CO-PRODUCING SOFT LAW AND UNCERTAIN KNOWLEDGE: BIOFUELS AND SYNTHETIC BIOLOGY AT THE UN CONVENTION ON BIOLOGICAL DIVERSITY

by

DEBORAH ANN SCOTT

A Dissertation submitted to the

Graduate School-New Brunswick

Rutgers, the State University of New Jersey

In partial fulfillment of the requirements

For the degree of

Doctor of Philosophy

Graduate Program in Geography

Written under the direction of

Richard A. Schroeder

And approved by

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New Brunswick, New Jersey

MAY 2015

ABSTRACT OF THE DISSERTATION

Co-Producing Soft Law and Uncertain Knowledge: Biofuels and Synthetic Biology at the UN Convention on Biological Diversity

By DEBORAH ANN SCOTT

Dissertation Director:

Richard A. Schroeder

In this dissertation, I examine processes of the Convention on Biological Diversity (CBD) to develop international soft law on biofuels and synthetic biology. I ask how decision-making happens in the unique context of this treaty and on these issues, specifically looking to the role of knowledge politics. To do this, I first establish the cultures and legal structures that have developed within the CBD's permanent bodies, identifying characteristics that have drawn criticism but that also have the potential to establish the CBD as a productive forum for examining emerging and uncertain technosciences. I then turn to the treaty's engagement with biofuels and synthetic biology under its "New and Emerging Issues" mechanism. I identify three main ways knowledge politics have been expressed: setting the issue's scope; establishing appropriate sources and types of knowledge for decision-making; and the meaning and implications of scientific uncertainties. I trace how the political, scientific, and administrative bodies of the treaty have grappled with each of these aspects, in the process providing a forum for consideration of the treaty's scope, its legal epistemology, and its approach to decision-making in a post-predictive paradigm.

Research methods include textual analysis, semi-structured interviews, participant observation of CBD negotiating events, and observant participation of treaty processes through an internship and consultancy with the CBD Secretariat on synthetic biology. This dissertation speaks to scholarship on global environmental governance and the governance of emerging technologies, expanding the concept of the co-production of law and science to include soft international law and a broad range of scientific uncertainties.

ACKNOWLEDGEMENTS

My advisor, Richard Schroeder, and my committee of Bob Lake, Kevin St. Martin and Lisa Campbell (and Trevor Birkenholtz in the initial stages), shared generously of their time and wisdom. The academic guidance was invaluable, but I am particularly grateful to them for demonstrating that it is possible to be decent, thoughtful, engaged people *and* top-rate academics. I cannot say strongly enough how impressed I am with their navigation of the politics and possibilities of academia.

Very important thanks go to the Rutgers Geography Department staff – Michelle Martel and then Johnny Nunez, Theresa Kirby and then Kelly Bernstein, Betty Ann Abbatemarco and then Cleo Bartos, and (always) Mike Siegel. Thank you for guiding me through the very special logic of Rutgers bureaucracy, rescuing me from computer crises, and talking me through paperwork. And just as much, thank you for allowing me the pleasure of your company through countless lunches. I'm so grateful for your welcome and for the community you have provided, even if (or maybe especially because) I mostly experienced it in a windowless, cinderblock lounge.

Collaborative Event Ethnography (CEE) relies on collaboration in coordinating fieldwork, collecting and analyzing data, and thinking through meaning. From my team members, I learned how to conduct event ethnography and create social science scholarship. This dissertation therefore reflects the efforts of the larger team working on site in Nagoya. The CBD COP 10 CEE team is: project leaders J. Peter Brosius, Lisa M. Campbell, Noella J. Gray, and Kenneth I. MacDonald, and researchers Maggie Bourque, Catherine Corson, Juan Luis Dammert, Eial Dujovny, Shannon M. Hagerman, Sarah Hitchner, Shannon Greenberg, Rebecca Gruby, Edward M. Maclin, Kimberly R. Marion

Suiseeya, Deborah Scott, Daniel Suarez, and Rebecca Witter. I would like to particularly acknowledge my fellow biofuels group members – Juan Luis Dammert, Sarah Hitchner, and Edward M. Maclin – for their work collecting data on biofuels at CBD COP 10 and considering its meaning afterwards. Some of the analysis of Chapter 3 was previously published in *Global Environmental Politics* (Scott et al. 2014).

CBD Party and observer delegates consistently express a great deal of respect and appreciation for the staff of the Secretariat of the CBD, and I must as well. Many “P” staff members are on two to three year contracts without any guarantee of renewal. “G” staff members have limited opportunities to advance in the byzantine UN hierarchy. For all members of the Secretariat, the schedule of SBSTTAs, COPs, AHTEGs, Working Groups, inter-sessional workshops, and other meetings is relentless. Parties consistently add to the workload of the Secretariat while rarely providing more resources. I have learned a great deal from the Secretariat of the CBD, and can only express my great appreciation for the assistance, patience, and friendship I have experienced. I would particularly like to thank Robert Höft for his kind and insightful supervision and guidance, and the co-authors of the information documents (and now *Technical Series*) for their excellent work.

My thanks to all who graciously agreed to be interviewed in the course of my research. Unfortunately, my pledge of confidentiality prevents me from listing those who have indelibly shaped my experience of the CBD and the world(s) of synthetic biology.

I was able to follow the enactment of a treaty through meetings and Secretariat work around the world thanks to support by the US National Science Foundation (award nos. 1027194 and 1027201), the Rutgers NSF Integrative Graduate Education and

Research Traineeship (IGERT DGE 0903675), the Rutgers School of Graduate Studies, and the Rutgers Center for African Studies.

One of the great surprises and joys of graduate school has been finding co-workers, in spite of the solo pursuit that is a dissertation. Heartfelt thanks to: my fellow Rutgers geography graduate students for their support and friendship as we grappled to get a hang of social theory and life in New Jersey; the IGERT Fuels group for pushing me to communicate with non-geographers; the CEE team for showing me the joys and possibilities of group research, not the least of which is a beach house; the CBD interns for being such delightfully interesting people; and my FireWorks co-workers for Boggle breaks, snacks, and solidarity.

I've been blessed with awesome communities throughout my years of graduate school – the best housemates, the best Syndicate book club, the best Mennonite fellowship, the best potluck and game night groups. And individuals from my previous communities have continued to enrich my life, from Goshen to Portland to Nairobi. Thanks to my siblings (including the outlaws) for care packages and all the other expressions of care, to my parents for their support throughout all my academic (and occasional non-academic) adventures, to my Montreal family for showing me the good life in Montreal, to my nephews and niece for being the absolute best.

I would like to dedicate this dissertation to my grandparents, Elfrieda and Peter Dyck and Page and Raymond Scott, for their inspiration in doing work with meaning and with love.

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List of Acronyms

ABS – access and benefit sharing
AHTEG – ad hoc technical expert group
BSL – Biological Safety Level
BWC – Biological Weapons Convention
CBD – Convention on Biological Diversity
CCD – Convention to Combat Desertification
CDM – Clean Development Mechanism of the Kyoto Protocol to the Framework Convention on Climate Change
CEE – Collaborative Event Ethnography
CER – Certified Emission Reduction
CG – Contact Group
CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS – Convention of Migratory Species of Wild Animals
COP – Conference of the Parties
CPB – Cartagena Protocol on Biosafety to the Convention on Biological Diversity
CSO – civil society organization
EC – European Commission
EMBO - European Molecular Biology Organization
EU – European Union
FAO – Food and Agriculture Organization of the United Nations
FtC – Friends of the Chair
G77 – Group of 77
GBEP – Global Bioenergy Partnership
GBO – Global Biodiversity Outlook
GEF – Global Environment Fund
GHG – greenhouse gas
GMO – genetically modified organism
GURTs – genetic use restriction technologies
HLPE – UN High Level Panel of Experts on Food Security and Nutrition
IAASTD – International Assessment of Agricultural Knowledge, Science and Technology for Development
IAS – invasive alien species
IBOL – International Bar Code of Life
IEA – International Energy Agency
IGERT - Integrative Graduate Education and Research Traineeship
ILC – indigenous and local communities
iLUC – indirect land use change
IPBES – Intergovernmental Panel on Biodiversity and Ecosystem Services
IPCC – Intergovernmental Panel on Climate Change
IPR – intellectual property rights
ISCC – International Sustainability and Carbon Certification
ITPGRFA - International Treaty on Plant Genetic Resources for Food and Agriculture
LMO – living modified organism

MEA – multilateral environmental agreement
NEI – New and Emerging Issues
NGO – non-governmental organization
NIH – US National Institutes of Health
OECD – Organisation for Economic Co-operation and Development
PCSBI – US Presidential Commission on the Study of Bioethical Issues
RSB – Roundtable on Sustainable Biomaterials
SBSTTA – Subsidiary Body on Scientific, Technical and Technological Advice
SBSTA – Subsidiary Body on Scientific and Technological Advice (of the UNFCCC)
SCBD – Secretariat of the Convention on Biological Diversity
SPS Agreement – Sanitary and Phytosanitary Standards Agreement of the WTO
STS – Science and Technology Studies / Science and Technology in Society
TEEB - The Economics of Ecosystem Services and Biodiversity
UN – United Nations
UNCED – United Nations Conference on Environment and Development
UNEP – United Nations Environment Programme
UNFCCC – United Nations Framework Convention on Climate Change
UNFF – United Nations Forum on Forests
USD – United States dollar
WG – Working Group
WHC – World Heritage Convention
WTO – World Trade Organization
WWICS – Woodrow Wilson International Center for Scholars

Chapter 1 Soft Law and Knowledge Politics in Global Environmental Governance

1.1 Introduction.

It was the fifth day of the 18th meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) of the UN Convention on Biological Diversity (CBD). Around 500 delegates were meeting in Montreal at the International Civil Aviation Organization's conference center, developing advice to send to the next meeting of the treaty's political body, the Conference of the Parties (COP) (Goldberg et al. 2014). As a consultant to the Secretariat of the CBD, I was at SBSTTA 18 to help delegates develop a "Recommendation" to the COP, which the COP would negotiate on further and release as a "Decision." This text might establish a work plan for the treaty on synthetic biology and, possibly, provide guidance to the 194 State Parties to the CBD in governing this emerging technoscience as a "New and Emerging Issue" to the treaty. As a graduate student, I was in my fourth year of studying the politics of knowledge in these processes of decision-making. Through a focus on the CBD's "New and Emerging Issues" mechanism, I was examining the co-production of knowledge and governance on synthetic biology and biofuels.

The contact group on Synthetic Biology had met earlier that afternoon, two hours with very little textual agreement to show for it. At the end of the session, the contact group Chair leaned over to me and the other supporting Secretariat staff member and grumbled, "Bloody waste of time." I drifted out to the main hallway to see if anything interesting had been added to the literature table. Nothing had. I was eating an apple and staring hollowly into middle space when one of the non-Party US delegates walked past. We had met briefly two years before at a CBD negotiating event, and I introduced myself again. She had moved divisions, but still worked for the US State Department. When I told her that I had drafted the Secretariat's information documents on synthetic biology, her eyes narrowed and she leaned closer. "Do people know who you *are*? You'd be getting a lot of angry people running at you if they did, wanting to know why you included this and not that!"

I sighed and shifted my feet; my housemate's high heels were eminently sensible, but it was the fifth day of wearing them, and my feet hurt. By June 2014, I had been working for the Secretariat intermittently for a year and a half, drafting and then editing documents explaining the science, the international legal coverage, and the controversies of synthetic biology for the benefit of the treaty deliberations. The Biotechnology Industry Organization had already accused me of using Orwellian "Newspeak" by referring to organizations critical of synthetic biology as "civil society organizations."[1] The University of Edinburgh's Center for Synthetic and Systems Biology had complained that in the drafts "nuance of language has occasionally been used to magnify the potential risks described, perhaps without intent. However, if allowed, it may be used to propagate contention and concern, which in turn could lead to a chilling effect on SB [synthetic biology] research and biotech development."[2] The editors of the journal *Nature* had written: "Not everyone agrees that synthetic biology is a force for good, and that opposition has found its voice in a consultation for the global Convention for Biological Diversity. It is crucial...that the balancing voice of science is heard before false

[1] The term "civil society" is extremely common within the UN, and specifically in the context of the CBD (such as *square brackets: the CBD newsletter for civil society*, a joint publication of the CBD Secretariat and the CBD Alliance). See BIO peer review comments to *Impacts* from 2013. Available at: http://www.cbd.int/doc/emerging-issues/Biotechnology-Industry-Organization-reviewcomments-SBImpacts-2013-09-en.pdf (last accessed 11 February 2015).

[2] See SynthSys peer review comments to *Impacts* from 2013. Available at: http://www.cbd.int/doc/emerging-issues/Uni-Edinburgh-reviewcomments-SBImpacts-2013-09-en.doc (last accessed 11 February 2015).

assumptions lead to the creation of onerous and unnecessary regulation" (*Nature* editorial 2014, 133). Some delegates were publicly extolling the documents; others were loudly calling for more rounds of peer review. People were approaching me in the convention center bathroom to thank me for producing quality documents, to ask me why the Secretariat had made certain drafting decisions, to question wording choices. I was very tired.

As shown by the strong reactions to the Secretariat information documents on synthetic biology, the political role of knowledge has not been hidden in the CBD's deliberations on the issue. From the sources of information drawn upon to the framing of uncertainties, the production of an epistemic base of knowledge on synthetic biology and biodiversity was publicly contentious. What is perhaps less clear from the vignette is the miniscule chance that the treaty would develop new, legally-binding internationally regulations for synthetic biology. As with most issues on the treaty's agenda, synthetic biology and biofuels were objects of "soft" legal governance by the CBD. At its most dramatic, the CBD COP could have called on member States not to release organisms, components or products of synthetic biology into the environment until more research established the potential impacts. Such an outcome would have had minimal legal strength, and it was an unlikely result at best.

This dissertation examines processes of international environmental decision-making towards developing soft law on the emerging technosciences of biofuels and synthetic biology. Studies on co-production often fail to interrogate the legal nature of the governance being developed, or focus on 'hard' law alone. Soft international law is in many ways a marginal space, largely established by States with less geopolitical power.

Although this means that it is often neglected and discredited, this positioning also affords possibilities to develop counter-hegemonic proposals. I am looking at where this form of law intersects with technosciences still in development, whose impacts are not yet understood and may actually defy measurement or understanding. I argue that in this confluence of uncertain issues and soft legal structure, new approaches to international decision-making are required that are not tied to the dual goals of resolving scientific uncertainties and hardening legal responses.

1.2 Co-production of governance and knowledge.

The term *co-production* expresses that "the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it" (Jasanoff 2004a, 2). Developed within the field of Science and Technology Studies (STS, also known as Science and Technology in Society), co-production describes how orderings of nature and society are often produced together and afterwards reinforce each other (Jasanoff 2004a & b). For example, scientists and technicians are influenced by ideas of what kind of knowledge political decision-makers need. Policy and law-makers draw upon scientific and technical knowledge to frame the natural world as governable in particular ways (Jasanoff & Wynne 1998; Jasanoff 2004b).

The concept of co-production has particular salience at the international level. Globalization(s) and new means of producing and assessing knowledge have developed together, as new ways to know the world are developed in response to, and used to legitimate, new arrangements of social order (Bonneuil & Levidow 2011). Global environmental problems are popularly understood to be defined by scientific measurements, but they owe their definitions just as much to the legal and political regimes that officially describe and propose to solve them (Taylor & Buttel 1992).

I expand co-production in two ways that are vital to my project. First, along with other geographers, I find that STS theory is best complemented by political ecology (Campbell et al. 2014; Goldman & Turner 2011). Political ecology provides a framework for attending to uneven power relations, as power is generated and expressed through knowledge, capital, and institutions of governance (Goldman & Turner 2011). Historically focused on the role of the political economy in shaping access to and control over natural resources, political ecology has broadened to consider other aspects of the complex relations of "nature" and "society" (Escobar 1999; Peet & Watts 2006). Political ecology is a particularly important framework for studying the CBD, guiding scholarship "from the politics of the protection of nature to the politics of nature's production" (Kosek 2006, 22). It has been used to explain the entwined histories of biodiversity conservation and power, from the early colonial botanical gardens to the rise of the gene is defining biodiversity (McAfee 1999 & 2003; Schroeder 1999b; Parry 2004; Cooper 2008; Lorimer 2012; Rossi 2013; Campbell et al. 2014). By including political ecology in my research on co-production, I am committed to keeping an eye on what is at stake in the development of knowledge (Campbell 2011).

Second, I expand consideration of what is being co-produced. Co-production scholarship usually focuses on "science" and "law" as two privileged forms of ordering the world (Jasanoff 2005; Latour 2010; Bonneuil & Levidow 2011; Mahony 2013). Science and law are considered to both embody "universalizing ambitions" to produce truths that "subsum(e) all other modes of knowledge or regulation" (Whatmore 2002, 61). STS scholarship has generally focused on laboratory sciences, although political ecologists have expanded attention to the environmental sciences (see Goldman et al. 2011). The other side of co-production is generally represented in scholarship by hard law, such as the binding obligations of the World Trade Organization (WTO) Agreements and free trade agreements (Winickoff et al. 2003; McCarthy 2005; Bonneuil & Levidow 2011). Another popular subject of co-production scholarship is the Intergovernmental Panel on Climate Change (IPCC), which positions itself as a scientific body (Shackley & Wynne 1996; Edwards & Schneider 2001; Miller 2009; Narita 2012). The IPCC feeds into the UN Framework Convention on Climate Change, the outputs of which vary widely in terms of their legal nature, but this otherwise excellent scholarship seems uninterested in differentiating among these outcomes – they are all considered “law.” To study the process of co-production is thus often to trace the erasure of social and material worlds to make way for singular legal and scientific explanations and productions of reality (see Scott 1998; Whatmore 2002; Miller 2004; Thompson 2004).

Yet, the ways in which human societies know, represent, and order the world are not restricted to modern science or formal law. At the CBD I have seen the co-production of what I describe as “soft law” and “knowledge.” In the next sub-section, I explain global environmental governance and the spectrum of hard to soft international law. I then identify three areas of knowledge politics that are particularly important in international environmental decision-making. The final sub-section addresses what is at stake in describing global environmental governance as a co-produced achievement.

i. Soft law and global environmental governance.

Since the 1990s, the term “governance” is increasingly used to reflect changing landscapes of power, influence and political action. At the domestic level, “governance” often references a shift in who is considered to be political actors, from *government*, as embodied by the nation-state and local structures and officials, to *non-state actors* such as private economic actors and civil society organizations taking an active role in "governing beyond the state" (Swyngedouw 2005, 1992). Within governance scholarship, significant attention is thus given to market-based mechanisms that include the private and public sectors or are organized by corporations (Miller & Edwards (eds) 2001; Kirton & Trebilcock (eds) 2004; Heynen et al. (eds) 2007). Governance can be seen as a form of neoliberal legality, by which national governments cede control to economic markets, enhancing private and corporate authority (de Sousa Santos 2005; Heynen et al. 2007). The State still remains important, responsible for creating the space for, and to some degree determining who are, "legitimate" non-state actors in these governance arrangements (de Sousa Santos 2005; Swyngedouw 2005).

Environmental governance is its own particular field. Lemos and Agrawal define environmental governance as the "set of regulatory processes, mechanisms and organizations through which political actors influence environmental actions and outcomes" (2006, 298). While in the field of trade, international agreements have significantly re-scaled authority to the supranational authority of the WTO (Buchanan 2001; McCarthy 2007; Rhodes 2010), authority on environmental issues has not seen a similar re-scaling from the domestic to the supra-national. Instead, in the literature on global environmental governance, "governance" largely indicates a move from States as the principle actors to a more complex field including non-state actors (Leary & Pisupati 2010; Duffy 2014).

Perhaps because of this focus on *actors,* literature on global environmental governance rarely explicitly situates mechanisms and processes within law. Even excellent work on governance at the UN Framework Convention on Climate Change (UNFCCC) and Kyoto Protocol rarely takes into account the legal structure and status of these bodies (see Demeritt 2001; Miller 2001; Lahsen 2007; Narita 2012). Governance, however, includes more than just an expansion of *who* exercises power; it can also indicate an expansion of the *types of mechanisms* by which States exert power. Understanding the legal nature of these mechanisms requires a brief explanation of public international law.

Public international law has three widely recognized sources: customary international law, principles of international law, and treaties (Janis & Noyes 2001; Hunter, Salzman & Zaelke 2002). The first two, customary law and principles, are formed if they are (1) followed consistently by States, and (2) done so under a sense of legal obligation (*opinio juris*) (Janis & Noyes 2001; Stewart & Johanson 2003).[3] This takes time and requires the actual implementation of the rule or principle by States. Once formed, customary law is binding on *all* States, whether or not they have explicitly committed to it through a treaty or other binding document. The only exception is if a State has persistently and openly rejected the principle or rule (Stewart & Johanson 2003). The formation of customary law is a nebulous, often contested process.

The Vienna Convention on the Law of Treaties (1969) establishes international rules for treaties, the third type of public international law. The Vienna Convention only addresses the formation and implementation of treaties; it does not dictate the *content* of treaties (Chinkin 1989). Some treaty text clearly constitutes “hard” law – concrete and

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[3] Customary law and principles are often referred together as simply “customary law.” An example

specific rights and obligations – but other text is so qualified or vague that it is unclear what, if anything, is required from a Party (Koester 2002).

In keeping with the ambiguities of international law, legal scholars are not in agreement as to whether this last type of text is law at all. To some, law must have the force to bind or it is not law (Peters & Pagotto 2006). Such a binary view of law/not-law is increasingly giving way to law as a continuum from "hard" to "soft," with a great deal of "blurred" space in the middle (Shelton 2000, 10; Kirton & Trebilcock 2004). A number of different factors may place a mechanism towards the soft end of the continuum for international law:

1. Its *form* may be soft, such as non-legal documents carefully and formally negotiated by States (e.g. UN "Non-Legally Binding Instrument on All Types of Forests") (Chinkin 2000). Explicitly non-legally binding texts have resulted from UN Conferences, such as the Rio Conferences (see Chapter 2). Fomerand (1996, 365) describes these texts as "half ex cathedra lectures, half sermons" with "no coercive value."
2. Its *actors* may include non-States, such as in voluntary corporate codes of conduct and the UN Global Compact in which corporations commit to align with ten principles for business (Kirton & Trebilcock 2004). Non-state governance arrangements such as voluntary Corporate Social Responsibility pacts are often developed in the hopes of preempting binding legal regulation (Shamir 2005; Lemos & Agrawal 2006). Another category of actor is the international institution, granted administrative authority to implement governing mechanisms (Peel 2010).

3. Its *content* may be soft, such as qualified or vague language in the context of a "hard" legal format, such as a treaty. Sometimes referred to as "legal soft law," these outcomes articulate principles that may explain or elaborate existing binding commitments of Parties (Chinkin 1989; DiMento 2003). As will be discussed later, I see most of the CBD's outcomes as falling into this category. It is not always clear where a given text belongs on the continuum of soft to hard law, particularly in this last category (Shelton 2000).

Soft law is primarily valued by scholars and practitioners for its potential to "harden" (Chinkin 1989; Najam, Christopoulou & Moomaw 2004). Repeated invocation of principles coupled with recognition by States may eventually elevate soft law to the status of customary law. Or soft language from a non-state governance arrangement or a non-legally binding State agreement may be picked up and used in a 'hard' treaty. (Dupuy 1991; Chinkin 2000; DiMento 2003). Until such an event, soft law has minimal power to force action (Shelton 2000).

The contested ability of international law to cause States to act in specific ways – i.e. the perception that it is "weak" – is something of a preoccupation in international legal scholarship. Tracking and measuring compliance with international obligations is a key tool of international law scholars, and a treaty's effectiveness is often measured by compliance to its clear, precise, and binding outcomes (see Young 1992; Adam 2010; Baakman 2012; Koester 2012). The language used in talking about global law, policy and governance demonstrates the value placed on the ability to force action. In this dissertation I use a term common in legal and governance literature: "mechanism." Its definition is “a process, technique, or system for achieving a result,”[4] conjuring images of machine-like certainty and effectiveness. Measured against these ideals, soft law is ineffective, with aspirational targets, vague exhortations, and non-existent compliance monitoring mechanisms. Indeed, some consider that soft law waters down the rule of law, giving the impression of international commitment but unsupported by coercive force, and thus operating as a distraction or “smokescreen” (Chinkin 2000; DiMento 2003).

Soft law is often neglected as a subject for scholarship – either not important enough to take seriously or acknowledged primarily as a disappointment (see Adam 2010; Harrop & Pritchard 2011). Yet, international soft law and the processes by which it is produced deserve a closer look. Historically, soft law has been a tool of decolonization. In the 1960s, newly independent States lacked the geopolitical power to coerce former colonial powers to commit to legally-binding obligations. Instead, they capitalized on their numerical majority to establish soft law documents through the UN that expanded the scope of issues addressed in international law, such as the International Covenant on Economic, Social and Cultural Rights (Chinkin 1989 & 2000). Legal scholar Boaventura de Sousa Santos sees different forms of law as “revolving doors through which different forms of power and knowledge circulate” (1995, 456). This was arguably what countries of the global South did – introducing new concerns and understandings of the world to the international community. Recognizing such outcomes as law, albeit soft, can open up opportunities for neglected knowledges and power to inform fields of governance (de Sousa Santos 1995 & 2005). By acknowledging a plurality of legal orders and refusing to cede the category of “law” to one hegemonic form of power, we may be able to better realize international law’s counter-hegemonic potential (de Sousa Santos & Rodriguez-

[4] See http://www.merriam-webster.com/dictionary/mechanism (last accessed 13 January 2015).

Garavito 2005).

Another reason to examine soft law is that governments are increasingly relying on 'soft' regulation of emerging technosciences. Soft law is perceived as more flexible, often requiring less formal decision-making processes and thus able to more rapidly respond to changes in scientific understanding (Dupuy 1991; Shelton 2000; Felt & Wynne 2007; Lee 2012). Such soft law is usually initiated by non-state actors, such as voluntary corporate codes of conduct, or involves a shift of decision-making from political to administrative arenas to be handled by "experts" (Kirton & Trebilcock 2004; Felt & Wynne 2007). There is a broad perception that scientific uncertainty necessitates softer regulatory responses, with the corollary that once uncertainties are overcome (ie, the science "hardens"), the legal response can then harden as well (Shelton 2000; Lee 2012). This dissertation asks how processes of decision-making might change if we question the expectation of hardening science and the goal of hardened law.

ii. Knowledge politics, biodiversity, and global environmental governance.

I follow Ian Scoones (2009) in using the term "knowledge politics" to indicate the inherently political nature of producing, invoking, and drawing upon knowledge in decision-making.[5] Through my research, I have identified the following as three ways that knowledge politics are expressed in the CBD's work on New and Emerging Issues (NEI): the issue's scope; sources and types of knowledge; and the meanings and implications of uncertainties. This section introduces these themes and briefly explores

[5] Sociologist Nico Stehr (2003) uses the term "knowledge politics" to refer only to the governance of knowledge, such as rules, sanctions, and restrictions on modern technosciences. I am using the term more expansively.

how they have historically unfolded in the case of biodiversity.

1. Setting the scope.

According to geographer Sarah Whatmore, “The first requirement of any governance regime is to define its object, an activity that is more fraught than this familiar formulation makes it appear” (2002, 97). Discursive strategies are used by actors to set boundaries to create governable issues. One approach is for actors in governing institutions to “render technical” a domain to be governed (Li 2007). Problems are defined and explained in terms that fit with the technical interventions that are possible in the context of a given institution (Ferguson 1994; Escobar 1995; Li 2007). Rendering technical not only removes an issue from the political realm, it usually establishes it as requiring the expertise of technical professionals (Li 2007). Another approach to setting the scope of an issue is to frame it at a particular scale and level in order to justify particular interventions (Tsing 2000; Smith 2003). For example, deploying a global scale in environmental decision-making and management has been used to override local rights of access and use (Schroeder 1999b; Campbell 2007; Seagle 2012). In the process, other scales of analysis and those associated voices, perspectives, and experiences may be silenced (Brosius & Russell 2003; West 2006; Ferguson 2006).

The term “biodiversity” itself was introduced as an effort to rescale and reorganize “forms of calculation, appropriation, and government” (Dempsey 2011, 45). The 1986 National Forum on BioDiversity in Washington DC, organized by the National Academy of Sciences and the Smithsonian, coined the term. Biodiversity was a product of the new field of conservation biology, which united ecology with the mission of conservation. The term was intended to shift attention away from the scale of individual organism and species and towards multiple levels of biological hierarchy, from genes to species to ecosystems (Takacs 1996). The concept of biodiversity was rapidly taken up in legal and policy communities; the formal UN negotiations from 1987 to 1992 were for a *biodiversity* convention (McGraw 2002b). At the initial meeting of the UNEP Governing Council in 1987 to consider a treaty, "scientific experts" convinced "the ignorant majority that biological diversity was the correct term." (McConnell 1996, 5). It would be a convention on biodiversity, although delegates had "as yet little clear understanding of its meaning" (McConnell 1996, 5).

In the 1980s and 1990s, climate change and the ozone layer were heralded as "truly global" issues – impacting all without concern for national boundaries, only addressed through coordinated efforts (Rowlands & Greene 1992). Biodiversity, on the other hand, was seen by some as a collection of individual components, mostly contained *within* domestic territories (Swanson 1999). This political framing fits with much of the scientific data available on biodiversity. The majority of information about biodiversity is intensely local; "scaling up" has primarily been attempted by integrating local and national biodiversity data into massive databases (Turnhout & Boonman-Berson 2011). Most biodiversity data is not globally available; existing databases "are unable to form a global whole" (Ibid, np).

Global problems grant authority to global institutions (Brand & Görg 2008). CBD bodies have done significant work to create and disseminate a discourse of biodiversity as a *global* resource (Escobar 1998 & 2009). The COP, SBSTTA, and Secretariat not only suggest research areas but also reframe existing scientific information to identify "global" trends, as in the 2010 *Millenium Ecosystem Assessment* and the regular *Global*

Biodiversity Outlook (MA 2005; SCBD 2010). The concept of "ecosystem services," discussed in the next section, can be seen as facilitating biodiversity's commodification at a global scale. Nonetheless, the scale and level at which biodiversity is described has been and continues to be a contested issue within the CBD. The text itself can be interpreted as framing biodiversity not so much a common global resource as a collection of domestic resources (McGraw 1999b). Critics of the CBD have used the argument that biodiversity is not truly a global issue to cast doubt on the treaty's legitimacy (Adam 2010).

2. Sources and types of knowledge.

Gieryn's (1995) concept of "boundary work" describes efforts to frame knowledge as either science or non-science. This boundary is deployed tactically to position an issue within certain realms of expertise and logic (Gieryn 1995; Bonneuil & Levidow 2011; Guston 2001). Boundary work is a key discursive resource in international environmental decision-making because modern science holds such an "epistemological privilege" in these forums (de Sousa Santos 1995; de Sousa Santos et al. 2007). As modern science denies rationality to other forms of knowledge that don't follow its principles, drawing the boundary between science and non-science can silence and suppress other knowledges and the subaltern groups who hold and are informed by such knowledges (de Sousa Santos et al. 2007).

Other kinds of knowledge not only exist, they are actively brought into forums of international environmental governance. Hulme (2012) identifies four categories of knowledge: scientific (method-centered, mobile); local /indigenous (place-centered, holistic); tacit (implicit, embodied); and self-knowledge (reflective, spiritual). Different kinds of knowledge are invoked and deployed by CBD delegates in order to build *imaginaries* of the objects of governance. The term “technoscientific imaginary” references imagined futures based in the present conditions of scientific work as well as assumptions and values related to the social roles the technoscience is expected to play (Marcus 1995b; Macnaghten, Kearnes & Wynne 2005; Wiek et al. 2012). Especially when many aspects of a technoscience are uncertain, imaginaries are important; the hopes, fears and ideas of an emerging technoscience play key roles in the funding of research, the regulation of products and processes, and how the technoscience comes into being (Felt & Wynne 2007).

Scientific knowledge about biodiversity has long been a tool for States to justify and exert authority over territories (Scott 1998; Neumann 2005; Kosek 2006). Colonial governments established networks of botanical gardens, preserving biodiversity through *ex situ* collections that decontextualized plants and thus created them as objects of value (Parry 2000). Along with *in situ* territory-based conservation, *ex situ* plant collecting was intimately linked to economy, empire, and state-building (Escobar 1998; Schroeder 1999a; Neumann 2001). Networks of botanical gardens have continued into the post-colonial age, feeding into the creation of conservation biology in the 1980s.

The field of conservation biology produced knowledge intended to lead to the normative goal of conserving biodiversity (Takacs 1996). The US was a key site for developing knowledge about and a community around biodiversity. This central role was closely linked to the US biotechnology industry’s promises to extract value from biodiversity (Dempsey 2011). The 1980s and early 1990s were full of expectation for the potential of bioprospecting – the application of biotechnology tools and approaches to harvest information from natural organisms, to be used in developing new crops, medicines, and other valuable substances (Parry 2000; Bavikatte & Robinson 2011). The promise of bioprospecting simultaneously requires advanced knowledge of genetics and "traditional" knowledge – how a natural substance is used and its historical roles in community life – in order to identify potentially valuable prospects (Zerbe 2002; Bavikatte & Robinson 2011). Intellectual property rights, however, have treated modern science as the exclusive mode of knowing and inventing genetic resources (Whatmore 2002).

Bioprospecting can be seen as an expression of *neoliberal conservation*, which is organized around the logic that conditions must be established so that nature can "take care of itself," economically justifying its preservation by efficiently providing services that can be valued in capitalist terms (Zerner 2000; Brockington & Duffy 2010; Dempsey 2011; Büscher et al. 2012). Another way to tap into and measure the value of biodiversity is through "ecosystem services," the economic value of the functions of ecosystems that benefit humans, such as pollination, flood control, and climate regulation (Dempsey 2011; Dempsey & Robertson 2012). In 1997, Robert Costanza's team estimated the world's ecosystem services to be worth $33 trillion USD (cited in Dempsey 2011). The concept of ecosystem services has been further developed and applied through the CBD. The 2001-2005 *Millenium Ecosystem Assessment* used ecosystem services as its organizing framework for assessing the global status of ecosystems (MA 2005; Dempsey 2011). In 2010, *The Economics of Ecosystem Services and Biodiversity* (TEEB) reports were launched at the CBD COP 10 to make an "economic case for conservation," based in the logic of natural capital (Morgera & Tsioumani 2011; MacDonald & Corson 2012).[6]

Social scientists have criticized the CBD for facilitating the privatization and commodification of nature (McAfee 1999; Zerbe 2002; MacDonald 2010; Corson & MacDonald 2012; MacDonald & Corson 2012). Catherine Corson and Kenneth Iain MacDonald describe the CBD as "wrapped in a cloak of neoliberal assumptions" (2012, 270). This can be seen in the CBD's support for, and development of, bioprospecting and ecosystem services. These projects have involved the development of particular kinds of knowledge about biodiversity, knowledge extracted from its context, universalized, and commoditized.

But this is not the only story of knowledge at the CBD. Ways of knowing biodiversity have been fiercely contested throughout the CBD's history. In negotiations for the treaty, developing countries[7] demanded that it be based on more than just the natural sciences, which were seen as dominated by "Northern-educated experts" and masquerading as value-free (McGraw 2002b). Thus, the treaty's scope goes beyond conservation, also encompassing sustainable use and access and benefit-sharing of genetic resources – explicitly political ways of relating to biodiversity. The Convention text acknowledges traditional knowledge, calling on Parties to "respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities," promote their application, and encourage the equitable sharing of benefits arising from its

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[6] See www.teebweb.org for links to the key TEEB reports launched at CBD COP 10 and subsequent studies (last accessed 23 February 2015).

[7] This dissertation employs the standard UN language of "developed" and "developing" countries. These are problematic, inaccurate labels, not to mention vague; there are no official definitions or lists of countries – it is a matter of self-identification by any given country. Nonetheless, these terms are used regularly within the CBD and most other UN conventions, agencies, and programs.

utilization (Article 8(j)). Over the past two decades, the CBD has become the “primary instrument” for the development and protection of the international concept of traditional knowledge (Morgera & Tsioumani 2011). The CBD has been a network for neoliberal ways of knowing, but it has also been a site of alternative discourses and knowledges.

3. Understanding and responding to uncertainties.

The term “scientific uncertainty” encompasses a broad range of ways and qualities of not knowing. Scientific uncertainties can be categorized by what aspect of knowledge is uncertain, or by the characteristics that impact decision-making. Social scientists categorize these as risk, uncertainty, ambiguity, and ignorance (Wynne 1992; Felt & Wynne 2007; Stirling 2007).[8] By far the most commonly institutionalized framing of scientific uncertainty in regulatory frameworks (Peel 2010), *risk* refers to situations in which potential outcomes can be identified and probabilities attributed to them (Wynne 1992). *Uncertainty* describes a situation in which the types and scales of possible harms are understood, but their probabilities are not (Felt & Wynne 2007).[9] *Ambiguity* refers to situations in which, rather than the probability of harm being in question, the meaning of the harm is unclear or contested (Wynne 1992; Felt & Wynne 2007). For example, ambiguity has been at the heart the genetically-modified food controversies, with disagreements on how best to measure impacts and apply values to guide research and ascribe meaning to results (Stirling 2008). In situations of *ignorance*, not all of the possible impacts can be predicted or even understood; we don't know what it is we don't know (Felt & Wynne 2007). In addition to these categories, *indeterminacy* is a quality of

[8] For example, Walker (2003) distinguishes among conceptual uncertainty, measurement uncertainty, sampling uncertainty, modeling uncertainty, and causal uncertainty.
[9] “Uncertainty” thus has a specific meaning as one particular kind. I use the term “scientific uncertainty” to refer to the full range of types.

knowledge that is intrinsically open-ended, conditional on being embedded in "social, technological and natural systems" (Felt & Wynne 2007, 36; Jasanoff & Wynne 1998).

In global environmental decision-making, how a scientific uncertainty is framed impacts the kinds of responses seen as appropriate. It is a common trend in all levels of governance for indeterminacies to be framed as "determinate uncertainties" that can be reduced and resolved over time (Jasanoff & Wynne 1998; Hinchliffe 2001; Nuffield 2012). Situations of ignorance and ambiguity are often framed as risks and uncertainties (Wynne 1992). Additionally, a commonly held assumption is that less scientific uncertainty and more scientific consensus will lead to more definitive political action (Haas 1992).

Biodiversity thus presents challenges to governance, as ecological knowledge is marked by "persistent and often untractable uncertainties and a high level of ignorance," of the quantities and quality of components of biodiversity, and of the causes and magnitude of harm (Cooney 2005, 3; Peel 2010). Although public laments of biodiversity loss invoke specific percentages and numbers of loss (ex: Loreau & Oteng-Yeboah 2006), estimates of the number of existing species range by orders of magnitude.[10] Scientists have a "rudimentary" understanding of the roles of species in ecosystems (Takacs 1996, 56; Dempsey 2011). Knowledge of ecosystems is context specific; scientific uncertainty persists (Turner 2011).

Such scientific uncertainties about ecosystems are framed as a problem for biodiversity governance, sometimes even as a *cause of* biodiversity loss (Baakman 2011;

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[10] This fact (quantifying the ignorance around biodiversity) is invoked at CBD events by representatives of the International Bar Code of Life (IBOL), explained further in Chapter 4. COP 10, IBOL side event, 20 October 2010.

O'Neill et al. 2014).[11] Scientific uncertainties can also function as resources, as scientists use them to establish boundaries between science and values or to position themselves as the most capable to respond to them (Shackley & Wynne 1996; Takacs 1996; Campbell 2011). In international environmental law and policy, the primary tool to respond to scientific uncertainties is the "precautionary principle."

The precautionary principle is often positioned as a counterpoint to risk regulation. Instead of dealing with calculable risks, the precautionary principle responds to other, more intractable uncertainties, especially ignorance and indeterminacy (Wynne 1992). Since its initial debut in international environmental policy in the mid 1980s, the precautionary principle has drawn controversy. While a key preoccupation of scholars and lawyers is whether it has attained the status of customary international environmental law, its content is just as contentious, raising questions of what regulatory responses are justified or required by precaution (Applegate 2002; Goklany 2001; Stone 2001; Peel 2004 & 2010). There are many variations of the precautionary principle, with different emphases. The CBD's version is found in preambular paragraph 9:

> Noting also that where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat (CBD 1992).

The CBD utilizes the "weakest" or "least restrictive" version of the precautionary principle: scientific uncertainty does not justify *inaction* (as opposed to justifying regulatory *action* or even *requiring* action) (Applegate 2002; Cooney 2005). Since the 1992 Rio Conference, this is the most common formulation of precaution in international environmental policy (Applegate 2002).

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[11] As Baakman says, "Ignorance about species and ecosystems is seen as another of the fundamental causes of the loss of biodiversity" (2011, 9).

Different perspectives are held on the certainty and seriousness of anticipated harm, the quantity and quality of information upon which to base concern, the timing of action in relation to scientific uncertainty, and the regulatory responses allowed or required (Applegate 2002). Thus, there is a broad range of "precautionary" policies. The WTO Sanitary and Phytosanitary Standards Agreement's version of precaution accommodates scientific uncertainties so long as they are "science-based" and resolved quickly – it operates as a temporary gap in risk regulation (SPS Agreement 1995). Compare this to the *Wingspread Consensus Statement on the Precautionary Principle,* which calls for precautionary measures "even if some cause and effect relationships are not fully established scientifically."[12] The CBD's political decision-making body, the Conference of the Parties (COP), frequently and prominently invokes the "precautionary approach."[13] Yet, as will be shown, CBD Parties do not share a common meaning for what a precautionary approach means for decision-making.

These three areas – issue scope, sources and types of knowledge, and scientific uncertainties – are not clearly demarcated. Discursive work to frame knowledge in a certain light is also used to establish the scope of an issue; portrayals of the unknown simultaneously describe the known in particular ways. I differentiate among these three areas as a practical way to organize my analysis, not because these are separate or separable issues.

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[12] See http://www.sehn.org/wing.html (last accessed 12 February 2015).

[13] As Peel (2004) notes, the terms "precautionary principle" and "precautionary approach" do not have different legal weight, but politically are often used to indicate different interpretations of the trigger for precaution, its implications for the burden of proof, and the degree of obligation. The CBD's outputs almost always use the term "precautionary approach," but the ways that actors use this term at CBD events indicates the full range of possible interpretations. This dissertation therefore makes no distinction between the two terms in the context of this treaty, following the lead of a Malawian delegate during COP 10 who referred to "the precautionary principle or approach – as used interchangeably in this forum" COP 10, Working Group I, 21 October 2010.

iii. A political theory for co-production.

Why study the co-production of soft law and knowledge in the context of global environmental governance? While this dissertation does develop a few limited suggestions for the development of governance of biofuels and synthetic biology, there is a larger question at stake: What is the basis for the legitimacy of institutions of international environmental governance such as the CBD? Noted legal scholar Daniel Bodansky (1999) has argued that, as authority to regulate environmental issues begins to shift from national to supranational institutions, the matter of international environmental law's legitimacy is coming under scrutiny. In response, legitimacy is increasingly drawn from claims to expertise, and in particular, from "sound science" (Peel 2010). Global environmental decision-making is thus often explicitly based on science that is portrayed as 1) objective (ie, free of political taint) and 2) universally applicable (Jasanoff 1996 & 2011; Peel 2010; Blok 2011). Science is looked to as the external authority that can unify disparate interests at the global level (Peel 2010; Bonneuil & Levidow 2011). Objective and universal scientific knowledge about the environment requires a stable, singular Nature as its object of study.

If objective knowledge of a stable Nature is the basis for legitimacy of international environmental decision-making, then technical and scientific experts are positioned to make the best decisions. Under this technocratic model of decision-making, objective science informs policy (van der Sluijs, van Est & Riphagen 2010; Hulme 2012; Mahony 2013). This aligns with Haas' (1992) popular theory of "epistemic communities," transnational networks of knowledge-based expert communities motivated by shared beliefs of problems' causes. When epistemic communities reach consensus, they are able to "resist the political temptations to subordinate their advice to political concerns" (Haas 1992, 42). This is an aspirational model – in a best-case scenario, epistemic communities are able to convince decision-makers to make the best decision, in spite of short-term political aims and influences.

Much social science scholarship argues against this description of nature, science, and international decision-making. Between political ecology and STS, the following arguments are well substantiated and considered to be theoretical touchstones:

- "Nature" is not a stable external reality, but is constructed in mediated relations between material and societal processes (Escobar 1999; Castree & MacMillan 2001; Braun & Whatmore 2010; Goldman et al. 2011);
- "Science" is a situated form of knowledge; it may be interpreted as performing a "view from nowhere," but this is an active achievement involving an extensive network of actors/actants to seemingly erase context (Latour & Woolgar 1979; Callon 1986; Haraway 1988; Jasanoff 2011);
- Environmental decision-making based on expertise alone will likely fail to acknowledge broader socio-material contexts; denial of such "overflows" inevitably causes problems (Wynne 1992; Fischer 2000; Callon, Lascoumes, & Barthe 2009; Stirling 2012).

These arguments refute the foundational claims of the technocratic model, but the question remains: on what basis does international environmental decision-making claim its legitimacy, if not expert knowledge of objective, universal science? Political ecology and STS scholarship often fails to return to this question after its work of unmasking the construction of knowledge.

As Durant (2011) and Braun and Whatmore (2010) have noted, political theory often remains undeveloped and implicit in STS scholarship, despite its key role in shaping ideas of how decision-making *should* happen (see Wynne 1992; Jasanoff 1996; Stirling 2007). Particularly in the case of global environmental governance, which has discursively relied so strongly on the idea of objective science, I believe that it is necessary to explicitly engage with political theory to establish an over-arching model of how, ideally, knowledge and governance could be co-produced.

Two promising models for decision-making are deliberative democracy and agonism. As with the technocratic model, these are aspirational models, something against which decision-making processes are measured. Deliberative democracy is based on a Habermasian theory of communicative action; debate should be open to all who may be affected and outcomes sought not through coercion but by seeking mutual understanding, among participants open to changing their minds as a result of reflection (Habermas 1996; Dryzek 2006; Dryzek & Stevenson 2011). Through the "free and open debate of ideas," the best decisions for governing will be made (Miller 2009). Chantal Mouffe, an opponent of deliberative democracy, describes it as based on the belief that free discussion can create a "rational moral consensus" (2005, 13). While proponents may not use this exact term, it does seem to describe the goal of deliberative democracy – to reach consensus through a process that is based on comprehensible and honest reasoning, including moral justifications offered by affected parties. It is different from a technocratic model of decision-making in its open stance to relevant knowledges - all who are potentially affected can join the debate, not just experts. Legitimacy for international environmental decisions under deliberative democracy comes from processes of deliberation and final products that represent rational moral consensus. Proponents of deliberative democracy as a way of developing global environmental governance include John Dryzek (2005, 2006) and Clark Miller (2007, 2009).

