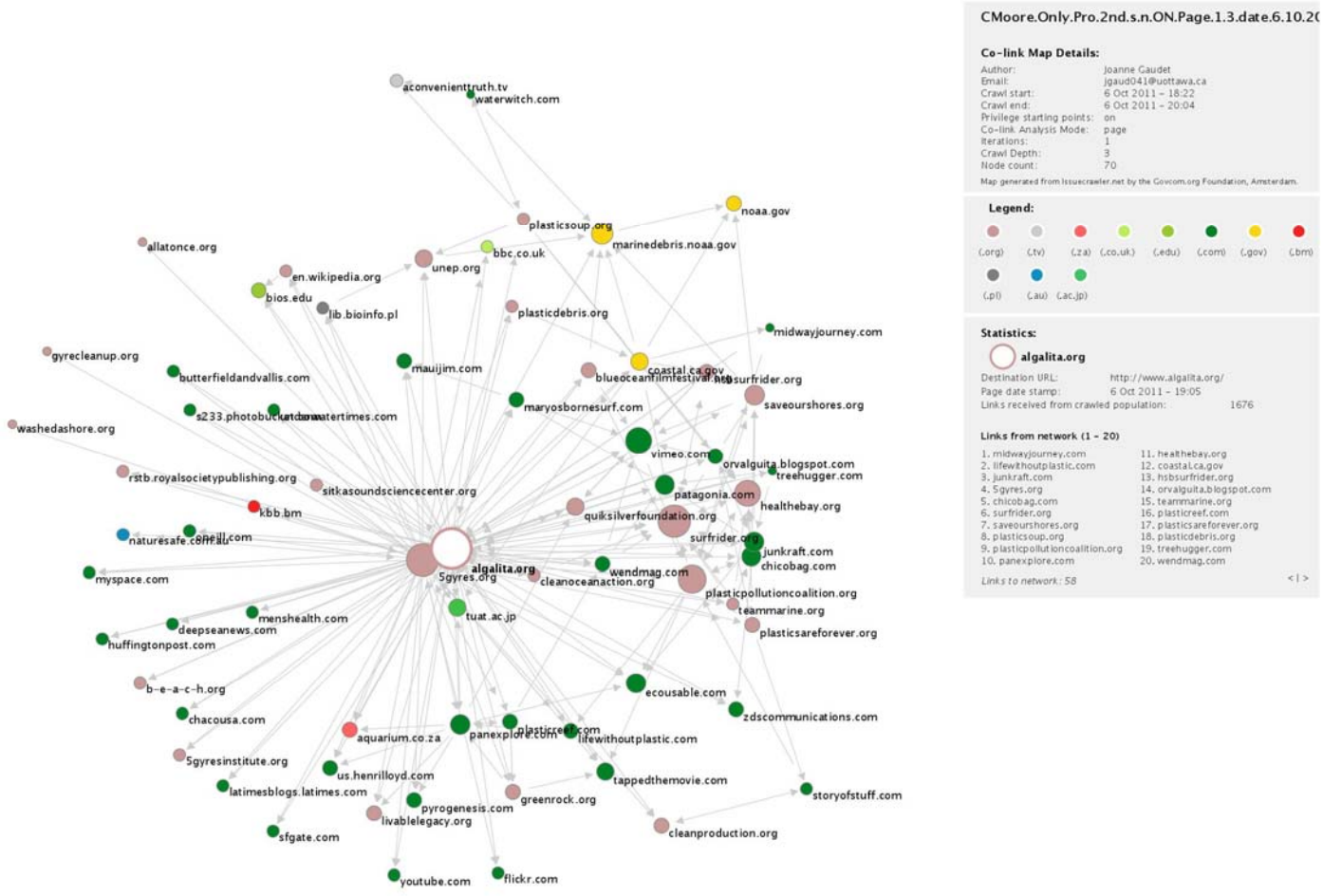
Taken as a whole, the data from the Google™ search engine, Google™ AdWords and Google™ Insights construct the Garbage Patch socio-environmental phenomenon as salient (though not to the scale of climate change). This is reflected in an increase in both Garbage Patch Web resources from 2009 to 2012 and in an increase in Web user searches from 2004 to 2012. Canadians and Americans hold highest interest in the search for Garbage Patch resources on the Web. Furthermore, variations in search terms used by Web users (as described above) reveal the data above is probably conservative. In this exploratory study, I therefore deem the proxy for salience as adequate.

