Framing, Exploring and Understanding Online Anti-Technology Advocacy Networks (working title)

1.0 Introduction

The global civil society is viewed as an 'intellectual and political space' for advocacy, space that resides beyond the mere market and the state, wherein human beings are seen to act together to explore routes to economic prosperity and social justice (Custard, 2008). Non-governmental organizations (NGOs) and international non-governmental organizations (INGOs) and other social movement actors are becoming more and more connected, working within online networks (referred to as 'advocacy networks' (Custard 2008; Keck and Sikkink 1998). An advocacy network consists of a set of actors that "…are bound together by shared values, a common discourse, and dense exchanges of information…" (Keck and Sikkink 1998: 2). These advocacy networks work to leverage alternate and collective resources and information in an effort to influence policy and public opinion.

The Internet has transformed many aspects of society. Similarly, it is changing how NGOs organize (independently and collectively) and, most importantly, how they structure their advocacy activities. According to Beierle (2009), basic advocacy strategies have not really changed with the advent of the Internet but tactics most certainly have. The Internet is a media that is constrained neither by geographic boundaries or intermediaries and the marginal cost of sending a message is nominal. In a world where access to and means of transmitting information is crucial, NGOs have

benefitted greatly from this low-cost communication enabling them to reach entirely new audiences, to build coalitions and to mobilize the public around specific issues of interest.

Understanding the collective power of Internet-based advocacy networks requires an understanding of how actors connect and communicate and collectively operate in the online environment. Yet, little is known about these complex online interactions that organize for advocacy and shape specific social issues. According to Taylor (2002), more needs to be done to trace the complex interactions and network dynamics amongst stakeholders and actors in this realm.

This paper builds on a previous paper "Controversies, Crawls and Comparisons: Viewing the 'Terminator Technology' Issue and its Stakeholders through the *Issuecrawler* Lens" (unpublished, Ryan 2008). Internet-based information around science-based topics are criticized as lacking credibility in its inability to reach audiences in effective manner (Bubela etal (2009)). Yarborough et al (2009) as quoted in Bubela etal (2009) suggest that efforts in science-based communication "…should be an honest effort at relationship and trust building" (517). Thus, according to the authors, stakeholders should consider the "fragmented nature of Internet audiences" and revolve their strategies around gaining the attention of those audiences when producing content online (Bubela etal (2009: 517)). Further, the authors suggest that "systematic tracking of news and cultural indicators" would greatly decrease gaps between science-based issues and the public sphere with the consideration that different media zones (i.e. the Internet) may constitute a different cultural context by which the public will interpret any given issue. The notion of "indicators" suggest that quantitative approaches may be an important and useful complement to more qualitative explorations of public opinion on key controversies or issues.

This paper tests a web crawling tool – IssueCrawler – to examine two key issues (terminator technology (or Gene Use Restriction Technologies (GURTs)) and synthetic biology) from a variety of perspectives and the interactions of the actors that rally around these issues. IssueCrawler is a server-side Web network location and visualization

software that works in a browser[1] to show how hyperspace can demarcate associational and social space. According to Rogers (2006), IssueCrawler "…takes into account a sense of a public 'real' – evinced in the making and displaying of a hyperlink" (15). Of specific interest in this paper is identifying who the central actors are, how they are networked, to highlight the strategies that they employ and how these online strategies evolve over time in response to changes in a given issue-based environment. Most importantly, this paper provides a preliminary overview of a combined methodology (incorporating social network analysis, web crawling techniques, and qualitative research) in order to more effectively explore issues.

Section 2.0 outlines the evolution and growth of advocacy activity on the Internet with an introduction to the two case studies of interest in this paper: terminator technology and synthetic biology. This section is followed by a brief overview of web crawler software as a tool for exploring Internet connections between actors and stakeholders in and around advocacy issues. Employing IssueCrawler software and its set of allied tools, the terminator technology issue and the synthetic biology issue are analyzed and explored in detail in Section 4.0. Section 5.0 introduces the "Wayback Machine" as an additional data source that is useful for exploring networks of advocates on the Internet and Section 6.0 outlines recommendations for next steps.

2.0 Advocacy and the Internet

According to the Union of International Associations (UIA), the number of INGOs has grown exponentially since the early 20th century to well over 25,000 INGOs as of 2002. NGOs are strategic organizations that lobby and campaign as a means to influence international and state policy or corporate behaviour on specific issues or sets of issues. NGOs or INGOs and other actors often join together, both formally and informally, to form Transnational Advocacy Networks (TANs)[2] or coalitions working to build international identities, to leverage reputational value of other network actors and to

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[1] Issuecrawler was conceived in the mid 1990s at the Department of Science and Tecnology Dynamics, University of Amsterdam. The software is currently accessible through Govcom.org. [www.govcom.org]
[2] TANs are explored further depth by Keck and Sikkink (1998); Yanacopulos (2005) and Custard (2008).

"…create a greater value and commitment together…" (Yanacopulos 2005: 95). Such networks often establish around specific issues with a common vision to advocate for change.

Advocacy is essentially an act of continuous communication. According to Beierle (2009), *successful* advocacy grows out of the effective communication of a well informed argument, the mobilization of the public and public opinion and in coalition building. Given its capacity to hyperlink across geographic boundaries and the relative low-cost of access and Internet-based tools, the Internet is viewed as a "main organizing tool" for many NGOs (Price 1999: 7). As more and more advocacy activities move online, the need for off-line staffing and membership dwindles. Thus, even the smallest of interest groups can greatly impact public opinion on a subject with a well-executed online campaign strategy.

Once an NGO establishes a presence is on the Internet, a probable next step is to participate in or build a web-based community or network (i.e. TANs or coalitions) to further the advocacy agenda. Ackland and Gibson (2004) view web-based communities as structures of websites such that if an Internet user enters one member page, he can then follow outgoing links and move onto other member sites within the community. An advocacy message or set of messages is repeated through this iterative process amongst a set of hyperlinked actors, emphasizing and augmenting discourse around a specific topic or issue. According to Hupa (2007), "…a set of web sites possessing a similar set of words [or concepts] constitute a topic on the Internet…they create a topic-based community" (3). Clark and Themudo (2006) refer to these political networks as 'dotcauses'.

The term 'topic-based community' can also be used interchangeably with 'single issue network'. This latter term refers to connections or links (and hyperlinks) that are established amongst actors or stakeholders (i.e. NGOs) that rally around or focus on one particular issue that can be easily understood and readily communicated. Common goals or interests amongst a set of (formally and/or informally) connected NGOs (i.e. coalition

or TAN) can be broad and complex. Establishing a well-communicated single issue network based upon a particular issue or topic provides an excellent avenue not only for NGOs to recruit members but also provides the opportunity "…to link the 'single issue' to the broader aims of the coalition…" (Yanagopulos 2005: 106).