Agonism describes a different model of democratic decision-making, in which adversaries recognize that their political conflicts do not have “rational” solutions and that their opponents are legitimate (Mouffe 2005). Agonism recognizes that “political questions are not mere technical issues to be solved by experts,” but rather are about conflicting alternatives of power relations (Ibid. 10). The deliberative political space is one of free and reasoned public deliberation; the agonistic political space is one of power and conflict. Disagreements are played out on a political register, acknowledging conflicting visions for society; because decisions are political (rather than rational or moral), they are always open to contestation (Mouffe 2005). Under agonistic democracy, legitimacy for international environmental decision comes from processes to negotiate difference, recognizing pluralism and resulting in the challenge of hegemonic power relations. Erik Swyngedouw (2010), Mike Hulme (2012), and Thomas Koetz et al. (2008) reference Mouffe’s theory of agonism as appropriate for global environmental decision-making.

An over-arching question for this dissertation is whether technocracy, deliberative democracy, or agonistic democracy is the best model for international environmental decision-making, particularly with regards to emerging technosciences in the context of soft law. Decision-making at the CBD does not currently follow any of these models. Whether the CBD should be working towards a deliberative space of rational moral consensus or towards an agonistic space of political challenges could impact how the treaty bodies organizes their processes, assess and value their outputs, and justify the legitimacy of this multilateral environmental treaty.

1.3 Research methodologies.

i. Studying global environmental governance as assemblage.

Scholars of international environmental law, policy and governance are faced with a number of challenges. The question of causation is particularly vexing; in addition to the challenge of attributing any given State action to specific international commitments, tracing the impact of international-level decisions on complex environmental problems is very hard, if not impossible (O'Neill et al. 2013; Shelton 2000). Some legal scholars have developed various approaches to get around the "causation issue" – testing a treaty's theoretical "strength" (Chasek 2001) or its "potential" to solve problems (Baakman 2012) rather than attempting to attribute any specific impacts to a treaty. Others simply focus on a treaty's textual outcomes and assume that the harder its legal nature, the more effective it will be (Jóhannsdóttir, Cresswell & Bridgewater 2010; Harrop & Pritchard 2011). Long-time negotiator Veit Koester is content to leave it as a matter of belief, asserting that the global state of biodiversity would be worse without the CBD, while acknowledging that this statement "is, of course, impossible to substantiate" (2012, 70).

In this dissertation, I am not asking how effective soft law is. The two hegemonic ways of knowing and governing the world today are modern science and national hard law (de Sousa Santos 1995). Even if a research project could be devised to test the impact of soft law – which I do not believe is possible – the results would be judged against the dominant paradigm as defined by modern science and national hard law. Emerging counter-hegemonic phenomena judged by the standards established within the dominant paradigm will fall short (de Sousa Santos 1995; de Sousa Santos & Rodriguez-Garavito 2005). Soft law will inevitably lack hardness; complex and uncertain knowledge will be faulted for, or stripped of, its complexities and uncertainties.

Instead of judging results, I focus on *process*: how issues of concern are identified and defined in the context of the treaty; what knowledges and rationales are legible to the treaty's bodies; how scientific uncertainties are framed. This focus on process is informed by seeing global environmental governance of emerging technosciences as an *assemblage* – a "dynamic structure applied to semi-stable socio-natural configurations and geographies" (Robbins & Marks 2010, 181; Deleuze & Guattari 1987). Considering governance as an achieved assemblage draws attention to the constitutive role of relationships, the contingency of configurations, and the non-hierarchical, networked nature of power (Escobar 2008; Rocheleau & Roth 2007; Robbins & Marks 2010; Lorimer 2012). It also foregrounds performativity – that scientific and legal representations of the world perform objects in particular ways, and so bring different enactments of reality into being (Mol 2002; Delaney 2010).

Ethnographic methods are well suited for studying the production of assemblages of objects, publics, and systems of governance (Braun 2006; Escobar 2008; Lorimer 2012). Classic ethnography involved social scientists going into the "field" to conduct participant observation in a long-term engagement with a specific community (Hart 2009). International systems of governance and other expressions of "globalization" challenge this approach to ethnography, and have prompted new theories of ethnography (Marcus 1995a). Rather than rooting a study in one physical place, ethnographers are defining fields of study relationally, looking to points of connection between people, objects, events and following the circulation and transformation of "cultural meanings, objects and identities in diffuse time-space" (Marcus 1995a, 96; Hart 2009). Campbell et al. (2014, 27-28) propose that, in global environmental governance, the "field" is configured in part by events – physically temporary sites where "narratives and ideas that come together at them become institutionalized in policies, relationships, and programs."

ii. Research methods.

In studying New and Emerging Issues at the CBD, I have employed the following research methods: analysis of texts; participant observation of negotiating events; observant participation through work for the CBD Secretariat; and semi-structured interviews.

1. Analysis of texts.

An ethnographic approach to policy-making processes traces narratives and ideas as they are gradually institutionalized into policies and programs that make up a field of governance (Goldman 2005; Li 2007; Corson, Campbell & MacDonald 2014). As will be abundantly clear to the reader of this dissertation, I take texts seriously. Unlike much legal scholarship which is entirely focused on the final legal texts of treaties, I follow the development of legal texts through negotiating sessions, policy briefs and PowerPoint presentations intended to inform negotiations, peer-reviewed and "gray" literature, and other texts through which the development of narratives and their specific rationales and forms of knowledge can be traced (Li 2007; Escobar 2008).

Texts are particularly important in studying international law. Legal text is often assumed to have a stabilizing function, able to fix assemblages in place and close controversies. By examining how texts are used in the context of international law and policy, however, one can see texts as less fixed, manipulated in practice and performed in different ways. International law and the UN system rely on the repetition of phrases and concepts to build customary legal principles and norms (Stewart & Johanson 2003). When negotiators use certain phrases – or object to the use of certain phrases – these are events that can eventually bring into being legal obligations beyond the scope of whatever issue is being discussed, beyond the scope of the treaty providing the context for the negotiations, beyond even the scope of the State Parties to the treaty. This power is inherent in every text that comes out of the CBD COP, but it is also diffuse – no one text can create customary law. It is a gradual process, requiring the accretion of time, repetition, and gravity and without any guarantee that it will ultimately become customary law. In the meantime, COP texts that do not create new binding legal commitments (as with most CBD Decisions) still have legal implications. As legal soft law, they are considered authoritative interpretations of the treaty text and may be used to advance legal concepts (Dupuy 1991). They can also mobilize and guide a vast infrastructure of scientists, funding agencies, non-governmental organizations (NGOs), and businesses attuned to the CBD's framings of the challenges facing biodiversity and the information and resources needed to address those challenges (Campbell et al. 2014).

When I quote from SBSTTA Recommendations and COP Decisions, the language may seem awkward, missing a verb or a subject. This is painstakingly negotiated language, and is meant to be read as coming from the entire COP or SBSTTA. Some paragraphs simply "note" or "recognize" a situation, other paragraphs have specific audiences such as Parties or sometimes "Parties and other Governments" (ie, the USA, which is not a Party to the CBD).

2. Participant observation.

Corson, Campbell & MacDonald (2014) argue for ethnography as a “core method in research on global environmental politics,” a key tool of which is participant observation at negotiating events (2014, 22). To observe negotiating events of CBD bodies is to participate in them. As accredited observers to the CBD, researchers have the right to request the floor in plenary and Working Group sessions (the Chair may refuse or place time limits on an observer’s intervention). They can ask questions in side events, which can provide a forum for accessing high-powered individuals otherwise too busy or inaccessible to interview. They can join in the activities of other observers, such as the CBD Alliance, a network of civil society organizations (CSOs) dedicated to facilitating the input of diverse voices into global biodiversity policy and law.[14] Even if a researcher chooses not to participate in those ways, by being present and observing, they are part of the event.

I have conducted participant observation at CBD events from two different perspectives: as part of a Collaborative Event Ethnography group and as a lone researcher. At the 10th CBD COP (Nagoya, Japan from 18-29 October 2010), I was part of a Collaborative Event Ethnography (CEE) with 16 other social scientists. This was the second CEE project; the co-PIs and some of the other researchers had also conducted a CEE of the Fourth World Conservation Congress in Barcelona in 2008 (Brosius & Campbell 2010). The core idea of CEE is that high-intensity short-duration events such as a treaty COP are important ethnographic fields better studied by a team of researchers

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[14] See http://www.cbdalliance.org/en/index.php/en/about-us/mission-and-vision (last accessed 14 January 2015).

than an individual because of their vast size and short time-frame (Campbell et al. 2014; Corson et al. 2014).

The summer before COP 10, we met weekly seven times through conference calls to discuss articles on the CBD, methods, and our three theoretical focuses (translation, scale, and performance). Each individual on our CEE team chose to focus on one theme (science, markets, or participation) and joined three topical groups (from a choice of eleven). I was in the science thematic group and the biofuels, agriculture, and "cooperation with other agreements" groups. During the COP, we met as sub-groups and the whole group daily to coordinate our plans and discuss emerging themes, share observations, and make connections among our disparate slices of the large mega-event. We attended negotiating events, side events, cocktail parties, and other organized forums for discussion and decision-making. At these events we tape-recorded and took pictures if allowed, took notes, and sometimes asked questions. Although a few members conducted interviews, we prioritized participant observation given the packed schedules and tight timeframe on which everything happened – not only did most participants not have time to give an interview, we couldn't spare the time either. After the COP, we uploaded notes and photographs to a common database. We met in the spring of 2011 for a week to continue to develop ideas in groups and reflect on COP 10.[15]

After COP 10, I participated as a solo researcher in SBSTTA 15 (Montreal, Canada from 7-11 November 2011) and COP 11 (Hyderabad, India from 8-19 October 2012). My strategy for studying these events was directly informed by my CEE experience: I used the same format to structure my note-taking; continued to be alert to

[15] The "science" group put together an AAG presentation that Lisa Campbell delivered in 2012 (Campbell et al. 2012). The only published paper that came out of one of my groups was a paper on the biofuels negotiations of which I was the lead and primary author (Scott et al. 2014).

the CEE's thematic focuses; and even followed some of the issues of other sub-groups. I also adjusted aspects of data collection. Instead of attempting to cover the maximum amount of negotiations and side events possible, I focused on events related to emerging technosciences (biofuels, synthetic biology, and geoengineering). This meant that I actually had a few gaps in my schedule, during which I engaged in casual conversations that helped me better understand the political undercurrents of negotiations and conducted a few semi-structured interviews. It also meant that I was sometimes faced with conflicting relevant events and forced to choose which issues and communities to follow.

My data from participant observation of CBD events is primarily typed notes that I took during negotiating sessions, supplemented by audio when this was allowed and pictures from side events. Some of the quotes that I draw on from the negotiations are not eloquent or even coherent. My apologies to the delegates – no one should have to see in print their words from 11pm in the middle of the second week of a COP. I use even these awkward, fumbling quotes because they demonstrate delegates deploying different framings of issues, trying to find acceptable justifications for their Party's negotiating lines.

When I describe discussions from COP and SBSTTA meetings, I often refer to speakers by the Party or delegation that they represent (Canada, the EU, the US, Friends of the Earth, etc.). This is obviously a gross simplification – a fiction, really – but it is a fiction under which the treaty operates. Although many CBD negotiators come to know each other well over years of meetings, even in smaller settings such as Friends of the Chair and Contact Groups, the chair will call on Party names rather than an individual's name. In the negotiations I have observed, delegates are most often from Ministries of Environment or State / Foreign Relations, but other Ministries include Agriculture and Agri-food, Land and Forestry, Business and Industry, and even missions to the UN. These different arms of national governments often represent very different approaches to biodiversity, particularly depending on whether they identify with utilizers or conservers of biodiversity. Nonetheless, whether a delegate comes from Environment Canada, Agriculture and Agri-Food Canada, or the Department of Foreign Affairs, Trade and Development, they are referred to as "Canada."

3. Observant participation.

In 2013, I joined the Secretariat of the CBD in Montreal as an intern from January through March, drafting two "information documents"[16] on synthetic biology: "Potential positive and negative impacts of components, organisms and products resulting from synthetic biology techniques on the conservation and sustainable use of biodiversity" and "Synthetic biology: possible gaps and overlaps with the applicable provisions of the Convention and its Protocols." In 2014, I was hired by the CBD Secretariat as a consultant to revise the information documents in response to peer review comments and to draft the "official document" on synthetic biology for SBSTTA 18. I spent three months from my home base in Philadelphia, PA doing this work. As part of the consultancy, I also assisted the Secretariat at SBSTTA 18 (Montreal, Canada from 23-28 June 2014) presenting at a training session for negotiators, working with Secretariat staff members to revise the draft Recommendation in response to initial Plenary comments, and assisting the Chair of the Contact Group on synthetic biology as delegates developed

[16] As will be explained in Chapter 2, "information" and "official" documents have different formats and roles in CBD processes.

a Recommendation to the COP.

By agreement with the Executive Secretary of the CBD, I am restricted in my use of much of this data. I did not conduct “participant observation” at the Secretariat: I was not allowed to record or write about the daily life of the office, how teams of staff members identified and set about solving problems, or how the staff translated the COP’s orders into their personal work plans. I was allowed to conduct semi-structured interviews with Secretariat staff members, which were given with great frankness and generosity of time, but I cannot quote from them.

I use the term “observant participation” to describe this work, signaling that the primary data comes from reflections of my own participation rather than observation of others (Green 2007, after Mosse 2001). I cannot write about some of the work that I did at SBSTTA 18 – particularly working with a small group of Secretariat staff members to incorporate suggestions from the Plenary sessions on synthetic biology into the draft text for the Contact Group to work on. During the negotiating sessions, I took notes that were as close to verbatim as possible, just as I had done previously. In that sense, my research methods were no different from previous negotiations. Unlike at past events, though, my first priority in taking notes was to assist the Secretariat staff and Contact Group Chair to craft negotiating text. And I did so from the front of the room, either on the dais in the large Plenary hall or next to the Contact Group Chair in a smaller room, rather than my previous back-of-the-room location with other observers (see Illustration 1). Because of my changed position in relation to other participants at SBSTTA 18, I use the term observant participant.

Illustration 1: The 25 June 2014 session of the Contact Group on Synthetic Biology, Montreal QC. Author is at the front of the room, far right, seated next to Contact Group Chair Andrew Bignell (New Zealand). Photo by IISD/ENB (www.iisd.ca/biodiv/wgri5-sbstta18/).

4. Semi-structured interviews.

I conducted semi-structured interviews with two main sets of informants: CBD Secretariat staff members (n11) and CBD observers (n7). I also formally interviewed one Party delegate to the CBD, and engaged in many informal conversations with other delegates. I used the interviews to gather information about how the Secretariat operates, how observers understand their role in the treaty system, and histories of the CBD beyond the formal paper trail. I also inquired about the individuals' own perspectives on knowledge politics at the CBD – how they viewed science and other knowledges in relation to the treaty, whose voices they thought should be heard in the process of decision-making, what scientific uncertainties were most relevant to their work and goals and how they thought these should be managed.

In addition, I interviewed three individuals engaged with studying and/or shaping synthetic biology governance and eleven biofuel engineers and scientists, none of whom were accredited CBD observers. These non-CBD related interviews shaped my overall understanding of the technosciences and their political meanings. In this dissertation, I draw on the synthetic biology interviews but not the ones focused on biofuels. I used NVivo to organize inductive coding of my notes and transcripts from negotiating events and interviews.

iii. Interdisciplinarity.

My research was supported by two projects that explicitly encouraged and required interdisciplinarity: the Collaborative Event Ethnography (NSF award nos. 1027194 and 1027201) and the Rutgers NSF IGERT (Integrative Graduate Education and Research Traineeship) Project “Renewable and Sustainable Fuels Solutions for the 21st Century” (DGE 0903675).[17] This section examines the models of interdisciplinarity that best fit these experiences and how my dissertation was shaped by and reflects them.

Barry, Born and Weszkalnys (2008) identify three models of interdisciplinary work: synthesis, which attempts to integrate disciplines; service, in which a subordinate discipline makes up for or fills in gaps in the master discipline; and agonistic, in which there is self-conscious dialogue and commitment to transcend epistemological and

[17] I have also engaged with academic communities outside of geography, such as attending a workshop on global environmental politics organized by the British International Studies Association and a workshop on setting research agendas on the societal aspects of synthetic biology organized by the Center for Nanotechnology in Society.

ontological assumptions of historic disciplines. In each of these models, interdisciplinarity signals individuals trained in discrete disciplines working together.

The CBD COP 10 CEE brought together geographers, anthropologists, sociologists, and a political scientist. Despite this breadth, we were able to collectively agree on methods and theoretical frameworks, and I would describe it as a smooth and successful synthesis of adjacent disciplines. This is not to trivialize the challenges of working across disciplines (and sub-disciplines) within the social sciences (Campbell 2005). For example, there was disagreement within the biofuels group about which events and types of data should be prioritized – I valued the negotiations as the most important and wanted us to gather data as detailed as possible, while others in the group saw side events or interviews as more important in establishing the discourse around biofuels and seemed (oddly) frustrated by and uninterested in following interminable fine-grained textual negotiations late into the night. Nonetheless, in general we were rather closely aligned from the start in terms of our questions and methods for exploring those questions. There was little opportunity for agonistic questioning as most of our assumptions were shared.

The Rutgers "Fuels IGERT" attempted to bring together a much broader range of disciplines into working conversation. The vision for the project encompassed four research areas: biofuels development; engineering systems; land use and environmental impact; and economics and policy matters.[18] Fellow PhD students and candidates came from departments of plant biology, chemistry, microbial biology, public policy, and ecology and evolution. In exchange for up to four years of support, we agreed to a number of conditions, including carrying out an energy project with an inter-disciplinary

[18] See http://www.igert4fuels.org (last accessed 15 January 2015).

team of students and including an aspect outside of our discipline in our research (this was often referred to as the "Fifth Chapter"). Our energy team struggled to find a project that we could do, let alone one that drew on our very disparate expertise (oceanography, plant biology, chemistry, and geography). The repeated suggestion of the project's Principal Investigator was to develop economic "models" that would incorporate our different knowledges. Under this vision for interdisciplinary work, all disciplines "served" econometrics and the goal of commercialization of biofuels.[19]

The "service" model of interdisciplinarity is usually invoked to describe the subordination of social sciences to natural sciences (Barry, Born and Weszkalnys 2008; Stengers 2010; Whatmore 2013). At the 2014 NSF workshop on societal impacts of synthetic biology, I heard this concern expressed many times by social scientists, a number of whom felt strongly that they were only included in projects to play this role. The idealized version of interdisciplinarity offered to us by our IGERT leadership was a slightly different framing. Social science – in particular, economic modeling – was to be the organizing framework through which other knowledges would be valued. The dominant knowledge was not held by the engineers, plant biologists, or chemists – they were expected to adjust their output to fit into economic models.

With the exception of the energy teams, our IGERT was focused on producing scholars conversant and able to work *in* multiple disciplines rather than able to work *with* other disciplines. The IGERT-specific classes, opportunities for international travel and 'field trips' to other labs, and, most of all, the requirement to incorporate an interdisciplinary dimension in the dissertation all seemed to work towards producing

[19] Ultimately, our Energy Team came up with a social-sciences-lite project, cajoling attendees at an IGERT symposium to fill out a survey on perceptions of goals, risks and uncertainties related to biofuel development and production.

individuals who could “do” interdisciplinarity on their own. This diverges from models of interdisciplinary scholarship such as Barry, Born and Weszkalnys (2008). My dissertation reflects this type of interdisciplinarity in two ways.

Through my work for the Secretariat, I wrote documents that explain the various areas of laboratory research in, and current and near-term commercialization of, synthetic biology, scientific and policy perspectives on biosafety concerns, potential impacts on biodiversity and associated social, economic, and cultural considerations, and relevant international legal coverage of synthetic biology. I essentially read my way to a broad understanding of the underlying science and the scientific, legal, and other societal controversies around synthetic biology. As a result, my analysis of the CBD’s engagement with synthetic biology is more nuanced; I understand better what is at stake in seemingly minor discursive moves.

My dissertation also brings different disciplinary frameworks into conversation: legal scholarship, STS, geography and other political ecology. Granted, I have drawn on these literatures for information, theory, and arguments that work with my own set of assumptions and values. While this is perhaps at most synthetic, my work for the Secretariat required a different type of engagement. Writing about synthetic biology research and commercialization and its related positive and negative visions required a self-conscious dialogue about the ontological and epistemological assumptions at play across the reports and papers. This dialogue was internal, but I tried to make at least aspects of it visible in the documents.

iv. Limitations and opportunities related to methods.

I have different kinds of data from the CBD's engagement with biofuels and with synthetic biology, in part because I intersected these issues at different points in the treaty's processes, and in part because of my different positions in relation to those processes. There are limitations and, I believe, opportunities related to both.

I started studying the CBD at the 2010 COP 10, focusing on biofuels. According to informal conversation with negotiators, the COP 10 biofuel negotiations were not as controversial as they had been two years earlier at COP 9. Still, biofuels attracted plenty of attention, with heated and lengthy Contact Group sessions that lasted long into the night. With the CEE biofuels group, we were able to capture through note-taking and sometimes audio-recording many of the moments when biofuels were invoked, explained, argued over, and theorized at COP 10. Chapter 3 focuses on the COP 10 biofuels negotiations, tracing knowledge politics through a fine-grained analysis of the sessions of the Working Group, Contact Group, and Friends of the Chair.

The limitations of conducting participant observation of UN negotiations are important to address. The CBD has a very "open" culture of decision-making, as will be discussed in Chapter 2. Even so, a researcher will never be privy to all of the processes of decision-making; even at the CBD doors are occasionally closed, there is always a "behind the scene." Additionally, as part of the CEE group on biofuels, I sometimes had to cover other events, and later found out that my group had not taken close (or, sometimes, any) notes on a biofuels Contact Group session. Thus, I cannot claim to have observed even all of what was publicly visible.

This gets to the question of how important full "coverage" is in this kind of research. O'Neill et al. (2013, 450) note concerns with the "completeness or generalizability" of CEE event data, which they see as best addressed by databases on COPs that allow for confirmation and replicability of data. Campbell et al. (2014) respond to the assumption that complete coverage leads to more objective or "true" analysis by noting that ethnography is about contextualized observation, not comprehensive sampling. To me, the question of coverage is directly linked to how one uses the data. Analysis must be conducted with a firm awareness that the visible negotiations are only "one layer of the apparatus, one that is fit for public consumption" (Dempsey 2011, 31). I look to data from negotiations to track the public reasoning and ways of knowing seen by participants as acceptable and/or necessary in the context of the CBD – ie, this particular treaty's "legal epistemology" (Bonneuil & Levidow 2011). While I address the larger economic and political stakes of biofuels and synthetic biology, I do not attempt to ascribe motivations to Party negotiators. Instead, I look to the work that their public arguments do.

Synthetic biology was introduced through the issue of biofuels at SBSTTA 14 in 2010. Since COP 10, it has been addressed as potential New and Emerging Issue in its own right. As described in Chapter 4, I have tracked four years of the treaty's engagement with synthetic biology from close to its beginning. Unlike with biofuels, I have been able to see the initial introduction and gradual development of many of the narratives and ideas around synthetic biology at the CBD. Most importantly, I have occupied very different standpoints during this research: as a member of a Collaborative Event Ethnography (CEE), as a lone social scientist, as an intern, and as a consultant to the Secretariat. Each of these positions involved somewhat different tasks, but ultimately the data that I have drawn upon in this dissertation was much the same across each position: notes from formal discussions in the context of COP and SBSTTA and side events to those events; the texts developed in those settings and corresponding texts; and some interviews. Did it make any difference that I occupied different positions in relation to other actors and to the subject material?

During COP 10, I explained and understood my presence in relation to the CEE. Others knew about us – delegates seemed pleased that we were studying this neglected treaty, it was noted that our 'delegation' was bigger than the official US delegation. At SBSTTA 15 and COP 11, I presented myself as a lone researcher. Over the course of these events, I sought out and was tentatively accepted by the CBD Alliance community. I socialized with CBD Alliance members, attended morning strategy sessions, and contributed to discussions on ecosystem restoration and synthetic biology.[20] I was careful to not publicly link my research with their political projects, but certainly did not feel that I was compromising my academic integrity through these relationships. Then I temporarily joined the Secretariat and took on a very different identity and standpoint. At the Secretariat, I was first an intern and then a consultant, sometimes referred to as the Secretariat's "technical expert on synthetic biology." At SBSTTA 18, I operated as a member of the CBD Secretariat.

Rocheleau and Roth (2007) recommend seeing assemblages as networks, with researchers occupying slightly different positions in relation to nodes of the network. My changing positions with relation to the CBD have impacted my scholarship in numerous

[20] Since SBSTTA 15, the CBD's growing interest in ecosystem restoration as a response to biodiversity loss has fascinated and concerned me.

ways. When I agreed to work with the Secretariat, I agreed to restrictions on my collection and use of data related to the Secretariat. This has impacted what I am able to address in this dissertation. Even if I had not joined the Secretariat, I likely would have encountered the same interview restrictions – in a previous Secretariat interview, the individual did not consent to be audio-recorded or quoted. However, I was struck by the level of candor and reflection in interviews with Secretariat staff members once they knew me, and it has been more painful than I expected to not be able to use their words – funny, wry, blunt, eloquent expressions of the emotions and experiences of working for an international treaty secretariat. It has also meant that instead of writing about the daily rhythms and logics of Secretariat work, I am left with my own experiences and related insights from that time. I can report firsthand that there is nothing thrilling about exposing the limits of expert knowledge (*ala* Wynne (1992), Mitchell (2002), and Li (2007)) when you are the "expert" producing said knowledge.

When I started this project, I intended to conduct an ethnography in which, like Mol, "my observations [would] be a means to get to know their standards, rather than an occasion to apply my own" (2002, 2-3). I was well aware of the importance of reflexivity in ethnography, but I didn't question the boundaries between me (the researcher) and the delegates, Secretariat staff members, and observers (the subjects) at COP 10. Working for the Secretariat scrambled my boundaries and rearranged my priorities - I went from observing and learning about standards to trying to figure out how to apply them. My intimate relationship to knowledge production for the CBD has led me to a very different affective relation to the CBD's knowledge politics. I have found myself taking an increasingly protective stance of my work for the Secretariat. As I discuss in chapter 5, I attempted to perform “neutrality.” In my academic work, I have avoided writing or even presenting on certain aspects of the negotiations in an attempt to protect my position as “neutral” in relation to certain controversies. As described in Chapter 4, the documents that I drafted for the Secretariat went through several rounds of peer review and attracted attention beyond the treaty – some supportive, some scathing. It has been a constant struggle for me to not take this personally.

But for all of the limitations on data collection, sleepless nights, and my semi-paranoid conviction that the NSA was tracking my phone and email correspondence to establish my political leanings and discredit my Secretariat work, my intimate position in relation to the treaty’s work on synthetic biology has provided opportunities and openings. It is one thing to read that “making and assessing knowledge is inevitably a political project” (Hulme 2012, 4), it is another to have the embodied experience of engaging in such a venture. I was constantly confronted with choices about how to frame various aspects of synthetic biology, what to include, what voices to give space and how to frame them. It was an opportunity to attempt to insert the research and analysis of social scientists into a treaty decision-making process. I also attempted to apply some of this analysis, drawing on a broad range of kinds of sources beyond peer-reviewed scientific literature and describing the underlying values and assumptions of technical debates. Lake (2014) talks about the difference between monopolistic knowledge, which claims privileged access to reality, and instrumental knowledge, which acts as a guide to action. The experience of developing documents specifically meant to guide the deliberations of CBD Parties was clearly an exercise in producing instrumental knowledge. And, at the same time that I carefully followed the COP’s instructions for my

Secretariat tasks, I was aware these documents would provoke reactions that I could include as data. I reflect further on playing an active role in co-production in Chapter 5.

Much political ecology scholarship examining purportedly “global” processes traces how those policies, discourses, and ideas shape (and are shaped by) local processes (Fortmann & Rocheleau 1985; Schroeder 1999b ; Goldman 2005; Li 2007). This dissertation does not engage with the complex realities to be found on the fields of biofuel feedstocks or in synthetic biology laboratories, except to the extent that those realities were invoked and described in the context of the CBD. The dangers of studying a global institution on its own terms include conveying a false unity to globalizing forces, focusing on transnational elites and reproducing a totalizing view of law and power (Tsing 2000; Buchanan 2001; de Sousa Santos & Rodriguez-Garavito 2005). However, one does not need to look to the local in order to find diversity in knowledge, power, and law. I stay within the global register to highlight its diversities and complexities.

As discussed in Chapter 2, the CBD is almost always portrayed as either ineffectual or as a potent force for neoliberalism. I see the treaty’s engagement with New and Emerging Issues as provisionally opening space for new assemblages of power and knowledge.

Chapter 2 Global Environmental Governance and the CBD

In studying the co-production of knowledge and governance, the type of legal setting is as important as the types of knowledge (Jasanoff 1996). This chapter examines the very specific legal context in which the CBD has engaged with biofuels and synthetic biology. This context is shaped in part by the historic development of modern international environmental law and the legal innovation of the “framework agreement,” and also by the other contemporary international instruments governing biodiversity. The CBD itself – in the form of the Convention text and its permanent bodies – has developed unique cultures and legal structures over time. The “New and Emerging Issues” mechanism and its contested application to emerging technosciences must be understood in this historical and contemporary context.

2.1 Governing global biodiversity.

This section traces the development of international environmental law – from its roots in soft law to the innovation of the “framework agreement.” The CBD must be understood as a product of this historic development as well as one facet of a larger landscape contemporary international law governing biodiversity.

i. A soft start to a global environment.

The 1972 United Nations Conference on the Human Environment (also known as the Stockholm Conference) is broadly recognized as the birthplace of a regulatory and legal framing of a “global environment” (Fomerand 1996; Leary & Pisupati 2010). At the conference opening, UN Secretary-General Kurt Waldheim declared that: “No crisis ever before has underlined to such an extent the interdependence of nations. The environment forces us to make the greatest leap ever into world-wide solidarity" (Johnson 2012, 8). This global environment was known – and known to be in peril – by international scientific experts (Gareau 2013). The outcomes of the Stockholm Conference grant modern science a key role in developing legal responses to the environment (Peel 2010).

Less widely noted, the Stockholm Conference also marked the entrance of "soft law" in international environmental governance (Dupuy 1991). A broad multilateral approach was considered key to responding to the global environmental crisis. This required the involvement of developing countries, up until then excluded or spoken for by colonial powers in international environmental agreements. Developing countries had the "weight of the majority without the power," and so fought for soft instruments as an accessible means to gradually modify the main rules and principles of the international legal order (Dupuy 1991, 350). The Stockholm Conference is a good example of this approach. Close coordination by the "Group of 77" shaped the outputs of the Conference, including the Stockholm Declaration with its twenty-six Principles (UNCHE 1972).[21] Principle 21 was seen as particularly important for developing countries as it established the sovereign right of States to "exploit their own resources," balanced by the "responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction" (Ibid). The "soft" Stockholm Principles have taken on greater importance with repeated invocations in multilateral instruments. Concepts from the Principles, such

[21] Commonly referred to as the G77, established in 1964. Today the G77 consists of 131 self-identified "developing" countries, which continue to be an important negotiating bloc. Shifts in political power sometimes lead to alternate groupings of countries, by region or other factors, such as the "Like-Minded Mega-Diverse Countries." See http://g77.org/ (last accessed 29 January 2015).

as support for "technology transfer" to developing countries and assistance for the free-flow of scientific information, are regularly included in MEAs (Peel 2010).

The Stockholm Conference also created the United Nations Environment Programme (UNEP). In the explosion of international environmental law-making since the early 1970s, UNEP is broadly considered to have played a key role: coordinating UN activities relating to the environment; monitoring the status of the global environment; supporting the negotiations for many multilateral environmental treaties; and promoting international environmental law as the key response to global environmental challenges (Haas 1992; Adam 2010; Baakman 2011; Johnson 2012).

During the two decades following the Stockholm Conference, optimism in multilateral governance and global scientific knowledge grew (Gareau 2013). The 1987 "Brundtland Report" introduced *sustainable development* as a guiding principle for international action (WCED 1987). In 1992, the UN Conference on Environment and Development (UNCED) held the high-profile Rio "Earth Summit." Many of the major outputs were soft law documents: the *Rio Declaration, Agenda 21,* and the *UNCED Forest Principles.* The world's attention, however, was on the "hard law" outputs – two new treaties, the CBD and the Framework Convention on Climate Change (UNFCCC), were adopted and opened for signature by States, and a proposal was passed for negotiations to develop a Convention to Combat Desertification (CCD). The Rio Summit represented a high point for the vision of international law's ability to solve global environmental problems (Gareau 2013). Forward momentum seemed to lead towards increasing centralization and hardening of global authority over the environment.

Instead, UNCED meetings since then have produced only soft documents: the *World Summit on Sustainable Development's Plan of Implementation* of 2002 and the 2012 *Future We Want*. The vision of a centralized authoritative – even authoritarian – regime to govern the global environment has faded (Leary & Pisupati 2010; Dryzek & Stevenson 2011). In its place is a narrative in which environmental problems are primarily the result of ‘insufficient capital, inadequate technology, and a lack of management expertise,” and solutions are thus “new modes of capital generation, technology transfer from the North to the South, and the transfer of managerial logistics and expertise” (MacDonald 2010, 524). Such solutions are not the remit of States alone; this vision fits with the neoliberal model of private actors as important partners in governing the environment (Swyngedouw 2010; Gareau 2013).

Use of soft law in international environmental governance has thus shifted since its introduction in the early 1970s. From a tool of developing countries to expand the scope of international law, it is now used in some UN settings to essentially argue for a narrowing of the role of States. As a “conference,” UNCED’s outputs were necessarily non-binding, declaratory statements (Dupuy 1992). At Rio, UNCED provided the setting for negotiating “conventions,” treaties in the form of framework agreements. The next section discusses the unique legal structure of the framework agreement and considers its relationship with soft law.

ii. Hard bodies, soft cores: Multilateral environmental agreements as framework agreements.

From the 1970s through the 1990s, hundreds of new MEAs came into force (Mitchell 2010; Johnson 2012). Compared to previous environmental treaties, these MEAs were based on a “broader, interdependent, symbiotic and holistic conception of the environmental system” – international responses to the challenges of a global environment (Haas 1992, 40). Many took the form of a relatively recent innovation in international law: the *framework agreement*.

Typical of the vagaries of international law, there is no technical definition of a framework agreement; it is generally understood to describe a treaty that establishes a “general system of governance for an issue area,” rather than detailed obligations (Bodansky 1999, 15). It allows States to proceed incrementally, establishing general objectives and basic institutions with an initial agreement, and then moving towards more specific commitments through the development of *protocols*. A protocol contains precise, legally-binding obligations regarding an aspect of the framework treaty's subject area (Hendricks 1998; Henne & Fakir 1999). Parties to a protocol are a subset of the framework treaty's Parties; only Parties to the framework agreement may join a protocol, and no Party can be required to sign a protocol.[22]

As a type of treaty, framework agreements are hard law instruments. But, as Harrop and Pritchard point out, the hard/soft distinction is often a “generic misnomer,” as there is a tendency for MEAs to “possess a soft nature” (2011, 476). Member States have broad discretion in their implementation of framework agreement obligations. In the absence of protocols, they primarily “operate in the manner of an aspirational, policy oriented soft law” (Ibid). The vast majority of the Convention establishes aspirations and leaves it up to States to take action “as far as possible and as appropriate.” This phrase is

[22] For example, the USA has never joined the Kyoto Protocol. Canada was an early Party to the Kyoto Protocol, but withdrew in December 2012. This does not influence their legal status as Parties of the UNFCCC. See http://unfccc.int/kyoto_protocol/status_of_ratification/items/2613.php (last accessed 29 January 2015).

peppered throughout the CBD text, including the chapeau[23] of CBD Articles 7, 8, 9, 10, and 14. Some of these Articles contain quite specific descriptions of actions; for example, Article 8 on *in-situ* conservation clearly directs Parties to establish a system of protected areas and develop legislation for the protection of threatened species. However clear or precise these directions are, their legal force is dramatically attenuated by “as far as possible and as appropriate.”

Framework agreements exist in order to provide a “flexible system for decision-making” (Hendricks 1998). The “two-step” process (convention, then protocol) is intended to ease States into legal commitments. A general assumption is that where “cognitive consensus” is lacking, either because of scientific uncertainty or because key actors do not agree on knowledge, Parties will not make legal commitments (Hendricks 1998; Bodansky 1999). Taking the first step of a convention may encourage scientific research and generally promote the development of information, while also promoting “normative consensus” around reasonable responses to the gradually defined problem. Another assumption is that, once States join a convention, “the international law-making process can take on a momentum of its own,” and most will join a resulting protocol (Bodansky 1999, 18).

The CBD's “sister” convention, the UNFCCC, is a self-labeled framework convention. The CBD does not have 'framework' in its title, but according to McGraw's interviews with negotiators, this was an “oversight” rather than a deliberate choice (McGraw 2002a, 18). Bodansky (1999) calls the CBD a “borderline” framework agreement in that some of its provisions are more specific than usual, such as the

[23] In treaties, the chapeau is the beginning of an Article or paragraph that establishes broad principles or a background for the subsequent points. The chapeau must be taken into account in interpreting each subsequent point.

provisions on *ex situ* and *in situ* conservation. Most legal commentators and the staff members of the CBD Secretariat consider the CBD to be a framework agreement (Burhenne-Guilmin & Casey-Lefkowitz 1992; Glowka et al. 1994; Hendricks 1998; Adam 2010; Harrop & Pritchard 2011; Secretariat interviews 2013).

Framework agreements thus tend to be judged on the basis of two assumptions: first, that a convention will act as the proverbial foot-in-the-door, giving time (and perhaps motivation) for a scientific consensus to form around a problem; and second, that a successful framework agreements' priorities will be covered by legally-binding protocols.

iii. Landscape of International Law on Biodiversity

The CBD is not the only international legal instrument governing biodiversity. The CBD's legal form, functions and innovations must be understood in the context of other biodiversity-related international law. This includes biodiversity-specific conventions, the "Rio" conventions, and trade agreements.

1. Biodiversity-specific conventions.

Five biodiversity-related treaties are generally considered the main conventions on biodiversity: the 1971 Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention), the 1972 Convention Concerning the Protection of the World Cultural and Natural Heritage (the World Heritage Convention (WHC)), the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the 1979 Convention on the Conservation of Migratory Species of Wild Animals (CMS, or the Bonn Convention), and the 1992 CBD. The 2001 International

Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) is sometimes also considered a key biodiversity treaty.

The main biodiversity-related treaties have multiple points of difference. With the exception of the ITPGRFA, these conventions entered into force before the CBD. The earlier conventions have narrow focuses, either on specific kinds of flora and fauna (CMS and CITES) or on specific types of sites (Ramsar and WHC). Other than the CBD, the conventions all utilize "global lists,"[24] committing Parties to special treatment for the sites and species on the lists. The work of CITES in particular is dominated by the movement of species onto and off of its Appendices, with different levels of restriction on international trade (McGraw 2002b). The CBD contains no global lists; in negotiations, developing countries roundly rejected such lists as "instruments to short-circuit national priorities and impose globally determined ones" (Burhenne-Guilmin & Casey-Lefkowitz 1992, 52). This difference in approaches is reflected in the kinds of obligations contained in the texts; Koester (2002) identifies CITES as having the highest number of concrete obligations and the CBD as the most soft obligations.

When the idea of a biodiversity convention was first proposed, it was envisioned as an "umbrella" convention that would subsume existing treaties on biodiversity, rationalizing and coordinating governance approaches (UNEP 1987). The umbrella approach was quickly discarded as "legally and technically impossible" (Glowka et al.

[24] The Ramsar Convention requires Parties to designate at least one wetland site on the List of Wetlands of International Importance (Art 2.4, Ramsar 1971). The WHC's World Heritage List includes properties forming "cultural and natural heritage," and there is also a list of World Heritage in Danger (Art. 11, WHC 1972). CITES Appendix I lists endangered species for which international trade almost entirely prohibited; trade in Appendix II species is controlled (Arts. 2, 3, & 4, CITES 1973). Migratory species threatened with extinction are listed on Appendix I of the CMS and those that need or would significantly benefit from international cooperation are listed on Appendix II (Art 3 & 4, CMS 1979). The ITPGRFA lists 64 crops for which access to and benefit sharing of their genetic resources are facilitated by the Treaty (Arts. 11, 15, 24, ITPGRFA 2001).

1994, 2). The CBD ultimately took the form of a framework treaty, not referencing the other biodiversity-related conventions except that the Secretariat is "to coordinate with other relevant international bodies" (Art. 24(d), CBD 1992). In 2004, the Joint Liaison Group of the Biodiversity-Related Conventions began to meet to "explore opportunities for synergistic activities and increased coordination."[25] Despite this, the global system of international law on biodiversity is still widely considered to be fragmented and lacking effective coordination (Jóhannsdóttir, Cresswell & Bridgewater 2010; Harrop & Pritchard 2011; Baakman 2011).

2. The sustainable development conventions.

The CBD is one of three so-called "Rio Conventions" arising from the 1992 UNCED Rio Summit. Its "sister" conventions are the UNFCCC and the CCD. The Rio Conventions were meant to be a "new breed of treaty," integrating environment and development to respond to a post-colonial world (Tinker 1995, 192). They were touted as the first global treaties to go beyond the physical dimensions of environmental problems and address socio-economic aspects (Bragdon 1996).

The CBD was not initially part of the UNCED process. In 1987, the USA came to the governing council of UNEP with a proposal to develop a global convention to rationalize existing conservation agreements, which were seen as "patchy in geographic coverage and confusing in content" (McConnell 1996, 5). The IUCN had been exploring the possibility of a conservation treaty since 1981, and in 1989 its Environmental Law Centre presented to UNEP draft articles for a strictly conservation-focused convention (Burhenne-Guilmin & Casey-Lefkowitz 1992). In response, the UN Food and Agriculture Organization (FAO) developed an alternative draft that stressed the socio-economic

[25] See http://www.cbd.int/blg/ (last accessed 29 January 2015).

aspects of biodiversity and sustainable use (Ibid). Neither of these drafts were used as the basis for formal negotiations, but they set the scene for competing visions for the treaty of "conservation" and of "development" (Shine & Kohona 1992).

Since the very beginning, the UNFCCC has been the sibling against which the CBD is compared and found wanting.[26] The UN General Assembly took over the negotiations for a climate change convention from UNEP, which the executive director of UNEP felt as a "slight."[27] In response he pushed for a biodiversity convention to be part of the UNCED process, in order to justify UNEP's institutional existence (McGraw 2002a & 2002b). By joining the UNCED preparatory processes, the biodiversity convention expanded from a conservation treaty to one of sustainable development (McGraw 2002b). Being part of the UNCED preparatory processes not only accelerated the timeline for the CBD negotiations and stretched delegations between simultaneous negotiating processes (Tinker 1995; McConnell 1996;McGraw 2002b). Even strongly staffed and financed countries like the UK were challenged, and developing country delegations were overextended (McGraw 2002b).

The UNFCCC continues to have an impact on the CBD. The term "climate envy" has been dubbed to describe CBD and CCD delegates' mix of resentment and yearning for the UNFCCC's political visibility and financial support (Morgera 2011; Hagerman et al. 2012). Members of the Swedish SBSTTA delegation wistfully note that, compared to the UNFCCC, the CBD "leads a much less recognized and scientifically poor existence" (Laikre et al. 2008, 814). This is partially blamed on a diffuse scientific knowledge base.

[26] The Climate Convention almost always goes by the acronym "UNFCCC." The CBD *could* be referred to as the "UNCBD," but this is uncommon.
[27] McGraw actually describes it as not only Tolba but UNEP itself feeling the slight – "UNEP was anxious to justify its institutional existence" (2002b, 15). The anthropomorphizing of international treaties, Secretariats, and other bodies is common.

The UNFCCC's relationship with the Intergovernmental Panel on Climate Change (IPCC) has prompted the development of the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) in the hopes that it will provide a similar degree of authority to international biodiversity governance based on “validated and independent scientific information” (Loreau & Oteng-Yeboah 2006, 245). The UNFCCC’s legal and economic structures are also emulated. The CBD has grappled to develop market-based systems for offsetting biodiversity loss similar to carbon markets (Morgera 2011).

There is another historical narrative relating these sibling treaties to one another, however, parallel to the tale of climate envy and neglect. By this telling, the CBD was one of the first international forums in which developing countries had significant negotiating clout, because their territories were thought to contain most of the world’s terrestrial biodiversity (McConnell 1996; McGraw 2002a & b). In this context, developing countries refused much of the language and approaches of the UNFCCC, in which developed countries were “foisting” unjust arrangements on the global South (McConnell 1996). In those early days of biotechnology and bioprospecting, the value of genetic resources held by developing countries was unknown, and they made the most of this “veil of uncertainty” to negotiate for access and benefit-sharing terms (McGraw 2002a).

3. The trade-related treaties

When supranational institutions are described as “hollowing out” the nation state, this is usually in reference to trade agreements, such as free trade agreements and the agreements of the World Trade Organization (WTO) (Swynegdouw 2007; Heynen et al

2007).[28] Trade agreements rarely touch directly on "environmental" issues, but their impacts "might easily exceed those of explicitly environmental multilateral agreements" (McCarthy 2007, 40). They set rules that guide and limit domestic legislation on areas as broad-ranging as intellectual property rights, agricultural subsidies, the transfer of technology, and many other areas that directly impact how States can govern the conservation and sustainable use of biodiversity.

Unlike the CBD, the WTO Agreement's provisions use specific, precise language and include compliance mechanisms with dispute settlement mechanisms and penalties for noncompliance (Harrop & Pritchard 2011). CBD Article 22(1) holds that CBD provisions "shall not affect the rights and obligations of any Contracting Party deriving from any existing international agreement, except where the exercise of those rights and obligations would cause a serious damage or threat to biological diversity." In other words, the CBD text cannot override the WTO Agreements, unless the WTO represents a "serious damage or threat" to biodiversity (Glowka et al. 1994). Interpretation of this provision continues to be a point of contention, as in the case of the synthetic biology negotiations, discussed in Chapter 4. Relationships between the permanent bodies of the CBD and WTO are also strained. The CBD Secretariat has observer status at the WTO Committee on Trade and Environment, but its applications for the TRIPS Council and the Committees on Agriculture, Sanitary and Phytosanitary Measures, and Technical Barriers to Trade have been pending for years.[29]

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[28] The WTO Agreements include: the General Agreement on Trade and Tariffs, the Agreement on Agriculture, the Agreement on the Application of Sanitary and Phytosanitary Standards (SPS Agreement), and the Agreement on Trade-Related Aspects of Intellectual Property Rights.

[29] See http://www.cbd.int/incentives/coop-wto.shtml (last accessed 29 January 2015).

2.2 CBD as an instrument of global environmental governance.

The CBD consists of the text of the Convention plus the permanent bodies established to interpret the text and aid States in its implementation. There are five bodies established by the Convention: the Secretariat (Art. 24); the Conference of the Parties (COP) (Art. 23); the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) (Art. 25); the Clearing House Mechanism (Art. 18(3)); and a financial mechanism (Art. 21). There are also two protocols to the CBD: the Cartagena Protocol on Biosafety and the Nagoya Protocol on Access and Benefit-sharing.