Finally, I explore the *pro* and *counter* stakeholder group e-network maps generated with the IssueCrawler tool. The first IssueCrawler iteration with *pro* and *counter* stakeholder group URLs yielded no network. This result is not surprising. It reflects a clear demarcation between stakeholder groups in the digital world that is identical to that in the material world. With respect to distinct borders separating the respective stakeholder groups, in response to the question – How do the respective e-networks mirror 'material world' social networks and issue dynamics? – I can unequivocally answer that e-network dynamics mirror material world social networks.

Figure 3 features the *pro* stakeholder group *in*link e-network map with all actor nodes. The actor node size reflects the number of *in*links in the network. Moore's Foundation website, algalita.org, has the largest node in the e-network. This means that within the *in*links e-network the algalita.org actor has the highest status (receiving the most *in*links). In essence, this mirrors material social network dynamics where Moore and his Foundation are heavily engaged in Garbage Patch scientific research and activism, in addition to being frequently cited in articles and journals. In addition, algalita.org in the *in*links and *out*links e-network (not shown) is the second most central actor (almost identical to 5gyres.org in which Moore is also engaged), which translates into power over e-network knowledge e-flows. Another feature of the e-network is the heterogeneity of actors. It includes scientific, community, business, educational, government (state and federal) and media actors. The level of actors ranges from place-based (i.e., local beach cleaning activities and reduced-plastic oriented activism) to global (i.e., United Nations). Furthermore, the spatial range of linked actors is international (i.e., USA, Japan, Canada, South Africa, the Netherlands, and the UK), though US-based

actors dominate. Overall, the digital dynamics mirror material world dynamics and issues save for one type of actor – commercial. I was surprised at finding commercial actors (mostly selling alternatives to plastic bags), as these were in large part invisible in the material world dynamics I investigated. Their presence in the *pro* stakeholder group e-network however is not surprising if it is understood as engagement to modify plastics-related behaviour. The commercial actors in the e-network therefore converge with material world activism engagement (Sassen 2006:35). Hyperlinks to commercial actors depict collaborative commercial social relations in the *pro* stakeholder e-network.

Figure 3: *Pro* Stakeholder Group *in*link e-Network Map



In response to my second question, How do competing stakeholders (re)produce their e-networks in an attempt to dominate Garbage Patch e-flows?, the *pro* stakeholder