There are few examples in the literature of IssueCrawler applied to exploring issues in a science-based context. One example is McNally (2005) wherein the author employs IssueCrawler to locate proteomics research on the Web. Increasingly, the World Wide Web has evolved into a catalytic and functional 'space' for people to conduct research. Results indicate that the network of global research on proteomics is scale free with a few highly connected ("hub") nodes. Furthermore, based upon her preliminary findings, the author suggests that the tool (IssueCrawler) "…can be integrated towards the development of a new *systems sociology* approach to the study of society" (3010).

2.1 Stakeholder Analysis and Single Issue Networks

Martin-Alier (2009) suggest that relations between local and global concerns are established through single issue networks. According to Pleyers (2009) single issue networks cut across existing advocacy outcomes via this approach by developing coherent, universally shared arguments.   In the anti-science or anti-technology movement, this strategy (or set of strategies) is extremely useful in initiating, communicating and elevating an issue in the online public sphere. These anti-science sentiments are most often anti-corporate in nature. According to Ziman (1994), much discourse (on the part of science and technology critics) appears to be designed to prove that science does not exist, it does not work and it only works "…on behalf of certain sinister power groups" (275). Regardless of *what* may or may not motivate a given campaign, single issues are compelling case studies for studying online advocacy networks.

The two cases studies explored in this paper are, inherently, technology-based in terms of their focus. The two are Gene Use Restriction Technologies (GURT) or 'terminator technology' (as it is often referred to) and Synthetic Biology.

Terminator technology is "…a class of technologies that enables proprietors to control the expression of any genetic trait using a chemical compound" (Einsiedel and Geransar 200?). According to Einsiedel and Geransar (200?), justification for the development of the technology or set of technologies falls under three key points: 1) It enables private sector efforts to "…protect its investments in research and development" (Forge 2006) or, in other words, is useful as a mechanism for appropriating those benefits. 2) The technology provides opportunities to optimize production value (for corporations and farmers alike) by limiting trait expression in crop varieties and to enhance features such as stress tolerance (i.e. to drought or to frost). 3) Finally, the technology provides a way to constrain or control what is known as 'genetic drift' of transgenes. Please refer to Appendix A for a historical timeline of the 'terminator technology' issue.

Despite these touted benefits of terminator technology, there are a number of perceived concerns that have arisen that has propelled it into an advocacy 'issue'. These include concerns with the environment and the preservation of biodiversity, questions regarding the viability for the technology to actually function in the field as well as associated socio-economic impacts. Dubbed *traitor technology* by NGOs ETC Group & RAFI (Rural Advancement Foundation International), the terminator technology controversy has given rise to not-for-profit stakeholders and activists rallying against the use of this technology in agronomic practice. In 2005, the 'Ban Terminator' Campaign was launched to spearhead efforts to ban terminator technology[3]. Among its many initiatives, the global campaign and its advocates have been proponents for the introduction and re-introduction of the Bill to Ban Terminator Technology (Bill C-353) in Canada.

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[3] Steering Committee members for BanTerminator include: ETC Group (Action group on Erosion, Technology and Concentration) www.etcgroup.org; GRAIN www.grain.org; Indigenous Peoples Council on Biocolonialism www.ipcb.org; ITDG (Intermediate Technology Development Group) www.itdg.org; Pesticide Action Network – Asia and the Pacific www.panap.net; Third World Network www.twnside.org.sgwww.biosafety-info.net; Via Campesina www.viacampesina.org.

Synthetic biology is, relatively speaking, a much *newer* issue. So new, in fact, that there is little consensus in terms of how to define it. Generally speaking, synthetic biology refers to the application of engineering principles to the fundamental components of biology (Synthetic Biology Project 2009) and, according to the International Risk Governance Council, "…incorporates a number of disparate research activities under its banner" (2009: 6). The term is a dominant one and most closely linked with project-oriented references, conferences and funding initiatives. Another co-related term is 'synthetic genomics'[4]. Other less widely adopted terms include: 'constructed biology' and/or 'intentional biology'. Inevitably, the terms all contain some aspect of the 'artificial' in the nomenclature. Leaders in this particular realm of science refer to synthetic biology as "…the design and construction of new biological parts, devices, and systems and the re-design of existing, natural biological systems for useful purposes" (SBP 2009) or simply as 'the engineers approach to biology' (Breithaupt 2006).

As diverse as its definitions are the applications of synthetic biology and fall into different areas of technology. Environmental applications include areas such as bioremediation and the engineering of microorganisms to degrade pesticides and remove pollutants (Tucker and Zilinskas 2006). New drug developments also hold possibilities, for example, with the construction of an artificial metabolic pathway used to produce other therapeutically useful compounds for cancer and HIV treatment (Voigt 2005) and the development of synthetic vaccines for treatment of diseases such as SARS, H1N1 or Hep C. In terms of industrial applications, synthetic biology is touted for its use in engineering microorganisms to produce carbon-neutral sources of energy.[5]

Concerns with respect to issues such as governance, corporate activities, regulation, environmental, biodiversity, social justice and other societal impacts have been raised by NGOs and civil society organizations over terminator and synthetic-related technologies (IRGC 2008). Spearheading these efforts is the ETC Group (formerly RAFI)[6]. For

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[4] 'Synthetic genomics' is not as broad as 'synthetic biology' as the latter term refers to more than just the synthesis of genetic material alone (IRGC 2008).
[5] Applications of synthetic biology are outlined in more detail by IRGC (2008: 11).
[6] Note: Prior to September 1, 2001, ETC Group was known as Rural Advancement Foundation International (RAFI) and was headquartered out of Winnipeg, Manitoba. [http://web.archive.org/web/19980529021744/www.rafi.ca/pr/release15.html].

example, ETC put forward an open letter in response to a declaration on governance of synthetic biology made at the Second International Meeting on Synthetic Biology in Berkeley in 2006. In its open letter, the ETC stated that "…we believe that this potentially powerful technology is being developed without proper societal debate concerning socio-economic, security, health, environmental and human rights implications" for a broader and more inclusive public debate on the implications of the field (ETC Group 2006)[7]. Another NGO, the Royal Society echoed these sentiments suggesting that "…mechanisms need to be developed to encourage the responsible development of synthetic biology and a range of stakeholders (including publics) should be involved in discussing developments from an early stage" (Royal Society 2008).

In a review of the ETC Group's searchable publication database, the organization had generated more than twenty publically available (online) reports and news releases related to the topic of synthetic biology (since 2004) and almost one hundred related to terminator technology (since 1998) as of December 21, 2009. The NGO, ETC Group, figures prominently in the advocacy networks for both issues.