The Convention text does not establish the role or structure of the Clearing House Mechanism. Initially, Sweden and some of the G77 countries proposed that it act as a broker, pairing developing countries with technical and/or financial partners (McConnell 1996). This ambitious (and expensive) vision was rejected in favor of an internet-based portal that collects relevant information on technologies and tools.[30] Negotiators could not agree on the form of a permanent financial mechanism in the initial negotiations, and it still has not been agreed upon. Since 1992 the Global Environment Facility (GEF) has acted as the "interim" financial mechanism for the CBD and the UNFCCC.[31] Although important to the functioning of the treaty, these two permanent bodies have not played a prominent role in the CBD's work on New and Emerging Issues. This section thus focuses on the Convention, the COP, the SBSTTA, the Secretariat, and CBD Protocols.

[30] See http://www.cbd.int/chm/ (last accessed 22 February 2015).
[31] See http://www.thegef.org/gef/whatisgef (last accessed 22 February 2015).

i. The Convention.

The objectives of the Convention on Biological Diversity are: the conservation of biological diversity, the sustainable use of its components, and access to genetic resources and the fair and equitable sharing of the benefits arising out of their utilization (Article 1). The Convention defines “biological diversity” as “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems” (Article 2, CBD 1992). It is the first international treaty to deal with genetic diversity (Burhenne-Guilmin & Casey-Lefkowitz 1992).

The scope of the Convention is potentially incredibly broad. Henne and Fakir describe the Convention as “cover(ing) all aspects of the relationship between human beings and the manifestations of life” (1999, 316). An often-invoked concern is that the CBD’s scope of issues is continually expanding (Le Prestre 2002b; Morgera & Tsioumani 2011). With such a broad issue area and mandate, even Secretariat staff members admit that it is hard to see what *doesn't* fit under the scope of the Convention (Secretariat interviews 2013).

As a framework treaty, the CBD grants its State Parties significant discretion in how to fulfill their obligations. A common criticism of the CBD's text is that most obligations are either not specific or are qualified – as one commentator says, “eviscerated” – by terms such as “as far as possible and as appropriate” (Kunich 2005, 63). Harrop and Pritchard see such qualifications as creating a “fundamentally flawed” text (2011, 476). Morgera and Tsioumani acknowledge that the CBD is intensely criticized for "its vague and heavily qualified text, which is fraught with loopholes" (2011, 1). Some commentators warn that through these qualifications, the CBD creates a "myth of action," giving the impression that it is actively protecting biodiversity without actually having the power to do so (Adam 2010, 132; Guruswamy 1998; Jóhannsdóttir, Cresswell & Bridgewater 2010).

More than 150 States signed the Convention when it opened for signature at the Rio Earth Summit (Baakman 2011). Today, the CBD has 194 Contracting Parties, including the European Union, giving it close to universal membership.[32] The USA is conspicuously *not* a Party because of the third objective, often referred to as "ABS" (access and benefit-sharing of genetic resources). At the 1992 Rio Summit, President Bush said that the new Convention "threatened to retard biotechnology and undermine the protection of ideas" (Baakman 2011, 337). President Clinton subsequently signed the CBD, but to this day the Senate has not ratified it and there is no expectation that it will. The USA, Andorra, and the Holy See are welcomed to CBD events as observing non-Parties. As one of the largest treaties in the world, the CBD could be seen as one of the most successful MEAs (Henne & Fakir 1999). On the other hand, broad membership could be interpreted as a sign of weakness, that States either don't consider membership to have meaningful requirements or that there is no effective monitoring or enforcement (McGraw 2002). Ultimately, "nobody knows the true answer" to why the CBD has such a large membership (Koester 2002, 96). It potentially gives greater weight to the soft law produced, particularly in its use of legal principles that may be moving towards becoming

[32] See http://www.cbd.int/convention/parties/list (last accessed 22 February 2015). The Cook Islands and Niue are not UN member states, but they are Parties to the CBD. There are 193 member states to the United Nations. See http://www.un.org/en/members/ (last accessed 22 February 2015).

customary international law, such as the precautionary principle and the principle of common but differentiated responsibilities.

ii. The Conference of the Parties.

The Conference of the Parties (COP) is the formal political decision-making body of the CBD. The COP is a permanent body of the treaty that comes into being every two years as a two-week meeting (Decision I/1/Annex Rule 4(2)). The COP is the only body in the CBD empowered to make political decisions, interpret the Convention text, and set the agenda for all the other bodies of the treaty. In the world of MEAs, COPs are vital to keep a treaty "alive," capable of ongoing administrative and political action to manage its subject area (Peel 2010; Baakman 2011). Environmental treaties that do not provide for such an active governing role by permanent bodies often become "sleeping treaties," considered to have little effect on States or other actors (Baakman 2011; Bodansky 1999).

The CBD COP's formal functions include: to consider national reports; to review advice from the SBSTTA; to consider and adopt protocols, amendments and annexes; and to establish subsidiary bodies as necessary (Art. 23(4)). Ad hoc open-ended Working Groups may be established by the COP for a limited mandate and period of time and are considered formal intergovernmental bodies; other subsidiary bodies such as ad hoc technical expert groups and liaison groups may be established by the COP but are not considered intergovernmental meetings.[33] The COP may also "consider and undertake any additional action that may be required for the achievement of the purposes of this Convention in the light of experience gained in its operation" (Art. 23(4(i))). While this may seem to give free rein, in the context of a framework agreement, a COP's legal

[33] See http://www.cbd.int/convention/bodies/intro.shtml (last accessed 22 February 2015).

power is tightly constrained. The only mechanism by which a COP can clearly legally bind its member States to national-level actions is to adopt new protocols, amendments or annexes to the Convention (Henne & Fakir 1999). The CBD COP has sparingly deployed this power, focusing instead on producing soft law by passing Decisions.

The major focus of a COP is thus usually the formal negotiation of Decisions. The COP President, a high-level government official from the COP host country,[34] chairs the Plenary sessions, primarily convened at the COP's opening and closing. The COP President appoints Chairs of two Working Groups that meet concurrently, intended to include all Parties and handle the initial negotiations of agenda items. When negotiations prove too complex or detailed for such a large forum, the Working Group Chair will establish a Contact Group or Friends of the Chair meeting, again naming chairs from Party delegations. These are meant to be smaller groups of interested Party delegates and observers, often meeting outside of the official hours of the Working Group so that smaller delegations can take part in them.

Formal decision-making at the CBD COP operates by consensus. The Convention text tasked the first COP with developing rules of procedure (Art. 23(3)). The first COP established Rules of Procedure but Parties could not agree whether any circumstances should allow decision-making with a 2/3 majority. Ultimately, they left the paragraph on decision-making in brackets, an indication of lack of agreement, and thus the paragraph is not legally operative (CBD Decision I/1/Annex Rule 40(1)). The operations of the CBD therefore default to the UN's general norm of consensus (Kupecek 1995).

[34] CBD COPs are held throughout the world, each time in a different city. COP 12 was held in Pyeonchang, Republic of Korea; COP 11 in Hyderabad, India; COP 10 in Nagoya, Japan; COP 9 in Bonn, Germany; COP 8 in Curitiba, Brazil; COP 7 in Kuala Lumpur, Malaysia; COP 6 in the Hague, Netherlands; COP 5 in Nairobi, Kenya; COP 4 in Bratislava, Slovakia; COP 3 in Buenos Aires, Argentina; COP 2 in Jakarta, Indonesia; and COP 1 in Nassau, Bahamas.

Each MEA develops its own COP culture, and the CBD is known for its openness (Siebenhüner 2007; Morgera & Tsioumani 2011). UK negotiator Fiona McConnell (1996) attributes this to the Convention's roots in UNEP, which had “comparatively informal” customs compared to the UN General Assembly, where the UNFCCC was negotiated. When I attended the UNFCCC COP 17 in 2011, no negotiating or even airing of positions occurred in the open Working Group sessions. Almost all negotiating sessions were closed – not only to observers such as me, but to the majority of State delegates as well. Political balances were sought among carefully chosen State delegations. At the CBD, almost all processes are open to all delegations and reported on by the *Earth Negotiations Bulletin*, published daily at COP and SBSTTA meetings by the International Institute for Sustainable Development.[35] A regular exception to the practice of open negotiations is the Ministerial segment, held during a COP’s second week and closed to most observers and delegates. Particularly contentious aspects of the negotiations may be shunted to this forum in the hopes that higher-level negotiators will be able to make meaningful concessions.

Recently, this practice of openness to all delegations has been tested. At COP 10, the Japanese COP President held exclusive sessions with delegates of select Parties in order to come up with concessions for a “package” deal that included the *Nagoya Protocol,* a Strategic Plan for 2011-2020, and decisions on the implementation of a strategy for resource mobilization – more concrete legal and policy outcomes than usually arise from a CBD COP. According to *Earth Negotiations Bulletin,* most delegates were understanding of this move, but some were concerned that it would establish a precedent at the historically open CBD COP (Jungcurt et al. 2010). Malaysian delegate

[35] See http://www.iisd.ca/vol09/ (last accessed 30 January 2015).

Gurdial Singh Nijar saw the process as leading to a protocol text that was "non-transparent and non-inclusive" (2011, 4).

A less deliberate but perennial stumbling block to inclusive negotiations is language; Contact Group and Friends of the Chair sessions operate exclusively in English. Large Plenary and Working Group sessions have simultaneous translation into the 6 UN languages and also usually the language of the host country. But, as a Secretariat representative acknowledged at SBSTTA 15, the substantive textual work is done in these smaller groups.[36] By the time draft text gets back to the Working Group, it is often accompanied by a plea not to upset the careful balance of the text.[37]

CBD COPs are also known for being open to observers, especially in comparison to UN General Assembly processes (McConnell 1996; Morgera & Tsioumani 2011). Delegates appointed by Contracting Parties (member States), non-Member States, and UN agencies are guaranteed access to a COP. Other observers (NGOs, social movements, private sector, etc.) must apply with the Secretariat and can be turned away if one third of the Parties object (Art. 23(5)). The general expectation is that, if a group is interested, they are welcome to a CBD COP. At COP 10, there were 2,251 registered Party delegates and over 1,900 registered participants from NGOs – if education, business, and other observers are added, there were more observers than national government delegates present (see Campbell et al. 2014). Observers may make statements in the Working

[36] SBSTTA 15, Plenary, 7 November 2011, presentation by Jo Mulongoy.
[37] This happened at COP 10 with the biofuels Decision. The Dominican Republic commented in the opening Working Group on biofuels, but no representative took part in the sessions of the Contact Group or Friends of the Chair. At the next Working Group session, the Chair opened discussion on the draft biofuels text with the "ground rule" that "clean" paragraphs (language not in brackets) would not be reopened. In Spanish, the DR delegate expressed his desire to propose amendments to clean paragraphs, but the Chair strongly appealed to him not to, pointing out that discussions had been "tedious and elaborate." The DR delegate accepted the Chair's appeal "against our will," and asked that the official record note their desire to discuss closed issues. COP 10, WGI, 21 & 28 October 2010.

Group negotiating sessions and attend Contact Groups; Friends of the Chair sessions may be either open or closed. Depending on the (co)chairs of the Contact Group, observers and non-Parties (ie, the US) may be welcome to make statements, although their perspectives and textual suggestions are only recorded if a Party delegate officially supports them. Additionally, "indigenous and local communities" (ILCs) are specifically mentioned in the Convention, and ILC representatives are welcomed to many treaty processes. This openness to non-Parties can be seen as yet another weakness of the CBD. The head of a CSO engaged with the CBD admitted in an interview that "I worry all the time that the CBD is being seen too much as the NGOs' treaty, and that weakens it, if it's seen that way" (Observer interview 2014).

Lines between observers and State delegates are not always clear-cut. State delegations often include individuals who are not State employees. According to an interview with a Brazilian NGO member (conducted by a CEE member),[38] of the 140 individuals on the Brazilian COP 10 delegation, 120 were from the private sector.[39] State delegations also include academics, members of research institutes, independent lawyers, and employees of NGOs. Larger delegations such as Brazil, China, and Japan use such non-State employees to keep track of side events and negotiations where the States are not planning to directly engage, essentially providing those groups with privileged access to follow negotiations but not permission to negotiate. Smaller delegations may rely upon such individuals as active delegates. For example, some of the most active individuals in the synthetic biology and geo-engineering Contact Group negotiations at COP 11 were a Malaysian Professor of Law, a member of the Philippine farmers' rights NGO SEARICE,

[38] Interview by Juan Luis Dammert B. at COP 10.
[39] The size of a CBD COP varies; there were over 7,000 delegates at the relatively politically prominent COP 10, while only around 3,000 delegates at COP 12 (Antonich et al. 2014; Jungcurt et al. 2010).

and an independent Bolivian lawyer – all official Party delegates (Informal interviews 2012). There is also diversity among types of State employees depending on their Ministry, as described in chapter 1.

There are numerous aspects of a COP outside of its formal negotiations. Side events are put on by States, intergovernmental organizations, business coalitions, environmental NGOs, civil society groups, research institutes, and others. The intended audience of most side events is State delegates, so side events are scheduled when Working Groups are not in session – usually one time slot during lunch and two time slots from the late afternoon into the evening, with 10 to 20 side events scheduled in each slot. Organizers of side events may present themselves as helpfully providing neutral scientific information, or may openly advocate certain positions in the on-going negotiations. Written materials are often passed out during side events. Outside of side events, the "literature tables" are a ubiquitous feature of a CBD COP. Massive amounts of literature from intergovernmental organizations, NGOs, civil society groups, national and subnational governments and corporations are heaped on tables in the convention center hallways, with new material added daily. It is quite common to see individuals with a few minutes of downtime idly shuffling through piles, looking for reports and pamphlets of interest.

With the CEE team, I have approached the CBD as one node in a network of global environmental governance, and COPs as moments within ongoing policy-making processes (Campbell et al. 2014). CBD COPs draw actors together, encouraging alignment, facilitating the spread of projects, creating assemblages of order and narratives to explain the world (Corson & MacDonald 2012). They are places where governance is enacted, relationships are performed, and new directions are signaled. Each COP has its own unique discourse, formed from official documents, language used in negotiations, explanatory narratives offered in unofficial side events, the framing of negotiations by the Chair of the COP, movies shown at NGO and corporate-sponsored cocktails – the plethora of performances, materials, and identities brought into play.

Of these myriad aspects of a COP worthy of study, my research focuses on the development of Decisions. Decisions are the main concrete output of CBD COPs. Each Decision is a "legally binding interpretation of the Convention" (Henne & Fakir 1999, 319), thus adding to the depth of meaning of the CBD text. The strength of CBD COP Decisions to compel or prohibit specific actions by States, however, is unclear (Jóhannsdóttir, Cresswell & Bridgewater 2010). As they almost always contain qualifying language (such as "encouraging" or "inviting" Parties to take actions "as appropriate"), they are soft in content as well as potentially in form.

Early in the treaty's life, many commentators anticipated that the CBD COP would primarily focus on developing protocols. Instead of producing hard law, the CBD COP has used Decisions to "evolve into a prolific norm-creating body across all areas covered by the CBD and on issues that are directly or indirectly related to biodiversity" (Morgera & Tsioumani 2011, 4). Norms are shared understandings of acceptable behavior that are not connected to a clear sanction if violated (DiMento 2003; Palmujoki 2009). CBD Decisions have elaborated norms through passing Decisions that include Codes of Conduct, Guiding Principles, and other guidelines for national and international decision-making and implementation in diverse areas, from dealing with the impacts of invasive alien species to ecotourism to ensuring respect for the cultural and intellectual heritage of indigenous and local communities (Decision VI/23; Decision VII/14; Decision X/42). Some of these norms have "seeped into other regimes" such as the International Treaty on Plant Genetic Resources for Food and Agriculture (Le Prestre 2002a).

CBD COPs have been busy; twelve CBD COPs have passed a total of 364 official Decisions.[40] These Decisions arguably do not add up to a coherent body of norms. Due to the "convoluted, repetitious, and disorderly drafting of the CBD COP decisions," norms are not always clearly stated or even consistent across Decisions (Morgera & Tsioumani 2011, 5; Morgera 2011). Le Prestre has referred to the uneven evolution of the CBD's work as having "foster(ed) the development and operationalization of poorly defined concepts" (2002a, 313). The CBD Secretariat has produced three editions of a *Handbook* of the CBD, tracking and providing details on the COP's substantive decisions, but the last version was in 2005 and it has been discontinued (Morgera & Tsioumani 2011).

iii. The Subsidiary Body on Scientific, Technical and Technological Advice

The CBD's Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) is meant to provide the COP with "timely advice relating to the implementation" of the Convention (Art. 25(1)). Like the COP, the CBD SBSTTA comes into being in the form of meetings, once a year for one week, convening twice between each COP (Decision V/20). SBSTTA meetings are much smaller than COPs – for example, SBSTTA 18 involved around 500 participants (Goldberg et al. 2014). Upon the request of the COP, the SBSTTA provides scientific and technical assessments, provides

[40] From adding up the Decisions found at http://www.cbd.int/cop/ (last accessed 27 January 2015).

advice on programmes and cooperation in research and development, identifies "technologies and know-how" and advises on its development and transfer, and responds to questions put to it by the COP (Art. 25(2)). In 2000, COP 5 granted the SBSTTA the ability to establish ad hoc technical expert groups (AHTEG) and adopt terms of reference for them, under the guidance of the COP (Decision V/20). The SBSTTA Bureau consists of ten Party delegates nominated by the five regional groups for fixed terms, and works with the Secretariat to help plan meetings of the SBSTTA (Decision VIII/10).[41]

Practically, a major focus of most meetings of the SBSTTA is the development of Recommendations to the COP. These Recommendations often include general findings by the SBSTTA about the issue at hand and then include a text that is essentially a first draft of a COP Decision. While it is extremely rare for a final COP Decision to include bracketed text, SBSTTA Recommendations are often full of bracketed text, indicating a lack of agreement among delegations.

Since its founding, the SBSTTA has attracted controversy. Developed countries wanted a subsidiary body that would provide "sound scientific advice," but developing countries argued against such a body for reasons of representation. A "strictly scientific" body would be dominated by "Northern-educated experts," and this would put developing countries at a disadvantage (McGraw 2002b, 17; McGraw 2002a). Developing country negotiators were also responding to the climate negotiations, where they felt problems were being framed as exclusively matters of natural science (McGraw 2002b; Koetz et al. 2008). Ultimately, developing countries agreed to the creation of the SBSTTA in exchange for *not* including lists of globally important components of

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[41] The five regional groups are: Africa, Asia, the Group of Latin American and Caribbean Countries (GRULAC), Central and Eastern Europe, and Western European and Others.

biodiversity (in the style of the other biodiversity-related treaties, as described in section 2.1.iii.1) (McGraw 2002b).

Tensions present in those initial negotiations are expressed today in debates around the SBSTTA's proper role: Is it a political or a scientific body? What should be its relationship to the COP? Which body should have the authority to set the SBSTTA's agenda? A Secretariat member described it as a "chicken or egg" question – must the SBSTTA wait for the COP to request that it address an issue, or is the SBSTTA able to bring an issue to the COP's attention (Secretariat interview 2013)? Officially, the SBSTTA does not have the authority to make political decisions; unlike meetings of the COP, SBSTTA meetings are never "negotiations." Yet SBSTTA meetings are often referred to as "mini-COPs," indicating – usually in a derisive manner – the primacy of the body's political function over its scientific and technical functions (McGraw 2002a & b; CBD 2006; Koetz et al. 2008; Secretariat interviews 2013). Debates unfold as boundary work between science and politics – scientists publicly lament the imbalance among SBSTTA delegates between scientific researchers and political bureaucrats, and attribute to this the "weakening" of scientific discussion (Laikre et al. 2008). This same boundary can also be seen as falling between the delegations who send most of the scientists (developed countries, and observers such as research institutes and NGOS based in or trained in developed countries) and the ones constituted primarily by diplomats (developing countries) (Le Prestre 2002b).

The UNFCCC continues to be a standard of comparison. The UNFCCC's Subsidiary Body on Scientific and Technological Advice (SBSTA) provides advice on scientific and technological matters, but it is complemented by the IPCC's "external, independent body of experts" (Le Prestre 2002b, 106; Laikre et al. 2008). Without a parallel source of expertise, the CBD's SBSTTA both provides scientific advice and translates this into policy language through its Recommendations (McConnell 1996; Le Prestre 2002b). The recent establishment of the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) is seen as ideally feeding into SBSTTA independent knowledge and assessments.[42] IPBES has elicited more boundary work, as SBSTTA delegates debate what is appropriate for their forum and what should fall in the realm of IPBES.[43]

iv. ***The Secretariat.***[44]

The Secretariat of the CBD (SCBD) is located in Montreal, Canada. Its main functions are to organize and service COP meetings, prepare reports for the COP, coordinate with other relevant international bodies, and perform any other functions as determined by the COP or any protocol (Art. 24). As of June 2014, the SCBD had 66 staff members on posts funded by the core budget, 19 posts funded by UNEP, 6 posts funded by the Japan Fund, and 13 posts filled by secondments from national governments (SCBD 2014a). There is also a constant flow of interns; there were 29 interns during my internship period, from January-June 2013 (SCBD 2013a). During the course of my research, the SCBD Executive Secretary changed from Ahmed Djoghlaf (Algiers) to Braulio F. de Souza Dias (Brazil) in January 2012.[45] When the COP asks the Secretariat for anything,

[42] See COP 10 side event, The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES): Status, Next Steps, and Implications for the Biodiversity Community. 21 October 2010.
[43] See COP Decisions X/2, XI/2, & XI/19.
[44] Information in this section primarily comes from interviews conducted with Secretariat staff members in 2012 and 2013.
[45] Executive Secretaries are appointed by the UN Secretary-General, in consultation with the CBD COP Bureau and the Executive Secretary of UNEP (see CBD Decision VIII/10).

from convening workshops to providing analysis, it officially requests this of the SCBD Executive Secretary, an indication of that post's responsibility and authority. The Secretariat is administered by UNEP, which is based in Nairobi, Kenya. Like most MEA secretariats, the CBD is generally considered understaffed, facing rising workloads and inadequate financial resources (Baakman 2011; Le Prestre 2002b; Siebenhüner 2007).

A treaty secretariat has three main functions: collecting and disseminating information; facilitating negotiations; and capacity building (Siebenhüner 2007). These terms sound neutral, as though a secretariat is simply a conduit for relevant expertise, or a "servant of the parties" providing exactly what is needed without thought of themselves (Sandford 1996). In action, secretariats are messy, embodied sites of co-production of new forms of knowledge and political action (Jasanoff & Wynne 1998). A main area of the SCBD's work, and thus a significant avenue for its influence, revolves around knowledge.

The SCBD produces two main kinds of documents to assist negotiations and meetings - "information" and "official" documents. Information documents for SBSTTA and COP meetings provide background and/or updates on issues as requested by the COP or the SBSTTA. These documents can be quite lengthy and are provided in only one language, usually English. Official documents for SBSTTA and COP meetings are restricted to 16 pages and made available in the six UN languages: English, French, Spanish, Russian, Chinese and Arabic. Official SBSTTA documents usually include a draft Recommendation, suggested by the Secretariat as a starting point for the SBSTTA's deliberations to develop a Recommendation to the COP. Within the Secretariat, staff members believe that most delegates focus more or less exclusively on the draft

Recommendations. A lot of attention is thus placed on developing the draft Recommendations, with wide and iterative consultation within the Secretariat on "difficult" issues such as synthetic biology. This is broadly acknowledged within the Secretariat as a political process, influenced by the CBD's consensus decision-making processes. Numerous staff members expressed the view that there was no point in drafting what could not reach consensus, and described attempting to avoid protracted arguments between polarized views. Several interviewees described the "art" of drafting documents, learning what hot-topic phrases to avoid, what Parties will accept and what they will fight. One staff member described the process as walking through a "minefield" of views, trying not to set any off.

Politics are not restricted to draft Recommendations. Jasanoff and Wynne describe international institutions as holding the power to "reframe problems for collective solution, redefine the boundaries and parameters of relevant knowledge, and determine the rules of participation in knowledge creation" (1998, 54). This power also includes relative freedom in choosing consultants, drawing on personal networks for peer review, and setting the tone of documents (Koetz et al. 2008). To some extent, what Koetz et al. (2008, 514) describe as the Secretariat's "political filtering process" occurs with *all* of the Secretariat's outputs, from information documents to reports of meetings to the *Global Biodiversity Outlooks* (GBO) that provide a "global assessment of the state of biodiversity" (SCBD 2010). The COP can try to control or restrict this process by placing conditions on document production. The first step to addressing most issues is for the Secretariat to invite Parties and other governments (and often relevant organizations) to submit information on a given topic identified by the COP or the SBSTTA. The COP may restrict the SCBD to simply compiling these submissions. If an issue is less politically sensitive, the COP may permit the Secretariat to “compile and synthesize” submissions, or even include other “relevant available information” outside of the submissions. Even with controversial topics such as synthetic biology, this may happen if the initial submission process does not elicit sufficient information for an informed debate.

Secretariat staff members believe they do far more than simply pass on technical information – both in the sense of their role and in the nature of the information. They see themselves as playing an active role in identifying trends and translating scientific information. The issues encompassed by biodiversity and addressed by the CBD are so broad and varied, few staff members have specific training in the majority of the work that crosses their desks. In interviews, several insisted that their distance from the scientific disciplines was an asset in their work. One said that if he had been trained in the specific area his work covered, he would be too focused, unable to see the “big picture.” Another framed it as needing to be able to look at scientific information from a policy perspective. Several staff members described themselves as playing a proactive role in helping to form consensus, talking with Parties and helping Chairs come up with negotiating text. And some talked about their efforts to provide capacity building to delegates as a way the Secretariat can help to elevate the discussion of scientific and technical issues on the CBD’s agenda.

Ultimately, though, Secretariat staff members have a modest view of their ability to influence the course of negotiations. The Parties are the ones in control. Staff can try to steer negotiations in a certain direction, but if Parties are not in consensus, nothing will happen. The SCBD may sometimes have the flexibility to bring up issues, but it’s up to the Parties to choose whether and how to respond. Staff members frequently noted that the SCBD was “not an implementing agency,” and that Parties prevent the Secretariat from having a national level presence. As one commentator says, the Secretariat’s “overt ambitions remain modest” (Le Prestre 2002b, 101).

v. The Protocols.

To many legal commentators, the hallmark of the CBD’s status as a framework agreement is the COP’s ability to negotiate new annexes and protocols, establishing *legally-binding* obligations (Burhenne-Guilmin & Casey-Lefkowitz 1992; Hendricks 1998; Adam 2010; Harrop & Pritchard 2011). Without such commitments in the form of protocols, these commentators see framework agreements as “lowest common denominator agreements” (Hendricks 1998; Adam 2010). At the close of the final CBD negotiations before the 1992 Rio Earth Summit, then UNEP Executive Director, Dr. Tolba, seemed to express a similar perspective on the value of the CBD. Tolba expressed confidence that the CBD would follow the trajectory of the first ozone layer convention - initially weak, but “given force” by the Montreal Protocol and its subsequent revisions (McConnell 1996, 102). Early in the life of the Convention, there were high expectations for protocols on a wide range of issues, including forests, Article 8j (indigenous and local communities), invasive alien species, and genetic resources of crop seeds (McGraw 2002b).

If the primary purpose of a framework agreement is to ease the transition from vague to specific obligations through protocols, then the CBD may be open to significant criticism. It took ten years before the CBD’s first protocol – the *Cartagena Protocol on*

Biosafety to the Convention on Biological Diversity (CPB) – entered into force in 2003.[46] The CPB primarily addresses "living modified organisms" (LMOs) – "any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology"- ie, genetically modified organisms (GMOs) (CPB Art. 3(g)).[47] The CPB establishes rules for the transboundary movement, transit, handling and use of all LMOs that may have adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health. This includes requiring Advanced Informed Agreements upon the initial introduction of a new LMO except under certain exempting circumstances, and a risk assessment by the Party of import (CPB Article 7 & Annex III). As the first binding international agreement addressing the risks of modern biotechnology, the CPB is an important instrument (Eggers & Mackenzie 2000). As the first protocol to a convention on the conservation and sustainable use of biodiversity, however, the CPB has been criticized as "not even directly related to stopping biodiversity loss" and "proof of the treaty's lack of science-based prioritizing" (Adam 2010, 151; McGraw 2002a, 19). Critics have seen the CPB as a demonstration that the CBD is a "prisoner of its own politics" rather than being based in "sound science" (McGraw 2002b).

A second protocol, the *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity* (*Nagoya Protocol)*, was adopted in 2010 and entered into force in 2014.[48] The Nagoya Protocol addresses the third objective of the CBD: the "fair and

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[46] See http://bch.cbd.int/protocol/ (last accessed 22 February 2015).
[47] The CBD text also uses the term "living modified organism," but does not provide a definition. Articles 8(g) and 19(3).
[48] See http://www.cbd.int/abs/ (last accessed 22 February 2015).

equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies" (CBD Art. 1). It establishes obligations and rights for "providers" and "users" in relation to access to genetic resources and traditional knowledge associated with genetic resources, benefit-sharing, and compliance. Commentators from social movements and developing countries are divided on whether the Nagoya Protocol represents progress in preventing biopiracy or simply waters down the CBD's existing provisions on access and benefit-sharing (Bavikatte & Robinson 2011; Nijar 2011). Some question whether the Nagoya Protocol will make an impact without the USA, a core user of genetic resources in biotechnology research (Warren 2010). Regardless of its effectiveness, the Nagoya Protocol is treated as peripheral to the global challenges facing biodiversity by some legal commentators (Adam 2010; Harrop & Pritchard 2011). Critics see the lack of protocols "directly" relating to biodiversity conservation and its focus instead on soft law measures as a serious failure (Wold 1998; Guruswamy 1999; Harrop & Pritchard 2011).

2.3 "New and Emerging Issues" at the CBD.

New and emerging technosciences play important roles in contemporary environmental governance. The model of sustainable development developed through the UNCED Conferences is based upon "ecological modernization" – the broad concept that current capitalist systems can be made sustainable, in part through the intervention of technoscientific advances (Hajer 1995; Brand & Görg 2008; MacDonald 2010). This technocentric variety of environmentalism "highlights the application of science, market forces and managerial ingenuity" to address capitalism's contradictions (MacDonald

2010, 518). Technosciences are an integral component of this win-win approach; through markets and technologies, environmental challenges will be overcome while the economy grows, even where problems exist *because* of current or past technosciences (Widengård 2011; Nuffield 2012).

But even as UN processes have taken up ecological modernization's "positive sum" discourse, consistent voices within these forums have expressed suspicion of "technofixes." Rather than relying on new technosciences to fix things, certain civil society organizations (CSOs) and groups of indigenous and local communities (ILCs) see the potential for emerging technologies to create new harms and exacerbate existing problems (Applegate 2002; FOE et al. 2012). These groups are concerned that there is no specialized body within the UN system to evaluate emerging technosciences. The 2012 Rio+20 meeting's "soft" outcome, *The Future We Want,* recognizes the importance of strengthening capacities in research and technology assessment (UNGA 2012, para. 275). UN deliberations for a "post-2015 sustainable development agenda" have included serious discussion about the form and goals of a potential "Technology Facilitation Mechanism" to promote the development, transfer, and dissemination of clean and environmentally sound technology. Civil society organizations are pushing hard for this to include technology assessment (UNGA 2012; Observer interviews 2013 & 2014).[49] In the meantime, civil society movements, NGOs, and certain States have taken their concerns with new technosciences to the CBD.

Contracting Parties have always been free to propose the introduction of new issues to the CBD's agenda. According to interviews with Secretariat staff members and observers, in the early days of the treaty a handful of people could hold a side event, get

[49] See also: https://sustainabledevelopment.un.org/index.php?menu=1453 (last accessed 28 January 2015).

some Party delegations interested, and get an issue introduced fairly easily. Among the plethora of issues that the CBD has taken on, emerging technoscientific objects and phenomena resulting from the use of technologies have been added through the programmes of work on marine and coastal biodiversity, climate change and biodiversity, and agricultural biodiversity. When asked, Secretariat staff members and observers listed a wide range of issues that they consider "unofficial" NEI, including coral bleaching, ocean acidification, marine debris, ocean noise, ocean fertilization, geoengineering, genetic use restriction technologies (GURTs, or "Terminator" technology), and genetically engineered trees.

Technosciences have not only been present at the CBD; they have elicited some of the COP's most specific language. In Decisions on GURTS, ocean fertilization, and geoengineering, the CBD COP has recommended or requested Parties to ensure that these activities not be undertaken until certain conditions are met, such as adequate scientific knowledge and assessments of environmental and socio-economic risks (Decision V/5; Decision IV/16; Decision VIII/23; Decision X/33; Decision XI/20). These Decisions are sometimes described as "de facto" or "quasi" moratoria (Alvarenga et al. 2006; Appleton et al. 2008; Jungcurt et al. 2010; Morgera 2011). The Decision on genetically-engineered trees uses softer language, but its explicit call for precaution is considered by some as partially responsible for slowing down the commercialization of GE trees (Decision IX/5; Secretariat interviews 2013).

The legal force of these "de facto moratoria" is unclear; where there is strongly directive language, it is softened by qualifications in the chapeau (Morgera 2011). For some of the civil society organizers involved, legal force is less important than political force. They point to the Canadian and German governments' punitive responses to large-scale ocean fertilization experiments conducted in their territorial waters, and that the governments did so in reference to the CBD's Decision (Observer interview 2014). Similarly, one Secretariat staff member saw value in the quasi-moratoria as drawing attention to issues previously ignored at the international level. They did not consider the CBD COP as actively governing these issues, but rather signaling to the international community a potential need for governance (Secretariat interview 2013).

Despite existing processes by which Parties could introduce new issues, in 2006, the CBD COP introduced a new mechanism, "New and Emerging Issues" (NEI), to allow issues of particular novelty and urgency to be added to the agenda of the SBSTTA (Decision VIII/10 Annex A(d)). This addition was part of an update to the *modus operandi* of the SBSTTA, intended to increase the effectiveness of the subsidiary body by encouraging its scientific and technical roles (Secretariat interviews 2013). NEI was not controversial at all; it was seen as formalizing a long-standing practice of introducing issues (Secretariat and observer interviews 2013 & 2014).

The Decision introducing NEI did not include the process by which the SBSTTA would identify such new and emerging issues. At the next meeting of the SBSTTA Bureau, a teleconference in September 2006, Bureau and Secretariat members considered how to respond to the new opportunity provided by the NEI mechanism. Bureau chair Christian Prip (Ministry of Environment, Denmark) proposed biofuels as an NEI (Secretariat interview 2013). The SBSTTA Bureau identified "the interlinkages between biodiversity and liquid biofuel production" as a potential NEI for the SBSTTA to consider, and placed it on the agenda of SBSTTA 12 (SCBD 2007).

The 2007 SBSTTA 12 biofuel discussions were high profile and extremely contentious. Some delegations accused the SBSTTA Bureau of using the NEI mechanism to add an issue to the agenda without consulting Parties, in a secretive – or at least, informal – process (Secretariat interviews 2013). While SBSTTA 12 agreed to recommend to the COP that biofuels be added to the agenda as an NEI, they also recommended that the COP develop a formal process for identifying NEI (Recommendation XII/7 & 8). At COP 9 in 2008, Parties agreed on seven criteria to be "used for identifying new and emerging issues related to the conservation and sustainable use of biodiversity," including: the relevance of the issue to the Convention's objectives; new evidence of unexpected and significant impacts on biodiversity; the urgency of the issue; and evidence of limited tools to mitigate negative impacts on biodiversity (Decision IX/29 para. 12). As one civil society observer noted, at that time the NEI mechanism was already seen as a "bit of a poisoned chalice" because of the highly contentious experience with biofuels (Observer interview 2013). In fact, some see the development of IPBES as stemming from the inability of the SBSTTA to take a "scientific" approach to NEI (Secretariat interviews 2013). In interviews with observers, delegates, and Secretariat staff members, the NEI criteria are broadly considered to have made it almost impossible for an issue to qualify as an NEI, particularly if the criteria are interpreted as mandatory rather than guidelines (Secretariat interviews 2013; Observer interviews 2013 & 2014; Delegate interview 2012).

Indeed, since biofuels' introduction in 2006, no substantive issue has been added as an NEI. Tropospheric ozone was unceremoniously added to the CBD's programme of work on biodiversity and climate change in 2012, but the NEI criteria were never explicitly applied and it has received minimal attention (Decision XI/11; Secretariat interview 2013). At the 2010 SBSTTA 16, the Philippines introduced synthetic biology to the biofuels Recommendation and, separately, as a potential NEI (Appleton et al. 2012a). Synthetic biology was immediately incorporated into the biofuels negotiations and addressed in the next COP biofuels Decision (Decision X/38). Three times now, at COPs 10 (2010), 11 (2012), and 12 (2014), synthetic biology has been considered as a potential stand-alone NEI, and the COP still has not decided whether synthetic biology meets the NEI criteria (Decision X/13; Decision XI/11; Decision XII/24).

Between the official and "unofficial" NEI, emerging technosciences have been very present at the CBD. Interviewees expressed various problematic aspects of the CBD's engagement with emerging technosciences. A Party delegate said that they weren't so much "New and Emerging Issues" as they were "New and Emerging Technologies," and that this was ironic because the NEI criteria were a poor fit for technologies whose impacts were still unknown (Delegate interview 2012). A Secretariat member noted that such issues, while important, could seem "peripheral" to the CBD's main objectives. The question of the proper role for ILCs in relation to emerging technosciences elicited discomfort across the board, as Secretariat, delegates, and observers struggled to determine and express their views. All interviewees agreed that the perspectives and special knowledges of ILCs were important to decision-making at the CBD, but there was a lack of clarity around how this should unfold in the case of emerging technosciences. One interviewee suggested that, if there wasn't yet enough information to project a technology's socioeconomic impacts, it was premature to bring in ILCs. Several noted that it would help if ILC representatives had more information about the issues – while also being quick to note that ILCs were perfectly capable of developing their own positions. Secretariat staff members described challenges of incorporating ILC representatives into CBD "expert" processes, trying to simultaneously elicit "academic," traditional, and local knowledges (Delegate interview 2012; Secretariat interview 2013; Observer interviews 2014 & 2015).

2.4 Unique characteristics of the CBD.

The very factors that draw criticism of the CBD – its soft legal outcomes, how the framework agreement has developed, its excessively broad mandate, the "politicization" of biodiversity knowledge – make the CBD a unique and potentially productive forum for international decision-making on emerging technosciences.

Soft law is currently primarily valued as a mechanism for expanding governing authority to non-state actors through its inclusion of non-state actors (Miller & Edwards (eds) 2001; Kirton & Trebilcock (eds) 2004; Heynen et al. (eds) 2007). Looking back to its roots, though, soft law was used by developing countries as a tool to expand the scope of international legal norms (Dupuy 1991). Thus, rather than diminishing State authority, soft law was a tool to redistribute authority among a larger, more inclusive international community.

Similarly, framework agreements have come to be valued primarily by how quickly and firmly they harden obligations through protocols, but there are other outcomes of this treaty structure with value. SCBD staff members describe the CBD as a framework agreement not because of the possibility of protocols but because of the Convention's *open nature* – Parties are free to determine how best to implement its provisions and able to negotiate to add new issues to the CBD's agenda (Glowka et al.

1994; Secretariat interviews 2013). In our interview, Lyle Glowka, then-legal adviser to the CBD, stressed the relationship between a "static" Convention text and the dynamism brought by that the review process.[50] As he explained, the outcomes of the CBD's institutions – the COP, the SBSTTA, Working Groups, etc – may not be legally binding, but they constantly evolve how the convention and its implementation are interpreted, and this keeps the treaty alive, current, and relevant. Baakman (2011) points out the example of the climate change; when the CBD was negotiated, the impacts and links of biodiversity and climate change were not "realized," and so the flexibility of the soft law approach was utilized to add this as a "cross-cutting issue" of the CBD's programme of work. Framework agreements can be understood as treaties whose very structure acknowledges the need for international deliberation and decision-making in situations that lack cognitive and normative consensus.

Many aspects of the CBD have been interpreted as weaknesses. Among the biodiversity-specific conventions, the CBD has the broadest mandate and the softest touch, operating without "global lists" that provide special treatment for specific sites or species. As one of the "sustainable development" conventions, the CBD is often compared to its sister treaty, the UNFCCC, and found wanting. Unlike the World Trade Organization Agreements, the CBD does not have vigilant compliance mechanisms to enforce what commitments have been made. As a framework agreement, the Convention text uses a lot of general language, and specific language is heavily qualified. The large number of Parties can be seen as a sign of the treaty's lack of meaningful obligations or monitoring and enforcement, and the absence of the USA as a stumbling block to global

[50] Although my agreement with the SCBD was that I would not reference specific individuals in writing about the interviews, Lyle Glowka requested that his specific ideas be attributed to him.

action. The openness of CBD COPs to observers can be seen as a weakness if it is known as the “NGOs’ treaty.” COP Decisions, soft as they are, fail to add up to a coherent body of norms. The Secretariat basically has no authority to oversee or assist in the treaty’s implementation at the national level. The SBSTTA is criticized as overly political and not sufficiently scientific or technical. The CBD’s protocols are seen by some as failing to directly address challenges to biodiversity conservation.

Yet, these characteristics of the CBD can be interpreted differently, too. Some of them are the result of the greater involvement of States historically marginalized in international politics and law-making. For example, the lack of global lists is a reflection of developing countries’ desire for political autonomy and refusal to continue colonial patterns of control through natural resource management and conservation. It also means that the CBD is not wedded to a narrow range of technical knowledges that support mechanisms such as lists. The “politicization” of knowledge is a reflection of the CBD’s historic recognition of the political nature of knowledge, whether scientific, traditional, local or otherwise. When dominant perspectives on conservation and science are put forth, more marginal perspectives often have space within the CBD to respond and challenge. For some issue areas, such as ABS, the USA’s non-Party status has arguably opened up space for the international community to seriously consider action that the USA would otherwise block. The subject area itself – biodiversity – is blamed for lacking “issue salience,” being too broad or deep to clearly define a problem, and lacking popular familiarity (McGraw 2002a). But biodiversity can also be seen as resisting closure, either the scientific certainty claimed by laboratory sciences or clean lines between science and politics. Engaging with contested, uncertain, political knowledge on those terms may open up global environmental problems to new understandings.

Instead, many actors at the CBD have responded to criticisms by seeking to ground the treaty's legitimacy in three areas: harder law, harder science, and harder economics. COP 10 was a key moment for all three of these strategies. In the run-up to COP 10, anticipation was high. The year before, the UNFCCC's widely publicized and politically prominent COP negotiations had collapsed in Copenhagen, and the CBD COP carried the weight of proving that the UN system was able to govern contemporary global environmental issues (Jungcurt et al. 2010a; Morgera & Tsioumani 2011). This "proof" was largely anticipated as requiring the COP to pass major legislation and policy. Years of negotiations for a protocol on access to and benefit sharing of genetic resources were scheduled to be finalized at COP 10, as well as a Supplementary Protocol to the Cartagena Protocol on liability and redress. The utter failure to meet the previous 2010 target on biodiversity[51] was going to be addressed by setting a new round of targets, with better indicators and a better plan of attack. For meeting these goals, *Earth Negotiations Bulletin* heralded COP 10 as "one of the most successful meetings in the history of the Convention" (Jungcurt et al. 2010b). Almost immediately, however, stakeholders have struggled to understand their rights and obligations in light of the Nagoya Protocol's many strategic ambiguities (Bavikatte & Robinson 2011; Harrop 2011) - the hardened law turns out to be quite squishy in parts.

Another approach is to justify the CBD by its economic effectiveness. Ecosystem services and the TEEB reports launched at COP 10 represent a way for the CBD to prove

[51] "To achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth." Decision VI/26.

the worth of both biodiversity and the treaty that protects and efficiently manages the use of biodiversity. The TEEB reports promised to help political and business decision-makers identify how to create new markets and property relations for biodiversity and its associated ecosystem services – and thus incentivize and justify its protection (MacDonald & Corson 2012). It was hoped that this would elevate biodiversity's profile – and that of the CBD – in international decision-making (Morgera & Tsioumani 2011, 9). Such commodification requires biodiversity that can be known and fixed as a "stable external presence" (Robertson 2007, 118). Thus it is perhaps not surprising that a new scientific body, IPBES, has entered the scene at the same time. Some stakeholders clearly hope that IPBES may yet turn out to be the CBD's IPCC – an external authority that can deliver universal scientific assessments. Others despair that its early development is already mired in contentious politics. One concern is that if it cannot free itself of political trappings, its assessments will not have sufficient authority to close controversies.[52]

The CBD's New and Emerging Issues mechanism has involved engagement largely outside of the possibility of hard law, science, or economics. The next two chapters explore how biofuels and synthetic biology have unfolded in the unique space of the CBD.

[52] See COP 10 side event, The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES): Status, Next Steps, and Implications for the Biodiversity Community. 21 October 2010.

Chapter 3 Biofuels as a New and Emerging Issue.

3.1 Producing biofuels.

Biofuels took the global stage in the late 1990s and early 2000s. Very quickly, they attracted attention and, almost as quickly, controversy. After almost twenty years of global experimentation, biofuels remain controversial. As I wrote the first draft of this chapter in December 2013, I listened to National Public Radio's Diane Rehm as she moderated a discussion on US corn-based ethanol production among representatives of the Environmental Working Group, the Associated Press, the Advanced Ethanol Council, and a bioproducts professor.[53] Discussion was heated, to put it mildly. Every 'fact' invoked was disputed with a contrasting truth claim. They argued over the US Environmental Protection Agency's methods to determine biofuels' greenhouse gas (GHG) emissions, disagreed on the number of acres of cropland diverted for biofuel feedstock, practically accused each other of deliberately lying. This fiery exchange suggests that biofuels are a good case study for examining the role of knowledge politics in the production of governance mechanisms.

The production of biofuels involves more than the physical manipulation of biomass; it requires the enrollment of desires for technical fixes to environmental and political challenges, the active management of criticisms through the production of imaginaries of future sustainable biofuels, and systems of support from States and non-state actors. This first section of the chapter establishes the context for and some of the stakes in the CBD's engagement with biofuels.

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[53] See http://thedianerehmshow.org/shows/2013-12-03/environmental-outlook-debate-over-ethanol-and-future-biofuels (last accessed 2 February 2015).

i. Biofuel types, imaginaries of future generations.

A biofuel is any energy produced from non-fossilized biomass such as plants, straw, food waste, and wood. Biofuels include fuelwood, charcoal, bioethanol, biodiesel, biogas, and biohydrogen – the oldest forms of energy, as well as new innovations. The debate around biofuels at the CBD and most international forums has focused on "modern" biofuels, mostly liquid fuels for use by the transportation sector (SCBD 2007).

Currently, commercial biofuels are almost entirely made from crops planted for dedicated use as biofuel feedstock. These are often referred to as "first generation" or "conventional" biofuels. Ethanol, made from fermented sugar and starch crops, is the predominant form of biofuels globally; the major producers are the USA (from corn) and Brazil (from sugar cane). Biodiesel, made from oil plants and animal fats, is primarily produced in the European Union (IEA 2011). In 2011, the global market for biofuels was $83 billion USD (Gerasimchuk et al. 2012). From 2001 to 2011, world biofuel production increased from 20 billion liters/year to over 100 billion liters/year (HLPE 2013).