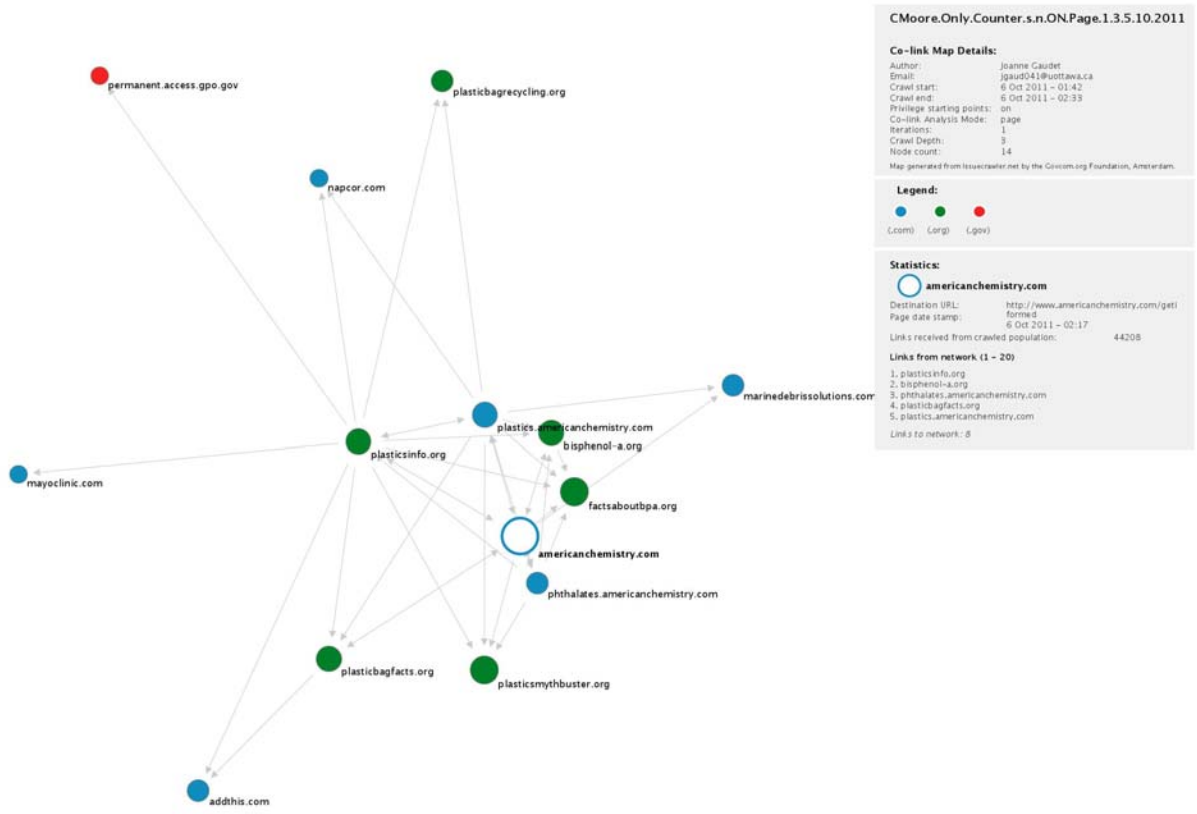
group engages in multi-actor type, multi-level, and multi-spatial Web politics. Place-based knowledge in the e-network participates in 'cross-border political activism' that contributes to global political clout, including at the United Nations (see related discussion in Sassen 2006:25, 34, 39-40). Similar to the dynamics Sassen (2006) uncovered in activist groups, the *pro* stakeholder group e-network promoted engagement (global multi place-based beach clean-ups) and democratization in transboundary public spheres (i.e., blogs, forums, e-news, RSS feeds, Facebook and Twitter). The main properties of e-networks in this group therefore also contributed to distributive outcomes including local organizations participating in global e-networks (2006:21). In one instance, the plastics industry socially constructed *pro* stakeholder dynamics as "…*forces* that support [plastic] bans" (emphasis added, Loepp 2012) which reflects the *pro* stakeholder e-network dynamics as "…forms of globality centered in multiple localized types of struggles and agency" (2006:21). This insight leads me to analysis of the *counter* stakeholder group e-network.

Contrary to the *pro* stakeholder e-network, the *counter* stakeholder group e-network depicted in figure 4 is less dense, involving few actors. This could in part be due to the small number of starting point URLs (see discussion in the conclusion below). I advance rather, that it is in great part due to the American Chemistry Council's high level of control over the network, including its domain name Web politics. The concentrated ownership and control by the Council of over 70% of websites in the *counter* stakeholder e-network leads to a homogeneous e-network. It also leads to a politics of *un*democratic link 'inflation'. Put simply, from the perspective of a Web user it might appear that a Web resource has a high number of hyperlinks from numerous sources, but the sources are actually controlled by one entity, in this case the American Chemistry Council[7]. In 2009, I documented another example of the Council's Web politics of link inflation. Immediately following the release of a Web article in the Wall Street Journal (Bialik 2009)[8] discrediting Moore and scientific knowledge regarding the Garbage Patch, the

[7] Unless a Web user reads webpage copyright and footnote information or looks up a URL in the WHOIS database, website ownership can easily go undetected.
[8] The two main 'targets' of Bialik's rhetoric of doubt were Moore and Suzuki, both of whom significantly contributed to the social construction of plastics in the garbage patch as an urgent problem which requires Canadians and Americans to reduce plastic consumption (Gaudet 2009).

americanchemistry.com website had 48 links pointing to the article (Google™ Advanced Search March 2009).