Documents, accessed and shared in the online public sphere, and generated by NGOs such as the ETC Group, represent only part of the effort of advocacy network actors who share a common discourse and exchange information and services (Keck and Sikkink (1998). Although not necessarily exclusive, these exchanges can take place via the Internet and may be represented or illustrated through the existence of 'hyperlinks' established to link one organization's website to another's website. These hyperlinks create pathways through which a user may navigate the Internet in order to find new information on a given topic. Mapping and monitoring these links may provide insight into the workings and collective structure of stakeholders that rally around or advocate for a particular issue. According to Rogers (2006), the collection of connected nodes generated through a web crawling tool/software (such as IssueCrawler) has the capacity

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[7] As of December 2009, the ETC Group had generated more than 20 publication related to the topic of synthetic biology since 2004 (see
http://www.etcgroup.org/en/materials/publications?field_language_value_many_to_one=All&field_type_value_many_to_one=All&tid=19).

to "…make things visible, to reveal non-public relationships, [to facilitate the user] to dig for dirt" (13).

3.0 WebCrawler as a Tool for Analyzing Online Advocacy Networks

It is evident that advocacy activity is alive and strong, particularly in the anti-technology realm. However, it not yet clear the impact that such organizations are having in terms of networked advocacy and communication. Given the ubiquitous role that the Internet now plays in advocacy strategies, it would be useful to explore the structure of networks or coalitions of actors through online or hyperlinked connections in order to better understand advocacy networks.

Web crawler tools are vast and varied but all offer an automated way in which to browse or 'crawl' a set of Uniform Resource Locators (URLs) – syntaxes that provide the location of a resource (web site address) on the Internet – and extract a set of hyperlinks from those URLs in order to retrieve those relations between websites. Once extracted, these networked 'links' can illustrate the structure of a given network of selected actors on the Internet. The following section provides an overview of the webcrawler tool IssueCrawler[8].

IssueCrawler is a server-side Web network location and visualization software that works in a browser[9] to show how hyperspace can demarcate associational and social space. According to Rogers (2006), IssueCrawler "…takes into account a sense of a public 'real' – evinced in the making and displaying of a hyperlink" (15).

The software package is comprised of crawlers, databases, analytical engines and visualization modules (Rogers 2008) to generate node lists, actor rankings and links of a given issue network. The program also offers a set of 'allied tools' which permits users

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[8] Other Web crawler software includes (but not limited to): LexiURL (developer: M. Thelwall) [http://lexiurl.wlv.ac.uk/]; Web Content Extractor [http://www.newprosoft.com/web-content-extractor.htm].

[9] Issuecrawler was conceived in the mid 1990s at the Department of Science and Tecnology Dynamics, University of Amsterdam. The software is currently accessible through Govcom.org. [www.govcom.org]

to more fully (and qualitatively) analyze a given Internet-based network and/or issue. The tools can be used to geographically or abstractly map a social network and it can be a useful tool for conducting impact assessment (event mapping) or changes in actor rankings over time. Through use of its various tools and its automation, IssueCrawler is intended as a tool to facilitate the user to observe online networks and to aid in the "…development of new political and social theory… with its emphasis on the importance of non-state actors…" (Rogers 2008a: 2). The nuances of the software and protocols for mapping and analysis are outlined in detail in Rogers (2006). According to McNally (2005), IssueCrawler is "a method for making … politics of association visible, analyzable and comparable" (3011). The tool has the capacity to highlight exchanges in public space (the Internet) as it relates to specific issues and/or controversies such as terminator technology or synthetic biology.

The process of the 'crawl' involves, first and foremost, identifying the stakeholders involved in a given advocacy issue. Drawing on the results of a basic literature review, one can identify the stakeholders (referred to as 'protagonists' in the IssueCrawler context), capture the URLs associated with those organizations or institutions and input these addresses into IssueCrawler's 'harvester'. From this point, the software performs co-link analysis to uncover outlinks that are common to the starting points as indicated in the 'harvester'. This data generates a series of output datasets that may be exported from the program for further analysis (statistical and social network analysis) as well as a series of visual maps including network and geographic maps[10]. The software and its capacities are tested in the following section through our 'issue-based' case studies of interest.

4.0 Viewing Advocacy Networks Through the IssueCrawler Lens

Although highly automated, web crawls are highly contingent upon the appropriate definition of primary search parameters. Similar to social network analysis and its related

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[10] Additional datasets/formats include comma separated values (csv), actor and page lists with interlinkings, ranked actor lists with inlink counts as well as retrieved starting point URLs and, for the social network analyst to conduct further analysis, a UCINet / Netminer compatible data file.

tools, ill-defined parameters or 'boundary specification problems' (Laumann et al 1983) can create incomplete data sets which can, in turn, lead to the generation of erroneous network structures (Kossinets 2005).   Preliminary parameters, in the case of IssueCrawler (and other web crawler programs), refers to developing a properly defined set of stakeholders or in web crawler-speak, a list of 'protagonists'. This is best accomplished through a targeted literature review on the topic of interest to ascertain who the key actors may be. In order to develop a well-refined protagonist list (and to avoid 'boundary specification problems'), it is best to consult a variety of sources (Internet, Delphi / expert consultation, popular media, etc). It is advisable to avoid using big media sites, portals, or search engines as protagonists or 'starting points' for Issuecrawler. These types of sites not only have high numbers of links but those links may be highly random and inconsequential in producing a true advocacy network. Often the 'links page' of a website is a good 'starting point' or protagonist URL[11]. Some organizational web sites have several (i.e. Greenpeace) so it is recommended to use only the 'links page' that refers specifically to your issue of interest. It is important to review your protagonist list to ensure that there are no duplicated URLs or links.

In the case of 'terminator technology' a Google search by topic was first conducted[12]. In order to refine the rather 'unclean' list of potential stakeholders that was generated, popular media archives were explored (through Factiva, Canadian Newsstand, Lexis-Nexis). Additionally, experts 'in the know' on the topic were also consulted[13]. In combination, these review tactics helped to define a well-rounded protagonist list for the 'terminator technology' issue (for the 'terminator technology' protagonist list, please refer to Appendix B).

For the synthetic biology issue, the process was a bit more complex. As it is a new issue (relative to 'terminator technology'), information and resources were somewhat more

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[11] As part of IssueCrawler's set of affiliated tools, LinkRipper enables the user to input a URL that contains multiple links, strips text and captures all internal and/or outlinks from that URL.

[12] Search parameters used were: "terminator technology", "gene use restriction technology", "GURT" or "GURTs", "suicide seeds".

[13] Dr. Edna Einsiedel (Communication and Culture, University of Calgary) and Jan Tranberg (formerly of AgWest Bio of Saskatoon) and currently with CropLife).

limited. However, the final protagonist list generated for this issue was comprised of actors that subscribed to the open letter lead by the ETC Group in response to a declaration on governance of synthetic biology made at the Second International Meeting on Synthetic Biology in Berkeley in 2006. The thirty five organizations that signed the open letter work in over sixty countries and include scientists, engineers, environmentalists, farmers, social justice advocates, trade unionists and biowarfare experts (for the 'synthetic biology' protagonist list, please refer to Appendix C).