"Next-generation" (or "advanced") biofuels play significant roles in national and international policy, despite the fact that almost none of them is commercially available. "Second generation" biofuels use technologies that utilize plants and plant parts that have not yet been commercially viable sources for biofuel, such as cellulose and lignin (Williams et al. 2009). Until a few years ago, cellulosic ethanol (from enzymatic hydrolysis) was expected to be *the* second generation biofuel. As this type has remained on the near-horizon without reaching full-scale commercialization, other methods are now considered as possibly being the keys to launching the second-generation, including methanol-to-gasoline, acid hydrolysis, and Fischer-Tropsch synthesis (HLPE 2013). As opposed to improved technologies for processing traditional feedstocks into fuel, "third generation" biofuels are anticipated to rely on improved feedstock, genetically engineered to be more adaptable for fuel generation. Algae is predicted to be a key third generation feedstock because it potentially takes little land, can grow in wastewater, is edible, and could be an efficient fuel (Nuffield 2011). The term "fourth generation" is sometimes used to indicate the deployment of synthetic biology, as foreign genes and pathways are introduced to produce new feedstocks and new microbes and enzymes for processing (Nuffield 2011; Mackenzie 2013).

Generational labels for biofuel types imply a predictable and sequential unfolding of scientific (and commercial) progress, but the future of biofuels is not at all predetermined. Next generation biofuels exist as imaginaries, as expectations built around current science, commercial promises, and assumptions of how such future objects will interact with the world. As with most technosciences, biofuels have faced cycles of hope, hype, and disappointment (Brown 2003; Felt & Wynne 2007). They have also been unpredictable: commercially-viable second generation ethanol remains stubbornly just out of reach, while the Roundtable on Sustainable Biomaterials (RSB) recently certified as "sustainable" farnsene, which could be described as a fourth generation biofuel, produced in Brazil by the synthetic biology company Amyris (RSB & Amyris 2014).

ii. Drivers and criticisms of biofuel production.

Liquid biofuels for transport were first produced in the late 1800s, but largely abandoned once fossil fuel prices fell in the 1940s (IEA 2011). With the global rise in oil prices in the 1970s, biofuels began to receive State support, particularly in Brazil and the USA. Brazil invested in sugarcane-based biofuels to improve its balance of payments on imported fuel through its PROALCOOL program (HLPE 2013). In the late 1970s, the US Energy Tax Act of 1978 subsidized blending ethanol into gasoline, providing a market for corn-based ethanol. In both countries, biofuel production slumped with lower oil prices (and, in the case of Brazil, higher sugar prices) in the 1980s and 1990s. When global promotion of biofuels surged in the early 2000s, Brazilian and American ethanol industries were well poised to take advantage of new forms of state support (HLPE 2013).

The primary driver of increased global biofuel production since the early 2000s has been national government policies supporting increased biofuel production (FAO et al. 2011). Over the past decade and a half, there have been three major motivations for national and regional policies: the need to reduce greenhouse gases, ideally without changing existing transport infrastructure; a desire to reduce import dependence on oil-exporting countries seen as politically unstable; and the hope that biofuels would provide industrial agriculture with a new demand for agricultural commodities, while simultaneously lifting small-scale farmers out of poverty (Bastos Lima & Gupta 2013). In the early days of the biofuels boom, biofuels were seen as a silver bullet, providing “win-win-win” scenarios - environmental, political, and economic solutions (Dauvergne & Neville 2009; Bastos Lima & Gupta 2013). At the international level, biofuels’ paired promise of economic and environmental solutions aligned with the discourse of ecological modernization popularized through UN processes (Widengård 2011). As biofuels were elevated as solutions to national and global problems, they required support mechanisms to increase their scope and scale. And, as they expanded, biofuels began to attract critical attention.

One of the first major criticisms of biofuels to grab global attention was the impact on food security. In 2006 and 2007, price spikes for staple agricultural commodities led to food riots across the world. The media and many civil society groups blamed biofuels for the higher prices. Studies on the impact of biofuels on commodity prices ranged from the US Bush Administration's estimated 2% to a (leaked) draft World Bank report's 75% increase (Dauvergne & Neville 2009). In 2008, it was estimated that 15% of global corn production and 18% of sugar cane production was used for ethanol and 10% of global vegetable oil production was used for biodiesel (HLPE 2013). Although not marked by riots, debate was reinvigorated in 2010 when commodity prices again rose (Gerasimchuk et al. 2012). In 2011, FAO and nine other intergovernmental institutions, including the World Bank and the WTO, published a policy report on price volatility in food and agriculture markets, finding that government support for biofuels had contributed to higher prices, exacerbated price volatility, and weakened the resilience of markets to external shocks (FAO et al. 2011).

Following closely on the first wave of “food vs. fuel” criticisms, a 2008 issue of *Science* published two reports that significantly brought into question biofuels' reputation as a “green” energy solution. Fargione et al. (2008) introduced the concept of “carbon debt,” the carbon dioxide released over fifty years from the conversion of native habitats to cropland for biofuel feedstocks. They calculated the carbon debts for feedstocks in six different ecosystems, finding that decades – sometimes, centuries – were required to repay the debt. Searchinger et al. (2008) proposed that indirect land-use change (iLUC) might have a major impact on the total greenhouse gas (GHG) emissions of any given biofuel. The phenomenon of iLUC can occur when the former users of land converted to grow biofuel feedstock, such as pastoralists, move on and convert other land (sometimes undisturbed) to their uses (Hertel, Tyner & Birur 2010). Depending on the carbon density of this other land, taking these indirect impacts into account can drastically increase the total carbon and GHG emissions attributed to any given biofuel project. The phenomenon of iLUC is usually considered in terms of GHG emissions, but it could also lead to a greater loss of biodiversity attributed to biofuels (Scharlemann & Laurance 2008).

Some models of biofuel feedstock and production could also directly impact biodiversity and ecosystem services. For example, biofuel processing and feedstock growth requires water. Irrigated feedstock, such as most US corn, requires a lot of water, and a lot of fertilizer and pesticides, which can lead to decreased water quality (Fargione et al. 2010). Particularly in areas that are already water stressed, biofuel feedstock production can exert additional pressure on water systems (Gerasimchuk et al. 2012). Direct land use change is also a concern; tropical forests directly converted into oil palm plantations have particularly captured attention (Koh & Ghazoul 2008; Ruysschaert & Salles 2014).

Another criticism has centered on the negative implications of biofuel production for land security and livelihoods of the most vulnerable. A recent study by Hunsberger et al. (2014) found that case study evidence of livelihood impacts is still thin, but that biofuels' impacts seem similar to other cash crops. As with other “boom crops,” lands under customary tenure lacking formal property rights are more likely to be targeted, people with insecure tenure more likely to be displaced, the jobs generated more likely to be unskilled and insecure (Ibid; Bastos Lima & Gupta 2013). Biofuels have been implicated in the recent global phenomenon of “land grabs”; between 2000-2010, land deals covering at least 71 million hectares were approved or negotiated. The majority of this land is agricultural, and over three quarters of the cross-referenced deals for agricultural land were intended for biofuel feedstock (Anseeuw et al. 2012). While many of these deals have been speculative and not resulted in the production or trade of biofuels, they have still had impacts, weakening local control and access to land and inflating land prices (Anseeuw et al. 2012; Neville & Dauvergne 2012). In many instances where biofuel feedstock projects have been established, the promises of rural economic development remain largely unfulfilled (Gerasimchuk et al. 2012).

It is important to recognize that *all* of these impacts depend on the specific feedstock, the production model, factors such as land tenure and other ownership arrangements, the placement of individuals within the commodity chains, and multiple other political, economic, and material factors (Borras et al. 2010; Hunsberger et al. 2014). The physical scale of biofuel feedstock production plays a significant role in the kinds and degree of ecological, social and economic impacts. Large-scale mechanization is linked to minimal employment creation (HLPE 2013).[54] Industrial plantations are monocrops and thus require more external inputs of fertilizers and pesticides, while it is more possible for small-scale producers to include energy crops as one part of a diverse range of crops (Kuchler & Linnér 2012). In 2007, civil society groups coined the term “agrofuel” to differentiate between small-scale biofuel production for local use and large-scale production through industrial modern agriculture methods (Levidow 2013).

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[54] This is not to say that unmechanized production is without problems; unmechanized large-scale feedstock production, such as Brazilian sugarcane, has been linked to harsh labor conditions (HLPE 2013).

iii. The maintained promise of "win-win-win" solutions.

According to the UN High Level Panel of Experts on Food Security and Nutrition (HLPE), responses to criticisms of biofuels are grounded in two competing narratives: either negative effects will continue to get worse, or technical progress will "radically mitigate" the negative impacts (HLPE 2013, 24). Narratives around next generation biofuels promise to avoid the social, ecological and economic challenges of conventional biofuels, by providing technologies that will produce fuel from waste and create feedstocks that grow quickly and affordably on marginal lands (Koh & Ghazoul 2008; Zarrilli 2010). The Food vs. Fuel controversy will be avoided, as technological innovations will make it possible to tap into the vast resources of under-utilized plant matter and under-utilized lands (Kuchler & Linnér 2012; Levidow 2013).

Policies are being developed based on imaginaries of problem-free (or at least, less problematic) next-generations of biofuels. This approach has not gone uncriticized. The HLPE notes that, "All crops compete for the same land or water, labour, capital, inputs and investment and there are no current magic non-food crops that can ensure more harmonious biofuel production on marginal lands" (HLPE 2013, 18). The International Institute for Sustainable Development cautions that next-generation biofuels may not necessarily be more sustainable, still potentially competing with food crops for inputs and land (Gerasimchuk et al. 2012). Indeed, as near-term next-generation technologies become identifiable, scientific studies are complicating the broad claims to sustainability. A study published in 2014 in *Nature Climate Change* reported that removing (instead of plowing under) corn residue for cellulosic ethanol could decrease soil organic carbon and increase carbon dioxide emissions (Liska et al. 2014). Since cellulosic biofuels were first proposed, ecologists have expressed concern that the very traits aimed for in biofuel feedstocks were shared by the most pernicious invasive species: no known pests or diseases, high water use efficiency, partitioning nutrients to below-ground in the fall, and C4 photosynthesis (Barney and DiTomaso 2008, 69; Raghu et al. 2006). If such feedstocks are successfully developed for biofuel production, there is concern that they could become invasive.

The promise of marginal lands has been countered by social scientists, pointing out the dangers of macro-scale assessments seeking to classify such land. Nalepa and Bauer (2012) warn that such assessments create seemingly “asocial voids” where the “unique, complex histories and ecologies” are de-emphasized and the lands are essentially described as *terra nullius.* The narrative of “marginality” devalues uses that are non-commodified and thus marginal to the global market, obscuring a wide range of land types and uses (Franco et al. 2010; Bailis & Baka 2011). This is particularly relevant in terms of the roles of “developing” countries in producing next-generation biofuels. While the bulk of both “marginal” and available arable land for biomass production is considered to be in developing countries, next-generation technologies will likely involve proprietary technology, higher capital investments, and higher demands on infrastructure logistics and human capital. The HLPE anticipates that second generation technologies will be appropriate in Brazil, which is land-rich and has high investment capacities, but doubts that other developing countries will be able to benefit, either by installing second-generation plants themselves or by providing biomass to second generation plants in Europe (HLPE 2013).

Despite these criticisms and doubts, the imaginary of problem-free next-generation biofuels retains its strength, justifying continued support for conventional biofuels as a necessary step towards advanced biofuels. The promise of next-generations depoliticizes debates on biofuels, implying that any harmful effects are “mere contingencies or deviations that can be avoided through corrective measures” (Franco et al. 2010, 673; Levidow 2013). These imaginaries are based on the naturalized promise of one generation following after another as well as uncertain socio-political contexts, as the meaning of marginal lands remains vague and undefined. Thus, the “win-win-win” narrative around biofuels has persisted in the face of scientific set-backs, normative concerns, and the global financial crisis (Borras et al. 2010).

iv. Landscape of governance of biofuels.

Biofuels governance has been described as still “in its infancy,” having expanded to dozens of different mechanisms but not yet solidified into a cohesive regime (Bailis & Baka 2011, 834).[55] There is great variety among governance instruments, ranging in scale (from sub-national to global), in type (from hard to soft law), in actors (from States to private/public partnerships), and in goals (from a singular focus on greenhouse gases to the broad goal of sustainability). This section gives a brief overview of the types of mechanisms governing the production of biofuels: state support; voluntary codes of conduct and certification schemes; and various forms of international soft guidance and hard law relating to biofuels.

1. State support: targets, mandates, subsidies, tariffs.

States provide different kinds of support for biofuel production. One of the most common is to set mandates, either as the percentage or amount of biofuels to be blended into fossil

[55] Of course, there is no guarantee that biofuels will “grow up” into a cohesive regime.

fuel or as volumetric targets for consumption. As of December 2014, 64 countries had biofuels targets or mandates (Lane 2014). Mandates ensure a market for biofuels, and thus provide stability and assurance to investors (Zarrilli 2010). Subsidies take the form of direct financial support, tax relief and credits, and price support (Zarrilli 2010; Gerasimchuk et al. 2012). High import tariffs on certain kinds of biofuels, such as ethanol, are also used to protect domestic biofuel industries (Zarrilli 2010). Such forms of support improve the competitiveness of domestic production and reduce financial risks for producers.

Globally, biofuel production is highly subsidized; because of lack of government reporting and shortcomings in transparency, it's hard to know the exact amount. The International Energy Agency (IEA) estimates $22 billion USD in subsidies to biofuels in 2010, not including hard-to-quantify policies such as preferential provision of access to land, water and capital (cited in Gerasimchuk et al. 2012). While many developing countries have a comparative advantage in terms of fertile land and appropriate climate, the kinds of financial protection that the US and EU provide to biofuels through subsidies and mandates are out of reach for many developing countries (Doku & Di Falco 2012). The main beneficiaries of subsidies are agribusiness corporations (Gerasimchuk et al. 2012).

As biofuels have attracted criticism, national programs of support have come under attack. Bastos Lima and Gupta describe national policies as “largely disconnected from scientific evidence and processes of international learning” (Bastos Lima & Gupta 2013, 58). Indeed, revisions of government policies have struggled to correct unintended impacts, as seen in this series of examples from the USA, Brazil and the EU. In response to criticisms such as impacts on food prices, the USA revised its mandates to limit conventional biofuels and encourage “advanced” biofuels. As next-generation biofuels kept failing to reach commercially viable status, the determinants for advanced biofuels were recalculated. Initially Brazilian sugarcane-based biofuels did not meet the standard of 50% less GHG emissions than gasoline, but upon re-evaluation, the EPA determined that they did meet the standards. Thus, the USA has begun importing Brazilian sugarcane ethanol to meet its “advanced” mandates and exporting its first generation corn-based ethanol to Brazil (HLPE 2013). In 2003 Brazil rolled out policies to support biodiesel feedstock production among family farms in particular regions of the country, in an attempt to realize the promises of rural development from biofuels. The program has encountered severe difficulties, as dispersed small scale farmers struggle to compete with established large-scale soy producers; almost all Brazilian biodiesel continues to come from large-scale soy production (Hall et al. 2009; Wilkinson & Herrera 2010; HLPE 2013). The EU attempted to adjust its Renewable Energy Directive to take into account sustainability concerns beyond GHG. Initially there was talk of including social aspects such as livelihoods, worker rights, and land tenure, but these were dropped because of concerns they would contravene WTO rules (Franco et al. 2010; Levidow 2013). In late 2012, the European Commission (EC) announced a proposal to deal with iLUC by requiring the determination of iLUC “factors” for each type of biofuel; these factors, however, would not be used in any accounting of GHG emissions, at least until after 2020 (Kretschmer & Baldock 2013; Ahlgren & Di Lucia 2014). The proposal itself is unlikely to be voted on until 2015 (Ahlgren & Di Lucia 2014). The acting EU Directive caps the percentage of “food-crop based” biofuels and requires that biofuels meet some sustainability criteria, but arguably favors stability of investment over seriously addressing social or environmental challenges (HLPE 2013; Levidow 2013).

2. Voluntary hybrid certification schemes and codes of conduct. Biofuels have emerged on the global stage since the 1990s in tandem with the emergence of hybrid governance schemes (Bailis & Baka 2011). Voluntary certification schemes are a common tool of hybrid private/public governance schemes that enroll actors beyond the State. The idea is that consumers will choose products with certified characteristics, and thus exercise their power of consumption to rein in corporations from making unsustainable choices (Fortin 2013). In the case of biofuels, certification schemes have taken on increased importance because the EU Renewable Energy Directive requires a certification of "sustainability" from an approved body (Hunsberger et al. 2014).

Multiple schemes exist in relation to biofuels, including the high-profile Roundtable on Sustainable Biomaterials (RSB, formerly the Roundtable on Sustainable Biofuels) and a number of similar "Roundtables" for specific feedstocks, including palm oil, soy, and sugar. These roundtables are multi-stakeholder initiatives, including energy companies, investors, inter-governmental agencies, producers, and conservation NGOs (Fortin 2013; Hunsberger et al. 2014). The RSB has developed a voluntary certification system for "sustainable" biofuels, with criteria in 12 environmental, social and economic areas.[56] Another voluntary certification system approved by the EC is the International Sustainability and Carbon Certification (ISCC) scheme.[57] The ISCC is more flexible than the RSB in that many of its criteria, such as food security and providing employees with information relating to worker health and safety, are considered "minor musts" which do

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[56] See http://rsb.org/pdfs/standards/11-03-08-RSB-PCs-Version-2.pdf (last accessed 22 February 2015).
[57] See http://iscc-system.org/en (last accessed 22 February 2015).

not all need to be met for a successful certification. Perhaps because of these softer standards and less transparency, the ISCC scheme is used more extensively than the RSB (Hunsberger et al. 2014).

The rise of certification schemes has prompted scholars to investigate whether such voluntary programs can effectively fill "gaps" in global environmental regimes (Gulbrandsen 2004; Darnall & Sides 2008). A common concern is that producers will act as veto-players in the development of certification programs; because their involvement is necessary for the schemes' success, corporations can hold out for less ambitious requirements (Lemos & Agrawal 2006, 313; Scarlat & Dallemand 2008). In a recent overview of biofuel certification schemes, Hunsberger et al. (2014) note persistent problems, including weak attention to social issues and a predominance of "business-friendly" schemes. Furthermore, they find that certification schemes, even ones explicitly aiming for a "strong" version of sustainability, reinforce a large-scale model of production because of barriers to small-scale producers entering the system (Hunsberger et al. 2014). Since the raising of iLUC as an issue in 2008, there has been the question of how certification schemes could take iLUC and other indirect impacts into account. In 2012, the RSB developed a "Low Indirect Impact Biofuels" approach that encourages practices that "decrease the risk of displacement and competition with the food, feed and fiber sectors" but do not involve tracking or measuring iLUC.[58]

3. International initiatives - hard and soft.

Bastos Lima and Gupta note that with biofuels there is a "density of public policies at the national level and a paucity at the international level" (2013, 56). At the global level, the only hard law relating to biofuels is the WTO Agreements. The WTO does not yet have

[58] See: http://rsb.org/activities-and-projects/indirect-impacts/ (last accessed 22 February 2015).

separate rules on biofuels, nor has the Appellate Panel directly spoken to biofuels (Endres 2010). Thus, each specific biofuel and its feedstock is separately included in the WTO's tariff schedules, with different kinds of biofuels treated as different kinds of goods. Ethanol is classified as an agricultural good, and thus is subject to the Agreement on Agriculture. Biodiesel, on the other hand, is produced through a chemical process of extraction and processing of plant oils, and thus is treated as an industrial good with a very different potential range of tariffs and rules (Weiβ 2011). Different classifications impact various aspects, such as the kinds of tariffs that can be set, what sorts of government procurement agreements are allowed, and what subsidies can be offered to feedstock producers. The possibility of consolidating biofuel coverage by WTO Agreements as an "environmental good" has been discussed in the Doha Round of negotiations.[59] This could impact the kinds of issues governments would be allowed to include as standards in mandatory certification schemes – at this point, there is concern that treating imports differently based on, for example, estimated GHG emissions could contravene WTO commitments (Webb & Coates 2012).

The Clean Development Mechanism (CDM) of the Kyoto Protocol to the UNFCCC is a major financial mechanism shaping environmental projects in developing countries. Under the CDM, Annex I (developed countries) can earn Certified Emission Reduction (CER) credits by investing in GHG emission-reducing projects in developing countries (UNFCCC 2013). In 2007, the CDM introduced an approved Methodology for biofuel production to qualify for CERs; today there are four approved Methodologies for

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[59] The Doha Round of negotiations was launched in November 2001. As of February 2015, it is nowhere close to being resolved. See http://www.wto.org/english/tratop_e/dda_e/dda_e.htm (last accessed 5 February 2015).

the production of biofuel for transport: three for biodiesel and one for plant oils.[60] Conditions on qualifying biofuel projects include not allowing cultivation in forests, recently deforested areas, or peatlands, and requiring that biodiesel be produced from waste oil/fat or degraded lands (UNFCCC 2013). Despite initial expectations that the CDM would provide significant support for biofuel projects – and that biofuels would play a significant role in the CDM's portfolio – hardly any biofuel projects have been approved.[61] A major roadblock in approval has been the need to prove actual GHG reduction potential. Data to measure the baseline and project activity of GHG emissions is lacking, and proposed biofuel projects have almost entirely been rejected for failing to prove they are sustainable (in terms of GHG) or have not been financially viable, even with CDM funding (Romero 2011).

Other modes of international governance are largely “soft.” A number of multilateral agencies and country coalitions have worked to develop common technical standards in order to aid the commoditization of biofuels, including the Global Bioenergy Partnership (GBEP, founded at a G8+5 summit), the IEA of the Organisation for Economic Co-operation and Development (OECD), and the International Biofuels Forum led by Brazil (Bastos Lima & Gupta 2013). Different agencies, programmes and committees within the UN system have published on biofuels with a focus on sustainable development. UN Energy is meant to coordinate all work within the UN on renewable energy, but this has been weak; Bastos Lima and Gupta refer to biofuels regulation within

[60] Plant oils are produced from the same kinds of plants as used for biodiesel, but the oil is not processed to transesterification. The approved methodologies are: AM0089 (2010); ACM0017 (2009 – replacing AM0047 from 2007); AMS-III.T (2007); AMS-III.AK (2010).
[61] As of early February 2015, there are only two biofuels for transport projects registered under of the CDM – a biodiesel project in China and a plant-oil production project in Paraguay. See http://cdm.unfccc.int/Projects/projsearch.html (last accessed 2 February 2015).

the UN as “scattered and *ad hoc*” (2013, 53). In 2008, the UN Food and Agriculture Organisation (FAO) convened a “High Level Conference on World Food Security: the Challenges of Climate Change and Bioenergy.”[62] Despite initial expectations that world leaders would agree on a collective approach to governing biofuels, the Conference merely passed a Declaration calling for assistance to food insecure countries, increased investment in agricultural research and development, and further studies on biofuels and food security (HLCWFS 2008).

Since then, UN bodies have made increasingly strong statements regarding the impact of biofuels on food prices. The High Level Panel of Experts of the Committee on World Food Security called for “the abolition of targets on food based fuels, and the removal of subsidies and tariffs on biofuel production and processing” (HLPE 2011, 13). The office of the UN Special Rapporteur on the Right to Food has been used, first by Jean Ziegler (2007) and then by Olivier De Schutter (2013), to consistently highlight the negative impacts of biofuels on the right to food. The 2011 report by eleven international agencies and organizations on biofuel productions’ impacts on global agricultural prices described removal of government subsidies and mandates for biofuels as the “most efficient” option, and suggested international policy coordination and harmonization (FAO et al. 2011). Such reports and statements, however, do not seem to be reflected in or have changed national policies.

In examining the existing international system for biofuel governance, Bastos Lima and Gupta declare: “It is hard to say that any of those bodies govern biofuel expansion in any meaningful way” (2013, 56). Regarding the lack of coordination or influence of international bodies, they note: “A sort of centrifugal force is emerging from

[62] See: http://www.fao.org/foodclimate/hlc-home/en/ (last accessed 22 February 2015).

the nation-state and spiraling outwards to the international level" (Ibid, 58). They call for greater global biofuel governance to effectively address social issues of access, allocation, and environmental sustainability.

v. Knowledge politics and the "sustainable" biofuel.

Much of the global debate on biofuels centers on the framing and authority of knowledge claims. For example, there is no scientific or political agreement on how best to measure the environmental or social impacts of biofuels, particularly the indirect impacts. Calculating the negative impacts of iLUC is "extremely difficult and fraught with uncertainty" (Nuffield 2011, xxi). The impacts and extent of iLUC cannot be directly observed, and thus scientists and policy-makers are reliant on models – which display an incredibly broad range of estimated annual GHG emissions because of differences in starting assumptions and model design and resolution (Di Lucia, Ahlgren & Ericsson 2012). Governments and private certification schemes invoke these intractable indeterminacies as preventing the establishment of any responsive governance mechanisms.

Other uncertainties, however, are integral in maintaining the promise of an eventual "sustainable" biofuel, thus justifying the continued production of current generation biofuels. "Marginal lands" lack a political or scientific definition. This vague concept taps into a narrative rooted in global assessments of the 1970s that claimed to identify unused resources of land in developing countries (Nalepa & Bauer 2012). Land in areas such as sub-Saharan Africa was framed as empty and underutilized, just waiting to be accessed with the proper tools and knowledge (Nalepa & Bauer 2012; Neville & Dauvergne 2012). High-level considerations of the impacts and possibilities of biofuels rely on “marginal lands” to invoke vast possibilities for biofuel feedstock production without social or environmental harm. Marginal lands are made meaningful by the promise of next-generation biofuels that will be able to produce and process feedstock grown in non-ideal conditions. This narrative draws force from an uncertain future: “Upstream solutions are thus promised for downstream problems, without having to take the details and socio-political dynamics of the downstream problems into account” (Felt & Wynne 2007, 25).

How biofuels have been defined has shaped their development. Biofuels encompass many possible production models, from harvesting hedgerow oil crops to following agro-ecological practices of co-planting energy and food crops, from the many current technologies for processing to speculative future technologies, from policies focused on local problems and solutions to those intended to have national and even global impact. Yet, as of 2011, 99.85% of biofuels produced and consumed were first generation, almost entirely produced using modern agro-industrial methods on large-scale farms and plantations, from biofuel feedstocks that were already globally traded commodities as food or industrial products (Bailis & Baka 2011; Bastos Lima & Gupta 2013, HLPE 2013). This is because almost all governance schemes for biofuels prioritize increased production and consumption of *global* biofuels, favoring large-scale models of feedstock production intended for the global market.

Industrial agriculture, energy, and national security make for high political stakes associated with biofuels. As discussed in the next session, biofuels at the CBD have triggered contentious debate, including how to draw boundaries around the issue at hand, what sources and types of knowledge are appropriate, and the proper framings of and responses to uncertainties.

4.2. Biofuels at the CBD

Since 2007, the CBD's permanent bodies have engaged with biofuels and their implications for biodiversity. This section examines the knowledge politics of this engagement, focusing on COP 10.

i. Introduction of biofuels to the CBD.

As described in Chapter 2, the SBSTTA Bureau and Secretariat initially proposed biofuels as a potential NEI to SBSTTA 12 (2007) as a way to "try out" the new mechanism (Secretariat interview 2013). At the time, biofuels were just starting to attract critical attention, and no UN body or other international organization had seriously engaged with their implications. "Global" biofuels were a relatively new and emerging phenomenon, but they connected with long-standing concerns of the CBD, including agricultural biodiversity, land use, the sustainable use of forests, and the impacts of subsidies.

This complex of issues around biofuels includes some of the most contentious in the CBD's history. Forests, for example, have been a sticking point in international decision-making since the 1992 Rio Convention, when the EU pushed for legally binding action on forests, the US announced a multimillion dollar package to protect forests, and the G77 blocked all references to a possible global convention on forests (McConnell 1996).[63] Many of the countries with forests saw their forests as valuable resources for

[63] Delegates at the Rio Convention ultimately agreed to the "Non-legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of all Types of Forests" (UNGA 1992).

economic development and trade, and any international mechanism on forests as an intrusion on national sovereignty. Other countries, led by the EU, saw forests as exemplars of the crisis of biodiversity loss and failures of good governance (Arts & Buizer 2009). After years of negotiations, the UN Forum on Forests (UNFF) passed an instrument in 2007 - the "Non-legally Binding Instrument on All Types of Forests," but this soft agreement does not resolve many of the fundamental disagreements (Kunzmann 2008). These tensions have found expression at the CBD, where some Parties have repeatedly questioned the CBD's role on forests (McConnell 1996). At COP 4 in 1998, the COP adopted a programme of work on forest biodiversity (Decision IV/7). Yet ten years later, at SBSTTA 13, one of Brazil's objections was that the UNFF was the *sole* forum for international forest policy, and that the role of the CBD under the programme of work on forest biodiversity was still not "defined" (Appleton, Chiarolla et al. 2008a, 10). Agricultural biodiversity has been another area of controversy at the CBD, providing the context for the treaty's "de facto moratorium" on GURTs (Decision V/5; Decision VIII/23).

Other issues have been sensitive enough that Parties have rarely addressed them in the context of the CBD. Global land use coordination or management had not been directly addressed by the CBD prior to biofuels, although some commentators had noted the treaty's potential coordinating role (Swanson 1996). Similarly, CBD Parties shied away from addressing incentive measures harmful to biodiversity such as subsidies for a long time, before settling on Aichi Target #3, which calls for them to be "eliminated, phased out or reformed" by 2020.[64]

In this context, some delegates treated the introduction of biofuels as a natural

[64] See http://www.cbd.int/sp/targets/rationale/target-3/ (last accessed 2 February 2015).

step for the CBD, while others treated it as unnecessarily wading into murky waters, stirring up controversies better avoided. By COP 10, the CBD had engaged with biofuels for four consecutive years, through three meetings of the SBSTTA, two meetings of the COP, an electronic forum on biofuels, three regional workshops (Latin America and the Caribbean, Asia and Pacific, and Africa), and many Secretariat documents. Each new round of discussion sparked contentious debate and seemed to further entrench positions. Major points of disagreement included the proper role of the CBD in international governance of biofuels, the scope of the definition of "biofuels," appropriate sources of information, and whether and how to apply "precaution" (see Table 2 in Appendix). Over time, the kinds of potential mechanisms under discussion had become softer, from developing biodiversity-specific certification standards (SBSTTA 13), to voluntary guidelines for industry (COP 9), to voluntary "toolkits" with unspecified target audience (SBSTTA 14). None of these mechanisms had been agreed upon.

Up till COP 10, the COP had restricted the Secretariat and the SBSTTA to information-gathering steps, such as convening regional workshops and researching tools relevant to sustainable production and use of biofuels. It was understood that these activities would prepare for COP 10 to actually decide on concrete "ways and means" to promote the positive and mitigate the negative impacts of biofuels on biodiversity (Appleton, Jungcurt et al. 2008a). SBSTTA 14 had also introduced bracketed text calling on Parties to prevent the environmental release of living organisms produced by synthetic biology (Recommendation XIV/10). Although the main focus of COP 10 was expected to be on the strategic plan, financial issues, and the protocol on access and benefit-sharing, biofuels were one of the "climate troika" (REDD+, biofuels, and geo-engineering) anticipated to be “hot” at COP 10 (Jungcurt et al. 2010b).

ii. Biofuels at COP 10.

Table 1 lists the relevant formal negotiation sessions and side events relating to biofuels that I or another CEE team member attended. The agenda item of Biofuels and Biodiversity was introduced in Working Group I (WGI), at which representatives of all Parties could be present and make official statements. As with many agenda items, the chair of WGI felt that a smaller setting was needed to work through textual changes, and named negotiators from Canada and Colombia as co-Chairs of a Contact Group on Biofuels. Through the Contact Group, a smaller number of interested Parties and observers met on the margins of the COP to develop a draft text for the consideration of the Working Group. The Contact Group initially met the evenings of Thursday and Friday of the first week (October 21 & 22), working on the basis of the SBSTTA 14 Recommendation as revised by the Secretariat after the initial Working Group interventions (referred to as the “non-paper”). Because limited headway was made on the “brackets,” that weekend the Co-Chairs produced a new draft recommendation. That Monday, however, the Africa Group, Philippines and Norway rejected the Co-Chairs’ draft as the basis for negotiations, and the Contact Group went back to the non-paper. As the end of the COP approached, the Contact Group transitioned to a Friends of the Chair group, but remained open to all interested negotiators and observers. A draft text was sent to WGI with brackets around language on which agreement hadn't been reached. The final WGI session removed all brackets; the text sent to and approved at Plenary was “clean.”

Table 1: biofuel-related events attended at COP 10

Negotiations	**Working Group I –** October 21 & 28
	Contact Group – October 21, 22, 25, & 26
	Friends of the Chair – October 27
Side events personally attended	**ETC Group**: Synthetic Biology: Extreme Genetic Engineering – October 18
	Global Forest Coalition, Econexus, Friends of the Earth Brazil: Biodiversity and Climate – October 21
	ETC Group: Terminator Technology – October 25
	Bioversity and UNEP/GEF: Securing sustainability through the conservation and use of agricultural biodiversity – October 19
	OECD: Recent OECD Work on Economic Aspects of Biodiversity – October 29
	World Business Council for Sustainable Development: Effective Biodiversity and Ecosystem Policy and Regulation- Business Input to the CBD – October 25
Side events attended by other CEE members	**Rio Conventions' Ecosystems Pavilion:** Ecological and Economic Foundations: Key Messages – October 25 (Dan Suarez's notes)
	Netherlands Ministry of Agriculture, Nature, and Food Quality: Analysis of the biodiversity effects of different policy options. A contribution to the TEEB report – October 20 (Dan Suarez's notes)
	CBD Secretariat: GBO 3 (Global Biodiversity Outlook) – October 20 (Lisa Campbell's notes)

In the formal negotiations, delegates continued to address controversies that had been raised in earlier debates: whether the CBD should develop a toolkit providing guidance on biofuels and biodiversity; whether biofuels should also be considered within the work programme on forest biodiversity; and whether and how to invoke the precautionary approach. New issues since COP 9 included: issues of land tenure security, water security, and other resources; whether to urge countries to develop inventories of ecosystems appropriate (or inappropriate) for the production of biofuel feedstocks; and how to respond to the use of synthetic biology for biofuels. The next sections focus on how such controversial issues were addressed through claims centered on knowledge.

1. Setting the scope.[65]

Governing bodies often "render technical" their objects of governance, explaining problems in terms that fit the solutions they are able to provide (Li 2007; Ferguson 1994; Escobar 1995). In defining biofuels and thus the scope of the Biofuels Decision, delegates often framed contentious issues as solvable without having to resort to political debate. This section describes two approaches used - framing disputes as having "logical" solutions, and relying on formal CBD text to close controversies – and one approach not used by Parties, that of engaging with the scale of biofuel production and use.

A. Rendering the political logical.

Brazil consistently argued throughout COP 10 for a narrow scope to the Biofuels Decision, offering reasons that the delegation was careful to frame as *not* political. For example, for "logical" and "technical" reasons, Brazilian delegates stressed that the Biofuels Decision should only address aspects entirely unique to biofuels.[66] Brazil used the example of the risk of introduction of invasive alien species, which it did not want referenced in the Biofuels Decision. Like most current-generation biofuel feedstocks, oil palm is a "flex crop," with multiple potential uses as food, feed, fuel, and industrial material (Borras et al. 2012). Brazil acknowledged that oil palm could be an invasive alien species in certain instances, but argued that oil palm should not be regulated differently if intended for biofuels rather than cosmetics or food. The Biofuels Decision should not send a message to national governments that crops for biofuels required a

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[65] This section draws heavily on Scott et al. (2014). I was the primary author, but the text benefited greatly from feedback and some drafting by my co-authors, particularly Sarah Hitchner.
[66] COP 10, Contact Group (CG) and Friends of the Chair (FtC), 26 & 27 October 2010.

different assessment of risks than if the same crops were grown for other “end uses” – and, therefore, the Decision should not address any challenges not unique to biofuel feedstock production.[67]

One Party delegate countered this argument by politely offering that, if the risk of invasive biofuel feedstocks was not unique to biofuels, it should be mentioned in not only the Biofuels Decision but also the Decision on Invasive Alien Species (IAS) and all other relevant COP Decisions.[68] Otherwise, delegates largely sat back and did not respond to this particular line of logic.

Brazil had some success with this argument. In the final Biofuels Decision, the potential of biofuel feedstocks to become invasive is relegated to a brief mention in a preambular paragraph.[69] But the Decision on IAS did ultimately include a reference to IAS in “agricultural and biomass production, including biofuel feedstocks” (Decision X/38, para. 6). And though Brazil's “only what is unique” argument could have shifted discussion of *most* impacts of biofuel feedstock production entirely out of the Biofuels Decision, it did not. Indirect land use change, food and energy security, and land tenure and resource rights remained within the operative text as issues demanding political responses (although, as will be discussed, the text has little to say on what those political responses should be). Other Parties simply refused to respond to Brazil's “logical” argument, referencing their *political* mandates to address these issues at the COP in the context of biofuel production.[70]

B. Rendering the political legal.

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[67] COP 10, FtC 27 October 2010.
[68] COP 10, CG, 27 October 2010, Switzerland.
[69] COP Decision X/37 preambular para. 4.
[70] COP 10, CG & FtC, 26 & 27 October 2010.

More effective than logic was using former COP Decision language to end arguments. In the context of the CBD, COP Decisions have unspecified but limited legal power to commit States to obligations. Decisions do act as official interpretations of the Convention text although, as discussed in Chapter 2, there are no mechanisms in place to ensure consistency among COP Decisions. As the following three vignettes demonstrate, formal text has another kind of power in the context of a COP – the power to close down political controversies.

Land (tenure) security.[71]

Biofuel production has been linked to the displacement of people with insecure or customary land tenure (Bastos Lima & Gupta 2013; Hunsberger et al. 2014). Land (tenure) security was thus seen by some delegations as a vital aspect of the Biofuels Decision. Deliberations on land (tenure) security pitted different kinds of authoritative sources against each other. A number of Parties insisted on the inclusion of land (tenure) security on the basis of their country's historical experience. Ghana explained their concern as based on "several examples in land use history in Africa – where decisions and people are left poorer after outsiders [come in]."[72] Later, speaking for the Africa group, the same delegate elaborated that the term "land security" was necessary because of the many situations where outside investors to Africa get land, make a profit as long as it is viable, and then leave without "managing the after-project."[73] Similarly, the Philippines explained that, in their experience, biofuels production led to violations of

[71] The final language is "land tenure and resource rights," but before this final term was decided, delegates argued for many variations, including "land tenure," "land security," "land tenure security," and "land tenure rights." COP 10, WGI, 21 October 2010; COP 10, CG, 21 & 26 October 2010; COP 10, FtC, 27 October 2010.
[72] COP 10, WGI, 21 October 2010.
[73] COP 10, CG, 26 October 2010.

their strict land rights laws.[74] Jamaica was less explicit, but noted that land security was "extremely relevant" to small island states.[75]

Rather than basing their arguments on experience, delegates who did not want to see the inclusion of land (tenure) security argued on the basis of the legal scope of the Convention and the lack of agreed international language on the issue. New Zealand wanted to delete all references to land security, as it "expands the scope of the Convention beyond what we feel is possible."[76] Argentina said that when it came to land security, there was "no real definition in a consensual way on the international level."[77] Brazil agreed that land tenure wasn't a "well defined" issue[78] and offered alternative language agreed upon in the context of the FAO: "access to land."[79]

In a much earlier Contact Group session, an EU delegate had pointed out language on "land tenure and resource rights" from earlier COP decisions.[80] At the time, this prompted discussion on whether "rights" needed to be more clearly associated with "land tenure," seeming to accept the inclusion of the term "land tenure." But in subsequent sessions, land tenure kept coming up as a problematic issue, because of the lack of "international agreement."[81] The debate was resolved in WGI by Switzerland suggesting language from a previous COP decision: "Land tenure and resource rights, including water."[82] This invocation of CBD COP language had not been sufficient in Contact Group or Friends of the Chair to close the controversy. But in the more public

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[74] COP 10, CG, 26 October 2010.
[75] COP 10, WGI, 21 October 2010.
[76] COP 10, WGI, 21 October 2010.
[77] COP 10, WGI, 21 October 2010.
[78] COP 10, CG, 21 October 2010.
[79] COP 10, WGI, 28 October 2010.
[80] COP 10, CG, 26 October 2010.
[81] COP 10, CG, 26 October 2010; COP 10, FtC, 27 October 2010.
[82] COP 10, WGI, 28 October 2010.

Working Group forum, Brazil conceded to the Chair's exhortation that it was "always helpful to revert to language from agreed COPs!"[83]

The positive impacts of biofuels on biodiversity.

Another example of the reliance on formal language to close controversies can be found in the phrase "promote the positive and minimize or avoid the negative impacts of the production and use of biofuels on biodiversity." First introduced at the 2008 COP 9, the phrase has been used in all subsequent CBD work on biofuels. In the final COP Decision X/37, the phrase is used nine times in less than four pages. During the negotiations, the phrase was taken as a given, with negotiators regularly not completing the phrase and gesturing to the Secretariat staff to include the "usual" language.[84]

The phrase illustrates a two-sided identity to biofuels: as protectors and perhaps even enhancers of biodiversity as well as threats to and destroyers of it. But at COP 10, the negative side got almost all the attention, as the "positive" aspects of biofuels played a very minor role in the negotiations. Of the 26 opening statements on biofuels made in WGI, only three Parties directly mentioned benefits from biofuels. Brazil and South Africa (on behalf of the Africa Group) referenced the potential contribution of biofuels to rural areas; Brazil pointed to modern bioenergy's ability to prevent deforestation by replacing "unsustainable traditional biomass"; and Canada broadly claimed that it "believes biofuels can be produced in ways to protect environment and economy."[85] Some Parties did not identify specific positive benefits, but criticized the SBSTTA

[83] COP 10, WGI, 28 October 2010.
[84] There were numerous examples of this at COP 10, CG, 26 October 2010.
[85] COP 10, WGI, 21 October 2010 (and for the next five footnotes referencing the WGI opening statements).

Recommendation as too negative.[86] Most Parties, however, dwelt at length on biofuels' negative impacts, from their invasive potential[87] and increased risk of desertification,[88] to negative impacts on socioeconomic conditions such as reduced water,[89] land,[90] and food security.[91]

Those few positive opening statements in WGI were the only times within the formal negotiations that our CEE team heard explicit mention of positive impacts of biofuels on biodiversity. The final text displays a relative balance acknowledging beneficial and negative impacts,[92] but negotiation at COP 10 was focused on debating the negative impacts only. We left COP 10 unenlightened as to what specifically was meant by the "positive impacts" of biofuels on biodiversity.

The answer is in the texts. COP Decision X/37 starts by "recalling...Decision IX/2." Decision IX/2 recognizes the "potential contribution" of sustainable production and use of biofuels to the 2010 CBD biodiversity targets, the promotion of sustainable development, the improvement of rural livelihoods, and the achievement of the Millennium Development Goals (preambular para. 3). *How* they contribute to these targets is unspecified, but Decision IX/2 does "tak(e) into account" the 2007 SBSTTA discussions reflected in Recommendation XII/7. Recommendation XII/7 actually contains a list of potential positive impacts, including: reduction of fossil fuel consumption; decreased land used for agriculture because of increased energy outputs;

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[86] In WGI opening statements of: Argentina, Japan, and Paraguay.
[87] In WGI opening statements of: Fiji (on behalf of the Pacific Island States), Jamaica, Algeria, the EU, Norway, and three civil society interventions.
[88] In Algeria's WGI opening statement.
[89] In the WGI opening statements of: the Bolivarian Alliance for the Americas (ALBA – Cuba, Venezuela, Ecuador and Bolivia) and Norway.
[90] In the WGI opening statements of: Tanzania, Ghana, Jamaica, the ALBA group, and Papua New Guinea.
[91] In WGI opening statements of: Dominican Republic, Ghana, Algeria, the ALBA group, Papua New Guinea, and Botswana.
[92] See COP Decision X/37 preambular paras. 4, 5, and 6.

decreased land abandonment and conversion of agricultural land to other uses; and an increased income base for farmers and forest owners and rural areas (para. 3(b(i, ii, iv, & v))). Also included are potential changes to agricultural production that do not seem necessarily related to biofuel production but could be a positive direction, such as reduced management inputs, increased crop diversity, the restoration of degraded lands, and reduced pesticide, fertilizer, and water use (para. 3(b(iii))).

Perhaps with the exception of Brazil, Parties at COP 10 did not argue that biofuel production had *yet* resulted in any of those potential positives. In side events, the promises of biofuels' positive impacts were directly challenged, not only by critical CSO groups such as the ETC Group and Friends of the Earth US, but also by research organizations portraying themselves as politically neutral. In sessions on TEEB (*The Economics of Ecosystem Services and Biodiversity* reports) and a Secretariat-organized session on GBO 3 (the *Global Biodiversity Outlook* report), biofuels were used as examples of the insight and power of modeling. The TEEB model was used to describe several "scenarios" for future biodiversity loss. In two different sessions, Ben ten Brink (the TEEB modeler from the Netherlands Environmental Assessment Agency) referenced biofuels as having been an assumed solution but, as shown by their model, actually worsening biodiversity loss.[93] At the session on GBO 3, Jo Mulongoy, then-CBD Principal Officer of Scientific, Technical and Technological Matters, explained the value of the GBO's use of "scenarios" by referencing how their scenario modeling showed that biofuels, once thought a solution, were actually bad for biodiversity.[94] More generally, since the 2007 SBSTTA Recommendation, the challenges of indirect land use change

93 COP 10, side event by Netherlands Ministry of Agrriculture, Nature, and Food Quality, 20 October 2010; COP 10, side event by Rio Conventions' Ecosystem Pavilion, 25 October 2010.
94 COP 10, side event by Secretariat of the CBD, 20 October 2010.

(iLUC) and "land grabbing" had been raised. The environmental benefits of replacing fossil fuels with biofuels were brought into question by iLUC, potentially linking biofuel production to widespread biodiversity loss and increased GHG emissions (Searchinger et al. 2007). An anticipated positive impact of biofuels, increased value of agricultural land, had revealed a darker side, identified as a driver of land grabs – large scale investments in agricultural land that often violate ILC rights (HLPE 2013). Both such potential impacts are inherently difficult to reliably track or measure and are very controversial at the international level.

Decision X/37 gives no indication, however, that any of the potential "positive" impacts identified in 2007 may have shifted or been brought into question. Parties relied on "promote the positive," even if what this formulaic language signified had changed.