Figure 4: *Counter* Stakeholder Group e-Network Map



Not surprisingly, the americanchemistry.com actor holds the highest status (receiving the most *in*links) as depicted in figure 4. Concerning power, on the *in*links and *out*links e-network map (not shown) the Council's plasticinfo.org holds the most powerful actor role over knowledge e-flows. This mirrors material world dynamics where Council press releases and spokespersons receive media attention and, as a member of the institution of science, the Council has access to policy and lawmakers (related discussion in Gaudet 2009). The only government actor in the network is an article on plastics in the microwave. Absent from e-network dynamics outcomes are democratization and increased participation. Looking more closely at "…imbrications between digitization and politico-economic processes" as embedded dynamics(Sassen 2006:22), however, I

captured participatory dynamics by the *counter* stakeholder group on the *pro* stakeholder group e-network. The American Chemistry Council plastics division "…has increased the resources and people dedicated to providing accurate information and put in place a rapid response team to engage people who read [misinformation and inaccurate information about plastics on the Internet]" (Verespej 2012). In this manner, *pro* stakeholder e-network transboundary public spheres are harnessed by *counter* stakeholder claims makers to counter-construct the socio-environmental phenomenon. The President of the Council's plastics division aptly described the amplification of *pro* stakeholder Web hypermobile resources – "[o]ne article on a blog can be picked up instantly by other sites, so it requires you to react quickly to counteract it" (2012). These dynamics demonstrate how the Council's Web politics of control conflict with Web hypermobility, interconnectivity, and amplification.

Moreover, the domain names and websites owned and managed by the Council largely socially construct 'facts' about plastics, based on objective science (i.e., plasticbagfacts.org, factsaboutbpa.org, plasticsmythbuster.org). Once more, this reveals Mode 1 science knowledge flows – *a*contextual and *a*social scientific knowledge constructed as objective and universal produced in self-referential processes that preclude reflexivity and co-production of knowledge.

In response to my second question therefore, How do competing stakeholders (re)produce their e-networks in an attempt to dominate Garbage Patch e-flows?, the *counter* stakeholder group engages in monopolistic rigid control of e-network knowledge e-flows. Even while maintaining a demarcation with the *pro* stakeholder e-network, the *counter* stakeholder network appears to harness *pro* resources and public spheres to promote its counter claims. The *counter* stakeholders channel e-network properties of decentralized access/distributed outcomes, simultaneity and interconnectivity to meet a goal of providing 'fair and accurate information' about plastics to support industry growth (Verespej 2012). In the conclusion, I revisit key findings and look to the future.

Conclusion

The main underlying argument in this paper, that understanding Garbage Patch knowledge flows is to take e-networks seriously, has indeed led to insights and promising

leads. It has simultaneously generated many new questions. Even though "…it is notoriously difficult to get people to take moral responsibility for situations that are geographically and temporally distant" (Whiteside 2006:35), *pro* stakeholder groups have e-networks that entice individuals to take moral responsibility and action for the Garbage Patch, globally. The internet and the Web here were understood as a social environment for competing knowledge claim flows. For *pro* stakeholder groups, e-networks also led to increased democratic participation. For *counter* stakeholder groups, in contrast, e-networks led to increased control and concentration of power of knowledge e-flows and the use of *pro* stakeholder e-network transboundary public spheres to promote *counter* stakeholder claims.

One of the main limitations with this type of analysis is its point-in-time characteristic. As such, it cannot readily convey the dynamics of the Web. Another limitation, more specifically in regards to the starting URLs for the *counter* stakeholder group, was its small number of starting point URLs. This is both a limitation (in the sense that it restricted the potential for a network given that the criteria for co-citation requested two *in*links to include a website in the network) and a finding. The latter is the more interesting for our sociological analysis. The success of the social construction of a socio-environmental phenomenon such as the Garbage Patch rests largely on the naming of the issue and its generalized uptake. The use of the Garbage Patch concept is widespread by the *counter* stakeholder group in newsletters, letters to the editor, media releases and articles (Gaudet 2009). To understand their *counter* stance, however, is to understand reluctance to *over*-use the concept – the Garbage Patch is a rallying social construction for the *pro* stakeholder group, and one that the *counter* group must oppose.

In spite of limitations with measures of salience, point-in-time analysis, and with the IssueCrawler tool, investigating socio-environmental phenomenon e-networks is promising to further our understanding of e-network interface between digital and material worlds, especially for global garbage flows. Objects of study such as plastics in the ocean, electronics waste, biomedical waste, and nuclear waste are a few examples. More reflection on methodological and theoretical tools is required, however, in order to be able to capture the complex dynamics. I hope that this exploratory investigation has contributed, at least in part, to tracing potential paths for reflection and research.

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