Once the protagonist lists were developed, the web crawl process through IssueCrawler is quite simple. First, each set of protagonist URLs are dumped into the IssueCrawler 'harvester' wherein 'harvest' parameters can be set for locating an online 'issue network' for both 'terminator technology' and 'synthetic biology'. Settings for number of iterations and crawl depth may be adjusted[14]. For our case studies, we use the defaults (one iteration; crawl depth two). Once initiated, IssueCrawler performs co-link analysis and finds outlinks and finds which outlinks are common to the 'terminator technology' or 'synthetic biology' starting points or protagonist URLs. In this way, IssueCrawler can be used to get a 'quick picture' of the given advocacy networks. However, unlike software like Google or similar search engines, the results are not immediate but rather are generated in a program 'queue' (which may consist of hundreds of users at a given time). It is not uncommon to wait several days for data to be generated on a given 'harvest'.

4.1 The 'Terminator Technology' Protagonist Network

One important feature of Issuecrawler is that it provides the user with the ability to 'schedule' subsequent crawls over time on a given protagonist list. This feature is useful is monitoring a mapping changes in a given network over time. Optimal scheduling is determined by the user/researcher and depends upon events of interest that may impact online activities, the timing of those events, how often protagonists tend to post / change their web sites, etc. Once produced, the data or output generated from a crawl includes node numbers as well as number of co-links which, in turn, can identify central actors within the network.   Table 1 below shows data generated through IssueCrawler (and

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[14] Settings are adjustable from 1-3 for number of iterations and 1-3 for depth of crawl.

augmented through standard social network analysis calculations (through the SNA program ORA)) on the 'terminator technology' (TT) protagonist network at *two* separate time intervals (scheduled): October 25, 2008 and December 21, 2009.

Table 1 Comparison of Terminator Technology Crawls using Social Network Analysis

	TT Crawl #1 Conducted October 25, 2008	TT Crawl #2 Conducted December 21, 2009
#Protagonists ('starting points) (see list in Appendix B)	20	20
# Nodes in IssueCrawler map	38	48
***Density**	0.0769	0.0743
***Total Degree Centralization**	0.8837	0.9270
***Betweenness Centralization**	0.1450	0.1404
***Closeness Centralization**	0.2361	0.2391

*Standard social network analysis measures calculated through Organizational Risk Analysis (ORA) program.

According to the results, there is little discrepancy in social network analysis calculations between the data generated on the two dates (TT Crawl #1 / October 25th, 2008 and TT Crawl #2 / December 21st, 2009). Additionally, the same actors repeatedly recur as top (three) ranked in key social network analysis measures (in-degree, out-degree, total degree, eigenvector centrality, betweenness centrality, closeness centrality). Yet, despite the lack of differentiation from a quantitative perspective, the networks at the two different time points, as illustrated through the IssueCrawler 'clustering' tool, show substantive differences in terms of structure (see Appendix D). For example, at TT Crawl #1, CorpWatch is identified as the central node (in IssueCrawler-speak, the 'destination URL') while at the latter time point (TT Crawl #2 / December 21, 2009) Banterminator is identified as the central 'destination' URL. Additionally, the October 25, 2008 time point (TT Crawl #1) depicts a more disaggregated network. In fact, the network is not completely connected with 'agriculturaljusticeproject.org' and 'foginfo.org' forming a separate dyad apart from the main component of the network.

Utilizing the IssueCrawler tool 'compare networks over time' (over entire crawled population), TT Crawl #1 (October 25, 2009) and TT Crawl #2 (December 21, 2009) are

compared and outlined in Table 2 below. The top 15 ranked nodes or actors according to number of 'in links' for each time point are listed. TT Crawl #2 is compared to the baseline of TT Crawl #1. Changes in network composition, the rankings of actors in crawls as well as total number of and change in number in links in TT Crawl #2 (relative to the baseline – TT Crawl #1) is also provided in the output data.

Table 2 Comparison of Terminator Technology Crawls

TT Crawl #1							TT Crawl #2					
Crawl start: 2008-10-25 03:21:26							**Crawl start**: 2009-12-21 16:20:32					
Crawl end: 2008-10-25 05:03:11							**Crawl end**: 2009-12-21 17:39:31					
Rank	**pRank**	**Rank change**	**Actor**	**Inlinks**	**Inlink change**		**Rank**	**pRank**	**Rank change**	**Actor**	**Inlinks**	**Inlink change**
1	n/a	n/a	banterminator.org	776	n/a		1	-	n/a	addthis.com	3993	3993
2	n/a	n/a	es.banterminator.org	500	n/a		2	1	-1	banterminator.org	992	216
3	n/a	n/a	twnside.org.sg	301	n/a		3	-	n/a	farmlandgrab.org	733	733
4	n/a	n/a	fr.banterminator.org	285	n/a		4	3	-1	twnside.org.sg	500	199
5	n/a	n/a	etcgroup.org	207	n/a		5	2	-3	es.banterminator.org	432	-68
6	n/a	n/a	biosafety-info.net	159	n/a		6	12	6	foei.org	402	335
7	n/a	n/a	corporatewatch.org.uk	145	n/a		7	10	3	etcblog.org	305	229
8	n/a	n/a	biodiv.org	101	n/a		8	-	n/a	greenpeace.org	305	305
9	n/a	n/a	viacampesina.org	91	n/a		9	4	-5	fr.banterminator.org	291	6
10	n/a	n/a	etcblog.org	76	n/a		10	5	-5	etcgroup.org	290	83
11	n/a	n/a	foe.org	70	n/a		11	-	n/a	angrymermaid.org	231	231
12	n/a	n/a	foei.org	67	n/a		12	-	n/a	bilaterals.org	197	197
13	n/a	n/a	grain.org	53	n/a		13	13	stable	grain.org	192	139
14	n/a	n/a	panap.net	43	n/a		14	20	6	biotech.indymedia.org	192	162
15	n/a	n/a	democracynow.org	38	n/a		15	-	n/a	practicalaction.org	177	177

Ban Terminator entities (fr.banterminator.org. es.banterminator.org and banterminator.org) are ranked high on the protagonist lists for both time points.

Those entities in TT Crawl #2 with 'n/a' listed under 'rank change' represent actors or nodes that were not part of the original baseline network (TT Crawl #1). For example, 'addthis.com' is a new entity or node to the 'terminator technology' advocacy network. However, after a review of the 'addthis' site, it can be quickly ascertained that this is not

an issue-related actor and should be omitted or ignored in the analysis. AddThis is a bookmarking and sharing tool on the Internet. It can be added to websites and blogs to help publishers (advocates) to spread their content across the Internet by making it easy for visitors to bookmark and share content of their favorite online destinations. The AddThis button can be found on hundreds of thousands of websites, and are currently viewed over 20 billion times a month by users all over the world, in over 20 languages[15].