Agriculture vs. Forests

Formal COP language was not always used as the last word. Brazilian delegates argued that the mandate for the COP 10 biofuel negotiations came from the Decision IX/2, "Agriculture and Biodiversity—Biofuels and Biodiversity," which specifically situated the issue within *agriculture*, and thus must exclude forest resources and other sources of biomass.[95] Whether forest biodiversity was relevant to biofuels had been contentious from the CBD's first look at biofuels. At SBSTTA 12 in 2007, whether the scope of "biofuels" included forms of bioenergy other than liquid fuels for transport, such as wood chips for heating or traditional uses of biomass, was seen as key to whether forest biodiversity would considered in relation to biofuels (Appleton, Chiarolla et al. 2008a). As it has across all UN forums, Brazil has pushed to narrow the CBD's work on forests to restrict any international authority over its domestic forests (McConnell 1996). Instead of

[95] COP 10, WGI, 21 October 2010; COP 10, CG, 22 October 2010.

clearly defining the scope, the final SBSTTA 12 Recommendation suggested that the Secretariat identify options for consideration of biofuels, “including” in the work programmes of agriculture and of forests (Recommendation XII/7 para. 2(c)). The COP 9 Biofuels Decision title had been interpreted as placing the issue of biofuels within the CBD’s Programme of Work on Agricultural Biodiversity. At COP 10, Brazil made the case that this meant forest biodiversity was excluded.

The EU,[96] the Africa Group,[97] Norway,[98] and NGOs such as the Federation of German Scientists[99] countered this argument with the substantive concern that “agriculture” left out forests, plantations, and biomass more generally. They argued that ignoring the consequences of increased biofuel production on both natural and planted forests would skew calculations of the environmental effects of biofuels, such as decreased forest biodiversity or increased water use and pollution. Even if the previous COP decision explicitly situated biofuels within agriculture, Norway argued that the COP was politically entitled to change this framing.[100]

The final title of Decision X/37 is “Biofuels and Biodiversity.” Thus, Brazil failed in its goal to clearly define biofuels as objects of *only* agricultural biodiversity. On the other hand, the actual text contains only one oblique reference to forests, that the Secretariat should take Decision IX/5 2(b) (on the use of forests for biomass) into account when working with relevant partner organizations.[101] COP 10 reopened the agriculture/forest debate to allow for the possibility of considering forests, but left it

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[96] COP 10, WGI, 21 October 2010; COP 10, CG, 22 October 2010.
[97] COP 10, FtC, 27 October 2010.
[98] COP 10, CG, 22 October 2010.
[99] COP 10, CG, 21 October 2010.
[100] COP 10, WGI, 28 October 2010.
[101] COP Decision X/37 para. 13, CBD 2011.

open, without clear resolution.

C. Scale: the elephant (not) in the room?

A characteristic of biofuels *not* used at COP 10 to restrict or clarify the scope of engagement on biofuels was the scale of biofuel production and use. Yet, most significant impacts – both negative (such as reduced land, food, and water security because of extensive resource use) and positive (such as increased energy security and decreased greenhouse gas emissions by replacing the use of fossil fuels) – are notable only at large scales of production. Scale – both in terms of the size of individual plantations and in the aggregate global impacts of production – has a decided influence on the scope of biofuels' impacts.[102] Hunsberger et al. (2014) have noted that large-scale feedstock production more often displaces landless persons and informal tenure holders. The UN High Level Panel of Experts on Food Security and Nutrition has noted the role of biofuels in driving domestic and foreign large-scale investments in land, often termed "land grabbing," and in impacting global food availability (HLPE 2013).

In my interviews with CBD Secretariat staff members, three different interviewees identified scale unprompted as a vitally important issue in understanding the potential impacts of biofuels on biodiversity (Secretariat interviews 2012, 2013). One noted that the scale of aggregate production was the only reason why indirect impacts were the key issue of biofuels (Secretariat interview 2012).[103] Another noted that biofuels are not inherently any more ethically or environmentally problematic than strawberries; that if the EU was to declare that all fruit salads must contain 20% strawberries, it could

[102] For example, small-scale production of known or potentially invasive alien species as biofuel feedstock could have large-scale impacts if the plant becomes invasive. Small-scale production could also potentially have positive rural impacts such as increased local energy security and local economic benefits.

[103] The interviewee referred to indirect impacts beyond land use change, including changes in the use of other resources such as water and fertilizer.

be a similar situation of unintended impacts related to such a mandate's scale (Secretariat interview 2013). Although scale was not explicitly stated, one interviewee's examples of "sensible" biofuel production models were all small-scale – integrated small-scale crops and the (usually small-scale) use of waste cooking oil (Secretariat interview 2012).

In the opening statements of WGI, the Global Justice Ecology Project called for a moratorium on large-scale biofuel development[104]; this was the only time I or my team witnessed the invocation of scale in the formal negotiations. In side events, CSO representatives often talked about the problems of large-scale production of biofuels, particularly in terms of the implications of a global "bioeconomy" based on biomass.[105] These perspectives did not enter the formal negotiations, however, and scale is not present as a meaningful criterion in the COP 10 outcomes on biofuels. As much as delegates attempted to narrow the scope of consideration of biofuels' characteristics and impacts, scale was not one of the proposed criteria for doing so. Thus, throughout the discussions, the full range of potential biofuel feedstocks and production methods was invoked by the term "biofuels," from harvesting a single hedgerow of Jatrophia to establishing an oil palm plantation. Scale goes unacknowledged in every CBD COP Decision on biofuels (Decisions IX/2, X/37, & XI/27).

2. Sources treated as authoritative knowledge.

Interviewees have framed the CBD's work on biofuels as a matter of politics winning out over science, of negotiations 'hijacked' by the geo-politics of biofuels (Secretariat interviews 2013; Observer interview 2013). At the COP 10 biofuel negotiations, tensions between political interests repeatedly surfaced in the form of disputes over the authority

[104] COP 10, WGI, 21 October 2010.
[105] COP 10, side event by ETC Group, 18 October 2010; COP 10, side event by Global Forest Coalition, 21 October 2010; COP 10, side event by ETC Group, 25 October 2010.

of sources of knowledge.

A. Performances of expertise.[106]

As discussed in chapter 2, the CBD text acknowledges and values traditional knowledge, and the treaty bodies have historically recognized the political nature of modern scientific knowledge. In practice, though, those involved with the treaty struggle to incorporate traditional and other non-scientific or technical knowledges. In developing the CBD text, negotiators relied heavily upon legal knowledge and other forms of "technical" knowledge found in scientific and administrative domains; traditional knowledge was regularly invoked but rarely used in this process (Guay 2002). In the synthetic biology portion of the biofuel negotiations, other types of knowledge were occasionally invoked, but delegates often relied on the authority of "expert" knowledge. When delegates challenged classic lines of authority, they did so by expanding or contracting *who* counted as an "expert," rather than trying to establish authority on other grounds.

SBSTTA Recommendation XIV/10 included two bracketed paragraphs addressing synthetic biology: 1) to convene an ad-hoc technical expert group on synthetic biology and other next-generation biofuel technologies, and 2) urging that "living organisms produced by synthetic biology are not released into the environment until there is an adequate scientific basis on which to justify such activities and due consideration of the associated risks."[107] These bracketed paragraphs were broadly understood as expressing skeptical and cautious positions, focused more on avoiding negative impacts than promoting positive impacts. The second paragraph was seen as a "de facto moratorium" on the environmental release of organisms produced by synthetic biology, like the COP 9

[106] This section draws from and significantly expands upon Scott et al. (2014).
[107] Paragraphs [14] and [16].

ocean fertilization "moratorium" (Decision IX/16(C)).

Discussions on whether and how the Biofuels Decision should address synthetic biology revolved around claims of authority to speak on the subject. Developed country delegates claimed expertise on behalf of their governments, but simultaneously denied personal expertise. The EU delegates argued that synthetic biology should not be in the Biofuels Decision for two main reasons: their legal experts had not yet decided whether organisms resulting from synthetic biology were the same as "living modified organisms" (LMOs, as per the CBD and Cartagena Protocol); and their "experts" reported that synthetic biology was *not yet* being used to produce biofuels.[108] Similarly, the New Zealand delegate reported having flown to her capital over the weekend and been told (in person, apparently) by *her* experts on synthetic biology that there were no current applications of synthetic biology for biofuels.[109] Throughout the discussions on synthetic biology, the co-chairs and the EU delegate threw in comments "I'm not a scientist!" and "I'm no expert!" Late one night, the Canadian co-chair wearily urged delegates to compromise on language acknowledging the "dynamic nature of research," observing "I don't know that any of us are scientists that are really competent in synthetic biology."[110]

Near the beginning of the Contact Group sessions, the Philippines delegate answered these claims of distant experts by declaring personal knowledge that "there *is* a rapid development of biofuels in my country....And the Philippines government is grappling with first generation biofuels, and we have now development of the second, third and soon to be the fourth generation biofuels, and synthetic biofuels is somehow

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[108] COP 10, CG, 26 October 2010. "Living modified organisms" (LMOs) is a term developed by the CBD, intended to include genetically-modified organisms (GMOs) resulting from modern biotechnology as well as organisms resulting from traditional techniques such as breeding (Mackenzie et al. 2003).
[109] COP 10, CG, 26 October 2010.
[110] COP 10, CG, 26 October 2010.

developing in our country."[111] This personal claim of knowledge gained little traction, however. The next day, the Philippines delegate shifted her tactics; like the EU, New Zealand, and other developed country delegates, she based her authority on distant experts. She reported that she had checked with "technical experts back in Manilla," and *they* said that synthetic biology companies were engaged in or close to biofuel production.[112] She also asserted authority by providing legal analysis, noting that organisms resulting from synthetic biology did *not* necessarily fall within the Cartagena Protocol's definition of LMOs.[113]

Another approach to expertise was to note that *everyone* lacked it when it came to synthetic biology. Advocates of a moratorium noted the universal lack of knowledge about synthetic biology's impacts on biodiversity and related issues. A representative of the Africa Group noted that "technology is moving very fast" and, in order to "keep pace with technology in our decisions we draft in here," called for a moratorium on environmental release until environmental and social impacts were better understood.[114] The Friends of the Earth (US) delegate, speaking for the ETC Group, Greenpeace, and Friends of the Earth (US, Brazil, Paraguay and Switzerland),[115] used the same argument, pointing out the lack of research on environmental or social impacts and the potential for novelty.[116]

Contending claims of expertise on synthetic biology and biofuels clashed without resolution throughout the sessions of the Contact Group and Friends of the Chair;

[111] COP 10, CG, 26 October 2010.
[112] COP 10, FtC, 27 October 2010.
[113] COP 10, CG, 26 October 2010.
[114] COP 10, CG, 26 October 2010.
[115] Friends of the Earth is an international federation of independent environment & social justice organizations and social movements. At settings such as a CBD COP, they mostly speak specifically on behalf of each national group, sometimes acting in coalitions as here.
[116] COP 10, WGI, 21 October 2010.

bracketed text was sent to the Working Group. At the WGI session, Parties lined up to make statements on synthetic biology (mostly declaring support for either the EU or the Philippines).[117] The Chair of WGI cut the discussion short, saying that it needed to be more “efficient,” and calling interested delegates to the front of the room for a closed ‘friends’ group discussion. The final text reflects compromise between the dueling claims of distant experts. It urges Parties to apply the precautionary approach, and “acknowledg(es) the entitlement of Parties, in accordance with domestic legislation, to suspend the release of synthetic life, cell, or genome into the environment” (CBD 2010b, para.16). On the one hand, synthetic biology was not pushed out of the Biofuels Decision, despite the insistence of some Parties that synthetic biology did not belong there because it was not yet used for biofuel production. On the other hand, not only was there no moratorium, but the text explicitly puts responsibility for regulation on *national* governments, withholding any promise of international regulation or even guidance on the use of synthetic biology for biofuels.

Particularly for the portion of the COP 10 biofuel negotiations involving synthetic biology, delegates chose to invoke the authority of distant scientific and legal “experts.” This gave delegates the authority to hold to their positions without having to provide extensive justifications. The Africa Group’s attempt to highlight the overall lack of expertise on the aspects of synthetic biology that mattered most to the CBD was unsuccessful. The compromise reflected the claims of distant experts.

B. Use of external sources.

Another source of authoritative knowledge invoked by delegates was reports by States and intergovernmental bodies. Such knowledge, however, seemed to have minimal power

[117] COP 10, WGI, 28 October 2010.

to close controversies. In addition to the claims of 'experts,' the New Zealand delegate referenced reports by the OECD and the Royal Society on the status of synthetic biology research on biofuels.[118] This elicited no reaction from the other delegates, other than the ETC Group invoking their own report on the issue.[119] Similarly, several times the Brazilian delegate referenced a statistic he attributed to UNEP, that biofuels accounted for only 2.5% of global land use for agriculture.[120] He used this to argue that there was no need to single out biofuels in particular compared to other agricultural crops for potential concern around, for example, IAS. As described in a previous section, other delegates simply did not respond to this argument.[121]

Negotiations on whether to include specific reference to impacts of biofuels on rights to water demonstrate shifts in the deployment of various sources of authoritative knowledge. The Norwegian delegation repeatedly relied on UN reports to justify the argument that the Decision should specifically reference *water* and not just “resources.” At the initial Working Group I discussion on biofuels, Norway referred to a UN Environmental Management Group report on biofuels that mentioned water security.[122] At the Contact Group, the Norwegian delegate physically gestured with a UNEP Bioenergy briefing she had gotten from the literature table outside the room, insisting: “Biofuel production is described as a 'thirsty plant' – If you look at the report by UNEP Bioenergy, the issue paper names and addresses the issue of water explicitly, it is important to address water explicitly!”[123]

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[118] COP 10, CG, 26 October 2010.
[119] COP 10, CG, 26 October 2010.
[120] COP 10, CG, 26 October 2010; COP 10, FtC, 27 October 2010.
[121] This happened both at the COP 10, CG, 26 October 2010 and COP 10, FtC, 27 October 2010.
[122] COP 10, WGI, 21 October 2010.
[123] COP 10, CG, 26 October 2010.

The Africa Group backed Norway, but invoked a moral-political authority rather than literature: "Because where we come from, the poors are also facing a problem with the water quality, so I think we can't ignore this."[124] But in the session when Norway invoked the UNEP report, EU, Canada and Brazil deployed many different reasons for why water should be left out. "Resource rights" was sufficiently comprehensive and *implicitly* included water.[125] Not all methods of biofuel production used irrigated water.[126] There was no internationally-agreed definition for "water security."[127] By the fifth day of small group negotiations, the debate had devolved to the Africa Group and Norway demanding that the co-chairs "*have* to put water back in" because it is "important," and the EU and Brazilian delegates simply leaning back and shaking their heads no.[128]

Ultimately this debate was resolved in WGI when a Swiss delegate claimed to have unearthed accepted text from a previous COP Decision: "land tenure and resource rights, including water."[129] The actual language from the cited Decision IX/5 para. 1(f) is "land tenure and resource rights and responsibilities," but the Chair of WGI jumped on the possibility of relying on "past text" and Switzerland's suggested language was quickly agreed upon.[130] Where intergovernmental studies (or moral claims) did not have the power to close controversies, past CBD COP text once again carried sufficient authority.

C. International science vs. national governments.

The previous two vignettes are about the deployment of different sources of knowledge in order to argue for particular text. The Decision itself also required delegates to come to

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[124] COP 10, CG, 25 October 2010.
[125] COP 10, CG, 26 October 2010.
[126] COP 10, CG, 26 October 2010, Brazil.
[127] COP 10, CG, 25 October 2010, EU and Canada.
[128] COP 10, FtC, 27 October 2010.
[129] COP 10, WGI, 28 October 2010.
[130] COP 10, WGI, 28 October 2010.

agreement on who would have the authority to produce certain kinds of knowledge. A major issue of contention was the concept of developing "inventories" of land that should or should not be considered for biofuel feedstock production. The kind of land that should be included was controversial, but even more so was the question of who had the proper authority to develop such inventories. Should only national governments have the authority to produce these inventories, or should international scientific organizations also be allowed to produce them? A delegate from Malawi (it was unclear whether speaking for his country or for the whole Africa Group) wanted the inventories to include areas of "internationally recognized high biodiversity value," rather than "nationally recognized" areas.[131] The delegate described how sometimes areas weren't nationally defined, but, for example, the "world has defined the importance of the Amazon." The Brazilian delegate quickly retorted: "We don't need anyone to define things for us." A bit later, the Malawian delegate referenced IUCN and Conservation International as having done a "lot of work" on this, and asked "Are there conservation biologists here who can assist us?" He seemed to be appealing to "international" science and its spokespersons (IUCN and Conservation International) NGOs to claim scientific authority. But no such biologists stepped in, and the other delegates were visibly frustrated with his appeal.

The final language is: "Develop national inventories so as to identify areas of high biodiversity value, critical ecosystems, and areas important to indigenous and local communities" (Decision X/37, para. 7(a)). The chapeau of the paragraph "*Invites* Parties, acknowledging different national conditions, other Governments and relevant organizations...," leaving open the slight possibility that scientific organizations could develop the inventories, depending on how "national inventories" is interpreted. These

[131] This paragraph relates events from COP 10, CG, 25 October 2010.

inventories are clearly described as *assisting* decision-makers; they are not policy-active on their own. Parties were very careful to draw boundaries between the scientific and political, and to ensure that sovereign political power remained with national governments.

3. Scientific uncertainties.

The SBSTTA 14 Recommendation to COP 10 on biofuels included two bracketed preambular paragraphs addressing scientific uncertainty and the need for monitoring and assessment (relevant sections given added emphasis):

> *[Recognizing* that **given the scientific uncertainty that exists**, and the recent information that has emerged, **significant concern surrounds the potential intended and unintended impacts** of biofuels on biodiversity and impacts on biodiversity that would affect socio-economic conditions and food and energy security resulting from the production and use of biofuels [as well as impacts on land security] and on indigenous and local communities;]
> [*Also recognizing* that **improved monitoring, scientific assessment, open and transparent consultation, with the full and effective participation of indigenous and local communities, and information flow are crucial needs for the continuing improvement of policy guidance**, and decision making, to promote the positive and minimize or avoid the negative impacts of biofuels on biodiversity and impacts on biodiversity that would affect socio-economic conditions and food and energy security resulting from the production and use of biofuels [as well as impacts on land security];] (SBSTTA Recommendation XIV/10).

Both paragraphs recognize a lack of knowledge on the impacts on biodiversity (and related socio-economic conditions), while the second paragraph emphasizes the need to respond to this with improved practices of information gathering. These proposed paragraphs, along with the proposed moratorium for synthetic biology, prompted debate on the status of scientific knowledge and the importance and role of recognizing scientific uncertainty. Actors' descriptions of scientific uncertainties map onto categories established by social scientists: risk, uncertainty, ambiguity, and ignorance (Felt & Wynne 2007; Stirling 2007; Wynne 1992). These categories corresponded to specific views of delegations on the relevance and proper application of precaution to biofuels at the CBD.

A. Risk / No need for precaution.

"Risk" refers to situations in which potential outcomes can be identified and probabilities attributed (Wynne 1992). Such a confidence in the predictability of biofuels' impacts was prominently displayed by numerous delegations at COP 10. On the first day of formal negotiations on biofuels, several South American countries called for deletion of the preambular paragraph on scientific uncertainty.[132] Brazil insisted that the paragraph did not "reflect the reality of scientific knowledge on biofuels."[133]

To support their assertion that biofuels presented no scientific uncertainties, the Brazilian delegation consistently argued for a narrow scope to the biofuels Decision. Brazil tried to remove: mentions of direct and indirect impacts on land and water use because those are broader than biodiversity[134]; concerns around biosafety because they are not specific to biofuels[135]; and synthetic biology because it is used for more than just biofuels.[136] By narrowing the issues of concern, areas of scientific uncertainty were shrunk to encompass the better known and understood aspects of biofuel production. Within that narrowed scope of concern, Brazil was able to confidently declare: "We don't feel we need to recognize as a group that in all biofuels production there is continued scientific uncertainty. We have a very long experience in producing biofuels in Brazil, and I don't know if this is a new issue for many countries and many continents, but we cannot accept that declaration [preamble on continued scientific uncertainty] because this

[132] COP 10, WGI, 21 October 2010, Brazil, Paraguay and Argentina.
[133] COP 10, WGI, 21 October 2010.
[134] COP 10, CG, 25 October 2010.
[135] COP 10, CG, 26 October 2010.
[136] COP 10, WG I, 21 October 2010; COP 10, CG, 26 & 27 October 2010.

is not what we recognize."[137]

The strongest advocates for a "risk" framing of biofuels also argued against invoking precaution. Brazil and Argentina consistently pushed to get the precautionary approach out of the Decision.[138] As a businessman on the Brazilian delegation explained at an ETC Group side event on the first day of the COP, Brazil knows how to produce sugar and understands the risks: "It's *very clear* the impacts of producing sugar in Brazil, we don't need to adopt the precautionary approach or principle to produce sugarcane and they [civil society] specifically want this."[139]

The EU is widely considered a champion of the precautionary principle on the international stage (Peel 2004). Yet, in the COP 10 biofuels negotiations, the EU invoked the need for precaution only in instances of *existing* scientific evidence of harms – ie, in cases of "risk." The Biofuel Contact Group was tasked with developing a paragraph on biofuels to go in the IAS Decision. In these debates, the EU insisted that biofuels be mentioned in relation to IAS, and that the precautionary approach be invoked in relation to it, "because there *is* scientific evidence that biofuel crops - crops used for biofuel production and use - have become invasive, and I think we should draw attention to that in this Decision, and maybe try to draft a paragraph that could be used in both Decisions."[140] On the other hand, the EU did not want to refer to synthetic biology in the biofuels Decision because there was "not sufficient scientific evidence to justify taking it up in this Decision."[141]

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[137] COP 10, BFC, 27 October 2010.
[138] This occurred at COP 10, WGI, 21 October 2010; COP 10, CG, 21 & 26 October 2010; COP 10, FtC, 27 October 2010.
[139] COP 10, side event by ETC Group, 18 October 2010.
[140] COP 10, CG, 21 October 2010.
[141] COP 10, WGI, 21 October 2010.

B. Uncertainty / Precaution as a stop-gap.

"Uncertainty" describes a situation in which the types and scales of possible harms are understood, but their probabilities are not (Felt & Wynne 2007). Uncertainty was often expressed as knowledge gaps on the impacts of biofuels. Delegates listed areas of impacts, indicating that the *kinds* of impacts were known but the specific scientific evidence allowing for prediction was still lacking. In the opening statements in WGI, Tunisia declared, "Information is quite pathetic with regard to biofuels, biodiversity and socio-economic conditions and food security. Biofuels are used to [the] detriment of earth and lands, and indigenous and local peoples. We have to have a scientific evaluation of negative impacts of biofuels."[142] Similarly, Algeria warned, "Biofuels could create destruction in systems of production where we can't respond to basic needs in the population. There is not enough data yet to respond to these issues; we don't have the big picture."[143] These calls were to essentially fill in gaps of information, and act with precaution in the meantime.

Parties that expressed concern about information gaps tended to invoke the need for precaution as a stop-gap until more was known. As Algeria said, "It is best to take an ounce of cure instead of having to deal with the infection after."[144] Tunisia and Algeria were not involved in the smaller negotiating forums, but in WGI they supported the textual options that called for precaution.

C. Ambiguity / Institutionalization of precaution.

"Ambiguity" as a type of scientific uncertainty refers to situations in which, rather than the probability of harm being in question, the meaning of harm is unclear or contested

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[142] COP 10, WGI, 21 October 2010.
[143] COP 10, WGI, 21 October 2010.
[144] COP 10, WGI, 21 October 2010.

(Felt & Wynne 2007; Wynne 1992). The only intervention that could perhaps be seen as an acknowledgement of ambiguity was in the initial WGI discussion on biofuels, in which a representative from UNEP/UN Energy stated that: “Biodiversity impacts are more difficult to address with the typical kind of indicators as they usually measure impact, hence the Precautionary Principle is critical to...avoid the impact.”[145] Although she slowed down and seemed unclear on how to end the sentence, the gist was that assessment tools were insufficient, that biodiversity impacts *could not* be measured, and thus precaution should be institutionalized. She did not, however, describe what the institutionalization of precaution would look like.

D. Ignorance / Moratorium.

In situations of “ignorance,” not all of the possible impacts can be predicted or even understood; we don't know what it is we don't know (Felt & Wynne 2007; Wynne 1992). Party delegations siding for a moratorium, such as the Africa Group, the Philippines, and Bolivia, stressed the need to prevent environmental release of organisms produced by synthetic biology in the face of unknown impacts. The Philippines often portrayed the state of knowledge on synthetic biology as ignorance, and called for a strong regulatory response. The delegate explained: “We don't have any scientific certainty as to the impacts of this organism, of all this artificial organism, on biodiversity....When there is scientific certainty, then we can proceed with the opposite of what paragraph 16 [the moratorium] is saying.”[146] The Philippines thus called for acting with precaution until the impacts of synthetic biology were proven to be safe. This flipping of the burden of proof, demanding proof of safety rather than evidence of specific dangers, is a very ‘strong’

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[145] COP 10, WGI, 21 October 2010.
[146] COP 10, CG, 26 October 2010.

interpretation of the precautionary approach (Peel 2004).

Civil society groups intervened throughout the biofuel negotiations to point out the lack of understanding regarding the impacts of biofuels and, especially, the impacts of organisms produced by synthetic biology. In the biofuel Contact Group, a representative of the Federation of German Scientists argued for a moratorium on the basis that "there are quite a number of various organisms that are modified or created that are enabling the [biofuel] processing but the problem is we do not know how to assess it yet...when it leaks into the environment and the consequences, we don't know how to assess it."[147] A Friends of the Earth (US) representative pointed out at a side event: "We really don't know how these organisms are going to act in the environment, they have not been studied ... and we have no concept of what will happen once these organisms are released. There have been no studies coming out of industry or governments."[148] These groups were not just calling for more research to plug already-identified information gaps or to better understand already-identified impacts; they were acknowledging ignorance in how to identify or assess impacts. Their comments verged on describing the impacts of synthetic biology as not just unknown but unknowable.

E. Outcomes of scientific uncertainty at COP 10.

SBSTTA 14 Recommendation mentions the precautionary approach four times (Recommendation XIV/10). COP Decision X/37 makes only one explicit call to apply the precautionary approach, and that is "to the introduction and use of living modified organisms for the production of biofuels as well as to the field release of synthetic life, cell or genome into the environment, acknowledging the entitlement of Parties, in

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[147] COP 10, CG, 26 October 2010.
[148] COP 10, side event by ETC Group, 18 October 2010.

accordance with domestic legislation, to suspend the release of synthetic life, cell, or genome into the environment" (para. 16).[149] The preambular SBSTTA paragraph addressing scientific uncertainty was reduced to recognizing "gaps in scientific knowledge and concerns that exist regarding such impacts" (preambular para. 2). The introduction of IAS is reduced to a preambular mention, although the Decision on IAS includes a paragraph calling for the application of the precautionary approach in the use of invasives for biofuel feedstocks (Decision X/38, para. 6).

Decision X/37's explicit invocation of precaution only in reference to LMOs and synthetic biology reflects a narrowing of the kinds of scientific uncertainties that trigger a precautionary approach. It also provides no guidance on what a precautionary approach can or should mean for biofuel production and use. Acknowledging the entitlement of Parties to use domestic legislation to suspend environmental release of synthetically modified organisms gestures towards one possible application of precaution, but stressing that this is a domestic choice downplays the role of international guidance.

Brazil restricted mention of IAS to one preambular paragraph in the Biofuels Decision, but the EU succeeded in including explicit mention of biofuels in the IAS Decision. Decision X/38 on IAS urges Parties to "apply the precautionary approach with regards to the introduction, establishment and spread of invasive alien species, for agricultural and biomass production, including biofuel feedstocks" (para. 6). Yet, this inclusion of the precautionary approach in the IAS Decision does not necessarily

[149] The Decision also invites Parties to "tak(e) into account paragraph 3 of decision IX/2" from 2008, which included the precautionary approach in a list of eleven relevant tools and guidance of the Convention (para. 8). In terms of legal interpretation, this oblique reference effectively brings the 2008 invocation of the precautionary approach in to Decision X/37. For that matter, unless retired, Decisions do not stop being in effect; thus, the call in Decision IX/2 to apply the precautionary approach to biofuel production continues to apply as an official interpretation of the Convention text. Nonetheless, the number of times an issue is explicitly invoked carries interpretive weight.

acknowledge broader scientific uncertainties. As seen in the negotiations, the EU's defense of precaution in relation to IAS was based on scientific evidence that invasive species are used as biofuel feedstocks – ie, a clearly defined and established risk. This is not surprising, as social scientists have criticized the EU's heavy reliance on scientific risk assessments in its institutionalization of precaution (Felt & Wynne 2007; Levidow & Marris 2001; Waterton & Wynne 2004). Nonetheless, within the CBD and on the international stage more broadly, the EU publicly operates and is seen as an advocate of the precautionary principle (Peel 2004). Thus, it is important to point out that the EU championed a very restricted version of precaution in the biofuels negotiations, bounded by proven "risks."

By reducing scientific uncertainties to gaps in knowledge, the CBD COP ignored broader concerns with measuring and understanding the impacts of biofuels on biodiversity and socioeconomic impacts related to biodiversity. It framed biofuels as knowable, and thus governable for sustainable ends.

iii. After COP 10

Decision X/37 requested the CBD Executive Secretary (ie, the Secretariat) to: compile, analyze and summarize information on tools for voluntary use to assess direct and indirect impacts of biofuels; compile information on gaps in available standards and methodologies; and contribute to and assist with the ongoing work of relevant partner organizations and processes (para. 11 & 12). Compilations were subsequently made available on the CBD's website, on a "Tools and Approaches" page that includes links in categories such as tools and approaches for biofuels sustainability assessments and tools and approaches for sustainable land use.[150] A page on "additional resources" provides links to reports by the FAO, UNEP, other UN agency publications, and other groups such as the Roundtable on Sustainable Biofuels, the OECD, GBEP, and various NGOs.[151] Neither page contains commentary, analysis, or summaries of the linked reports and tools.

The Secretariat has provided commentary and analysis on biofuels and biodiversity primarily through information documents. A background information document for SBSTTA 16 (SCBD 2012a) was expanded upon to become *Technical Series No. 65: Biofuels and Biodiversity* (Webb & Coates 2012). In response to COP 11's request that the Secretariat "compile information on relevant definitions of relevant key terms to enable Parties to implement decisions IX/2 and X/37," the Secretariat produced a background information document for SBSTTA 18 (SCBD 2014b). This section traces the Secretariat's approaches to knowledge politics through these documents, and Parties' responses to them.

1. Technical Series No. 65: Biofuels and Biodiversity

A. Scope of subject.

Technical Series #65 notably expands the scope of discussion on biofuels from previous CBD engagement. In interviews, several Secretariat staff members indicated that they had noted issues "in the literature" – specifically iLUC and subsidies – that they felt ought to be brought to the attention of Parties (Secretariat Interviews 2012, 2013). Secretariat staff members seemed comfortable broadening the scope upon the authority of scientific

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[150] See: http://www.cbd.int/agro/biofuels/tools.shtml (last accessed 5 February 2015). Many of the links are noted as having been submitted by countries, organizations, and UN bodies in response to CBD notifications.

[151] See: http://www.cbd.int/agro/biofuels/resources.shtml (last accessed 5 February 2015).

literature – one staff member specifically noted that the publications of Searchinger et al. (2008) and Fargione et al (2008)[152] on iLUC impressed him enough to bring the issue into early SBSTTA negotiations. Staff members also seemed comfortable claiming the authority of a more 'scientific' approach. For example, the *Technical Series* compares biofuels' impacts not just against fossil fuels but also against other renewable sources of energy such as solar and wind power (Webb & Coates 2012, 25). One of the authors said that it was "as a scientist" that he noticed that comparisons were almost always limited to fossil fuels, and that biofuels ought to be judged against other renewable fuels (Secretariat Interview 2012).

A prominent analytical tool used to reframe and expand discussions in the *Technical Series* was scale. While the COP 10 negotiations and COP Decisions never differentiated biofuel production models on the basis of scale, the *Technical Series* explicitly differentiates between small-scale feedstock production and industrial-scale plantations, particularly in terms of local socio-economic and environmental impacts (see Webb & Coates 2012, Ch. 7). The first paragraph of the executive summary states that: "Although small-scale production of biofuels may be sustainable and have many beneficial applications, there have been concerns about the sustainability of large-scale production of biofuels, such as biodiversity loss, conflicts with food security and increased net greenhouse gas emissions" (Ibid, 7).

Technical Series No. 65 not only examines the individual impacts of different methods of production, it reframes biofuels as a *global* issue of resource use. In the

[152] The staff member described it as a paper by "Tilman" published in *Nature* at the same time as the Searchinger paper in *Science.* Tilman was a co-author of the very prominent Fargione et al. (2008) paper on iLUC and furthermore did not publish a paper in *Nature* in 2008, so I believe the interviewee slightly misremembered the reference.

Technical Series and in interviews, Secretariat staff members argued that criteria and standards for individual biofuel plots are incapable of governing for sustainability – how a hectare of biofuels is produced does not address what uses it may have displaced or its aggregate impacts (Webb & Coates 2012, 40; Secretariat Interview 2013). Thus, meaningful governance mechanisms to produce sustainable biofuels cannot only address individual plots or even national-level impacts; international land-use planning and monitoring is needed. And this international effort cannot be focused solely on biofuels; planning for all agricultural production – really, all land-uses – needs to be integrated (see Webb & Coates 2012, ch 5 and 8). This argument expands the scope of biofuels as an issue beyond the local or national level, but possibly also beyond the remit of the CBD; it is hard to imagine Parties embracing the CBD as a forum for global land-use planning.

B. Sources of authoritative knowledge.

Technical Series No. 65 frames biofuels as an issue in need of a better connection between policy and science. The CBD Executive Secretary's foreword to the *Technical Series* describes the report as based on "the best available scientific information," and notes that it is "necessary that decision-makers use the best available science to guide them towards more sustainable production and use of biofuels, and towards better agricultural practices in general" (Webb & Coates 2012, 5). The introduction of the report notes that "This is one subject where unsubstantiated generalizations are widespread, exceptions easily found and where there is a conspicuous role for better science" (Ibid, 9).

"Better science" is not necessarily framed as having all the answers. Indeed, the more critical sections on policy "running ahead of science" note the failure of policies to acknowledge scientific and political uncertainties (Webb & Coates 2012, 46). For example, subsidies, which "have come under scrutiny as being insufficiently supported by science," are criticized for not responding to the uncertainty of GHG emissions from indirect land-use change (Ibid). Another basis of criticism is basing biofuel policies on only *one* kind of scientific information or analysis, such as "degraded" lands only being understood in terms of agroeconomic profitability rather than also production history and social and cultural values (Ibid, 34). Similarly, the commonly-invoked argument that algal biofuels will reduce land pressure is noted as an example of the need for ecosystem-based approaches to assessment; from a broader ecological perspective, algal biofuels would "shift pressure between biomes and not necessarily reduce them" (Ibid, 17). Life-cycle analysis accountings of the carbon footprint of biofuels are criticized on both fronts: for failing to account for the inherent difficulties in quantifying GHG emissions, and for only considering GHG and ignoring issues such as acidification, ozone depletion, and biodiversity (Ibid, 27-28).

The Secretariat authors thus took a broad view of the kinds of scientific information seen as necessary for policy. As the authors described in interviews, however, they were careful in choosing sources of authoritative knowledge. They considered peer-reviewed scientific publications appropriate, as well as documents produced by national governments and other UN bodies such as the FAO, UNEP, and UN-Energy (Secretariat interviews 2013). Outside of this, there was a sense of some negotiation – one of the authors reflected that big international organizations were okay, but that organizations known for being against biofuels were not cited; the other author indicated that it was easy to determine which sources were "credible" and provided impartial assessments.

C. Types of scientific uncertainties addressed.

Numerous scientific uncertainties around the impacts and results of biofuel production and use are noted in *Technical Series #65.* An identified "knowledge gap" is whether research and development resources are going towards addressing the sustainability constraints of current biofuels or are supporting "known inefficient, and often detrimental, practices" (Webb & Coates 2012, 48). This scientific uncertainty is framed as a matter of transparency (something that is known but not shared, or something that could easily be known) rather than a question without a knowable answer. The potential benefits of reduced GHG emissions and greater energy security are described as "unproven" (Ibid, 7). The report cautions that life cycle assessments still need to address the inherent uncertainty of key parameters (Ibid, 29).

Indirect land-use change (iLUC) is called the "key unresolved biodiversity-related issue" of biofuels (Webb & Coates 2012, 38). The executive summary notes the "inherent difficulty" of addressing the cumulative impact of iLUC from biofuels (Webb & Coates 2012, 7). The effects of iLUC are described as "real" – ie, the kinds of harms are known; the problem is quantifying these harms in terms of "scale and severity" (Ibid, 7 & 38). The inability to accurately quantify iLUC is not framed as temporary, but rather the result of fundamental differences in methodologies and key assumptions. *Technical Series No. 65* can be interpreted as framing iLUC as an intractable uncertainty (the type of harm is understood, but the scale and probability *cannot* be understood) or even recognized as an indeterminacy. The lack of regulatory responses to iLUC is blamed on a "lack of clear guidance from the scientific community," as scientists say they need more research, data, and better models (Ibid, 38). The Secretariat notes that consensus had shifted, from trying to monitor or directly manage iLUC to harm mitigation by identifying broad levels of risk of ILUC and attempting to shape policy to discourage high-risk and encourage low-risk production. The Secretariat notes the need for global, holistic land-use planning and suggests considering the use of other renewable alternatives that do not require as much land or compete with other land uses (Ibid, 44).

2. SBSTTA 16 and COP 11.

The Secretariat's suggested Recommendation to SBSTTA 16 is less than one page in length, distilling the main messages of the background documents and suggesting political action. According to interviews, SBSTTA 16 biofuel negotiations were again hard-fought, requiring multiple nights of Contact Group sessions (Secretariat interview 2013). The outcome of the negotiations, SBSTTA Recommendation XVI/13: Biofuels and biodiversity, was completely "clean" text (i.e., no brackets), and COP 11 Working Group I (WGI) spent less than an hour discussing biofuels before approving the Recommendation without "reopening" it.[153] In the suggested Recommendation, the Secretariat proposes ways to operationalize the particular approaches to knowledge, scope, and scientific uncertainties present in *Technical Series #65.* As demonstrated in the final COP 11 Decision, Parties mostly did not take up those proposals. The next three sub-sections compare sections of the draft Recommendation developed by the Secretariat with the final COP Decision. Numbers indicate the paragraph numbers in the original documents.

A. Sources and uses of authoritative knowledge.

Secretariat suggested Recommendation	COP Decision XI/27
3. Recognizing that various incentive measures, including subsidies...are	5. *Recognizing* that some incentive measures can be significant drivers of

[153] COP 11, WGI, 11 October 2012.

significant drivers of biofuels expansion...*urges* Parties and other Governments to ensure that these measures are evaluated against clearly defined objectives, including, *inter alia,* the Aichi Biodiversity Targets and the net reduction of greenhouse gas emissions...and, where indicated by the outcome of such evaluations, to adjust these measures accordingly;	biofuels expansion, in certain circumstances, *invites* Parties and other Governments to evaluate these measures using the Aichi Biodiversity Targets, in the context of the Convention's cross-cutting issue on incentive measures, taking into account national socio-economic conditions;

The Secretariat's suggested Recommendation and the COP Decision differ in what kinds of knowledge are to be used in developing and evaluating policy and what roles such knowledge should play. The Secretariat proposes that evaluations of incentive measures be carried out on the basis of transparent scientific standards (GHG emissions) and international political commitments (the CBD's Aichi Targets). The right of national governments to conduct such evaluations is clearly acknowledged – this is not a suggestion that the power to evaluate be handed to an international scientific or political community. Importantly, there is also a clear link between these evaluations and political action - incentive measures should be adjusted according to the results of evaluations. The SBSTTA Recommendation and COP 10 Decision retain a paragraph on incentive measures, but with significant changes. Parties and other Governments are "invited" - softer language than "urged" - to evaluate "some" incentive measures according to the Aichi Targets, "taking into account national socio-economic conditions." By not including GHG emissions, scientific standards have been excised, and adding national conditions as a measure of evaluation can be interpreted as softening the role of the CBD's Targets. Furthermore, there is no link between evaluation and political action.

Scientific knowledge was accorded minimal authority in the outcomes of the very short COP 11 WGI discussion on biofuels. Delegates from Qatar, Bolivia, and Switzerland, wanting to reopen the text, noted their concerns with biofuels were based on *scientific* evidence.[154] Bolivia noted work in "academic circles" that disproved the idea of renewable resources – the "evidence shows" land grabs, monocrops at the expense of biodiversity, policies "divorced from science-based knowledge."[155] Delegates arguing for the text to stay as-is referred to their countries' positive experiences with biofuel production. Brazil, Canada, and the EU referenced the balance and success of their internal policies governing biofuels for sustainability. Argentina specifically noted that "external standards" should not be "imposed" on national governments. Parties arguing from the dominant position thus relied on the authority of national experiences, while subordinate Parties invoked "science." Qatar and Bolivia agreed to not block consensus on the Decision, but insisted that the record note their reservations.

B. Types of scientific uncertainties and responses to them.

Secretariat suggested Recommendation	**COP Decision XI/27**
2. *Takes note* of the gaps in tools and approaches, and remaining uncertainties surrounding the sustainability of biofuels...in particular the inherent difficulty of addressing the cumulative impacts of biofuel activities through indirect land-use change;	8. *Also takes note* of gaps in scientific knowledge of biofuels and in relevant tools and approaches, and remaining uncertainties, in particular the inherent difficulty of measuring and addressing indirect impacts of biofuels on biodiversity;
6. *Requests* the SBSTTA...to assess the effectiveness of tools and approaches for strategic environmental assessment and integrated land-use planning...	10. *Requests* the Executive Secretary, as part of his ongoing work with regard to decision X/37, in collaboration with Parties, other Governments and relevant organizations, and considering ongoing work, to compile information on relevant definitions of relevant key terms to enable Parties to implement decisions IX/2 and X/37...

[154] COP 11, WGI, 11 October 2012.
[155] COP 11, WGI, 11 October 2012.

The Secretariat’s suggested Recommendation acknowledges multiple kinds of scientific uncertainty. Scientific uncertainty is noted as “gaps” and “remaining uncertainties,” not just in terms of proof of the sustainability of biofuels, but also in the tools for evaluating and governing biofuel production. More intractable uncertainties are also acknowledged in the “inherent difficulty” of addressing iLUC. The final Decision text's subtle differences foreground the “gaps in scientific knowledge”; “remaining uncertainties” seem confined to indirect impacts. On the other hand, noting “indirect impacts” is broader than just iLUC, and the inherent difficulty of *measuring* as well as addressing these indirect impacts is noted. The political request for the SBSTTA to expand its scope of action to assess strategic environmental assessment and integrated land-use planning can be seen in part as a response to such intractable uncertainties.

But while the final text's paragraph on scientific uncertainties may be slightly broader than the Secretariat's suggested text, its political response is narrower. The Secretariat's suggested Recommendation requested that the SBSTTA assess the effectiveness of tools and approaches for strategic environment assessment and integrated land-use planning. Such an assessment would have to grapple with the scientific uncertainties inherent in these tools and approaches, and the implications for governing for sustainability. The final COP Decision, on the other hand, requests the Executive Secretary to “compile information on relevant definitions of relevant key terms.” There is an additional paragraph noting that “many technical and scientific issues associated with biofuels are difficult to assess...and that these may be addressed in a broader context” (para 9), but this opaque language does not clarify who would address these uncertainties or what the guidelines of such a context would be. Overall, the Parties' final text may slightly expand the acknowledgment of relevant scientific uncertainties, but the reductions of the rest of the text strip this acknowledgment of political relevance.

3. Scope of the issue.

Secretariat suggested Recommendation	COP Decision XI/27
4. *Further recognizing* that the sustainability of biofuel production and use, with regard to biodiversity, is a particular aspect of the broader issue of sustainable consumption and production, including the management of land, water, energy and other resources, and that consideration of these matters will be necessary to achieve the Aichi Biodiversity Targets, in particular targets 4, 5, 7, 8, 14 and 15, *encourages* Parties: (a) To consider these matters, in consultation with relevant sectors and stakeholders, when updating and implementing their national biodiversity strategies and action plans, and other relevant policies; and (b) To make use of tools for strategic environment assessment and integrated land-use planning to address these matters;	2. *Invites* Parties to: (a) Consider relevant biofuel matters, when and if appropriate, when updating and implementing their national and subnational biodiversity strategies and action plans and other relevant policies; (b) Consider the use of various relevant voluntary tools regarding the impact of the production and use of biofuels on biodiversity, such as in strategic environment and socio-economic assessment and integrated land-use planning in accordance with national circumstances

The Secretariat's suggested Recommendation does not mention the scale of biofuel production, although supposedly the scale of production supported by incentive measures would have been a factor in their evaluation of impacts. The suggested Recommendation situates biofuel production and use within the larger issues of sustainable consumption and production. Unlike *Technical Series No. 65,* the suggested Recommendation does not explicitly invoke the need for global land-use planning. Calling on the SBSTTA to assess the effectiveness of tools and approaches could be interpreted as opening a door for analysis and conversation on global land-use, however. The COP Decision situates the issue of biofuels solidly back within the realm of States, excising reference to global-level issues such as sustainable consumption and production.

In informal conversation at COP 11, one delegate told me that Parties had come to India “without any appetite to negotiate on biofuels.” Another delegate indicated that Parties had found a balance in how to disagree on biofuels, and no one was going to move for fear they would lose what they'd gained. By not engaging with the *Technical Series'* reframing of the problems and opportunities of biofuels, Parties were able to keep this balance.

3. SBSTTA 18 – the return of iLUC.

The CBD has done little on biofuels since COP 11. In response to Decision XI/27, the Secretariat provided SBSTTA 18 with a report of definitions of key terms (SCBD 2014b). The section on “direct and indirect land use change” describes monitoring and managing iLUC as “difficult and complex,” and “a key issue regarding the sustainability of biofuels production and use with regard to biodiversity” (Ibid, 4). The report notes that iLUC makes it impossible to define “sustainable” biofuels production based on site-specific factors, and that measuring the impacts of factors beyond the site of production necessarily requires the use of models.

At SBSTTA 18 in 2014, some delegations strenuously argued that the report and its reflections on iLUC were “unbalanced” and “incomplete”[156] Brazil said that the discussion failed to acknowledge that iLUC models “lack accurate methodology to measure and produce precise results,” and that assessments of iLUC were therefore “not only high uncertain but also unobservable, unverifiable, and reliant on assumed economic and social contexts in the modeling.”[157] Argentina noted that there was no “international consensus” on the concept of land- use change because of the “difficulty in quantifying”

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[156] SBSTTA 18, Plenary, 26 June 2014, Brazil & Argentina.
[157] SBSTTA 18, Plenary, 26 June 2014.

the many factors that impact particular sites. The delegate added that one “cannot standardize environmental criteria in a very clear fashion.”[158] SBSTTA 18 ultimately requested that the Secretariat revise the document and submit it to further peer-review (Recommendation XVIII/12).