Other notable additions to the 'terminator technology' issue network in TT Crawl #2 are: farmlandgrab.org, greenpeace.org, angrymermaid.org, bilateral.org, practicalaction.org, fao.org and corporateeurope.org. Some of these nodes or actors are 'new' to the Internet which would explain their lack of presence in the baseline network. For example, Food Crisis and the Global Land Grab (farmlandgrab.org) is a blog established by Grain[16] in 2008 use as a repository of sorts, for a collection of online materials used in research conducted by the organization[17].

Some nodes or entities are not only new, but may in fact be only one-off or temporary. The Angry Mermaid Award (angrymermaid.org) was conceptualized and established a presence on the Internet in 2009. It is an 'anti-corporate' entity established by Friends of the Earth (and others[18]) in anticipation of the Copenhagen Climate talks in December 2009. It is designed to allow Internet users and advocates to 'vote' for those corporations or business groups that have made the "…greatest effort to sabotage the climate talks, and other climate measures, while promoting, often profitable, false solutions…"[19]. Voting was open to the online public in November of 2009 and closed as of December 13th.

Another key observation of the TT Crawl #2 data in Table is that most nodes or entities show an increased number of inlinks over those reported in the baseline (TT Crawl #1)

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[15] Further information can be found at: http://www.addthis.com/help/getting-started/reasons/.
[16] GRAIN is small international NGO concerned about farmers' control over biodiversity and local knowledge.
[17] . The report generated from the research is entitled: Seized: The 2008 land grab for food and financial security and was issued in October 2008.
[18] Other supporting organizations include: Attac Denmark, Corporate Europe Observatory, Focus on the Global South, Oilchange International and Spinwatch.
[19] http://www.angrymermaid.org/about

suggesting that 'top 20' actors are expanding links within the Internet - relatively speaking.

Despite the evident growth of the network of protagonists, it would appear that there is a shift in advocacy activities over the past year. A review of select websites suggest that advocacy activities have more recently shifted into climate change related topics or interest as a tactical response to the Copenhagen Climate talks scheduled in early to mid December of this year. The Climate talks were well publicized and it is not surprising that advocacy organizations would shift or spin activities to appeal to public sphere interests.

Based upon the results generated through the IssueCrawler mapping and network comparison tools, it would appear that deeper explorations of the entities or nodes are required. Nodes such as 'addthis.com', although useful as a tool for increasing Internet-based visibility for key organizations and advocates, may be deemed extraneous to the 'terminator technology' issue network.

Another key feature of IssueCrawler is its capacity to generate maps, linking URL domains of stakeholders to discrete geographic locations on a world map. Figure 1 below shows the geographic locations of Terminator Technology protagonists.

Figure 1 Map of Geographic Locations of Terminator Technology Protagonists (snapshot as of October 25, 2008)
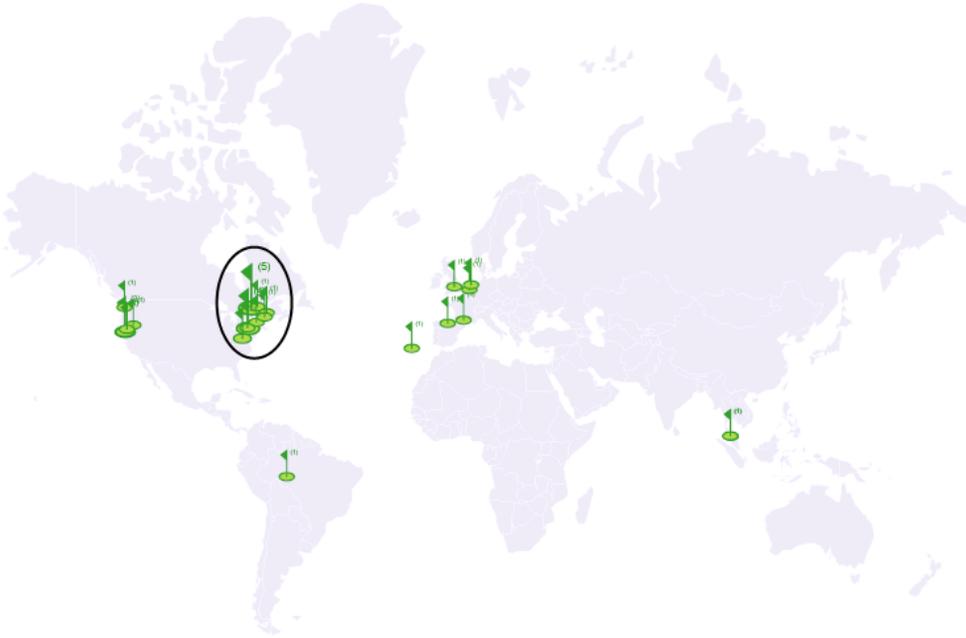
IssueGeographer output - October, 2008

Rogers (2006) suggests that clear-cut interpretations of a map can begin by establishing whether or not actors and actor types cluster. According to the results generated in the aforementioned map, it appears that terminator technology protagonists tend to cluster geographically around central Canada (Ottawa) and the Eastern United States (New York and Washington, D.C.) Based upon these actors' efforts to impact policy and public opinion, it would be strategically optimal to locate (geographically) near government-based centres. These preliminary results would indicate that although virtual networking and influence are of great importance, geographic co-location (face-to-face) appears to matter as well.

4.2 The 'Synthetic Biology' Protagonist Network

As previously mentioned, the synthetic biology issue is a relatively new one. For the analysis of this set of protagonists, the strategy is adjusted slightly in order to further test the IssueCrawler set of tools and, perhaps, generate more efficacious results.

The (larger) set of 35 protagonists were used as starting points for the web crawl and were generated from the list of actors that subscribed to the open letter lead by the ETC Group. To illustrate and explore the network of protagonists over time, more networks were drawn from the scheduled crawls (programmed for every two weeks). The first crawl was initiated on March 30, 2009 with the final crawl scheduled for November 30, 2009. The data from five (5) networks[20] (of the total 18) were drawn on for analysis and run through the 'compare networks over time' IssueCrawler tool (as in the terminator technology example, subsequent crawls (SB Crawl #2-#5) are compared to the baseline crawl (SB Crawl #1). Parameters for this tool were set for analysis of the entire crawled population as with the case of the terminator technology protagonist list/network. However, in this case, the ranked listing for each time point of the synthetic biology protagonist network returned several extraneous (non-issue) URLs including: addthis.com; youtube.com; facebook.com; myspace.com; twitter.com; flickr.com; digg.com[21]. These actors tend to 'dirty' the results. So, as an alternative, the 'compare networks over time' parameters were switched from 'crawled population' to 'sites'. Not only does this strip the output data of more extraneous nodes, aggregate numbers of inlinks are reduced markedly. Results are outlined in Appendix E.

The top 15 actors at each of the five time points of the 'synthetic biology' protagonist list are listed. Output shows several actors repeatedly ranked within the top 10 protagonists for each time point (SB Crawl #1 - #5): foei.org; grain.org; twnside.org.sg; viacampesina.org; etcgroup.org; oneworld.net; corpwatch.org; soilassociation.org; worldbank.org; foe.co.uk. Of these, Friends of the Earth (foei.org), Grain (grain.org), The World Network (twnside.org) appear most often in the top three. At time point #1 (March 30, 2009), the ETC Group is ranked as number one with the most inlinks yet drops to 7th place at time point #2 (May 19, 2009) and then down to 10th by the last time point (November 30, 2009). An actor notably absent from the first two time points but

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[20] Crawl dates: March 30, 2009; May 19, 2009; July 13, 2009; September 23, 2009; November 30, 2009.
[21] Digg is an online place to share information/content from anywhere on the web. "…From the biggest online destinations to the most obscure blog, Digg surfaces the best stuff as voted on by our users. You won't find editors at Digg — we're here to provide a place where people can collectively determine the value of content and we're changing the way people consume information online…" (http://about.digg.com/)

rising in the ranks in the latter three is The World Bank. At time point #3 (July 13, 2009), the World Bank is ranked at #15 and moves to 5th position by the final time point (November 30, 2009).

The geographic locations of synthetic biology protagonists are illustrated in Figure 2. Similar to the mapping of terminator technology protagonists (refer to Figure 1), synthetic biology actors appear to cluster around certain geographic areas; predominantly, in central Canada, the Eastern United States and in Western Europe.

Figure 2 Map of Geographic Locations of Synthetic Biology Protagonists (snapshot as of March 30, 2009)

IssueGeographer output - March, 2009

4.3 Beyond Mapping: Getting to the Heart of the Issue

The aforementioned analytical process is limited to merely the mapping of hyperlinks between predefined protagonists. In the context of analyzing and understanding the scale and scope of an issue, mapping is incomplete. IssueCrawler, however, offers ways in which to more deeply analyze given URLs to ascertain the level to which URL-content is dedicated to a given issue.

Google Scraper is a tool that can generate 'source or tag clouds' through the assessment of a list of URLs using a defined set of keywords (i.e. issue-related terms). GoogleScraper queries Google on each keyword and records and displays the number of occurrences in each URL. These word or term 'clouds' reflect the content of a site or sites based upon a keyword or issue of interest and demonstrate the partisanship or commitment of sources (URLs or advocates) to a particular issue.

As an example, we examine the 'terminator technology' issue using Google Scraper[22]. Figure 3 below shows term clouds for four keywords or phrases: 'terminator technology', 'genetic use restriction', 'terminator seed' and 'GURT'. The queries to generate these clouds were applied to the 'terminator technology' list of protagonist URLs (Appendix B).

Figure 3 Term Clouds for the Terminator Technology Issue

  A. "terminator technology"

  B. "genetic use restriction"

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[22] A similar analysis of 'synthetic biology' was conducted but generated few to no 'term cloud' results. This may, in fact, be due to the fact that 'synthetic biology' is a new issue and may not, as yet, be part of the Internet advocacy vernacular.

C. "terminator seed"

etcgroup.org (82)
banterminator.org (78) organicconsumers.org (33)

es.banterminator.org (16) grain.org (6) twnside.org.sg (3) geneethics.org (3) viacampesina.org (2) nfu.ca (2) genewatch.org (1) econexus.info (1) foe.org (1) ipcb.org (0) ucsusa.org (0)

corpwatch.org (0) rafiusa.org (0) panap.net (0) foginfo.org (0) andes.org.pe (0) itdg.org (0)

D. "GURT"

banterminator.org (45) etcgroup.org (24)

organicconsumers.org (13) grain.org (12) viacampesina.org (11) es.banterminator.org (10) twnside.org.sg (7)

econexus.info (3) genewatch.org (2) panap.net (1) corpwatch.org (1) rafiusa.org (0) ucsusa.org (0) foe.org (0) foginfo.org (0) geneethics.org (0) ipcb.org (0) itdg.org (0) nfu.ca (0) andes.org.pe (0)

Ban Terminator and the ETC Group reflect the most content on the terminator technology issue relative to other protagonists based upon the four keywords and phrases queried. Of the four, the phrase 'terminator technology' is most often employed in terms of content and communications by protagonists.

Another feature of Google Scraper is that it can be used to conduct a deeper analysis of source websites or URL protagonists and can return a list of articles containing a keyword, set of keywords or phrases related to a particular issue. In this process, Google is queried for each defined keyword on each URL. Results, which include article title, URLs and descriptions, are displayed as an html table and are also written to a text file.

Analysis of the terminator technology protagonist list (Appendix B) was conducted on October 25, 2008. Over 4600 articles were returned. The breakdown of these results is provided in Table 3 below.

Table 3 Articles by keyword or phrase (Googlescraper)

Keyword or Phrase	Number of resulting articles
'terminator'	2329
'terminator technology'	1130
'GURT' or 'GURTS'	739

'terminator seed'	409

This particular feature of Googlescraper is, at the very least, an excellent tool for cataloguing online articles on a given issue. It is important to note, however, that these results do contain duplicates. Thus, a more in-depth review of the articles in question is required.

Collectively, IssueCrawler and its set of allied tools appears to be useful in analyzing issues and online networks of advocacy actors. However, the tool only returns 'real time' results. Thus, there is history – as in the case of 'terminator technology'[23] - Issuecrawler may be limited in its capacity to highlight, document or assess a particular issue.

5.0 The Wayback Machine and the Terminator Technology Issue

As previously mentioned, an important limitation of any Web crawling software is that crawls can only be conducted in real time. Thus, understanding a given issue – particularly based upon past events – cannot be fully analyzed through the software alone. The "Wayback Machine"[24] [http://www.archive.org/index.php] is an Internet archive that captures and stores billions of web pages at historical intervals (going back as far as 1996). The "Wayback Machine" search engine provides the portal through which URL addresses may be fed and a collection of searchable web pages (and their links) is generated. Unfortunately, it appears that "Wayback Machine" web pages are not amenable to analysis through IssueCrawler. Thus, to truly understand the historical hyperlink activity of a given Internet actor, the researcher needs to conduct intensive page-by-page analysis of the stakeholders' URL archive.

Using The ETC Group as an example, its URL is entered into the Wayback Machine search engine [www.etcgroup.org] which returns a total of 411 web archived pages dated

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[23] The ETC Group ('RAFI' at the time) reported on Terminator Technology as early as 1998. This research and the application of IssueCrawler to the issue in question did not start until Spetember 2008.