Social scientists have long urged decision-makers to take into account “indeterminacies” – types of knowledge that are intrinsically open-ended, embedded in “social, technological and natural systems” (Felt & Wynne 2007, 36; Wynne 1992; Jasanoff & Wynne 1998; Hinchliffe 2001). The translation of indeterminacies to “determinate uncertainties” is lamented, as decision-making processes are seen as often overstating the degree to which scientific uncertainties can be reduced and resolved (Jasanoff & Wynne 1998; Hinchliffe 2001; Nuffield 2012). Brazil and Argentina were essentially identifying the indeterminate nature of knowledge on iLUC related to biofuels. Rather than this recognition opening up decision-making, however, they used it to argue for a *narrower* scope. Brazil and Argentina argued that the difficulties in quantifying iLUC and related environmental criteria made them an unreliable, unjustifiable basis for international environmental policy. Without the ability to be known in a quantifiable and scientifically-verifiable way, this concern was framed as illegible to the CBD (Scott 1998), and thus not requiring a response.

3.3. Conclusions on biofuels at the CBD.

Any negotiation involves defining the subject at hand and thus the scope. Brazil's use of “logic” at COP 10 to argue for a narrow scope was easily countered by other Parties; delegates invoked their political mandate as over-riding mere logic. On the other hand,

[158] SBSTTA 18, Plenary, 26 June 2014.

formal text is clearly a powerful tool in the context of the CBD COP. Particularly in the more public setting of WGI, Parties accepted its authority to close the controversy of land tenure. Parties relied on the phrase "promote the positive..." to sidestep contentious debate on politically sensitive and scientifically uncertain issues such as iLUC and land grabs. And while COP 9's (implicit) restriction to agriculture was (implicitly) opened up by removing "Agricultural Biodiversity" from the Decision title, biofuels were not formally moved from the agriculture programme of work, nor were they formally added to the forest programme of work. Since COP 10, CBD bodies have not further explored the connections of biofuels and forests.

Soft law's potential to be elevated to customary international law is always present as a consideration at CBD COP debates. Parties are wary of using language that might be used as a foothold to establish new common international understandings. Using previous COP language on "land tenure and resource rights" reassured Parties that they were not establishing new language in a UN forum. The continued use of the phrase "to promote the positive…" is a different matter. Through the process of self-reference, formulaic language can seem to develop a certain stability and naturalness that helps to "black box" the processes by which it was formed (Callon 1995). This appears to have happened with "promote the positive..." having become the go-to phrase – and thus framework – for the relationship of biofuels and biodiversity. But this framework allowed delegates to avoid difficult debates on the shifting science and politics of biofuels, and led to a Decision built around a mantra that actually indicates very little. Although it is common within the UN system to build on negotiated language, in this case relying on the formal text did not help to stabilize relationships or move actors toward a common understanding of the problem.

Bringing the scale of biofuel feedstock production into the discussion could have clarified and highlighted politically contentious and problematic issues with biofuel production. Indeed, the Secretariat used scale in *Technical Series No. 65* to reframe discussion on biofuels and biodiversity. Party delegates, however, have shied away from clarifying political stakes. Neither, for that matter, have they relied on scientific information. In international forums, scientific expertise is often brought in as an objective "view from nowhere" to "lend epistemic authority to norm-making" (Bonneuil & Levidow 2011, 94; Jasanoff 1996). Various forums at COP 10, particularly side events, certainly involved deployments of science as an ultimate authority (Campbell et al. 2013). In the biofuel negotiations, however, science was not the only type of knowledge invoked. Parties were reluctant to grant authority to scientific claims or outside information, even when generated by UN bodies and especially when provided by international environmental NGOs.

This could be interpreted as a failure of "science-based" decision-making. DuPuis and Gareau (2008) argue that neoliberal governance has shifted the kinds of knowledge used in international environmental decision-making from public State-sponsored technocratic research to private, particular research that doesn't speak to global issues. They lament the loss of technocratic analysis in favor of situated knowledge generated by private stakeholder groups. While this may be happening in the Montreal Protocol, DuPuis and Gareau's case study, this does not seem to be the case in the CBD biofuel debates. UN-generated knowledge was not so much replaced by private stakeholder groups as it was pushed aside in favor of distant State-sanctioned experts, the authority of previous COP text, and assertions of national governments' sovereignty authority.

This could be seen as a refusal by CBD Party delegates to treat scientific sources as neutral and universal. One of the potential implications of this is a shift in the landscape of knowledge for decision-making. In international environmental law, modern science is often the assumed authority, with predictable spokespersons – Northern scientists and politicians (Jasanoff 1996; Jasanoff & Wynne 1998). The historic network of relations in the CBD was based in part on developing countries' supposed lack of scientific knowledge (McGraw 2002). As Southern claims of expertise broaden to include not only experiential but also "expert" knowledge, this may unsettle long-standing networks. In the case of synthetic biology, claiming expertise was more effective than calling expertise into question. It at least led to a compromise text between dueling expert views.

Who can claim "expertise" may be gradually opening, but otherwise, acknowledgement that scientific claims are rooted in particular values and contexts seems to have led to a devaluing of the authority of all such claims, leaving clashing claims of national governments. In the absence of neutral, "universal" science, Parties at COP 10 fell back on previous COP language or settled for compromises that left controversies open.

As expressed by actors at COP 10, biodiversity-related aspects of biofuels involve a broad range of kinds of scientific uncertainties. The biofuels Decision, however, collapses this range into "gaps in knowledge," framing biofuels as knowable, even if not yet fully known. This framing cuts off engagement with more difficult, intractable scientific uncertainties, which has implications for governance. If a situation presents only risks rather than broader scientific uncertainties, then risk assessments are sufficient. In situations of ambiguity, ignorance, and indeterminacy, however, risk assessments are simply inadequate (Felt & Wynne 2007; Stirling 2007).

Technical Series No. 65 takes a nuanced approach to engaging with scientific claims and identifying relevant scientific uncertainties. A broad range of knowledge claims, from economic to ecological to social, are drawn upon and placed in context. The report acknowledges the importance of indeterminate uncertainties such as iLUC, while not shying away from the challenges this presents to governance systems. The Secretariat’s response to this challenge is to reframe the issue of biofuels as one of global land-use choices. The CBD COP has not embraced this reframing. At SBSTTA 18, some delegations argued to force iLUC out of the treaty’s attention on the basis of its indeterminate nature.

What lessons have the CBD bodies drawn from the biofuel negotiations? Would engagement with other techno-scientific issues display any development in the approaches to translation? The next chapter examines processes of the CBD's engagement with an issue introduced through the biofuel negotiations – synthetic biology.

Chapter 4 Synthetic biology as a prospective New and Emerging Issue.

4.1. Producing and governing synthetic biology.

As described in the previous chapter, synthetic biology was brought into the CBD through the 2010 biofuel negotiations. Since then, the treaty bodies have struggled to approach this contentious area, internally disagreeing on whether it is even an appropriate issue for the treaty to consider, let alone how to engage with it. This difficulty is not unique to the CBD; while there is academic, government and industry agreement on the *importance* of synthetic biology, there is very little agreement on any other aspect, from what synthetic biology actually is to the implications of what it is promised to do.[159] Promoters of synthetic biology promise a whole new world: micro-organism “factories” for industrial production; biological solutions to toxic clean-up; plants that fix nitrogen; plants designed to be transformed into biofuels (Keasling 2013). Some doubt that those promises will be fulfilled and criticize the flood of money and resources; others worry that such successes will negatively impact traditional livelihoods and uses of biodiversity, increase corporate control of agriculture, and lead to the unintentional transfer of altered genetic material into natural ecosystems (ICSWGSB 2011). There's no agreement on what could go wrong; there's no agreement on how things could go right.

The first section of the previous chapter addressed the production and governance of biofuels in order to establish the context for and stakes in the CBD’s engagement with

159 A number of academic journals, from *Nature* (2014) and *Science* (2011) to *Studies in History and Philosophy of Biological and Biomedical Sciences* (2013) and *Public Understanding of Science* (2012), have recently featured special issues on synthetic biology. Breakthroughs in research and commercial applications of synthetic biology are regularly reported and lauded in the pages of high profile newspapers, such as the *New York Times* and the *Guardian* (Pollack 2014, 2013, 2010; Sample 2014; Stilgoe 2014; Strom 2014; Thomas 2014). Governments have identified synthetic biology as a key technoscience to unlock the “bioeconomy” – an economy based in biotechnology and/or biological resources (OECD 2009; US White House 2012).

that issue. In addressing the production and governance of synthetic biology, this chapter additionally addresses how knowledge about this was created by the Secretariat. In 2012, COP 11 asked the Secretariat to: 1) compile and synthesize relevant information the potential impacts of synthetic biology on biodiversity, and 2) consider possible gaps and overlaps within international law's coverage of synthetic biology.[160] I was brought in as an intern to draft two documents: *New and Emerging Issues Relating to the Conservation and Sustainable Use of Biodiversity* - *Potential Positive and Negative Impacts of Components, Organisms and Products Resulting from Synthetic Biology Techniques on the Conservation and Sustainable Use of Biodiversity* (which I will refer to as *Impacts*) and *New and Emerging Issues Relating to the Conservation and Sustainable Use of Biodiversity* - *Possible Gaps and Overlaps with the Applicable Provisions of the Convention, Its Protocols and Other Relevant Agreements Related to Components, Organisms and Products Resulting from Synthetic Biology Techniques* (which I will refer to as *Gaps and Overlaps*). In this section, I use excerpts of these texts both to provide background information on synthetic biology and to trace how I and other members of the Secretariat navigated the controversial choices inherent in any attempt to address synthetic biology.

i. Defining synthetic biology.

There is no scientific or legal agreement on the meaning or scope of the term "synthetic biology." This is not unique to synthetic biology; it is challenging to draw clear distinctions among emerging biotechnologies, which have an "interweaving genealogy"

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[160] Decision XI/11. For purposes of brevity, I have roughly summarized the call to the Secretariat here; as discussed later in the chapter, the Decision's precise language on the scope of the Secretariat's work was very deliberate.

of bodies of knowledge (Nuffield 2012). This makes writing about synthetic biology for an international treaty a challenging task. While my response was to highlight disagreements around a definition, peer-review and Secretariat feedback pushed me to downplay it as an issue. Ulimately, *Impacts* opens with an explanation of synthetic biology that acknowledges the lack of definition as well as the existence of broad agreement around the goals of synthetic biology:

> **One of the most commonly cited definitions of synthetic biology is: (i) the design and construction of new biological parts, devices, and systems, and (ii) the re-design of existing, natural biological systems for useful purposes.**[161] Key features of synthetic biology include chemical synthesis of genetic sequences and an engineering-based approach. It is important to note that there is no legally accepted definition of synthetic biology, and the existence of a singular definition is debated in academia (see Box 1: Definitions of Synthetic Biology). There is, however, general agreement on its goals: to exercise control in the design, characterization and construction of biological parts, devices and systems, leading to more predictable designed biological systems (Nuffield 2012; ICSWGSB 2011; Kitney and Freemont 2012; PCSBI 2010; ECNH 2010). Sometimes described as a "converging technology," synthetic biology brings together and builds upon multiple fields, including engineering, molecular biology, systems biology, nanobiotechnology, and information technology (EGE 2009; PCSBI 2010; RAE 2009).
> (SCBD 2014c, 7)

This initial brief explanation of synthetic biology is followed with an explanation of different supporting technologies used in synthetic biology and relevant areas of research. Supporting technologies used in synthetic biology include: 'next-generation' tools to sequence DNA, including metagenomic tools; chemical synthesis of DNA and advanced methods to assemble large strands of DNA; various approaches to modifying existing genomes, from using directed evolution to produce and test billions of slightly different genomic mutations; to using targetable nucleases to transform specific DNA sequences

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[161] This definition is found at www.syntheticbiology.org (last accessed 22 February 2015). The site was started by individuals at MIT and Harvard and can be edited by "all members of the Synthetic Biology community."

(Garfinkel et al. 2007; Gibson et al. 2008; Baker 2011; Cobb et al. 2012; Pauwels et al. 2012; Lienert et al. 2014). The following excerpt from the official SBSTTA document summarizes *Impacts'* sections on the areas of research in synthetic biology:[162]

> **DNA-based circuits** involve the rational design of sequences of DNA to create biological circuits with predictable, discrete functions, which can then be combined in modular fashion in various cell hosts. Genetic circuits are seen to function as electronic logic components, like switches and oscillators. The idea of interchangeable, discrete parts that can be combined in modular fashion is "one of the underlying promises of the whole approach of synthetic biology."[163]
>
> **Synthetic metabolic pathway engineering** aims to redesign or rebuild metabolic pathways, to synthesize a specific molecule from the "cell factory." A synthetic pathway (rationally designed or based on a natural sequence but computer 'optimized') is added to the cell, and then conventional metabolic engineering tools may be used to increase the desired output. Some claim that the aim to *systematically* engineer metabolic interactions sets it apart from conventional metabolic engineering. It can also be seen as different in that synthetic biology tools make it possible to build non-natural pathways that would be difficult to produce with traditional genetic engineering techniques.[164]
>
> **Genome-level engineering** focuses on the genome as the "causal engine" of the cell. Rather than designing short DNA sequences or engineering for specific metabolic pathways, researchers work at the whole-genome level, albeit often aiming to produce a "minimal genome." There are two strategies to genome-level engineering: top down and bottom up. **Top-down genome-engineering** starts with a whole genome, from which researchers gradually remove "non-essential" genes to pare down to the smallest possible genome size at which the cell can function as desired. The primary goal is to craft a simplified "chassis" to which modular DNA "parts" can be added. The smaller genome is meant to reduce cellular complexity and thus the potential for unexpected interactions. **Bottom-up genome-engineering** aims to build functional genomes from pieces of synthesized DNA; it is also referred to as "synthetic genomics." Thus far, this has been accomplished with viruses, a 1.08 million base pair bacterial genome, and a chromosome of a yeast genome. At this point, natural genomes are needed as models because of the many DNA sequences that are necessary but have unknown functions.[165]

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[162] As the official SBSTTA document does not include citations, I have added a footnote at the end of each paragraph including the references drawn upon.
[163] Garfinkel and Friedman 2010**,** 280; O'Malley et al. 2008, 57; Endy 2005; Lam, Godinho & dos Santos 2009; Heinemann and Panke 2006.
[164] Lam, Godinho & dos Santos 2009; Nielsen and Keasling 2011; Porcar and Pereto 2012; Various 2009, 1071; Arkin & Fletcher 2006; Pauwels et al. 2013.
[165] O'Malley et al. 2008; RAE 2009; Sole et al. 2007; Heinemann and Panke 2006; Lam, Godinho & dos Santos 2009; EGE 2009; Garfinkel et al. 2007; König et al. 2013; Cello et al. 2002; Basler et al. 2001; Tumpey et al. 2005; Gibson et al. 2010; Dymond et al. 2011.

> **Protocell construction** aims to create the simplest possible components to sustain reproduction, self-maintenance and evolution. Thus this research seeks to design for less complexity at the *cellular* level (rather than at the genome as in the case of genome-level engineering). This is understood to require three things: a container or membrane to confine reactions; a metabolism so that energy can be stored; and molecules to carry information in order to adapt to changing environments. Research is aiming to achieve compartmentalization through approaches such as lipid-based vesicles, inorganic nanoparticle based membrane vesicles, and membrane-free peptide/nucleotide droplet formation. “Cell-free approaches” attempt to do away with the cell altogether to provide a more controllable biochemical context for synthetic biology devices.[166]
>
> **Xenobiology** (also known as chemical synthetic biology) is the study of unusual life forms based on biochemistry not found in nature. Xenobiology aims to alter the “biochemical building blocks of life,” such as by modifying genetic information to produce XNA (xeno-nucleic acids) or by producing novel proteins. Xenobiology is often cited as a potential “built-in” biosafety mechanism to prevent genetic drift to wild organisms. Physical genetic material transfer might still occur, but in theory natural polymerases would be unable to accurately “read” the XNA, and thus not lead to protein production. This goal is often described as producing “orthogonal” systems, where modifying one component does not result in side effects to other components in the system. Orthogonality is a foundational property of engineering, and synthetic biologists are attempting to achieve its expression within living systems. By operating on an orthogonal system, the idea is that synthetic biology devices would be insulated from the rest of the cell’s processes and prevent the transfer of parts resulting from synthetic biology to natural biological systems. This claim, however, is untested as xenobiology is in early stages of development.[167]
> (SCBD 2014e, 3-4)

Describing synthetic biology is not a simple task. Writing these paragraphs required navigating conflicting claims – synthetic metabolic pathway engineering is/isn't synthetic biology; DNA-based circuits are/aim to be rational design; synthetic biologists are/aren't on the cusp of achieving orthogonality. In writing the *Impacts* document, as much as I tried to point out boundaries commonly drawn within the realm of synthetic biology, it was impossible to not draw some myself. For example, I left out areas of research only

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166 Armstrong et al. 2012; Lam, Godinho & dos Santos 2009; Sole et al. 2007; EASAC 2010; Sole et al. 2007.

167 Pauwels et al. 2012; Schmidt 2010; Joyce 2012; Schmidt 2009; Pinheiro and Holliger 2012; Pinheiro et al. 2012; Sutherland et al. 2013; Esvelt and Wang 2013; PCSBI 2010; RAE 2009; Skerker, Lucks & Arkin 2009; Moe-Behrens et al. 2013; Chaput et al. 2012.

sometimes included within synthetic biology, such as engineered synthetic multicellularity and the design of microbial consortia (Lam, Godinho & dos Santos 2009; Maharbiz 2012). The boundaries between areas of research are not consistent across commentators: top-down and bottom-up genomic engineering are often considered separately, while DNA-based circuits and synthetic metabolic pathway engineering are sometimes considered together. Perhaps most importantly, the boundaries between synthetic biology and 'conventional' genetic engineering are hotly contested. I attempted to address the underlying grounds for differences of opinion in what encompassed "synthetic biology" in an early paragraph of *Impacts*:

> **Disagreement over a definition for synthetic biology is tied to differing views of the novelty of the field of synthetic biology and its relationship with "conventional" biotechnology** (Nielsen & Keasling 2011; PCSBI 2010; Zhang et al. 2012). The relationship between synthetic biology and previous biotechnology tends to be described differently based on the audience. When talking to regulators and the public, synthetic biologists tend to emphasize "continuity with the past" and safety; when talking to prospective funders, they emphasize novelty (Tait 2009, 150). Even within scientific communities, there are differences of opinion whether synthetic biology is revolutionary or an incremental advancement of biotechnology (PCSBI 2010; Zhang et al. 2011). This range of viewpoints leads to different perspectives, both on the status of current synthetic biology applications and on expectations for the future of synthetic biology. Currently, the majority of current and near-term commercial and industrial applications of synthetic biology use synthetic DNA-circuits and metabolic pathway engineering to create microbes that produce molecules for pharmaceuticals, fuels, chemicals, flavorings and fragrances (Wellhausen and Mukunda 2009). These two approaches are rooted in "conventional" biotechnology; depending on one's perspective, many of those applications could be considered "conventional" and not synthetic biology. From that perspective, synthetic biology is almost entirely restricted to research labs. From a broader view, commercial, industrial, and research applications of synthetic biology are already happening and are rapidly proliferating (Industrial Biotechnology 2014). Expectations for the future of synthetic biology also differ. If synthetic biology lives up to its potential, predictable and rational design of biological components and systems could usher in a new paradigm for biology (Zhang et al. 2011). But it's unclear whether or how soon this will happen. Scientific understanding of most genes is still quite limited; the ability to forward engineer is currently limited to a handful of genes (Schmidt & de Lorenzo 2012; Weber & Fussenegger 2012). Many of the future synthetic biology applications that represent potential positive impacts for

> biodiversity would require environmental release, and thus pose different challenges to biosafety than current uses (Anderson et al. 2012).
> (SCBD 2014c, 8)

Setting the boundaries of an issue is key to defining the boundaries of debates on that issue. As one interviewee aptly put it: “The act of labeling a field is often the creation of a field, because to some extent…large parts of what counts now in synthetic biology has existed for quite some time now. So the labeling or the naming of a field is part of the politics around the field” (Social scientist interview 2014). The implications of describing a product or process as “synthetic biology” are different depending on the audience – it indicates novelty, which can be a selling point to investors but a potential red flag to regulators.

Without a common definition to ground them, debates on synthetic biology have a way of slipping back and forth, from one imaginary to another, contracting and expanding the discipline depending on the audience and its concerns. One example is the Glowing Plant, the only currently commercially available multi-cellular organism *explicitly* described as resulting from “synthetic biology.”[168] In April 2013, the “Glowing Plant” company started a project on the crowd-sourcing website Kickstarter, promising to use synthetic biology techniques to design and print DNA which would transform the plant *Arabidopsis* to produce luiferase and luciferin and, thus, to glow. By the close of its campaign in June 2013, over $450,000 USD had been raised and over 8,000 people had reserved seeds or plants. At the time of SBSTTA 18 in June 2014, Glowing Plant

[168] Most self-described “synthetic biology” companies focus on *micro*-organisms. Some multi-cellular, agricultural crops – particularly corn engineered for more efficient ethanol production – have been described by critics (ETC 2013) and proponents (BIO 2013) as the result of synthetic biology, but agricultural companies themselves avoid the term. Syngenta 2012 & http://agrivida.com/technology/overviewtechnology.html (last accessed 22 August 2014).

expected to ship its products within the USA in September 2014.[169] Because of a loophole in the US Department of Agriculture's regulatory authority over GMOs, they will be shipped without having to meet biosafety standards for the introduction of a new GMO.[170]

But will the Glowing Plant be the first public release of an organism resulting from synthetic biology into the environment, or just another GMO release? Glowing Plants' Kickstarter campaign was framed as a unique opportunity to support DIY (do it yourself) research in the cutting edge field of synthetic biology.[171] A coalition of critical civil society groups promptly launched a “Kickstopper” campaign, calling for a stop of what would be the first major environmental release of a synthetically-modified organism (Callaway 2013). As these criticisms attracted attention, the Glowing Plants team began to edge away from the term “synthetic biology.” In May 2013, Antony Evans, CEO of Glowing Plant, responded to civil society groups' request to cancel the project: “We are using the term 'synthetic biology' in it's most general sense, the technology we are using is functionally the same as that which has been used in the creation of many other biotechnology products over the last two decades.”[172] In June 2013, Evans completely disowned the term in an interview with the *New Scientist:* “I think what we're doing is conventional genetic engineering” (Aldhous 2013). When I contacted Evans in January 2014 and asked which of their techniques they considered to be synthetic biology, he

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[169] As of early February 2015, Glowing Plant still has not shipped seeds or plants, as it has not yet produced sufficiently luminescent plants. See http://blog.glowingplant.com (last accessed 7 February 2015).

[170] The US Department of Agriculture's oversight of GMOs is based in its authority to regulate plant pests; in the past few decades, modified DNA has generally been inserted into genomes using the plant pathogen *Agrobacterium* (Ledford 2011). The Glowing Plant team used a gene gun instead, and thus could ship their product within the US without having to demonstrate safety or provide risk assessments (Callaway 2013; Pollack 2013). Gene guns can be used in all types of biotechnology projects, not just synthetic biology.

[171] See: https://www.kickstarter.com/projects/antonyevans/glowing-plants-natural-lighting-with-no-electricit (last accessed 22 February 2015).

[172] See: http://www.etcgroup.org/content/response-glowing-plants-project (last accessed 22 February 2015).

responded:

> That's a grey area - I think there is a spectrum between traditional genetic engineering and synthetic biology, which is really an extension of those early techniques. I don't think there is any widely accepted definition of what is synthetic biology and what is genetic engineering, for us the aspects which make our project more synthetic biology are the use of synthetic DNA and the introduction of longer sequences encoding for complete metabolic pathways rather than just single genes. 'Purer' synthetic biology involves recoding for new types of amino acids or creation of entirely new organisms with no precedent in nature - we aren't doing this (personal communication, January 2014).

The Glowing Plant team's shifting descriptions of their project demonstrates the flexibility to reframe specific projects, either towards attention and investment or away from controversy and regulation. They did not have to worry about attracting the attention of potential regulators – either domestically (because of the USDA's loophole) or internationally (because the USA is not a Party to the CBD). So when Evans publicly put significant distance between their project and synthetic biology, this was in response to negative publicity, not the threat of stifling regulation. In his email to me, he gave a more nuanced framing of where he would place their project on the “spectrum” from genetic engineering to synthetic biology – of which neither end is clearly defined. At SBSTTA 18 side events, other scientists offered similar descriptions of synthetic biology, ranging from evolutionary (metabolic engineering) to revolutionary (xenobiology).[173] This imaginary of synthetic biology is rooted in a temporal framing: the synthetic biology being practiced *now* is nothing new; it is the *future* synthetic biology that may challenge regulatory and ethical frameworks. And, just as next-generation biofuels promise to avoid the problems of current generation biofuels, future advances in synthetic biology promise to provide technical solutions to any such future challenges. This was particularly

[173] See SBSTTA 18, side event by WWICS, 23 June 2014; SBSTTA 18, side event by WWICS, 24 June 2014.

invoked in discussions around potential positive and negative impacts of synthetic biology on biodiversity.

ii. Imaginaries of synthetic biology: potential positive and negative impacts.

There are a multitude of definitions for synthetic biology, developed by different communities of synthetic biologists, critical activists, supportive corporate consortia, and non-binding government advisory commissions. The majority of definitions rely on "abstract concepts and metaphors" such as "the application of engineering principles to biology" (SCHER et al. 2014). Seeing as the design of interchangeable, modular genetic parts is still largely out of reach (Heinemann & Panke 2006; Kwok 2010; Schmidt & de Lorenzo 2012), these definitions arguably describe *goals* for the discipline more than current realities. It is not uncommon for discourse around younger technosciences to be primarily "prospective and promissory," defined as much by what it could be in the future as by its contemporary manifestations (Nuffield 2012, 30; Brown 2003; Macnaghten, Kearnes & Wynne 2005).

Such prospective definitions for synthetic biology are helping to develop public "imaginaries" of synthetic biology – an amalgam of the practices and objects produced by synthetic biology along with "implicit assumptions, values and visions" (Macnaghten, Kearnes & Wynne 2005, 279; Felt & Wynne 2007; Nuffield 2012). Imaginaries of synthetic biology are developing in the context of longstanding societal narratives about science and technology, risk and reward, objectivity and rationality (Felt & Wynne 2007). Similar to how imaginaries for next-generation biofuels rely on pre-existing narratives of marginal land in developing countries, imaginaries of synthetic biology build directly on previous promises that biotechnology would produce predictable and controllable GMOs (Wynne 2005; Marris 2014).

The 11th COP requested the Secretariat to compile and synthesize relevant information on "components, organisms and products resulting from synthetic biology techniques that may have impacts on the conservation and sustainable use of biological diversity and associated social, economic and cultural considerations." As I quickly discovered, scientific research into the potential impacts on biodiversity of synthetic biology techniques and outputs is very limited. Thus, compiling and framing information on aspects of synthetic biology that "may" have impacts was essentially an exploration into imaginaries of synthetic biology – ideas of what it could be, its intended goals, and potential unintended consequences.

At the broadest level, proponents hope that synthetic biology will produce novel organisms to respond to a wide range of modern challenges, from identifying and curing diseases to new platforms for manufacturing, and opponents fear that these expanded possibilities will lead to unintended and unanticipated negative impacts. In *Impacts* a section on "applications of synthetic biology and their potential positive and negative impacts" addresses: bioenergy, environment, wildlife, agriculture, alternative methods to produce natural materials, and chemical production. The section on "associated social, economic and cultural considerations" also includes research and products related to biosecurity and health. In each sub-section, the stated goals of research are described as well as potential impacts on the conservation and sustainable use of biodiversity identified by researchers or observers and analysts. In drafting these sections, I engaged at least two kinds of speculative claims.

The first kind of speculation was around the impacts of *current and near-term* products of synthetic biology – products that were known and understood, but whose impacts were not. For example, squalene, an emollient, has historically been sourced from the livers of deep sea sharks, although in recent years plant-based squalene from olives and other oils has been an available alternative. Since 2011, squalane, produced by yeast transformed by synthetic biology, has been on the market in Japan.[174] Perhaps, as claimed by synthetic biology advocates, this has resulted in increased conservation of deep-sea sharks (Centerchem undated). Perhaps, as claimed by synthetic biology critics, it has damaged the livelihoods of smallholder olive farmers (ETC 2013). No one is tracking such impacts, so they remain unknown and the source of vigorous speculation.

The second kind of speculation involves consideration of the potential impacts of *future, anticipated applications* of synthetic biology. For example, the section on "environmental applications" describes research projects in pollution control and remediation by: reprogramming micro-organisms to break down herbicides and acid mine drainage; work to design bio-sensors; and early research in engineering micro-organisms to secrete plant hormones and respond to desertification (Kirby 2010; Sinha, Reyes & Gallivan 2010; French et al. 2011; Brune & Bayer 2012). *Impacts* acknowledges the significant work remaining before application of this research, and that the use of engineered micro-organisms has been a 'holy grail' since the introduction of recombinant DNA technology (Skerker, Lucks & Arkin 2009). While microbial ecologists understand genetically engineered micro-organisms to have failed to survive in the past because of the unpredictable complexity of natural microbial ecosystems, synthetic biologists see the

[174] Squalene is the natural compound, and squalane is the hydrogenated form of the compound. Squalane is more commonly used in cosmetics and as a lubricant.

previous failures as being due to the lack of sophistication in the genetic engineering. They are thus optimistic about the potential for synthetic biology to succeed (Marris & Jefferson 2013). *Impacts* also points out that if synthetic biology does succeed in producing micro-organisms sufficiently hardy for environmental release, this will raise new and potentially significant challenges for biosafety with the possibility of invasiveness and unintended effects (König et al. 2013). Finally, *Impacts* notes that those who are optimistic acknowledge these negative possibilities but invoke the (not yet realized) promise of xenobiology for 'building-in' biosafety (PCSBI 2010; Schmidt & de Lorenzo 2012).

As is clear from this brief summary, I found it challenging to write about “the positive and negative impacts” of synthetic biology. The section describes research that is relatively far from commercialization or application, and then tries to engage with the potential implications and impacts of future, “successful” versions of this technoscience. On the one hand, this builds speculation on top of speculation – how much meaning can really be ascribed to the extrapolation of how possible organisms might affect possible environments? Then again, the concept of environmental applications of engineered micro-organisms is an important component of past and present imaginaries of biotechnology (see PCSBI 2010; Schmidt & de Lorenzo 2012; Church et al. 2014); it neatly encapsulates the idea of humanity engineering nature in order to save nature. Considering the power of this narrative, it seemed important to acknowledge existing counter-narratives: the first, questioning whether human engineering has truly overcome natural complexity; and the second, pointing out that success would *necessarily* raise additional and possibly novel biosafety concerns.

Acknowledging powerful narratives – even if counter-narratives are provided – can still bring attention to and even legitimate speculative claims. The links between synthetic biology and biodiversity conservation are tenuous; no explicit synthetic biology projects are currently intended to target conservation. There are, however, possibilities. "De-extinction" projects attempt to restore extinct species through genetic manipulation of existing genomes, which *could* involve synthetic biology techniques as well as advanced cloning and other tools of biotechnology. At a 2013 conference "How will synthetic biology and conservation shape the future of nature?" other ideas for potential synthetic biology projects for conservation were identified, including adapting coral to temperature and acidity, attacking the fungus that causes white-nose syndrome in bats, and finding solutions to the crashing of bee populations.[175] None of these projects are actually happening – they represent the promise of synthetic biology, if it is allowed to develop. As Wiek et al. (2012) note, they are used in an imaginary of a synthetic biology that achieves sustainability by replacing lost biodiversity and even designing new biodiversity. They are present enough in discourse about synthetic biology that I felt I should acknowledge them as potential "positive impacts," along with their potential for negative impacts.

iii. Landscape of governance of synthetic biology.

Biofuels governance consists of disconnected mechanisms without a cohesive regime; controversies center around how best to respond to uncertain impacts. Controversies in synthetic biology governance, on the other hand, center around how the very landscape of

[175] For an overview of the meeting, see Rob Carlson's blog "Harry Potter and the Future of Nature" at http://www.synthesis.cc/2013/05/the-economics-of-artemsinin-and-malaria.html (last accessed 22 February 2015).

governance is depicted. To some actors, synthetic biology is adequately covered by existing legislation and policy on genetic engineering. To others, it is essentially an unregulated field. These differing views stem from different perspectives on the relationship of synthetic biology to conventional biotechnology and the adequacy of legislation governing the production and trade of GMOs.

As with biofuels, there are three main forums for producing governance: State support and regulation; codes of conduct and other voluntary forms of self-regulation; and international soft and hard law relating to biotechnology.

1. State support and regulation.

States engage with synthetic biology at various stages (research, industrial use, commercial production and dissemination), either to enable the delivery of benefits or to manage and mitigate risks (Nuffield 2012). A significant form of support for synthetic biology is through the direct State funding of research. Oldham, Hall and Burton (2012) found 530 funding sources for published research in synthetic biology, the majority from government agencies and national coalitions such as the US National Science Foundation, the European Union Framework programme, and the Human Frontier Science Foundation.[176] US and European governments are estimated to have funded over a half billion USD in synthetic biology research from 2005 to 2010 (WWICS 2010). While these are the two core areas of research, other sites of major research include China, Brazil, India, Mexico, Argentina, South Africa and Singapore (Oldham, Hall & Burton 2012). Funding flows through research councils, technology strategy boards, and government departments such as the UK's Ministry of Defense and the US's Defense

[176] The Human Frontier Science Program is an international programme established by Australia, Canada, France, Germany, India, Italy, Japan, South Korea, Norway, New Zealand, Switzerland, the UK, the European Union and the United States (Oldham, Hall & Burton 2012, 10).

Advanced Research Projects Agency (Nuffield 2012).

National legal systems of intellectual property rights (IPR) can also facilitate and incentivize synthetic biology research and development. The patent system has been an uneasy fit with biotechnology, with the dual problems of broad patent claims restricting the innovation of others and narrow claims creating patent "thickets" of unmanageable numbers of patents for single, complex devices (Rai & Boyle 2007). Some researchers in synthetic biology are experimenting with models of IPR based on open-source software, while others rely heavily on patents (see section 3.5 of the Impacts document; Calvert 2012).

At the stage of laboratory research, most States regulate some degree of physical containment depending on the research focus. Formal research laboratories are categorized by Biological Safety Levels (BSL) 1-4, from basic to maximum containment following the World Health Organization's standards (WHO 2004). BSL correspond to certain codes of practice and the presence of laboratory design and facilities (Ibid.). Although BSL categories are set by an international body, there is no international oversight of their application. It is up to national (or regional) governments to require that research is conducted under specific BSL categories of labs. Some civil society groups and analysts of nonproliferation policy have called for the "strictest levels" of containment of organisms resulting from synthetic biology – BSL 3 or 4 – until safety is demonstrated (FOE et al. 2012, 6; Tucker & Zilinskas 2006). Research involving recombinant or synthetic nucleic acid that is funded by the US National Institutes of Health (NIH) must follow the NIH's "Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules," which includes some conditions for physical and biological containment (NIH 2013).

Outside of the laboratory, the commercial use and environmental release of organisms produced using synthetic biology techniques are generally regulated by States within frameworks of “risk assessment” and “risk management,” put in place to respond to genetic engineering. These frameworks are based on assessing risks by evaluating characteristics of the recipient and donor organisms and any traits that are added.[177] A pressing question is whether these risk frameworks are adequate for synthetic biology. Reports by national governmental bodies – such as the US Presidential Commission on the Study of Bioethical Issues (PCSBI 2010), the Belgian Biosafety and Biotechnology Unit (Pauwels et al. 2012), the UK Health and Safety Laboratory (Bailey, Metcalf & Crook 2012), and the UK Synthetic Biology Roadmap Coordination Group (UKSBRCG 2012) – express the view that existing regulatory regimes and risk assessment methodologies for GMOs provide adequate coverage of the current and near-term results of synthetic biology techniques. Some civil society groups argue that the ability of synthetic biology techniques to produce significantly different organisms than conventional genetic engineering necessitates updated regulatory oversight and risk assessment methodologies (FOE et al. 2012). There seems to be a shared acknowledgement that, if synthetic biology research advances on its current trajectory, these current frameworks may be challenged. This is particularly in terms of anticipated enhanced abilities to create organisms with more “novel” genetic codes, either human-designed thus without natural analogues or garnered from very many different organisms (Rodemeyer 2009; Schmidt 2009; Bailey, Metcalf & Crook 2012; Pauwels et al. 2012).

[177] It is worth noting that the regulatory frameworks for biotechnology in many countries, such as the US and UK, have been criticized for lacking stability and clarity (Nuffield 2012; Rodemeyer 2009).

There is disagreement over whether current research already challenges existing frameworks.

Finally, there is the possibility that synthetic biology will be used to circumvent existing product labeling laws developed for older technologies. The majority of current and near-term industrial uses of synthetic biology involve modifying micro-organisms to produce molecules that would otherwise be sourced naturally or produced using synthetic chemistry. These products are not technically genetically modified – indeed, they tend to not contain any genetic material at all. Not only do they fall outside of labeling laws for GMOs, but some companies want to market the products as "natural." The majority of vanillin sold is produced using synthetic chemistry. The Swiss company Evolva claims it has used synthetic biology to design a yeast that produces vanillin, and are poised to sell this on the European market labeled as "natural" vanillin. Some civil society groups are concerned that this will compete with small-scale vanilla producers and have launched a campaign calling for clearer labeling laws.[178]

2. Codes of conduct and other voluntary schemes.

A significant mechanism governing biofuels for "sustainability" has been second-party certification, based on voluntary standards developed in private/public partnership. Rather than certification schemes, non-state governance in synthetic biology is talked about in two main areas: industry oversight for biosecurity; and the "self-regulation" of the scientific community.

Synthetic biology techniques could increase the dangers posed by biological weapons by making them easier to acquire or create and, in the long term, enhancing

[178] See: www.synbiowatch.org (last accessed 22 February 2015). There was vigorous debate on this between civil society representatives and the head of Evolva at SBSTTA 18, side event by WWICS, 24 June 2014.

their lethality and infectiousness (Mukunda, Oye, & Mohr 2009). Synthetically produced DNA is commercially available, and represents a potential pathway for producing such pathogens.[179] This is a pathway unregulated by States; the US Department of Health and Human Services recommends that commercial DNA synthesis firms screen customers and "sequences of concern," but no States have mandatory licensing or screening regulations (DHHS 2010). Instead, two consortia of DNA synthesis companies have developed separate but similar protocols that include screening sequences for pathogens and customers for legitimacy (IASB 2009; IGSC 2009). There are acknowledged gaps in this approach to self-regulation for biosecurity. Consortia membership does not cover all synthesis companies; not only are some US or Europe synthesis companies not signed on, but there are no member companies from China although several leading global suppliers are Chinese (Tucker 2010; Terrill & Wagner 2010). Also, it is debated whether a screening system for DNA sequences is even useful; virulence is hard to predict, dependent on context and environment, and customers can simply order short DNA sequences rather than longer ones that could more easily be identified as part of a known pathogen (Garfinkel & Frieldman 2010; Relman 2010).

Outside of biosecurity concerns, various groups speaking for the "scientific community" have considered voluntary codes of conduct and "self-regulation" (IAP 2014; Nature Editorial 2014). The *Asilomar Declaration* is often referred to as a point when scientists in biotechnology practiced self-regulation. In 1975, US scientists working on recombinant DNA technologies agreed to a short-lived moratorium on some aspects of their work (Berg et al. 1975). After Asilomar, precautions for rDNA experiments

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[179] A popular example is an infectious poliovirus produced in an American lab in 2002, using oligonucleotides ordered from a commercial supplier (Cello et al. 2002).

gradually relaxed. In 2006, the "SB2.0" international conference on synthetic biology was anticipated to produce an "Asilomar-like" declaration, particularly with regards to screening sequences. The draft declaration was never voted on or passed.

The *Asilomar Declaration* is frequently cited in discussions of oversight of synthetic biology research. Before the 2006 SB2.0 conference, it was invoked to rally scientists to self-regulate, although it wasn't always clear whether this was because commentators felt that advances in technology called for a reconsideration of current practices or just wanted to preempt additional government oversight (Ferber 2004; Service 2006; Tucker & Zilinskas 2006). Since the failed meeting of 2006, *Asilomar* is invoked to make different arguments. The US PCSBI (2010) uses *Asilomar* to justify regulatory inaction, because the systems that developed as a result of its processes are seen as continuing to adequately oversee synthetic biology. Some synthetic biologists describe methods to "build-in biosafety" (ie, xenobiology and other speculative methods of biological containment) as an "extension" of *Asilomar* self-governance (Bailey, Metcalf & Crook 2012; Schmidt & de Lorenzo 2012). These future fixes are based on the imaginary of synthetic biology allowing scientists to continually exert greater *precision* and *control*. On the basis of this expectation, regulators are urged to hold off on additional synthetic-biology-specific regulations. As the IAP (Global Network of Science Academies) argues, "There is reason to expect that the greater precision embedded in synthetic biology makes it less, not more, difficult to regulate, manage and audit, compared to older technologies" (IAP 2014, 2).[180] Although literature on regulation of

[180] The US PCSBI further naturalizes this imaginary by deploying analogies of material technologies that "build in" safety: "Technology can be harnessed to build in safeguards, just as cars have brakes and seatbelts, houses have smoke detectors, and computers have anti-virus software. A number of safety

emerging technologies often assumes a significant role for self-regulation and voluntary codes of conduct (Abbott, Sylvester & Marchant 2010; Lee 2012), the synthetic biology community seems to be shying away from *any* political response, however soft, and pointing instead to the promise of *technical* solutions.

3. International initiatives.

The extent of international regulatory coverage of synthetic biology is unclear. Many treaties, agreements and soft law instruments could be interpreted as applying to the research, industrial use, and/or commercial production of synthetic biology, but few treaty bodies explicitly address synthetic biology. As with many other aspects of synthetic biology, there are deep disagreements over the meaning of this lack of specific regulatory attention: does it represent serious gaps in regulatory coverage, or rather reflect that "synthetic biology" poses no challenges unique from other biotechnologies?

In 2012, COP 11 requested the Secretariat to "consider possible gaps and overlaps with the applicable provisions of the Convention, its Protocols and other relevant agreements related to components, organisms and products resulting from synthetic biology techniques." For the purposes of this chapter, it is sufficient to discuss very broadly the types of international legal coverage of synthetic biology. *Gaps and Overlaps* divides them into two kinds: 1) addressing the potential risks arising from the application of synthetic biology techniques; and 2) addressing access to genetic resources, benefit-sharing from their utilization, and intellectual property rights. The CBD and its Protocols are arguably the most relevant international treaties with relation to both the potential risks to biodiversity and the potential benefits that could arise through access to and

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features can be incorporated into synthetic organisms to control their spread and life span" (PCSBI 2010, 129).

sharing of the benefits of genetic resources. As is often the case in international environmental law, however, the WTO Agreements also cover this issue – at least in terms of trade and intellectual property rights. Other issue-specific treaties could address specific applications of synthetic biology, such as the Biological Weapons Convention (BWC), the International Treaty on Plant Genetic Resources for Food and Agriculture, and the International Convention for the Protection of New Varieties of Plants. Other than the engagement of the CBD with synthetic biology through the processes discussed in this chapter, the BWC is the only other treaty body to have specifically considered synthetic biology. The BWC's Parties have identified that biological agents and toxins produced by synthetic biology are covered by the treaty, but have not produced any concrete outcomes, such as an oversight framework, guiding principles, or models to inform risk assessment (BWC 2006 & 2013).

Regarding coverage by the CBD and its Protocols, a starting question is whether organisms produced by synthetic biology are GMOs. The CBD and its Cartagena Protocol on Biosafety (CPB) are the two main international instruments governing GMOs, or rather, “living modified organisms” (LMOs), a term of art that encompasses GMOs.[181] If so, LMOs resulting from synthetic biology are subject to: 1) the CBD's biosafety provisions, committing Parties to regulate, manage or control associated risks that are likely to have adverse environmental impacts, and 2) the CPB's provisions that directly regulate transboundary movement, transit, handling and use of all LMOs that may have adverse effects on the conservation and sustainable use of biodiversity (CBD

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[181] The CBD and CPB's uses of the term “LMOs” are slightly different. The CBD text does not define LMO's, but it is understood to include organisms modified through traditional techniques such as plant breeding (Glowka et al. 1994). Under the CPB, LMOs are defined as “any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology” (CPB, Art. 3(g)).

Art 8(g); CPB Art. 4). For qualifying LMOs, the CPB establishes an Advanced Informed Agreement procedure to ensure that countries have the necessary information to make informed decisions before agreeing to import an LMO into their territory for the first time (CPB Art. 7). Annex III of the CPB sets out general principles, methodological steps, and points to consider in conducting risk assessments of LMOs.

These provisions only apply to the products of synthetic biology if they are LMOs. In *Gaps and Overlaps,* I identified several current outputs of synthetic biology that may not be considered "living" and therefore would fall through a gap[182] in international coverage: "naked"[183] DNA strands synthesized by commercial companies and mailed to customers; the products of micro-organisms modified by synthetic biology such as biofuels, medicine, and flavors; and the transfer of digital information instead of physical transfers of biological materials. If research in synthetic biology lives up to expectations, it will raise the question of whether protocells and the results of xenobiology are "living."

For those products of synthetic biology that do qualify as LMOs, there is the question of whether the regulatory frameworks meant for conventional biotechnology adequately cover synthetic biology. For example, under the CPB's Annex III, risks of LMOs are assessed by the characteristics of the recipient and donor organism and any added traits. This process may not be adequate if an organism is developed from dozens of donor organisms, or if added traits have been designed by humans and have no natural analog for comparison (ICSWGSB 2011; Schmidt 2009). Another potential gap is the CBD and CPB's use of probability-based language as thresholds for action ("are likely to

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[182] I never understood what constituted an "overlap," and no one ever pressed me to explicitly address this.
[183] As per the IUCN Guide to the Cartagena Protocol on Biosafety, "naked DNA" refers to "DNA that is not attached to or inclose association with other biological molecules" (Mackenzie et al. 2003, 45).

have adverse environmental impacts," "may have a significant adverse impact"). As with many emerging (and even some established) technosciences, there is disagreement over the degree to which potential dangers related to synthetic biology are known or can be assessed (de Lorenzo 2010; Erickson, Singh & Winters 2011; Dana et al. 2012; Snow & Smith 2012). If specific adverse impacts cannot be identified - let alone the probability of their coming to pass – it is unclear whether or how such provisions would apply. Furthermore, these thresholds do not seem to respond to "catastrophic" or "existential" threats that are low-probability but high-consequence. Some analysts have identified synthetic biology as presenting such risks from accidental or malicious release (Rees 2013; Wilson 2013).

Where synthetic biology requires access to genetic resources, the CBD's access requirements apply, requiring prior informed consent (unless otherwise determined) and the negotiation of mutually agreed terms (CBD, Art. 15). The Nagoya Protocol also applies to the extent that synthetic biology utilizes genetic resources. The Nagoya Protocol has only recently entered into force, and numerous aspects of its text are still ambiguous. One question is what genetic resources are covered by the Protocol - those acquired after the entry into force of the Nagoya Protocol (October 2014), those acquired after the entry into force of the CBD (December 1993), or all genetic resources so long as they are utilized (Buck & Hamilton 2011; Nijar 2011; Greiber et al. 2012). The geographic scope of the Nagoya Protocol is also uncertain, in terms of whether areas beyond national jurisdiction, such as the high seas and deep seabed, are included (Buck & Hamilton 2011; Greiber et al. 2012). These outstanding questions are not, however, uniquely related to synthetic biology, and so the Secretariat staff chose not to include them in any of the published drafts of *Gaps and Overlaps*.