[24] The Wayback Machine is administered by the non-profit organization Internet Archive (based in Egypt) that builds a digital library of Internet sites and other cultural artifacts in digital form on a continual basis. Like a paper library, it provides free and open access to researchers, historians, scholars, and the general public.

from August 2001 and August 2008[25]. A review of the ETC primary page(s) indicates, for the most part, little change in web content and structure until 2005 at which point a significant amount of web changes can be noted starting in the month of May[26]. The timeline of these changes appears to fall into key historical events affiliated with the 'terminator technology' issue and, notably, follows the February decision by the Convention for Biodiversity (CBD) to uphold a ban on terminator technology (See Appendix A for further details). A closer look at an archived webpage dated December 27, 2005 highlights the introduction of the 'Ban Terminator' campaign originates through the "publications" sub webpage as "*ban terminator seeds - join the global campaign*" and is featured as a prominent button on the page. By the following January (2006), this banner has been moved to the very front page (see Figure 3 below). This message continues to be notably displayed until August 15th 2006. At that point, the ETC redesigns its website and rolls out its new organizational tag line "*monitoring power, tracking technology, strengthening diversity*" (formerly "*action group on erosion, technology and concentration*" - org acronym ETC). The 'BanTerminator' button has been removed from the main web page but there are several links to publications/new pages dedicated specifically to terminator technology / GURTS.

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[25] Note: Prior to September 1, 2001, ETC Group was known as Rural Advancement Foundation International (RAFI), headquartered out of Winnipeg, Manitoba. Archives of RAFI webpages – although not numerous - can be found under the searchable URL: www.rafi.ca through the Wayback Machine. Terminator technology is first referred to in May 1998 [http://web.archive.org/web/19980529021744/www.rafi.ca/pr/release15.html].
[26] Archived Web pages that contain changes are denoted with an asterisk (*).

Figure 3 The ETC Group Primary Web Page (Wayback Archives (January 2006))

Source: Wayback Machine [http://web.archive.org/web/20060129225652/http://www.etcgroup.org/]

6.0 Recommendations for Future Steps

The complexities of advocacy issues ('terminator technology' and 'synthetic biology') brings to the table a number of key stakeholders from government, the private sector, non-government organizations and consumer interest groups as well as a proliferation of information sources, all of whom, to a greater or lesser degree, rely upon the Internet to disseminate information. This paper / study provides some insight into the use of IssueCrawler and its set of allied tools to explore these online networks of actors and to more deeply examine these controversial issues. Despite the promise that this program shows in terms of facilitating research in this area, the efficacy of IssueCrawler is a function of how the research method is developed, strategized and employed. Two key factors need to be considered prior to initiating the analytical process.

First, stakeholders are key. Therefore, finalizing and utilizing a relevant protagonist list is important. This requires some up-front research using several sources: consultation with key experts, resourcing popular media and the Internet to find out who is involved in the issue. Additionally, it is important to not only consider central actors in an issue but

to also give credence to secondary and tertiary actors. Disparities in terms of access to technology /issues around literacy that can impact message and activities of stakeholders activities. Based on the results of this study, some seemingly extraneous actors are rising in prominence within issue networks. Add.this, Facebook and others act as powerful connectors and/or pathways for protagonists to connect to the public sphere and for the public sphere to access information in an expedient manner.

Secondly, timing matters. In this paper, we analyzed (in real time) our networks of protagonists at relatively random points in time (October 25, 2008, December 21, 2009, etc). In order to really understand the mobilization of an issue in the context of the Internet, protagonist networks and their hyperlinks needs to be analyzed over time (through scheduled crawls) at significant points in time (for example, before and after a particular event).

Finally, IssueCrawler cannot be employed in isolation. The data generated from employing any web crawling tool is limited if not complemented by additional qualitative and quantitative research. Triangulation of quantitative and qualitative data is required in order to fully understand a given issue and its advocacy issue. Triangulation is a powerful research technique that combines two or more data sources and several research methodologies to conduct research. Cohen etal (2000) define triangulation as an "attempt to map out, or explain more fully, the richness and complexity of human behavior by studying it from more than one standpoint" (112). Triangulation "…gives a more detailed and balanced picture of the [given] situation…" (Altrichter etal (2006: 117)). In the context of examining 'terminator technology' and 'synthetic biology', triangulation would be useful to validate and support the data generated by IssueCrawler on these issues. Relevant complementary data sources – i.e. such as the 'Wayback Machine' Archives – have been identified within the scope of this paper. Other popular media data repositories (Lexis-Nexis, Factiva, Canadian Newsstand) would also be useful for tracking down issue-related articles. Complementary quantitative approaches or methods include social network analysis with the use of SNA software (ORA, UCINet, NetDraw

and others) to conduct statistical analysis, standard network analysis and to generate network graphs (with attribute data) and may have some use in this context.

A key limitation of IssueCrawler is that the data generated contains no real qualitative information regarding the nature of the organizations or protagonists nor can it speak to the character of the development of links between stakeholders beyond the mere 'hyperlink'. The Yearbook of International Organizations (YIO) is published by the Union of International Associations (UIA) and provides the most extensive coverage of nonprofit organizations by any source (Keck and Sikkink, 1998). The YIO offers organization-based attribute data including, among other things, year of establishment, location, mandates and activities. Key within this context is the YIO's record of links and partnerships by organization. This resource could be a useful complementary source of data and information on issue-related stakeholders. Research has been (and continues to be) conducted on INGOs and NGOs using the YIO as a primary source. For example, the Annenberg Networks Network at the University of Southern California is conducting longitudinal assessments on networks of NGOs. The group draws heavily on the YIO for both qualitative and quantitative data. The project in question – *The Evolution of Interorganizational Networks in NGO Communities* (Fulk and Monge 2009) – focuses on a specific global issue, Children's Rights and explores the growth, stability and decline of the network of actors/stakeholders over time. The project also utilizes historical data and information gathered through the Wayback Machine Internet archives.

As previously mentioned, the 'Wayback' Archives appear to be valuable (yet time intensive) resource in terms of exploring historical activity of issue advocates and the evolution of connections amongst network actors. A relief to the labour intensity of gathering data through 'Wayback' may soon be realized through the IssueCrawler set of tools. In a recent personal communication with Richard Rogers (gov.net), he indicates that an analytical methodology and associated tools have been developed to 'dig' through and map connections from pages archived in the 'Wayback Machine'.   However, the process has not, as yet, been proven. As of today, it is not publicly supported nor is it formally promoted by the organization.

The IssueCrawler tool/software package has the capacity to highlight the politics of association, identify linking behaviours of publics and stakeholders and illustrate issue spaces (geographically and virtually) as it relates to specific issues and/or controversies such as terminator technology (Rogers 2005). In particular, the software can highlight where an issue is based according to the Internet. This information can be paired with a comprehensive analysis of the issue at hand (through a review of popular media articles) in order to compare where the issue is based (institutionally) relative to where the issue is happening geographically (Govcom.org 2008).

Regardless of what or how methods are triangulated and employed, the strategy for exploring issue networks needs to be mapped out well in advance. The relevance, reliability and validity of data generated through use of web crawler are a function of how parameters are defined up front and in the timing of the application. Event impact analysis appears to be an important factor in analyzing advocacy issues. Thus, timing and longitudinal analysis are key. Also, surveys and interviews with key stakeholders may also prove useful in supporting data.

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Appendix A: Terminator Technology Timeline & Information

1998	• TT patented in the US by Delta & Pine Land Company (D&PL) and the USDA (March) Patent #5,723,765 (D&PL has exclusive selling rights while USDA would earn 5% of net sales of any commercial product using the technology). Patents applied for in 78 other countries. • Monsanto says it will purchase D&PL (May 11)… acquisition is stalled by US anti trust agencies • Former Chairman of FAO Council writes article published by Biotech and Development Monitor criticizing the TT (summer) • UN Food and Agricultural Organization Commission on Genetic Resources for Food and Agriculture in Rome (June) • Clinton admin clamps down on research in TT (September 14) • Indian government bans TT seeds (before October 10) • UN CGIAR vote to condemn TT and ban it in all crop improvement programs (October 30) • Indian government summarizes threats posed by TT seeds.
1999	• RAFI discovers that seed companies have collectively obtained 29 patents on technologies that would be used to create TT (January) • 1999 – former secretary general of UNCED speaks out against TT (April 7) • CBD's SBSTTA reject proposals during Montreal meeting to recommend a permanent moratorium on GURTs (June 15 – 21) • Panama says it opposed to TT (June 21) • Rockefeller Foundation tells Monsanto to end research in TT (June 24) • USDA and D&PL secure new patent for improvements in TT (July 20) US Patent # 5,925,808 • Monsanto pledges not commercialize terminator seeds (October 4) • USDA and D&PL secure new patent for improvements to TT (November 2) US Patent # 5,977,441) • USDA dismayed at Monsanto decision not to commercialize terminator (December 21) • Monsanto drops bid for purchase of D&PL (December)
2000	• Ghana opposed to TT (January 14) • FAO director general against TT (Feb 8) • scientists call for 5 year ban on GM crops (May) • Conference of the Parties to the UN-CBD recommend that GURTs should not be approved for field testing until justified by appropriate scientific data (May 15 – 26) • UN FAO Ethics panel voices concerns about TT (Sept 26 – 28)
2003	• UPOV concludes that TT could be bad for farmers (Jan 10) • BDC Expert Panel considers impact of TT (Feb 19-21) • US and seed industry strong UPOV into removing criticisms of tt from document (March 13 – April 11)

	• SBTTA recommends that CBD forgoe action on TT report (November 10-14) at the ninth meeting of the Scientific Body of the UN CBD – issue not to be considered again until 2006
2004	• response by Canadian government to a petition under the Auditor General Act (August)
2005	• CDN government will propose lifting of de facto ban on terminator seeds (before February 7) • CBD upholds recommendation to ban TT (February 7) • Schmeiser speaks out against TT at UN meeting (February 11) 10th meeting of SBTTA in Bankok • Andean and Amazon indigenous leaders denounce TT (Sept 26-27) in Choquencancha meeting • D&PL and USDA obtained a patent in Canada (October) then acquired a similar one in EU a few weeks later • Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) (subsidiary body to the CBD) discuss a report by a scientific advisory panel that call for a ban on field trials of GURTs… Canada along with NZ and Australia indicate that the report does not reflect the consensus and recommend allowing countries to conduct field trials to provide scientific data / these countries do not support a categorical ban on TT field trials… the SBSTTA can not reach consensus on the scientific panel report and recommend that the COP reaffirm its decision of 2000 (February)
2006	• UN meeting in Granada / CBD's working group on Article 8j – 8th biennial meeting (January 23 – 27) • European parliament resolution backs ban of TT (March 16) • India – ½ million sign petition denouncing TT (March 20) • Parties to the Convention discuss the SBSTTA's recommendations of 2005 at the 8th Ordinary Meeting in Brazil (March)… parties reject case by case assessments of GURTs and reaffirm COP decision of 2000. •

Companies developing or who have developed GURTs:
- Novartis
- AstraZeneca
- Monsanto
- Pioneer Hi-Bred
- Rhone Poulenc
- DuPont.

Related terms:
- Terminator technology (by RAFI)
- Gene use restriction technology (GURT or T-GURT)
- Technology protection system (by D&PL)
- Traitor Technology
- Terminator Genetic Seed Sterilization Technology

Sources for this information:

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Appendix B. 'Terminator Technology' Protagonist List

http://andes.org.pe
http://banterminator.org
http://corpwatch.org
http://econexus.info
http://es.banterminator.org
http://etcgroup.org
http://foe.org
http://foginfo.org
http://geneethics.org
http://genewatch.org
http://grain.org
http://ipcb.org
http://itdg.org
http://nfu.ca
http://organicconsumers.org
http://panap.net
http://rafiusa.org
http://twnside.org.sg
http://ucsusa.org
http://viacampesina.org

Appendix C. 'Synthetic Biology' Protagonist List

Acción Ecológica (Ecuador) - www.accionecologica.org
California for GE Free Agriculture - www.calgefree.org
Centro Ecológico (Brazil)
Clean Production Action - www.cleanproduction.org
Corporate Europe Observatory - www.corporateeurope.org
Corporate Watch (UK) - www.corporatewatch.org
Econexus - www.econexus.info
Edmonds Institute - www.edmonds-institute.org
ETC Group - www.etcgroup.org
Farmers Link - www.farmerslink.org.uk
Friends of the Earth International - www.foe.org
Foundation on Future Farming (Germany) - www.zs-l.de
Foundation Science Citoyennes (France) - www.sciencescitoyennes.org
Gaia Foundation - www.gaiafoundation.org
GeneEthics Network (Australia) - www.geneethics.org
Genewatch (UK) - www.genewatch.org
GRAIN - www.grain.org
Greenpeace International - www.greenpeace.org
Henry Doubleday Research Association (UK) - www.gardenorganic.org.uk
Indigenous People's Biodiversity Network
International Center for Technology Assessment - www.icta.org
International Network of Engineers and Scientists - www.inesglobal.com
Institute for Social Ecology - www.social-ecology.org
Institute for Bioethics, Culture and Disability - www.bioethicsanddisability.org
International Union of Food and Agricultural Workers - www.iuf.org
Lok Sanjh Foundation (Pakistan) - www.loksanjh.org
National Farmers Union (Canada) - www.nfu.ca
Oakland Institute - www.oaklandinstitute.org
Polaris Institute - www.polarisinstitute.org
Pakistan Dehqan Assembly
Practical Action - www.practicalaction.org
Quechua Ayamara Association for Sustainable Livelihoods (Peru) - www.andes.org.pe
Research Foundation for Science, Technology and Ecology (India) - www.navdanya.org
Soil Association - www.soilassociation.org
Sunshine Project - www.sunshine-project.org
Third World Network - www.twnside.org.sg

Appendix D
   A. *'terminator technology' protagonist list network – October 25, 2008*

B. ''terminator technology' protagonist list network – December 21, 2008