Overall, *Gaps and Overlaps* finds that "the current regulatory mechanisms that could apply to synthetic biology techniques and the components, organisms and products resulting from them would not address all potential positive and negative impacts. While the mandate of some treaties or institutions is sufficiently broad to address some or all synthetic biology techniques, there is no mechanism to ensure that the issues are actually addressed in a consistent and comprehensive manner" (SCBD 2014d, 10).

4.2. Synthetic biology at the CBD.

From its initial introduction in the biofuels debates to rounds of negotiations on whether it qualified as a stand-alone "New and Emerging Issue," synthetic biology has been under consideration at the CBD for over four years. In this section, I situate synthetic biology within the CBD's history of engagement with genetic resources. I then briefly describe the treaty's work on synthetic biology up to COP 11 in 2012 and explain my work for the Secretariat in 2013 and 2014. The bulk of the section analyzes three areas of major contention from COP 11 (2012) through SBSTTA 18 (2014): defining and drawing upon a knowledge base for the negotiations; defining a scope for the treaty's work in the absence of an agreed-upon definition for synthetic biology; and identifying and responding to scientific uncertainties.

i. Introduction of synthetic biology to the CBD.

Synthetic biology entered formal discussions at the CBD in May 2010, at the 14th meeting of the SBSTTA in Nairobi, Kenya. During the two week meeting,[184] the J. Craig Venter Institute announced their successful construction of the first “self-replicating synthetic bacterial cell” - a 1.08 million base pair bacterial genome entirely synthesized from 'scratch' and transplanted into a cell stripped of its genome (JCVI 2010; Gibson et al. 2010). As one civil society observer put it, when some delegates heard this news they were “rightly shocked that that was happening” (Observer interview 2013). Civil society groups had already laid the groundwork for discussion on synthetic biology at the CBD, with side events at SBSTTA 13 (2008)[185] and SBSTTA 14 (2010)[186] introducing synthetic biology as “extreme genetic engineering” and considering its use in next-generation biofuels research. Thus, it was controversial but not surprising when the Philippines introduced synthetic biology in two draft texts – as a specific consideration in the SBSTTA 14 biofuel discussions, and as a New and Emerging Issue (NEI) to be considered across all of the CBD’s Programmes of Work.

From the perspective of the civil society coalition on synthetic biology and their Party allies, synthetic biology “clearly fits into the mandate of the CBD in so many ways” (Observer interview 2013). Synthetic biology embodies approaches to nature that coincide with dominant ways of knowing and valuing biodiversity in the context of the CBD. In the late 1980s and early 1990s, biodiversity was seen as a “storehouse of genetic material,” from which bioprospecting would extract huge profits as well as planetary environmental solutions (Tinker 1995, 200; Parry 2004). The CBD's commitment to

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[184] SBSTTA meetings are usually held annually for one week, thus meeting twice between each gathering of the COP. In the period between COPs 9 & 10, however, only one SBSTTA meeting was held, lasting for two weeks.
[185] See: http://www.cbd.int/kb/record/sideEvent/1151?RecordType=sideEvent&Event=SBSTTA-13 (last accessed 22 February 2015).
[186] See: http://www.cbd.int/kb/record/sideEvent/1874?RecordType=sideEvent&Event=SBSTTA-14 (last accessed 22 February 2015).

equitable access and benefit-sharing of genetic resources was therefore seen as a “grand bargain” between the South, which had biodiversity, and the North, which wanted to use biodiversity (Laird & Wynberg 2012). Genetic material was extracted from its ecosystems and communities of use, and assigned value through modern science in colonial “centers of calculation” (Parry 2000; Whatmore 2002). Over the past two decades, the economics and processes of bioprospecting have shifted; it is no longer seen as cost-effective or necessary to mount expeditions to collect large amounts of biomaterials from exotic places. As technosciences such as synthetic biology have made it possible to look deeper within genomes, researchers increasingly can find what they need from existing collections and even from their surrounding ecosystems (Laird & Wynberg 2012).

While physical bioprospecting has started to diminish in importance, a “gene-centric view of biological life” has become increasingly dominant, within the biological sciences as well as the CBD (Guay 2002; Escobar 2008). While other biodiversity sciences “cast an image of fuzziness” and are highly context-specific, the more reductionist approach of molecular biology provides clear-cut descriptions and explanations for biodiversity, which are thus more likely to be seen as policy-relevant (Guay 2002). This has meant the extension of a very specific sociotechnical network, as the “universal” language of genetics requires particular scientific knowledges, infrastructures and practices (Braun 2007). For example, the “Barcode of Life” project has been relatively high profile within CBD events. The Barcode of Life is an approach to identifying species based on a specific region of a mitochondrial gene – the idea is to standardize species identification much in the way that the UPC “barcode” is used to distinguish products.[187] Representatives of the International Barcode of Life (IBOL) project and its associated Consortium for the Barcode of Life were very engaged in the negotiations for an ABS protocol (see Schindel 2010). IBOL's goal of a hand-held device to easily "scan" and genetically identify items of biodiversity in the field resonates with the CBD's movement towards knowledge that produces an "economized" and "entrepreneurial" biodiversity, a biodiversity "that capital can see" (Dempsey 2011, 38).

Thus, synthetic biology could be seen as an apt issue for the CBD from a number of different angles – on the one hand, it offers the promise of rational, quantifiable solutions for biodiversity problems that fit within capitalist systems of knowledge and profit; on the other hand, it offers an opportunity to explore and critique those systems. If the scope of potential impacts to be considered by the CBD is broad enough, it could include questions of ownership, resource control, and other socio-economic matters as well as how to govern for biosafety in situations of variable uncertainties. The Philippines' introduction of synthetic biology into both the biofuel and the NEI draft texts was strategic. Although many different technologies are deployed in attempts to develop viable next-generation biofuels, synthetic biology is considered key (Mackenzie 2013). Introducing questions and concerns about synthetic biology to the biofuel discussions was a way to disrupt the narrative that next-generation biofuels promised to solve all the current problems with biofuels. Just as importantly, it was an immediate way to have CBD bodies immediately consider what should be done about synthetic biology, rather than focusing on the question of whether it should be added as an NEI.

At the SBSTTA 14 NEI discussions, Parties agreed to recommend that the COP

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[187] See: http://www.barcodeoflife.org/content/about/what-dna-barcoding (last accessed 22 February 2015) and my notes from COP 10, side event by the Consortium for the Barcode of Life, 20 October 2010.

not add *any* of the proposed issues to the SBSTTA agenda. Both the SBSTTA 14 Recommendations on NEI and on biofuels included bracketed text calling on Parties not to allow the field release of synthetic life, cell or genome into the environment (SBSTTA Recommendations XIV/10 & XIV/16). At the next major negotiating event, COP 10, synthetic biology was a substantial aspect of the biofuel negotiations, while significantly less time and attention was given to NEI (see Jungcurt et al. 2010a). The final NEI Decision invites Parties, other Governments and relevant organizations to submit information on synthetic biology for consideration of the SBSTTA, in accordance with the procedures in Decision IX/29 (ie, the criteria established for NEI). The Secretariat received six documents from civil society groups, a pre-existing report by the Royal Academy of Engineering on behalf of the UK, and two Party comments: from Mexico, simply saying that no proposals met the criteria of Decision IX/29; and from Grenada, simply saying that synthetic biology should be considered an emerging issue (see SCBD 2012c). Unsurprisingly, the understanding at SBSTTA 16 was that sufficient information had not been collected, and that the process for identifying NEI needed to be refined (Appleton et al. 2012 a-c).

ii. Work for the Secretariat: drafting documents and assisting at SBSTTA 18.

Synthetic biology was introduced into formal negotiations at the CBD through the biofuel negotiations, but it has taken on a life of its own. I have been present for much of this journey, initially as a participant observer, and later as an "observant participant" in the treaty processes. Having witnessed heated negotiations on synthetic biology in the COP 10 biofuels negotiations, I continued to follow the issue at COP 11. At the end of a COP

11 session of the Friends of the Chair on NEI, I introduced myself to Robert Höft, the CBD Secretariat staff member overseeing the NEI negotiations, and asked if I could come to Montreal at some point to conduct interviews. Robert suggested that I consider spending a few months at the Secretariat as an intern undertaking some of the synthetic biology work. I spent three months (January through March 2013) in Montreal at the Secretariat offices, preparing drafts of the two background information documents on synthetic biology for the treaty (*Impacts* and *Gaps and Overlaps*) and conducting interviews with current and former Secretariat staff members for my dissertation. At the end of three months, the drafts were not finished, and I continued to work on them from New Jersey until early June 2013. The documents were made available for peer review from July to September 2013.

Technical reports prepared for the SBSTTA are "peer reviewed as appropriate," as called for in the consolidated *modus operandi* of the SBSTTA (Decision XIII/10, Annex III, E14).[188] Peer review may be carried out by reviewers selected by the Secretariat or by a "wider audience" of Parties, SBSTTA Focal Points, ILCs, other Governments, and others. In the case of the synthetic biology information documents, the Secretariat issued a public *Notification* of the availability of the drafts for review for three months, along with the standard template for comments and additional views (SCBD 2013b). Such *Notifications* are sent to CBD National Focal Points, SBSTTA Focal Points, and relevant organizations, but are also made publicly available, with any individual or organization welcome to respond. Peer review comments were received from five Parties, one non-

[188] The concept of peer review plays two different roles in SBSTTA processes: first as an evidentiary standard in the development of documentation (which I refer to as "peer-review"), and secondly as a mechanism for reviewing documentation for the treaty (which I refer to as "peer review").

Party, and six observer organizations.[189]

The Secretariat received funding from the UK for consultants to continue work on the synthetic biology documents. In January and February 2014, I revised *Impacts* in response to the peer review comments. In addition, I produced a separate document responding to each comment with an explanation of revisions made or a justification for why no revision was made. Another consultant was hired to revise *Gaps and Overlaps;* they did not work out, and a Secretariat staff member quickly drafted additional text, adding analysis of four principles of customary international environmental law and eight additional treaties and organizations that cover synthetic biology. I responded to the "technical" peer review comments on *Gaps and Overlaps* and reviewed the Secretariat's additions. Until mid-April, I worked on the official document, summarizing the two information documents and applying the Decision IX/29 para. 12 criteria on NEI to synthetic biology. In April, the draft information documents were made available for a second round of peer review for two weeks (which was a surprise to me and apparently to many countries and observers as well, as I only saw brief comments from Germany, Japan and Canada).

As is common with CBD information documents, *Impacts* and *Gaps and Overlaps* are rather lengthy – each one is 63 single-spaced pages – and available only in English. By contrast, the official SBSTTA document, *New and Emerging Issues: Synthetic Biology,* was limited to 16 pages and made available in the six UN languages:

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[189] Peer review comments were received from: Parties (Belgium, Canada, China, the European Commission and the UK); one non-Party (the USA); and six observer organizations (the J. Craig Venter Institute (JCVI), the University of Edinburgh's Centre for Synthetic and Systems Biology, the Woodrow Wilson International Center for Scholar's Synthetic Biology Project, the Biotechnology Industry Organization (BIO), the ETC Group, and the European Molecular Biology Organization (EMBO). They are available at http://www.cbd.int/emerging/ (last accessed 22 February 2015).

English, French, Spanish, Russian, Chinese and Arabic.

In June 2014, I attended SBSTTA 18 and participated as a "technical expert" for the Secretariat in the synthetic biology discussions. I presented the information documents on behalf of the Secretariat at a pre-SBSTTA workshop on synthetic biology for CBD delegates organized by the EC-sponsored Synenergene Civil Society Forum. At SBSTTA 18, I took notes at all of the formal discussions and answered any questions that the Contact Group Chair directed to me. The opportunity for the most input came when I worked with three Secretariat staff members to revise the initial draft Recommendation in response to Party comments at the initial Plenary discussions on synthetic biology. This revised draft Recommendation was then used in the Contact Group discussions.

At no time was I hidden from delegates. But I was also never fully "revealed" as the primary author of the synthetic biology documents, with the exception of my presentation at the pre-SBSTTA civil society information session. The information documents are presented as the product of the CBD Secretariat, with no individual authors attributed (SCBD 2014c & d). This is not uncommon - the twenty-six SBSTTA 18 information documents contain a range of approaches to attribution. Ten documents attribute authorship to named groups, such as the WWF and UNEP; three documents individually name the "experts" who led the writing, usually coming out of an "expert group"; one document is described as having been commissioned by the Secretariat without naming the author; and eight documents are attributed to the Secretariat, although some of those are merely compilations or summaries of submissions.[190]

I do not know why the choice was made to present the documents as coming from

[190] See: http://www.cbd.int/doc/?meeting=sbstta-18 (last accessed 22 February 2015). The remaining documents are reports from workshops, most on marine spatial planning.

the "Secretariat." Documents from the Secretariat rarely have a Secretariat staff member's name attached to them, and as I was a CBD intern at the time of the initial drafting, this may just have been the most accurate description. It might also be that Secretariat staff members realized, based on previous engagement with the issue, that the documents were bound to be controversial. Keeping the primary author anonymous prevented the documents from being attacked on the basis of the author's qualifications or association with a particular political stance. One of the ways that the SCBD exercises its power of framing is through selecting consultants (Koetz et al. 2008), and it has received some criticism in the past for its lack of transparency in this process (Le Prestre 2002b).

iii. Synthetic biology at COP 11, the Secretariat, and SBSTTA 18.

In the biofuels chapter I delved into one negotiating event, COP 10, to closely analyze the role of knowledge politics in producing Decision X/37 on biofuels. In this chapter, I draw from three different treaty processes: COP 11 (October 2012); the Secretariat's inter-sessional production of documents on synthetic biology for SBSTTA discussions (2013 & 2014); and SBSTTA 18 (June 2014). Following knowledge politics through these processes provides a sense of their unfolding – for example, I trace Secretariat documents from the COP's explicitly political determination of the documents' scope, to the Secretariat's production of documents, to the SBSTTA's utilization of those documents. It also provides an intimate account of the co-production of knowledge and governance.

1. Epistemic base of decision-making

By the time I came to the biofuel negotiations, an information base on biofuels and biodiversity had largely been established. Synthetic biology as a field, and especially information on synthetic biology and biodiversity, was at a more nascent stage. At the

CBD, a significant matter of debate has been upon what kinds and sources of knowledge are appropriate for basing decisions on synthetic biology. Recognizing that there was not a clear body of knowledge about the impacts of synthetic biology on biodiversity, COP 11 essentially requested that the Secretariat develop one. This section examines the contested processes by which an epistemic base for international decision-making was produced and used.

A. COP 11: Setting the scope of the Secretariat's work.

As described in chapter 2, the COP can exert control over the Secretariat's freedom to engage on an issue by restricting the SCBD's mandate. COP 10's initial request for information on synthetic biology was *only* to "Parties, other Governments and relevant organizations" (Decision X/13, para. 4). The Secretariat was directed to encourage Parties to follow Decision IX/29 when they submitted proposals on NEI (Decision X/13, para. 6). When the issue was next taken up at SBSTTA 16, the official SBSTTA document on NEI consisted of a compilation of received submissions and two very short comments from Parties (SCBD 2012c). Delegates at SBSTTA 16 and COP 11 acknowledged that this was not sufficient information to base substantive debate. As the Chair of the COP 11 Friends of the Chair on NEI put it: "We didn't do the homework."[191] Nonetheless, at COP 11 some delegations still expressed reluctance to allow the Secretariat to independently gather information or conduct synthesis or analysis, either because it was not within the remit of the Secretariat[192] or because it would cause too much work for the Secretariat.[193] The Chair settled the debate: "even if it is a nightmare," the Secretariat would compile

[191] COP 11, FtC, 15 October 2012. Secretariat interviews also confirm that this was the general agreement at SBSTTA 16.
[192] COP 11, FtC, 15 October 2012, Brazil.
[193] COP 11, FtC, 15 October 2012, EU.

relevant information *in addition* to what was submitted.[194]

So the Secretariat would be allowed to independently compile information, but about what? Delegates to COP 11 disagreed on what issues should be addressed. The Recommendation from SBSTTA 16 included two bracketed options, both asking for information on the "possible impacts" of synthetic biology on biodiversity (SBSTTA Recommendation XVI/12). Canada argued that this was "too open-ended," potentially resulting in a large volume of information that would not be practically useful for Parties.[195] Argentina argued it was premature to take into account environmental impacts because synthetic biology was a "very small laboratory concept."[196] Other delegations generally accepted that information on impacts on biodiversity (or rather, the conservation and sustainable use of biodiversity) would be appropriate to compile.

Significant debate focused on whether it was appropriate to also include information on social, economic and cultural impacts of synthetic biology. These discussions quickly expanded from determining what information was needed to determine whether synthetic biology was an NEI to debating the proper scope of the treaty. Delegations such as Switzerland, New Zealand, and Brazil called for the Secretariat to focus on biodiversity and conservation (and *maybe* human health); socio-economic and cultural considerations should be excluded as simply too broad.[197] The Philippines and Bolivia insisted that social, economic and cultural considerations were relevant to the objectives of the Convention as well as the NEI criteria.[198] The Philippines pointed out that the word "social" is found thirty times in the Convention text. Ultimately,

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[194] COP 11, FtC, 15 October 2012.
[195] COP 11, WGII, 11 October 2012; COP 11, FtC, 15 October 2012.
[196] COP 11, WGII, 11 October 2012.
[197] COP 11, FtC, 15 & 16 October 2012; COP 11, WGII, 18 October 2012.
[198] COP 11, FtC, 15 & 16 October 2012; COP 11, WGII, 18 October 2012.

the Chair of Working Group II called for Parties to meet in the "back of the room" to come to agreement.[199] The final text invites "additional relevant information on components, organisms and products resulting from synthetic biology techniques that may have impacts on the conservation and sustainable use of biological diversity *and associated social, economic and cultural considerations*" (Decision XI/11, para 3(a), emphasis added). This language represents compromise, in that it includes socio-economic considerations but restricts them to ones associated with the conservation and sustainable use of biodiversity.

It also represents a common approach to reaching compromise by the CBD COP: vague text with multiple possible interpretations. This phrase remained a matter of contention throughout the production of the documents. In the *Impacts* draft, I wrote about biosecurity, economics, health, ethics, and intellectual property as "associated considerations." A number of the peer review responses criticized this list as exceeding the boundaries of the Convention's expertise and relevance. Canada and the US specifically identified biosecurity and intellectual property considerations as beyond the proper scope of the document and best handled by *other* treaties and organizations. I responded to these comments with "no changes made," explaining that they fell within the "associated...considerations."

B. Secretariat: judging appropriate sources of information.

In the context of the CBD, COP 11's request that the Secretariat "compile and synthesize relevant available information" is a grant of significant freedom. Not only may the Secretariat actively search for information rather than sitting back and waiting for submissions, it can also conduct analysis on the meaning and relevance of that

[199] COP 11, WGII, 18 October 2012.

information to the treaty. Relative freedom, however, is hardly the same as free rein, as I discovered.

I conducted semi-structured interviews at the Secretariat while drafting the information documents, hoping to get data for my dissertation as well as guidance in how to approach my work for the SCBD. I asked how interviewees judged the appropriateness of sources of information for Secretariat documents. Interviewees often seemed to treat this as a question with a self-evident answer: Party submissions must always be included, and, of course, use peer-reviewed literature. Beyond that, interviewees sometimes mentioned other UN bodies (particularly the FAO), personal networks of people in relevant fields and organizations, international organizations, and indigenous and local communities.

It is unsurprising that every interviewee pointed to “peer-reviewed literature.” Within scientific communities, peer-review is an important mechanism by which scientists act as gatekeepers of what counts as scientific knowledge, policing (and thus helping to create) boundaries between science and society (Gieryn 1995; Felt & Wynne 2007). It is the primary evidentiary standard at the IPCC (Miller 2009); non-peer-reviewed sources may only be drawn upon if they are flagged and clear indications are provided for how they should be assessed (IPCC 2010). While the CBD does not have such clear evidentiary standards, Decision IX/29 calls for proposals for NEI to be accompanied, where possible, by “credible sources of information, preferably from peer-reviewed articles” (para. 11(e)).

Self-evident as this may seem, I found that the task of compiling appropriate sources presented challenges in practice. The first complication is that, like most UN bodies, the CBD Secretariat does not have institutional access to the vast majority of peer-reviewed articles. When I initially arrived at the Secretariat, I was informed that I should use Rutgers University to access journal databases. Beyond that, I could go to McGill or other local universities and use their materials on-site as a visitor (which I did for several books). I was informed in interviews that the Secretariat had inquired with local university libraries whether some arrangements for accessing materials could be made, but that individual institutional access was simply too expensive. Staff members expressed different attitudes over how problematic this was. Everyone stated they could access relevant materials, either through individual subscriptions to journals (primarily *Nature* and *Science*), writing to authors, using open-access journals, or just asking interns with university-granted access to retrieve specific articles. Most interviewees were confident that they had sufficient access through these various methods to do their jobs. In my experience, I would have found the process of compiling relevant information even longer and significantly more challenging.

Secondly, while peer-review is an important indicator of the quality of research and thought, it is not necessarily considered a sufficient standard within the SCBD. Some Secretariat interview responses framed the choice of sources as a simple matter of sticking to the "science and the facts," but those same interviewees also indicated criteria that they independently used to review material, such as credibility and scientific rigor. One interviewee in particular spent a long time discussing science as a "human endeavor," noting the use of science to promote specific agendas and that the production of scientific information involved political influences. A number of interviewees indicated that, with both peer-reviewed and "grey" literature, it came down to making a personal judgment call based on their sense of how a given source fit into the overall body of literature.

I drew on many peer-reviewed articles in the background documents; of the almost 250 references in *Impacts*, at least 115 were peer-reviewed. These included: articles on scientific (mostly synthetic biology) research; articles from social sciences, law, and ethics; scientific reviews; and commentaries mostly written by scientists, often sharing their perspectives on the policy, economic and social implications of their research (SCBD 2014c). With the exception of a few commentaries and research articles from the ecological sciences, peer reviewed-literature largely contained optimistic predictions of the impacts of synthetic biology. Reports from governments – not peer-reviewed, but broadly recognized within the CBD as legitimate and critical sources of information – tended to mirror and expand upon these predictions of positive social impacts (see RAE 2009; EASAC 2010; PCSBI 2010; UKSBRCG 2012). The social sciences literature was very useful in describing, categorizing, and sometimes critiquing the epistemological viewpoints of the scientific literature, but rarely addressed impacts (with a few exceptions, such as Wellhausen & Mukunda 2009).

Peer-reviewed literature was not the only type of resource available. Non-peer-reviewed "grey" literature encompasses reports and materials from governments, NGOs, think tanks, and ILC groups. In producing the synthetic biology documents, I did not have materials by ILC groups to draw upon. There was no consultation process with ILCs, as there had been for the CBD's work on geo-engineering. I did not specifically reach out to ILC groups for information; overwhelmed by existing information, it never occurred to me to do so. I did have access to the views of other groups – mainly NGOs, urging caution and corporate groups promoting synthetic biology. In an interview, one Secretariat member noted that most substantive information on emerging technosciences is held by industry and NGOs, and that industry didn't share its information with the CBD, while NGOs did (Secretariat interview 2013). Indeed, numerous Secretariat staff members and delegates (in informal conversations and when interviewed) readily admitted that NGO representatives were some of the most knowledgeable about emerging technosciences. However, Secretariat staff members also took care to point to their limited use of NGO materials – NGOs were valued as information compilers, not for their critical viewpoints. Numerous SCBD interviewees described relying on NGOs to gather evidence (one described them as helping to "pre-digest" information), but that they would not pass on to Parties the same conclusions that NGOs drew from that evidence.

Personally, I found it extremely challenging to determine what sources to draw on and how to use them. In *Gaps and Overlaps* I wrote about the coverage of the Convention and its Protocols; as with most matters of international law, it is all a matter of interpretation. In many cases, no one else had specifically interpreted these texts in terms of their application to synthetic biology, so I described possible interpretations. Some analysis was available from think tanks (seen by some as "corporate-friendly") and critical NGOs (see ICSWGSB 2011; Bagley & Rai 2013; IAP 2014). I included these interpretations but was clear that they came from specific organizations. In the case of *Impacts*, I found plenty of *discussion* of potential impacts of synthetic biology on biodiversity and associated considerations, but a deficit of actual *research*. Synthetic biologists, corporate groups, research centers and NGOs alike were all faced with a lack of evidence of impacts. Each of those groups responded by putting their own frames of meaning on past analogous techniques and objects and speculating on synthetic biology in the present and future.

Peer-reviewed literature contains bold claims about the potential positive ecological and socio-economic impacts of future and near-term applications of synthetic biology – that they will stabilize supplies of and increase access to malaria medication (Heinemann & Panke 2006; Ro et al. 2006; Collins 2012); solve concerns about genetic drift through xenobiology (Skerker, Lucks & Arkin 2009; Schmidt & de Lorenzo 2012; Esvelt & Wang 2013); and provide biofuels that do not impact food prices or use agricultural lands (Khalil & Collins 2010; Bokinsky et al. 2011;Ducat, Way & Silver 2011; Ducat et al. 2012). These claims are based on speculations of how future applications of research might be used: that industrial production will be more stable than harvesting and lead to greater access by the poor; that preventing genetic drift will completely contain organisms; that biofuels from non-food feedstocks will resolve “Food vs Fuels” tensions. I included these claims, but it seemed reasonable to include contrasting perspectives from gray literature, particularly when they were expressed in official submissions to the CBD from CSOs. In each section I tried to strike a rough balance – reporting on anticipated positive impacts as well as potential negative impacts that either seemed tied to the claims of positive impacts or that had a robust evidence base, even if only through analogy to the impacts of similar processes and products. This approach was challenged in the peer review process.

Within scientific communities, the peer-review process builds community by drawing boundaries, excluding information that does not meet the standards of scientific knowledge and persons who do not meet the standards of 'peers.' It is a powerful mechanism for regulating what counts as objective knowledge (Jasanoff 2011; Nuffield 2012). Edwards and Schneider (2001) describe peer-review as a technique of accountability rather than a "truth machine," providing a way for a community to enforce fundamental norms and practices. The CBD's peer review process can be seen as a technique of accountability among the treaty's Parties and stakeholders. But as almost anyone can be considered a "peer," this means that the norms of various communities, sometimes conflicting, may be invoked.

Some of the government peer review responses strongly criticized the drafts' use of non-peer-reviewed papers from civil society groups. The UK, Canada, and the US (a non-Party) each noted that Decision IX/29 states that proposals for emerging issues "should, where possible, be accompanied by information on...credible sources of information, preferably from peer-reviewed articles" (para. 11(e)). The US State Department wrote:

> "We would like to call attention to the paper's reliance on non-peer reviewed literature from organizations that are dedicated opponents of synthetic biology....We note with concern that, instead of citing peer-reviewed publications, the background paper cites seventy-five times in thirty-three pages white papers from ETC Group, Friends of the Earth, and the International Civil Society Working Group on Synthetic Biology (a coalition organized largely by ETC Group and Friends of the Earth)."[200]

Canada noted that discussion on potential impacts was "supported by only a handful of peer reviewed papers," and that many other sources were from "special interest groups."[201] The UK requested that the documents make a "clear distinction between the weight given to evidence derived from peer-reviewed sources and from documents

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[200] See: http://www.cbd.int/doc/emerging-issues/US-reviewcomments-SBImpacts-2013-09-en.pdf (last accessed 22 February 2015).

[201] See: http://www.cbd.int/doc/emerging-issues/Canada-reviewcomments-SBImpacts-2013-12-en.pdf (last accessed 22 February 2015).

produced by special interest groups."[202]

The line these responses draw is not between peer-reviewed and non-peer-reviewed literature, but rather between peer-reviewed and special interest groups – particularly *critical* special interest groups. Most of the responders suggested additional relevant articles; I have a file folder almost an inch thick of additional submissions and references suggested in peer review, including eleven peer-reviewed papers, four government reports, and two news articles. While these proportions seem to demonstrate a clear valuing of peer-reviewed literature, the peer-reviewed papers add up to 66 pages compared to 135 pages of government reports. Peer-review was clearly not the only criterion for judging the appropriateness of a source.

Whether through interviews, informal conversation, side events, or formal negotiations, I've heard almost everyone involved with synthetic biology and the CBD at some point note the importance of including the perspectives (and sometimes "knowledge") of ILCs. Some thought it was a matter of timing for when such knowledge was appropriate, such as the State delegate who thought they should be involved "further down the road," once synthetic biology's impacts were better understood (Delegate interview 2012). Others thought that meaningful ILC input would require more extensive processes of consultation, with workshops and interactive processes (Secretariat interview 2013). But everyone ascribed to the view that ILCs were legitimate actors in some way.

Attitudes are more mixed on the proper role of critical CSOs. In my interview with a delegate and informal conversation with other State delegates, "very active" NGOs

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[202] See: http://www.cbd.int/doc/emerging-issues/UK-overviewofcomments-SB-2013-10-en.docx (last accessed 22 February 2015).

(the ETC Group was often specifically named) were seen as having pushed geo-engineering and synthetic biology onto the CBD (Delegate interview 2012). When I participated in an NSF "workshop on research agendas in the societal aspects of synthetic biology" in November 2014, social scientists and synthetic biologists alike wanted to know my opinion on whether synthetic biology wasn't "really" on the CBD's radar because CSOs had used compliant developing country delegations as mouthpieces. A Secretariat staff member noted having seen CSOs communicating with delegates of developing countries that would not otherwise be central to a debate, and those delegates then becoming the spokespersons for precaution (Secretariat interview 2013). In one interview, an observer noted that, with synthetic biology, the impacts were too far away and unsure for most CSOs to engage, and those who understood the issue were already involved and thus not "objective" (Observer interview 2014). As previously mentioned in Chapter 2, the head of an observer CSO admitted worrying that the CBD might be seen as "the NGOs' treaty" (Observer interview 2014). In many of the peer review responses, CSOs were framed as illegitimate commenters or producers of knowledge for the purposes of the CBD.

Peer review was a strong disciplining factor in the final information documents. I made significant revisions in response to the comments, many of which related to the use of references. In the draft I had relied heavily on secondary reports, both to describe original research and to report on its varying interpretations, in order to cover a wide breadth of material in the time available. In the revised version, I cited original research when it was being discussed. I made sure that every time that I cited a "critical" civil society group (or any other "special interest" group), it was clearly signaled in the text. In this way, I learned the norms of communicating within the CBD – how to acceptably select and draw upon sources.

Yet the peer review responses did not entirely dictate the form or content of the final products. I did not remove the arguments of critical civil society groups from the texts, although I did adjust how they were included. Almost all of the references came from submissions to the CBD through the official process, and were thus recognized by the SCBD as valid, although needing context. Furthermore, Secretariat staff and I decided not to change text in response to almost half of the EC's comments on *Gaps and Overlaps.* The EC demanded a reference for each statement that involved any independent analysis or interpretation of the CBD and its Protocols in the context of synthetic biology. As mentioned, there was very little existing legal analysis on international law's coverage of synthetic biology; if we had simply reported on *already identified* gaps and overlaps, it would have been a very short (and unhelpful) document. Instead, we carried out analysis, made analogies to other biotechnologies, identified potential gaps unique to synthetic biology, and always attempted to clearly communicate the range of options for interpreting texts. Based on their review responses, the EC was not comfortable with the Secretariat exercising this much freedom. Perhaps emboldened by the past rounds of negotiations that had failed because of an insufficient base of knowledge, the Secretariat stood firm.

C. SBSTTA 18 – the use of documents in decision-making.

How did CBD delegations respond to and utilize the 142 pages of information produced by the Secretariat for them? None of the delegations at SBSTTA 18 openly criticized the documents. Generally, delegations with a cautious stance on the impacts of synthetic biology praised the documents, describing them in terms such as "informative,"[203] "an accurate overview,"[204] and "the most balanced and objective document possible."[205] Delegations that were more cautious about potentially harming the economic prospects of synthetic biology demanded another round of peer review, arguing that the second round had been too short for adequate responses.[206] A few delegates admitted that they found the documents confusing.[207]

Specific substance from the documents was rarely invoked in the discussions. The documents were sometimes brought into the conversation in order to back up a point – for example, the UK and EU referenced the broad range of regulations covered by *Gaps and Overlaps* to argue that synthetic biology was *not* insufficiently regulated.[208] At one point, when arguing whether synthetic biology really had "benefits" to biodiversity, the example of squalene was raised (as previously discussed in section 4.1 iv). Delegates went back and forth, bringing up different points ("Products used in the perfume industry previously used sharks for this oil. That's a direct, clear benefit for sharks!" "Unilever already committed to make squalene from olives – it's unclear that using squalene impacts the shark market as opposed to the olive market!"). No one acknowledged that exactly those views were raised in *Impacts.*

Delegates wanted the documents to answer the simple question: does synthetic biology meet the criteria for a NEI? I did not see how there could be a simple answer, however. The Nuffield Council on Bioethics (2012) identifies ambiguity - the capability

[203] SBSTTA 18, Plenary, 24 June 2014, South Africa.
[204] SBSTTA 18, Plenary, 24 June 2014, Austria.
[205] SBSTTA 18, Plenary, 24 June 2014, France.
[206] SBSTTA 18, Plenary, 24 June 2014, UK, Belgium, Argentina; SBSTTA 18, Plenary, 25 June 2014, Canada.
[207] SBSTTA 18, Plenary, 24 June 2014, Timor Leste; SBSTTA 18, CG, 25 June 2014, Canada.
[208] As in SBSTTA 18, CG, 25 June 2014.

of a single phenomenon to bear two or more incompatible meanings - as one of three main challenging of emerging biotechnologies. They note ambiguity in the nature of biotechnology and its relationship with past technologies, ambiguity in how potential harms and benefits of biotechnologies are understood, and ambiguity in how we understand and categorize the resulting novel objects (Nuffield 2012). Certainly, in attempting to apply the Decision IX/29 criteria for an NEI to the issue of synthetic biology, I struggled with ambiguity. The seven criteria include the relevance of the issue to the Convention’s objectives; new evidence of unexpected and significant impacts on biodiversity; the urgency of the issue; and evidence of limited tools to mitigate negative impacts on biodiversity (para. 12). In attempting to apply these criteria, I was faced with an abundance of opinions and an absence of evidence, which itself had ambiguous meaning. Due to layers of ambiguity – around how existing information should be interpreted, how to treat the lack of evidence, and how to interpret the criteria – each criterion could be answered differently, depending on one's interpretation. I had tried to reflect this in the official document.

Delegates agreed to another round of peer review for the information documents, with Australia specifically requesting language that the Secretariat would carry out “robust analysis.”[209] As the discussion went on, the Mexican delegate voiced what was apparently a shared expectation – that not only would this future analysis be robust, but “the results will say whether [synthetic biology] is emerging or not!”[210] Although the Africa Group pointed out that analysis had been on-going since 2010 and asked when it

[209] SBSTTA 18, CG, 26 June 2014, Australia.
[210] SBSTTA 18, CG, 26 June 2014, Mexico.

would be "enough,"[211] other delegates were quite happy to place their expectations in another round of peer review and more "robust" analysis on the part of the Secretariat. Two important moves were made here. First, calling for another round of peer review gave delegates an escape valve, a way to avoid making decisions pending more robust analysis. Delegations such as Canada expressed "a very high level of discomfort" calling for any kind of specific action (ie, a moratorium) while still waiting for analysis.[212] Second, delegations expressed a desire for the analysis that would come out of this third round of peer review to determine whether synthetic biology met the criteria for an NEI. They wanted neutral, technical analysis, resulting in clear answers.

2. Defining synthetic biology: attempts to bound an issue.

The lack of an agreed-upon definition for synthetic biology has played a variety of roles at the CBD. Different aspects have been the focus of consideration at various points: at COP 11, it was about synthetic biology's relation to other biotechnology; during the peer review process, it was about identifying "products" of synthetic biology; at SBSTTA 18 it was about identifying "benefits" of synthetic biology. At each point, what synthetic biology "is" has been an opportunity for boundary work.

A. COP 11: novelty of synthetic biology.

As noted in section 4.1ii, synthetic biology's relationship with older, "conventional" biotechnology is an issue of contention. At COP 11, delegates framed this relationship in different ways. Delegations arguing for a moratorium on the environmental release and commercial use of synthetic biology described it as a field quickly increasing in novelty; delegations arguing against a moratorium (or indeed any action by the CBD on the issue)

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[211] SBSTTA 18, CG, 26 June 2014, Africa Group / South Africa.
[212] SBSTTA 18, CG, 26 June 2014, Canada.

described it as nothing new. For example, Ghana (speaking for the Africa group), described synthetic biology as a discipline "that is emerging, and very, very fast," and therefore required a gradual approach of gathering information rather than "assum[ing] that it is good."[213] The EU directly responded: "So-called synthetic biology is a field that started in 1974....This field started with GMOs."[214] The next day, New Zealand stated that synthetic biology "has actually been around since 1975, one of our scientists pointed out the first molecular genetic technique took place in 1975...These have been happening for a long time."[215]

In the context of the CBD, describing synthetic biology as a mere continuation of conventional biotechnology leads to the use of specific legal terminology. A major issue of the COP 11 NEI negotiations was whether to refer to the organisms produced by synthetic biology as living modified organisms (LMOs). Canada, supported by the EU, argued that "LMOs" was the appropriate descriptive term.[216] The Philippines consistently countered that the legal definition of LMOs might not encompass all outcomes of synthetic biology.[217] When the chair asked if anyone in the "back of the room" could clarify whether all organisms from synthetic biology could be considered LMOs, an observer sidestepped the scientific question to answer in terms of the legal (and political) repercussions of the use of terminology. She noted that the concept of LMOs had been "exactly designed for the Cartagena Protocol." If synthetic biology was considered to produce LMOs, she warned, the CBD's engagement on synthetic biology would essentially be restricted to the Cartagena Protocol's risk assessment procedures, which

[213] COP 11, FtC, 15 October 2012. Another example is Bolivia at COP 11, WGII, 18 October 2012.
[214] COP 11, FtC, 15 October 2012.
[215] COP 11, FtC, 16 October 2012.
[216] COP 11, FtC, 15 October 2012.
[217] COP 11, FtC, 15 October 2012.

may not be adequate for all outcomes of synthetic biology. Ultimately, the Mexican chair of the Friends of the Chair group on NEI urged delegates to leave it up to the Secretariat to determine whether the term "LMO" sufficiently covered the results of synthetic biology.[218]

As with most issues, my work for the Secretariat did not provide a simple answer to this question. I identified a number of current outputs of synthetic biology that likely would *not* be considered LMOs (naked DNA strands; products of micro-organisms modified by synthetic biology that do not contain DNA; and the transfer of digital information instead of physical transfers of biological materials), as well as future outputs anticipated from current research (protocells and the results of xenobiology) (SCBD 2014c). Whether this leaves "sufficient" coverage is up for interpretation; the Secretariat documents did not attempt to close any of the definitional controversies. At SBSTTA 18, the EU delegate claimed: "We don't think we need a global regulatory framework, especially when we don't understand what synthetic biology is. We don't have a definition! What is in the market and near market *is* GM technology."[219] The Africa group delegate from Ethiopia responded: "(To say) there is no synthetic biology products in the market – that is not true, there are...Denying this, saying only in market is GMO, that's not true, that is why we are here, why we are debating about this."[220]

B. Secretariat: what are "products" of synthetic biology?

Going into my internship at the CBD, I considered myself forewarned by the COP 11 debates. I knew that the question of a definition for synthetic biology was politically controversial, but I also assumed that a common definition existed within the scientific

[218] COP 11, FtC, 15 October 2012.
[219] SBSTTA 18, CG, 26 June 2014.
[220] SBSTTA 18, CG, 26 June 2014.

community, and that my task would be to translate that scientific definition into the context of the CBD and its protocols.

I quickly realized how wrong I was, particularly in thinking that there was *a* scientific community engaged in synthetic biology. The scientific research being conducted under the umbrella term "synthetic biology" employs a vast range of techniques and tools, few of which could be described as unique to synthetic biology. Nor does the research seem to share a common goal; significant effort is going towards "platform cell factories" for industrial production and processing, but there are a multitude of other goals of self-described "synthetic biology research," from discovering the origin of life to finally succeeding with gene therapy to preventing genetic drift of altered genetic material in the environment. Major journals such as *Nature Biotechnology* (Various 2009) and *Nature Reviews Molecular Cell Biology* (Church et al. 2014) periodically ask a range of synthetic biologists to comment on the discipline. From these, a reader would be hard-pressed to identify a convergence on a singular understanding of synthetic biology.

The CBD Parties had requested the Secretariat to compile and synthesize information on the potential impacts of "components, organisms and products resulting from synthetic biology techniques." It was going to be hard to address the impacts of synthetic biology without at least a working definition of synthetic biology. But I also did not think that the COP had empowered the Secretariat to develop even a working definition. I decided to acknowledge from the start that "the existence of a singular definition for synthetic biology is still debated" and provide a box with seven different definitions (SCBD 2013c, 3 & 4). In the rest of the draft, however, I basically followed the lead of my references – if the authors described it as synthetic biology, I reported it as such.

Peer review responses criticized this approach. Canada was concerned that too broad a scope of "synthetic biology" would encompass general biotechnology and crop breeding, and recommended selecting an interim definition to avoid this. The UK noted that the drafts "do not attempt to resolve...competing definitions" and thus just complicated things, and that, in the UK's view, the majority of applications of synthetic biology were covered by legislation on GMOs. The US said that the lack of an agreed definition "makes it impossible to determine which of the many current and near-term products listed in the report should be considered as synthetic biology or resulting from synthetic biology." The Woodrow Wilson International Center for Scholars (WWICS) perhaps put it most clearly: "Since there is no clear definition of synthetic biology, many of the statements in this document are blurring the lines between synthetic biology, genetic engineering and biotechnology in general."

The responses of the Biotechnology Industry Organization (BIO) to the draft provide a classic example of such blurred lines. Among BIO's extensive criticisms of the Impacts draft, they stated that the draft's examples of current and near-term products of synthetic biology were "in many cases not from synthetic biology, but from 'standard old-fashioned genetic engineering'." They highlighted the example of Myriant's bio-succinic acid, "produced by an organism that contains no foreign DNA and was generated by standard techniques of gene deletion and selection for faster growing natural mutants. No 'Synthetic Biology' was used."[221] Yet a 2013 document by BIO, *Current Uses of Synthetic*

[221] See: http://www.cbd.int/doc/emerging-issues/Biotechnology-Industry-Organization-reviewcomments-SBImpacts-2013-09-en.pdf (last accessed 22 February 2015).

Biology for Renewable Chemicals, Pharmaceuticals, and Biofuels, includes a glowing description of Myriant's bio-succinic acid. In the peer review response, BIO recommended that the definition of synthetic biology "be limited to processes or organisms that involve the use of nucleic acids that are produced by de novo synthesis." Under this definition, only two of BIO's ten (admittedly vague) examples of synthetic biology in *Current Uses* would qualify as synthetic biology.[222]

Rather than reducing the scope of the documents, I highlighted definitional controversies in the revisions. For example, a major question is whether 'synthetic' metabolic engineering is meaningfully different from conventional metabolic engineering. Many – if not most – of the examples of current and near-term applications of synthetic biology fall within this category: Sanofi's artemisinin for malaria; Amyris' Biofene for biofuels; Evolva's vanillin. Therefore, along with any discussion about such products or their impacts, I also mentioned that it was a matter of disagreement whether the product was considered to come from "synthetic biology."

As previously mentioned, the question of what could be defined as products of synthetic biology continued to be contentious at SBSTTA 18. In side events, CSOs criticized biotechnology companies for marketing products as synthetic biology to investors and then turning to regulators and the public and saying that it wasn't synthetic biology.[223] They called for the CBD to demand that corporations be transparent in terms of the processes and techniques used in production, but delegates did not take this up in the Contact Group discussions.

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[222] BIO describes enzymes made with novel synthesized genes by LS9 (to process biofuels) and Merck (to produce a medicine for diabetes). The other examples all seem to be of metabolic engineering or directed evolution.
[223] SBSTTA 18, side event by WWICS, 24 June 2014; SBSTTA 18, side event by Ecoropa, 25 June 2014.

C. SBSTTA 18: benefits of synthetic biology.

Delegates and observers at SBSTTA 18 seemed to share an assumption that the CBD needed to develop (or adopt) a definition of synthetic biology. Although a coalition of critical civil society groups encouraged Parties not to let the lack of a definition stop them from acting - as they noted in their Plenary statement, there is no "conclusive definition for a gene, a forest, or even biodiversity," but this has not stopped the CBD in those areas[224] - the same coalition suggested that Parties adopt a working definition of synthetic biology, with an annex of specific techniques and approaches.[225] The Liberian delegate offered such a working definition, developed by the ETC Group.[226] None of the other delegates, however, displayed an appetite to negotiate a definition of synthetic biology during SBSTTA 18. There was broad agreement for an on-line forum and workshop of "experts" that would consider an operational definition for synthetic biology.[227] The Africa group's request that the workshop include representatives of ILCs and relevant organizations was uncontested.[228]

This seemed to take care of the question of a definition. Except, of course, that delegates still had to come up with an entire Recommendation on synthetic biology without a common understanding of what the term meant. This caused problems.

Delegates were trying to develop a document with two parts: an initial section of the SBSTTA's findings and then recommendations to the COP. In the Secretariat's suggested Recommendation, the initial section includes very broad descriptions of

[224] SBSTTA 18, Plenary, 25 June 2014; see also SBSTTA 18, side event by Ecoropa, 25 June 2014.
[225] As presented at the pre-SBSTTA18 seminar by Synenergene, 22 June 2014.
[226] SBSTTA 18, Plenary, 24 June 2014.
[227] See SBSTTA 18, CG, 26 June 2014.
[228] There was a somewhat lengthy squabble over the "openness" of these processes, but this seemed to be entirely based in disagreement over whether an "open-ended on-line forum" meant it would be accessible to all Parties or that it would not have a fixed end date. That it would be open to all was not contested. SBSTTA 18, CG, 26 June 2014.

synthetic biology: that it involves "various techniques, organisms and components," some have resulted in commercial products and industrial processes and others are anticipated; there are a "number of intended benefits"; and there are "also risks...some expected and manageable, some involving a high degree of uncertainty and others unforeseeable" (SCBD 2014e, 15). This language had gone through multiple rounds of Secretariat staff review, and seemed to me to be so vague as to encompass more or less all perspectives on synthetic biology. In the initial Plenary discussions, delegates did not address those descriptions. As we were developing the "non-paper" from the Plenary comments, our Secretariat team made only one adjustment on the basis of the European Union's "Vilm" report, adding that the uncertainty around risks was "as to the frequency of occurrence and the magnitude of harm."[229]

To my surprise, at least the first two hours of the first meeting of the Contact Group on synthetic biology were entirely focused on these initial paragraphs. Subsequent sessions repeatedly returned to these descriptions before language was resolved. Some of the disagreement was around how to talk about uncertainty in relation to "risks" and "benefits," as will be discussed in the next section. A significant sticking point was whether any benefits of synthetic biology to biodiversity were already known to exist or, instead, "may" exist. According to the EU delegate, there was "no question of benefits." He cited "the OECD report, only one example to convince the audience – there are 30 medicines from metabolic engineering."[230] The Ethiopian delegate speaking for the Africa group countered that the production of medicines based on natural products did

[229] Non-papers are not officially published by the CBD, but such "in-session documents" are publicly available on the CBD's webpages for each set of negotiations and meetings: http://www.cbd.int/doc/meetings/sbstta/sbstta-18/in-session/sbstta-18-non-paper-item-6-25June201418h12m-en.pdf (last accessed 26 August 2014).
[230] SBSTTA 18, CG, 25 June 2014.

not *necessarily* bring benefits, pointing to increased resistance to the anti-malarial artemisinin that seemed to correspond with its synthetic production. The conversation moved on, but kept looping back to how "benefits" would be described. The EU delegate offered the example of a diabetes type 2 drug, taxol. The Africa group representative shot back: "Diabetes or biodiversity? We talk about humans, yes of course. If we say benefits are generated for biodiversity – nothing is there currently. Only commercial." Later, responding to the Africa group representative's expansive call that there were "no examples" of current benefits, the EU delegate pointed out that human health could be considered an "associated social consideration," included as one of the criteria for NEI in Decision IX/29. A delegate of New Zealand supported that there were "universal" benefits to human health and industrial processes from synthetic biology, but that none of the reading she'd done indicated benefits to biodiversity.

Rather than continue to argue for human health benefits, the EU delegate switched tack and invoked the Barcode of Life project.[231] The EU delegate described IBOL as a "synthetic biology technique" to identify species, because it uses DNA sequencing. "That's not synthetic biology!" yelled multiple people in responses, including some observers. The Swedish delegate jumped in with examples of "direct benefits" - products used in the perfume industry that had previously been sourced from sharks and whales. The Chair turned to the Africa group and asked "Can you live with the fact that there are benefits?" "We don't agree," the same representative responded. He noted that species identification relied on metagenomic techniques, not synthetic biology, which is the "creation of life – of artificial organisms." An observer from the ETC Group also noted

[231] See http://www.barcodeoflife.org/content/about/what-dna-barcoding (last accessed 22 February 2015) and my personal notes from COP 10, side event by the Consortium for the Barcode of Life, 20 October 2010.

that the squalene example was a claim made by commercial companies, that most squalene comes from olives, not sharks, and that it was unclear that squalene from synthetic biology impacted the shark market rather than increasing the vulnerability of olive farmers. A French delegate jumped in to support the Africa group, noting that it was a strange argument, to "allow me to do crazy things, in order that I stop making [ie, doing] other crazy things."

Multiple arguments were brought to bear in these exchanges, demonstrating the breadth of disagreement around the issue's boundaries. Delegations arguing for the benefits of synthetic biology did so on the basis of: a broader scope of techniques to be considered "synthetic biology"; a broader scope of concern for the CBD that included human health; and examples of positive impacts of product displacement. Each of these claims was countered by arguments for narrower interpretations. Expanding synthetic biology to include the Barcode of Life was shouted down. Health benefits were denied either as untrue (as in the case of artemisinin resistance) or insufficiently related to biodiversity. Claims of benefits through product substitution were complicated by civil society groups questioning what was actually being displaced, and a Party delegate refuting the validity of substituting one problematic practice with another.

The final, agreed-upon paragraph reads: "There are intended benefits from research and from current and near-term commercial, industrial applications and products of synthetic biology but these are currently poorly understood" (SBSTTA 2014, para. 1(c)). The promise of benefits is qualified as "intended" and "currently poorly understood." But it is also bolstered as a fact – benefits exist, even if they are not understood at the moment.

3. Understanding scientific uncertainties.

At the CBD, scientific uncertainty has been given many different frames of meaning – from a trigger for precaution to a reason to delay taking any regulatory action, especially "precautionary" ones. Likewise, there are different understandings of what "precaution" entails. Unlike the biofuel negotiations, the CBD synthetic biology discussions on scientific uncertainty and on precaution do not clearly connect. With biofuels, delegates clashed over whether precaution was necessary; with synthetic biology, precaution was generally seen as appropriate, but there was disagreement on what "acting with precaution" meant. Delegates have also had to grapple with scientific uncertainties much more directly than in biofuels, as they determine how to apply the NEI criteria in the absence of clear evidence.

A. COP 11: Precaution vs. a moratorium.

At COP 10, the Philippines, the Africa group, and a few other developing country Parties supported by CSOs pressed for language urging Parties and other Governments not to release organisms produced using synthetic biology into the environment until various stipulations were met. Leading up to COP 11, similar language was included as a bracketed option in the SBSTTA 16 Recommendation on NEI (Recommendation XVI/12). At COP 11, this paragraph was broadly referred to as a "de facto moratorium."

Delegations argued against a moratorium on multiple grounds, including a lack of information to justify it[232] and that it would contradict the CBD and CPB's guidance on LMOs.[233] Some arguments against a moratorium invoked precaution. Canada, the EU, and New Zealand each invoked the precautionary approach as an alternative to a

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[232] COP 11, WGII, 11 October 2012. This included the EU, Canada and Norway

[233] COP 11, FtC, 15 & 16 October 2012, New Zealand and the EU.

moratorium – so long as Parties were urged to act with precaution, the more drastic step of a moratorium was unnecessary.[234] Brazil pushed further. It insisted that the proposed moratorium was based on a "misunderstanding" of the precautionary approach. At least twice in the course of COP 11 discussions on synthetic biology, the Brazilian delegate read out the Rio Declaration's version of precaution: "Where there are threats of serious or irreversible damage, lack of scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (Rio Declaration 1992). Brazil argued that this was not the same as prohibiting actions because of a lack of full scientific certainty of their impacts.[235] Brazil continued this line of argument at SBSTTA 18, stressing that CSOs misapplied the precautionary approach in arguing that "development should only occur if there is scientific certainty of any environmental, social or economic impacts."[236]

Those arguing *for* a moratorium invoked the precautionary approach as justification, with two main arguments. First, precaution was needed because synthetic biology was an emerging technoscience. For example, the Philippines issued a "strong call for a precautionary approach on new technologies that are intended to address existing problems but may have serious impacts on biodiversity."[237] As Ghana said, synthetic biology may be useful, but it was a discipline that was moving fast, and precaution required a "gradual entry" into this knowledge system to give time to understand its implications.[238] Bolivia argued that the "precautionary principle exists for this exact matter" - while knowledge about the risks of synthetic biology remained

[234] COP 11, WGII, 11 October 2012, Canada & EU; COP 11, FtC, 15 October 2012, New Zealand
[235] COP 11, WGII, 11 October 2012; COP 11, CG, 16 October 2012.
[236] SBSTTA 18, Plenary, 24 June 2014.
[237] COP 11, WGII, 11 October 2012.
[238] COP 11, FtC, 15 October 2012.

"woefully inadequate" and old risk assessment models were inadequate, the CBD needed to "put the brakes" on synthetic biology.[239] A second reason for precaution was that heightened threats to more vulnerable populations required a stance of precaution by the international community. Echoing their previous arguments at COP 10, the Philippines described developing countries and island states as potential "pilot areas" for synthetic biology, unable to effectively legislate to protect themselves.[240] Later, at SBSTTA 18, the Global Youth Biodiversity Network and an indigneous peoples organization similarly asked Parties to take a precautionary approach for those who are poorer and cannot defend against the unknown.[241]

There was no agreement on how to invoke precaution at the Friends of the Chair meetings, and the paragraph went back to the Working Group still bracketed. Delegates managed to reach a final agreement by meeting in the back of the room,[242] but Argentina continued to refuse consent until the following day (the very last day of the COP). At that point, they granted consent with the addition of "in accordance with domestic legislation *and other relevant international obligations.*"[243] Argentina's inclusion of "other relevant international obligations" was understood to be a "hint to the norms of the World Trade Organization (WTO)" (Jungcurt et al. 2012, 23). Under the WTO SPS Agreement, precaution is restricted to acknowledging gaps in knowledge, and precautionary actions are only allowed for a finite time, after which any uncertainties should have been resolved (Peel 2010).

[239] COP 11, WGII, 18 October 2012.
[240] COP 11, WGII, 11 October 2012. Also, COP 10, CG, 26 October 2010.
[241] SBSTTA 18, Plenary, 25 June 2014.
[242] Once a civil society delegate saw that a US State Department representative was part of the group, he joined in on the logic that it was open to "non-Parties." I did not join the group, as I interpreted it as unlikely to be intended as "open" to someone studying and documenting the negotiations.
[243] COP 11, WGII, 19 October 2012.

The final paragraph is as follows:

> *Recognizing* the development of technologies associated with synthetic life, cells or genomes, and the scientific uncertainties of their potential impact on the conservation and sustainable use of biological diversity, urges Parties and invites other Governments to take a precautionary approach, in accordance with the preamble of the Convention and with Article 14, when addressing threats of significant reduction or loss of biological diversity posed by organisms, components and products resulting from synthetic biology, in accordance with domestic legislation and other relevant international obligations (Decision XI/11, para. 4).

The 2010 decision on biofuels specifies activities that required precaution (the introduction and use of LMOs in biofuels and the field release of synthetic life, cell or genome into the environment) and indirectly suggests what an application of precaution could look like (the suspension of environmental release) (Decision X/37, para. 16). According to the 2012 Decision on NEI, precaution is only called for "when addressing threats of significant reduction or loss of biological diversity" (Decision XI/11, para. 4). This phrase, mirroring Principle 15 of the *Rio Declaration*, could be interpreted as raising the threshold for invocation of precaution to only instances in which sufficient evidence indicates a *significant* threat. It also restricts the range of acknowledged scientific uncertainties to the conservation and sustainable use of biodiversity and frames them as "scientific," as opposed to language suggested by Ghana that explicitly included socio-economic issues and ILC livelihoods.

B. Secretariat: Scientific uncertainty and precaution in the drafting processes.

When I came to the CBD Secretariat in January 2014, I had been studying the CBD for three and a half years and had observed several rounds of major negotiations. I generally felt that I had a solid grasp on the main issues addressed by the treaty and the range of approaches for doing so, and I believed that the precautionary approach / principle was key to some of the most contentious debates within the CBD. To me, the question of how to govern in the face of incomplete, absent, or indeterminate scientific evidence kept surfacing in the treaty – from its long-standing engagement with emerging technosciences such as GURTS and geoengineering, to grappling with ecological phenomena difficult to predict or track such as invasive alien species and overfishing. I didn't just consider precaution as important to the CBD; I saw the CBD as an important forum for fleshing out the meaning of precaution in international law.

This is not a perspective openly shared by the CBD Secretariat staff, however. In interviews, staff members ascribed very little importance to scientific uncertainty in their work. Several of the interviewees expressed that there simply isn't that much relevant uncertainty. Credible sources converge in their findings; the overall "thrust" of information generally indicates what a sensible decision is. One interviewee noted that it's a question of different *levels* of scientific uncertainty: from an international policy perspective, not much is uncertain when it comes to evidence or drivers of the biodiversity crisis; as one zooms in, scientific uncertainty becomes more of an issue. Among these interviewees, scientific uncertainty was less a matter of science and more a political tool used by countries to make an issue "go away."

Two of the interviewees noted that the Secretariat has choices in how it frames and communicates scientific uncertainties. Both mentioned the IPCC's approach to quantifying scientific uncertainty, but also acknowledged that this was not the CBD's approach. One described the CBD as being focused on "exposing" rather than "removing" scientific uncertainty. The other described it as a two-part problem, of scientists being unwilling to talk about scientific uncertainties with the general public, and of there being a history of “bad use” of scientific uncertainty to justify inaction on issues such as smoking, pesticides, and other harmful substances.

Similar to the general downplaying of the importance of scientific uncertainty, Secretariat staff members seemed reluctant to comment on the precautionary approach / principle in interviews. At least three of them responded to questions of precaution at the CBD by pointing to climate change as a better issue for exploring precaution. Many did not feel “qualified” to speak about precaution at the CBD, no matter how long they'd been working with the CBD, no matter their higher education, no matter what contentious issues they worked with. A couple made dismissive comments – that it was hard to see how the precautionary approach / principle had any impact, questioning whether anyone paid attention to the “precautionary things” that had been adopted by the CBD.

For my tasks for the Secretariat, however, the deeper I delved into synthetic biology, the more prominent scientific uncertainties became. That seemed to leave me with the option of “exposing” scientific uncertainties. I did this primarily by noting different perspectives among scientists and also within non-peer-reviewed literature.[244] I also directly addressed some outstanding scientific uncertainties within synthetic biology in a section titled “Emergence of unpredictable properties.” This section noted broad recognition within scientific communities that synthetic biology could result in radically different forms of life, citing a popular example of unexpectedly virulent engineered

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[244] For example, the section on xenobiology explains how one arm of synthetic biology research is trying to develop “built-in” biosafety mechanisms to prevent genetic drift to wild organisms, and that other scientists warn that natural evolution may foil this approach. A later section on biological containment strategies includes perspectives beyond peer-reviewed scientific literature. I noted that engineered induced lethality is frequently mentioned as a response to policy concerns about environmental release, invoked by governmental bodies, iGEM teams, and synthetic biologists. I also included a paragraph quote from the International Civil Society Working Group on Synthetic Biology's submission to the CBD urging that such biocontainment approaches not be field tested or commercialized until closely assessed for their ecological and socio-economic impacts (SCBD 2014c, 32).

diseases and mentioning that some scholars have referred to synthetic biology as an "existential threat." In their peer review comments, research centers and biotechnology organizations strongly criticized this section. They argued that the included quotes were taken out of context to seem more negative and were "merely PR by these high-profile scientists" anyways.[245] Rather than removing this section, I removed some of the more contentious quotes, explained the context of others, and expanded the section to address more fully the disagreement over the adequacy of existing risk research and regulatory structures for synthetic biology.

C. SBSTTA 18: Applying criteria in the absence of evidence.

The process for selecting an NEI has been controversial since the mechanism was first introduced. The Decision IX/29 para. 12 criteria for selecting an NEI were developed in the context of heated debates on biofuels. Synthetic biology is the first issue for which anyone has tried to apply the NEI criteria.[246] In the process, the criteria's ambiguities are coming to light.

As previously mentioned, the delegates of COP 11 agreed that the previous submissions process had produced an insufficient literature base for negotiations. Although none of the submissions had attempted to apply the NEI criteria, delegates seemed to generally assume that synthetic biology would *not* meet all of the criteria – particularly criterion (b): "New evidence of unexpected and significant impacts on biodiversity." A major discussion point at the Friends of the Chair on NEI sessions at COP 11 was whether *all* of the criteria had to be met for an issue to qualify as an NEI.

The chapeau of Decision IX/29 para. 12 declares that "the following criteria

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[245] See comments by EMBO, BIO, SynthSys and JCVI.

[246] As explained in Chapter 2, tropospheric ozone was technically added to the agenda of the CBD through the NEI mechanism, but the criteria were never explicitly applied.

should be used for identifying new and emerging issues related to the conservation and sustainable use of biodiversity." The EU, Canada, and New Zealand insisted that this meant that all of the criteria of para. 12 must be met.[247] They framed it as a matter of respecting the CBD processes and past Decisions: "We recognize it's not easy to apply the criteria, but we don't want to open [that decision]."[248] This elicited two different responses. First, the Philippines insisted that this was *one* interpretation of Decision IX/29, but not the only one. In their opinion, there was sufficient flexibility to interpret Decision IX/29 as not requiring all criteria to be met – if any *one* criterion was satisfied, perhaps it could be an NEI.[249] Ghana responded differently, asking whether Parties didn't have the political power to change a past COP decision, adapting the criteria in light of the specific challenges of synthetic biology.[250] Ultimately, the COP 11 Decision on NEI is silent on this, simply requesting the Secretariat to apply the criteria.

As discussed in section 4.2iii1D, I found the process of applying the criteria to be shrouded in layers of ambiguity; each criterion depended on one's interpretation of existing information and the criteria themselves. For example, the simple answer to criterion (b) is that there is *not* new evidence of significant impacts of synthetic biology on biodiversity (see SCBD 2014e). However, what meaning should be attributed to this lack of evidence? Did it mean that, for the purposes of the CBD, synthetic biology had not impacts on biodiversity, and therefore was not a concern? Or did it instead highlight the insufficiency of research investigating the potential impacts of organisms and products of synthetic biology on biodiversity and associated socio-economic impacts?

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[247] COP 11, FtC, 15 October 2012.
[248] COP 11, FtC, 15 October 2012, EU.
[249] COP 11, FtC, 15 October 2012, Philippines.
[250] COP 11, FtC, 15 October 2012.

At SBSTTA 18, delegates proposed differing interpretations of the criteria and its application. For some delegations, the criteria could not be met on the basis of the compiled background information – there simply was not enough evidence to meet the criteria. Brazil described knowledge on synthetic biology as still "incipient," and synthetic biology as "not mature enough to be taken up as a new and emerging issue."[251] Canada did "not believe the state of knowledge is sufficient to determine" that synthetic biology was an NEI, and Australia agreed. Argentina said that with a "lack of solid scientific evidence, SBSTTA should not come up with any stance." On the other hand, delegations such as the EU, Austria, and Bolivia argued that the Secretariat's analysis of the criteria showed that synthetic biology did meet the criteria.[252] Some delegations simply stated that synthetic biology *was* an NEI, without referencing the criteria at all.[253] And some expressed the view that whether synthetic biology was an NEI was no longer a relevant question – CBD bodies had engaged with the issue for four years, the Secretariat had published extensively on the issue, the issue was effectively on the CBD's agenda.[254]

Ultimately, Canada's argument prevailed: "we just don't know if the criteria are met."[255] SBSTTA 18 "*concludes* that there is currently insufficient information available to finalize an analysis, using the criteria set out in paragraph 12 of Decision IX/29, to decide whether or not this is a new and emerging issue related to conservation and sustainable use of biological diversity" and "*awaits* the completion of a robust analysis using the criteria in paragraph 12 of Decision IX/29" (Recommendation XVIII/7, paras. 1

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[251] Brazil, Canada and Argentina's comments all from SBSTTA 18, Plenary, 24 June 2014.
[252] SBSTTA 18, Plenary, 24 June 2014, EU & Austria; SBSTTA 18, CG, 26 June 2014, Bolivia.
[253] SBSTTA 18, Plenary, 24 June 2014, Egypt, Costa Rica, & Zambia (for the Africa Group).
[254] SBSTTA 18, CG, 26 June 2014, Mexico. Also expressed by Jim Thomas of the ETC Group at SBSTTA 18, side event by WWICS, 24 June 2014.
[255] SBSTTA 18, CG, 26 June 2014.

& 2). One of the few sections of unbracketed text includes a recommendation to the COP to urge Parties to "take a precautionary approach," but there was no agreement over what this would mean

The official document for COP 12 on synthetic biology was a slightly revised version of the SBSTTA 18 official document with one significant change: the COP 12 official document contains no application of the NEI criteria to synthetic biology (SCBD 2014e). Any attempt to apply the criteria was quietly dropped. The final COP 12 Decision on synthetic biology:

> 1. …*recognizes* that this issue is of relevance to the Convention and concludes that there is currently insufficient information available to finalize an analysis, using the criteria set out in paragraph 12 of decision IX/29, to decide whether or not this is a new and emerging issue related to conservation and sustainable use of biodiversity;
> 2. Awaits the completion of a robust analysis using the criteria set out in paragraph 12 of decision IX/29 (Decision XII/24).

4.3 Conclusions on synthetic biology at the CBD.

This chapter documents the contested and on-going development of an epistemic base on synthetic biology and biodiversity for international decision-making. Throughout most of the process, CBD delegates displayed an acute awareness that compiling information on synthetic biology was not a neutral endeavor but rather a co-production of knowledge and governance. The initial decision by Parties to restrict the Secretariat to compiling submissions can be interpreted as a tactic by States to not cede political power to the Secretariat to shape the negotiations' knowledge base. When this approach failed to produce an adequate body of knowledge, Parties fiercely contended over the shape of the Secretariat's work in two ways: the scope of the issues to be addressed in the documents; and the sources of knowledge for the documents.

Whether social, economic and cultural considerations would be included was understood as shaping the scope and relevance of the Convention itself; this is an explicit example of the co-production of knowledge and governance. Wynne notes that orienting decision-making around technical expertise not only excludes many actors, it also excludes actors from “negotiating what the salient questions are in the first place” (2003, 410). At the CBD, delegates did not let the documents’ scope be defined by recourse to technicalities – it was blatantly a political debate. As with many political debates at the CBD, this one was settled with ambiguous language – “associated social, economic and cultural considerations” could be interpreted either narrowly or broadly, as was clear from the range of peer-review responses on the identified considerations.

Parties also recognized the choice of sources as fraught with politics, but mainly because I had included critical CSO perspectives. The majority of peer reviewers pressured the Secretariat to ascribe little or no authority to critical civil society groups, reserving authority for peer-reviewed scientists and government reports.[256] Thus, the SCBD documents were sites of boundary work, drawing lines between what can claim the authority of a “scientific text” and what falls outside and is labeled political, influencing whose voices are heard in framing problems (Gieryn 1995; Jasanoff 2005; Mahony 2013). At the IPCC, restrictions to peer-reviewed literature have “minimize[d] opposition to the core framing of climate change,” keeping out alternative framings of the problems and potential solutions (Miller 2009, 154). Callon sees scientific texts as making connections with other texts, reworking them, “inserting them into new relationships” (1991, 135). I saw my writing for the SCBD as helping to rework the

[256] There were no formal submissions from groups identifying as ILC (as opposed to the more general “civil society”). It would be interesting to see on what grounds peer reviewers would respond to critical ILC input.

network of knowledge on biodiversity and synthetic biology in similar ways: pointing out the assumptions and values underlying speculative claims; comparing the imaginaries of civil society groups, corporate consortia, and synthetic biologists; describing where different actors wanted to draw boundaries and their implications. It is not surprising that actors who hold key positions in the networks of knowledge of synthetic biology – academic centers and developed States – resisted a redrawing and expansion of these networks, not to mention official treaty documents drawing attention to boundary disputes they might otherwise have preferred to remain opaque.

At stake in discussions of synthetic biology is whether something undefined can be regulated, even with a soft touch. A number of implications of the lack of an agreed-upon definition can be traced from the CBD's engagements with synthetic biology. In an interview, a social scientist referenced the problem of "flipping" definitions for tactical reasons (Social scientist interview 2014). Synthetic biology companies have flipped depending on their audience, framing their products as a benign extension of existing practices (fermentation, just like making yogurt!) to fearful publics but also promising revolutionary results (Marris 2015). Another approach is to frame it as a temporal progression; two representatives of "synthetic biologists" suggested in SBSTTA 18 side events that delegates should consider synthetic biology as a spectrum of activities, from "evolutionary" to "revolutionary."[257] They assured delegates that synthetic biology as *currently* practiced was but a small step forward, adequately covered by existing regulatory frameworks. Down the road, more revolutionary science would deliver great results and might challenge those frameworks, but in the meantime, regulatory action was unnecessary.

[257] SBSTTA 18, side events by WWICS, 23 & 24 June 2014.

CBD Parties have utilized the flexibility of an uncertain definition in the CBD processes. In the peer review comments, some Parties argued for a narrow scope to synthetic biology, excluding metabolic pathway engineering and thus most current and near-term products. At SBSTTA 18, when called upon to prove synthetic biology's benefits, those same Parties took an expansive view of the field, drawing broadly from biotechnology to find examples of benefits to biodiversity. This is not to say these delegates were hypocritical; rather, they took advantage of the flexibility available.

Parties signaled that a definition was needed before any action – and possibly, any serious discussion on synthetic biology – could occur. Delegates were not content with having been handed a list of different definitions and an explanation of the implications of those differences. They wanted *a* definition, and as the Secretariat hadn't produced one, they drafted a process to develop it. Agreement was in short supply at SBSTTA 18, but delegates easily agreed to an expert workshop to develop a working definition. Ultimately, there were only 2 paragraphs in the SBSTTA 18 Recommendation to COP 12 completely unbracketed: that Parties await "the completion of a robust analysis using the criteria in paragraph 12 of decision IX/29"; and that the Secretariat should convene an "open workshop of experts, including representatives of indigenous and local communities and relevant organizations" (Recommendation XVIII/7, paras. 2 & 7). At COP 12, this expert workshop was revised to establish an ad hoc technical expert group (AHTEG), which represents one of the highest levels of institutional support at the CBD in terms of resources, time, and political attention. The synthetic biology AHTEG has been tasked with developing "an operational definition of synthetic biology, comprising inclusion and exclusion criteria, using all relevant information, based on scientific and peer-reviewed studies" (Decision XII/24, Annex).

Another approach to pushing off engagement with political implications has been to invoke the precautionary approach. Although usually seen as a politically contentious concept, the precautionary approach has actually been used in the synthetic biology negotiations as a "boundary object." Boundary objects are concepts "plastic enough to adapt to local needs…yet robust enough to maintain a common identity" (Star & Griesemer 1989, 393). While this flexibility allows delegates to agree on text despite a lack of consensus, it can also facilitate the avoidance of differences, deferring conflict (Gray et al. 2014). CBD Parties have thus far avoided political engagement with the question of how to deal with the scientific uncertainties of synthetic biology. Not only have they failed to provide guidance to States, they have no common agreement on how to actually respond to scientific uncertainties when faced with the task of applying the NEI criteria. When it came to interpreting the NEI criteria, delegates treated this as a *technical* matter, rather than a *political* process requiring the negotiation of different frames of understanding. Not only did they push off decision-making, they appeared to push it onto the Secretariat. Once the next round of peer review afforded more verifiable, preferably peer-reviewed, information, the Secretariat would be able to undertake the (apparently non-political) act of applying the criteria and finding the answer to whether synthetic biology technically qualified as an NEI. Thus far, the dominant response to the uncertainties, ambiguities and unknown aspects of synthetic biology is to postpone decision-making until the gaps are filled in.

Synthetic biology is the first issue to which the NEI criteria will be applied. The application of these criteria represent an important moment for international environmental law, as the international community decides what stance to take in relation to unknown threats and opportunities of emerging technosciences. By choosing to engage with these technosciences while they are still emerging, not yet solidified into industrialized and commercialized forms, the treaty will necessarily be faced with incomplete knowledge. It's not just that their physical impacts cannot yet be tracked; there may not be enough information to run models, or we may not have the means to measure the full range of their impacts, or we may not be able to predict how they will be used. The question is: does this lack of information mean that the international community must wait until such technosciences have fully emerged, their impacts become predictable, before taking any action? And if the answer is no, if action of some kind is called for, what should guide decision-making in instances of such scientific uncertainty? The final chapter addresses these questions.

Chapter 5 Conclusions.

In order to explore the co-production of governance and knowledge, this dissertation has examined the specific legal and cultural context of the CBD and the processes through which the treaty bodies have engaged with biofuels and synthetic biology. This context is shaped by the historic development of modern international environmental law, in which the "global environment" and soft law were introduced together in the early 1970s. Although momentum initially seemed to lead towards a hardening of global legal authority over the environment, since the 1990s this vision has given way to softer international mechanisms and increasing roles for private actors. Today, soft law is used in some UN settings to functionally restrict the role of States in governing. Nonetheless, it was once used by developing countries as a tool to expand the scope of international legal norms, redistributing authority among a larger, more inclusive international community.

As a "framework agreement," the text of the Convention establishes general objectives and a context for negotiating protocols, that would contain specific, legally-binding obligations. Framework agreements tend to be judged on the basis of two assumptions: first, that a convention will act as the proverbial foot-in-the-door, giving time (and perhaps motivation) for a scientific consensus to form around a problem; and second, that a successful framework agreement priorities will be covered by legally-binding protocols. Yet, framework agreements can be valued differently; I argue that they are treaties whose very structure acknowledges the need for international deliberation and action in situations that lack cognitive and normative consensus.

Many aspects of the CBD have been interpreted as weaknesses: qualified language; a lack of compliance mechanisms; an overly "open" COP and an overly "political" SBSTTA; a treaty with a broad mandate and a soft touch. Projects within the CBD attempt to rectify these weaknesses by drawing on the authority of harder law, more certain science, and economic approaches to governing. The "New and Emerging Issues" mechanism has been applied to emerging technosciences that defy approaches based in harder law, science, or economics. As such, it is an opportunity for the treaty bodies to explore how the treaty's "weaknesses" may be openings for the development of new assemblages of power and knowledge.

The chapters on biofuels and synthetic biology explore how knowledge politics have shaped the treaty bodies' engagement with these issues, particularly around setting the scope of engagement, identifying appropriate sources and kinds of knowledge, and acknowledging and responding to scientific uncertainties. Through these, I identify many instances of CBD bodies avoiding engagement with these issues as political controversies. I also, however, identify moments where the SBSTTA, Secretariat, and COP acknowledged the political nature of knowledge, explicitly reframed debate around a broader scope of engagement, and grappled with intractable uncertainties.

In this chapter, I first identify what was specifically "co-produced" in the CBD's work on biofuels and synthetic biology. Then I turn to broader findings on knowledge politics in these cases, including a consideration of three potential models of democratic decision-making for the CBD NEI. This informs the next section on "CBD-specific findings" which addresses the upcoming synthetic biology AHTEG, the NEI mechanism, and the CBD's potential use of soft law. In the last section, I reflect on two aspects of my research process: playing an active role in the co-production of international knowledge and governance, and studying global environmental governance.

5.1 Outcomes of co-production.

What was ultimately co-produced in the treaty processes this dissertation has examined? For both biofuels and synthetic biology, CBD COP Decisions have developed minimal concrete governance, all of it soft. CBD processes have also resulted in documents producing knowledge that frames the relationship of biofuels and synthetic biology to biodiversity. These outcomes can be seen as responding to the different regulatory, scientific, and social contexts of the two technosciences.

i. Soft law and knowledge on biofuels.

Biofuels are intensely governed at the national level, mainly through mechanisms that support domestic production. Soft governance "beyond the state," through private and private/public certification programs, has taken on harder meaning as these programs have been directly connected to the EU's regulatory processes. In the time leading up to COP 10, it seemed possible that the CBD would develop soft guidance through standards for certification, industry guidelines, or a toolkit. Particularly as it was the EU pushing the CBD to produce such outcomes, it was reasonable to expect that such outcomes would be enrolled in the EU's sustainability certification scheme.

The results of the CBD's engagement with biofuels do not include any such concrete outcomes, however. The most recent CBD COP Decision on biofuels from 2012 invites Parties to "consider relevant biofuel matters, when and if appropriate," when updating biodiversity plans and to "consider the use of various relevant voluntary tools"

(Decision XI/27, para. 2(a) & (b)). Together, the three COP Decisions on biofuels provide minimal guidance for States seeking to produce sustainable biofuels (Decision IX/2; Decision X/37; Decision XI/27). They broadly highlight issues to be considered by States, such as land tenure security and indirect land-use change. They also can be seen as supporting, or at least not refuting, the imaginary of biofuels as objects that *can* be governed for "sustainability" – that it is possible to promote positive and minimize or avoid negative impacts on biodiversity.

The documents of the CBD Secretariat on biofuels have actively reframed consideration of the relationship between biofuels and biodiversity, reflecting concerns in academic literature while also independently introducing new frames (such as comparing biofuels' impacts with other renewable energy sources) and new political scales (such as global land-use planning). These documents, particularly *Technical Series No. 65,* stand on their own as outcomes of the CBD's engagement with biofuels. As explained in the introductory chapter, I am not attempting to trace the impacts of such documents (or Decisions) outside of the CBD – it's possible that they have helped to shift international conversations on the sustainability of biofuels. Looking within the CBD, however, they do not seem to have reframed debates at SBSTTA or COP.

On the whole, the CBD's engagement with biofuels seems to have provided less guidance for the production and use of sustainable biofuels than it has produced outcomes that impact the CBD itself. Slightly new language of "land tenure and resource rights, including water" may act as a toehold for future COPs to establish stances in this internationally controversial area – thus far, after its introduction at COP 10, the phrase was used again in 2012 in the COP 12 Decision on biofuels (Decision XI/27, para. 1).

COP 10's narrow recognition of scientific uncertainties related to biofuels and the attempts at SBSTTA 18 to push out the issue of iLUC on the basis of its indeterminate nature have implications for the treaty's interpretation of precaution. They may be weakening the force of the precautionary approach to respond to intractable uncertainties and indeterminate knowledge.

ii. Soft law and knowledge on synthetic biology.

Very few current mechanisms governing synthetic biology are specific to "synthetic biology," rather, they relate to genetic engineering processes and products more broadly. The scope of regulatory oversight of potentially novel aspects of synthetic biology is hotly contested. The CBD COP was highly unlikely to set in place new international regulations for synthetic biology; at COP 10 and COP 11, the strongest mechanism on the table was a "de facto moratorium" that would have acted through political pressure rather than legal sanction. There was, however, the possibility that the treaty processes would interpret *existing* regulations, particularly the CBD's Protocols, as applying in specific ways (or not applying at all) to synthetic biology.

CBD COP outcomes on synthetic biology have been heavily qualified and consistently expressed that synthetic biology is not yet officially on the CBD's agenda (Decision X/13; Decision X/37; Decision XI/11; Decision XII/24). These Decisions have also flagged issues such as environmental release and field trials of organisms resulting from synthetic biology, urged scientific assessments to encompass food security and other socioeconomic considerations, and promoted interdisciplinary research that, again, includes related socioeconomic considerations. The CBD is the first international treaty body and the first intergovernmental organization to address synthetic biology at all. By highlighting these issues, the COP is communicating international concern and attention not just to its Parties and other governments, but also to the communities of "synthetic biologists." As before, I am not attempting to measure the impact of the CBD's engagement, but it seems to me that the attention the CBD's processes have received from corporations, think tanks, universities, and CSOs indicates that the CBD has the potential to impact not just how synthetic biologists are internationally or nationally governed, but also how they design and carry out their research.

As I write these conclusions, the information documents from SBSTTA 18, revised in response to a third round for peer review for COP 12, are in the final stages of publication as an SCBD *Technical Series.* In keeping with authorship attributions of *Technical Series* (as opposed to SBSTTA and COP documents), I will be credited as the first lead author of the *Impacts* section and the second lead author of the *Gaps and Overlaps* section. In a way, these reports can be seen as further solidifying "synthetic biology" as a discrete field for commerce and governance. But I would like to think that they do different work than national governments' "roadmaps" and reports that frame synthetic biology as a fait accompli that will unfold linearly on a predetermined path (Nuffield 2012; see PCSBI 2010 & UKSBRCG 2012). I tried to address the contingencies and uncertainties of the laboratory science and of its environmental, economic, ethical, and legal contexts. I attempted to reflect the scope of issues relevant to the treaty and in the process expand what are considered as concerns. It is still too early in the treaty processes to see whether these attempts are taken up by delegations, whether the *Technical Series* on synthetic biology will impact the SBSTTA and COP debates more than the *Technical Series* on biofuels.

The AHTEG on synthetic biology and associated processes, including an online forum and more opportunities for submission of information, are scheduled to take place in 2015.[258] As with biofuels before COP 10, the CBD is poised to make substantive decisions around synthetic biology. There could yet be concrete outcomes: the NEI criteria have not yet officially been applied by the COP; precaution could still be interpreted in a more expansive way; the AHTEG process may develop concrete and specific guidance for Parties in developing regulatory frameworks for the unique aspects of synthetic biology. As these processes unfold, we'll see whether CBD bodies change their mode of engagement, and whether synthetic biology has a different fate than biofuels.

5.2 Outcomes of knowledge politics.

This dissertation has focused on the unfolding of knowledge politics around the scope of the objects of governance, the sources and types of knowledge used, and the framing and responses to scientific uncertainties. This section identifies broader findings flowing from the close analysis of the CBD's engagement with biofuels and synthetic biology.

i. Setting the scope: co-production in action.

In the biofuel negotiations, delegates settled on an understanding of "biofuels" primarily through referencing past COP text, and occasionally by using ambiguous text. These

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[258] On 6 February 2015, the SCBD published a notification inviting Parties, other Governments, relevant organizations, ILCs and other relevant stakeholders to submit information on synthetic biology to help the work of the upcoming AHTEG (SCBD 2015). On the CBD's website, the SCBD has posted a tentative calendar of activities on synthetic biology for the next year, including a process for nominating participants in an online forum as well as the AHTEG, a three month online forum, drafting and publishing background documents for the AHTEG, the AHTEG meeting, and subsequent drafting and rounds of peer review responding to the outputs of the AHTEG. See: https://bch.cbd.int/synbio/calendar.shtml (last accessed 11 February 2015).

approaches were used to avoid disputes over the political implications of the scope of the CBD's engagement with biofuels, from forests to global land-use planning. In the synthetic biology negotiations, where there was little pre-existing formal CBD language to drawn on, delegates demanded a definition for synthetic biology and went so far as to put in place an AHTEG to develop one. By the time of COP 10, delegates addressing biofuels had language such as "promote the positive" to avoid conversations on the actual benefits of biofuels to biodiversity. Delegates to SBSTTA 18, on the other hand, actually debated the potential positive impacts of synthetic biology. These were frustrating debates; at the time, they felt like back-and-forth bickering, yes-it-is-no-it-isn't, that was hardly productive. But looking back, incredibly important issues were being directly engaged. Debate was occurring on the scope of the treaty itself, as well as on the scope of impacts that ought to be considered.

Orderings of nature and society are often produced together; this is why co-production is a powerful idiom. The processes by which the CBD and SBSTTA set the scope of the issues to be (softly) governed demonstrates how entwined these processes can be. By defining the issue, delegates were defining the CBD. And where formal text was available, delegates relied on it to avoid debates over the political scope of the treaty. When used to describe emerging technosciences, the term "imaginaries" indicates that understandings of an object are infused with assumptions and values of its future progress and the roles it will play in society. CBD processes of debate and document production do not just formulate new imaginaries of the objects of governance; they develop imaginaries of the CBD itself. Is it a treaty that encompasses concerns of human health? Of intellectual property rights? Of ethical concerns? Can it play a role in coordinating global actions? To answer these questions, delegates must acknowledge contending visions of what roles a framework treaty such as the CBD can play in influencing scientific and commercial progress.

ii. Sources and types of knowledge: establishing a legal epistemology.

A "legal epistemology" describes how a legal body knows – how it determines what information its decisions will be based upon, how it crafts specific representations of science and law, and what kind of knowledge it produces (Jasanoff 2005; Bonneuil & Levidow 2011). Some bodies' legal epistemologies can be clearly traced through formal processes, such as the WTO Agreements' selection of experts and Appellate Panel outcomes (see Bonneuil & Levidow 2011). The CBD does not have such open or systematic processes to determine its epistemic base for decision-making. From studying the CBD's processes of decision-making on biofuels and synthetic biology, evidence suggests that the CBD's legal epistemology is under active contestation.

The CBD's engagement on biofuels has been widely criticized for being based in politics rather than science. But, considering the treaty's formal recognition of the importance of traditional ecological knowledge and its history of engaging with the political nature of knowledge, science / non-science is unlikely to be a hard boundary for determining what is an appropriate source of knowledge.

Two trends can be noted in the COP's exploration of what lies beyond science. In the biofuel negotiations, the recognition that scientific sources are not neutral or universal seemed to lead to dropping science altogether as an authority for grounding claims, and instead using past COP language and national sovereign authority. Social scientists have long urged decision-makers to recognize that scientific claims are rooted in particular values and contexts (Haraway 1988; Wynne 1992). The response to this recognition, however, is meant to be an opening of decision-making processes to broader kinds of knowledge claims, while still recognizing the important role of scientific claims. It's not supposed to lead to a dismissal of scientific knowledge altogether.

With synthetic biology, it seems as though there is a push to set a boundary between legitimate and illegitimate holders of non-scientific knowledge. Following John Dewey (1927), "publics" can be understood as brought into being with controversies, groups that identify as indirectly but seriously affected by a human activity. Scholars have productively explored the processes by which publics form, developing identity through interventions in and engagement with controversies (Latour 2005; Callon, Lascoumes, & Barthe 2009; Whatmore 2009). In the CBD's work on synthetic biology, some actors are working to erect a boundary between legitimate publics (ILCs under the proper circumstances) and illegitimate publics (CSOs with political agendas). Not only is this boundary inexplicit, with unclear criteria for inclusion and exclusion, but it threatens to differentiate among Parties with legitimate interests (protecting or enabling commercial and scientific actors) and illegitimate interests (spokespersons for CSOs with political projects).

iii. Scientific uncertainties: decision-making in a post-predictive paradigm.

The CBD COP Decisions on biofuels primarily address a narrow slice of the broad range of scientific uncertainties related to biofuels – gaps in information. Certain Parties are working to keep this narrow, and to ensure that indeterminacies are removed from the ambit of the treaty. If precaution is only applied to situations of bounded, determinate, tractable uncertainties, it will continue what Applegate (2002) describes as the "taming" of the precautionary principle.

Some social scientists suggest that precaution should be seen as a *process* (Peel 2004 & 2010; Stirling 2008). Decision-makers would turn to precaution when faced with scientific uncertainties that go beyond risk, to those of uncertainty, ambiguity, ignorance and indeterminacy (Wynne 1992). In such scenarios, a scientific evaluation of environmental and human health risks would be seen as only one factor to be taken into consideration. Additional relevant factors would include: who benefits from the proposed action and who stands to bear the costs and risks; what degree of control affected communities have; what indirect effects may exist; what are potential blind spots and divergent scientific views; what alternatives exist (Wynne 1992; Peel 2004; Stirling 2007 & 2008). Under this processual model, precaution requires recognizing the inherent limitations of anticipatory knowledge, and adapting to expand the types of knowledge upon which decision-making should be based (Wynne 1992).

If this model is to be followed, acknowledging a broader range of scientific uncertainties is only the first step. Scientific uncertainty can provide a convenient "fig leaf"; Parties can take action by calling for more research rather than taking political action (Jasanoff & Wynne 1998, 36; Secretariat interview 2013). In the synthetic biology negotiations, Parties have been relatively comfortable admitting to outstanding scientific uncertainties, but this has not led to political action. Instead, the precautionary approach has been used as a boundary object, a sufficiently vague concept that Parties can agree on language while holding conflicting stances on how synthetic biology should actually be governed. And precaution has been linked to the WTO through "other relevant international obligations," which could provide a very narrow interpretation of possible precautionary actions.

In 1992, Wynne wrote that a "shift toward prevention" in environmental policies "implies acceptance of the inherent limitations of the anticipatory knowledge on which decisions about environmental discharges are based" (111). Building on this, Macnaghten, Kearnes and Wynne (2012) call for a transition from a predictive to a "post-predictive paradigm," in which governance schemes are not built around the expectation of predictable impacts. At this point, it seems as though CBD bodies have not made this transition, as they continue to demand anticipatory knowledge, reluctant to act in its absence.

iv. Models of democratic decision-making.

Technocratic decision-making, deliberative democracy, and agonism represent three different idealized models of decision-making. The CBD's engagement with biofuels and synthetic biology has not met the standards of any of these models. Which one of these models is best suited to decision-making at the CBD, specifically for emerging technosciences?

1. Technocratic decision-making.

In Haas' description of an epistemic community, the group's expertise is "knowledge-based" and gains authority by coming to consensus (Haas 1992 & 2004). By this definition, neither biofuels nor synthetic biology have expert "epistemic communities" playing a role in shaping the CBD's work on these issues. The Malawian delegates' appeal to international environmental NGOs and other conservation biologists in the COP 10 biofuels negotiations might be seen as a request for an epistemic community to step forward. Transnational communities have certainly coalesced within the CBD around shared political projects, including coalitions of critical activists and, nascent but growing, groupings of corporate and/or academic representatives. As yet, none of these communities has set the terms for or significantly impacted the CBD's debates on NEI. As indicated by other delegates' reactions to Malawi's request for someone to assert scientific authority, CBD Parties have resisted accepting an expert group on its face as a neutral advisor, at least in these sets of negotiations.[259]

One might argue that the lack of epistemic communities is the problem - that the biofuels negotiations in particular jettisoned technocratic knowledge in favor of power politics. Yet, in my observations, the biofuel negotiations rarely included explicitly political arguments; instead, debates unfolded around knowledge claims. Introducing more of a "technocratic" basis to these deliberations would not necessarily have diverted these arguments. Furthermore, under the theory of epistemic communities, it is a community's expert consensus that justifies and gives force to its political advice. In issue areas as contentious and emergent as biofuels and synthetic biology, if authority rests on scientific certainty, there will be insufficient authority upon which to base any decisions.

In 2002, Collins and Evans proposed a "Third Wave" of STS scholarship to guide the use of "expertise and experience" in decision-making. They support the inclusion of publics without technical or scientific expertise in what they term the "political dimension" of decision-making, reserving the "technical dimension" to a core-set of scientists and technical experts (Collins & Evans 2002). In this way, they propose to

[259] It should be noted that in other subject areas, CBD bodies have a long tradition of calling upon scientists and NGOs, particularly international environmental groups such as IUCN, for input.

incorporate the relevant experiences of non-experts, while still reserving a special role for technocratic knowledge. In an interview one observer expressed a similar perspective, that the process of decision-making at the CBD must be open to all different perspectives – "you don't get to the end of the process by censoring" – but that certain types of information were appropriate to influence certain types of decisions (Observer interview 2014). From this perspective, the COP provided space for the "political dimension" to unfold, framing the questions for the AHTEG. The AHTEG on synthetic biology would then finally provide a forum for the "technical dimension," and should be restricted to a core-set of experts with relevant expertise.

I argue that this approach to technocratic decision-making with discrete phases for political, non-expertise sources of input is inappropriate for the CBD. STS scholar Brian Wynne (2003) critiques Collins and Evans' Third Wave for not acknowledging that the public is necessary for more than speaking to risks, but also to framing and giving meaning to issues. Indeed, the Terms of Reference ask the synthetic biology AHTEG to produce seven discrete outputs, each of which will require political choices – from what sources of information to draw upon, to where to draw the line for what is included in "synthetic biology," to how to frame the unknown impacts of synthetic biology. Synthetic biologists alone should not be entrusted to make these choices.

But the CBD is a treaty with a history of awareness of and sensitivity to the politics of knowledge; the political implications of who makes up an AHTEG will not go unnoticed or unexamined. According to Secretariat staff members, a major point of contention at COP 12 was deciding on a process for nominating and selecting the "technical experts" to take part in the AHTEG. The *modus operandi* of SBSTTA restricts

AHTEGs to no more than 15 experts (Decision VIII/10, Annex III, H para. 18), but the synthetic biology AHTEG has been adjusted to allow five to eight experts nominated by each of the five regions (Decision XII/24, Annex, footnote 2). There is to be balanced representation of Parties from all regions, including representation of ILCs and "all relevant stakeholders, including other Governments, with knowledge of the Convention and its Protocols." This last clause seems to base technical expertise in knowledge of the CBD, as well as, or perhaps rather than, synthetic biology. This could be another line of exclusion, if stakeholders without a deep familiarity with the CBD are not included.

Finally, it should also be noted that, in other governing forums, neoliberalism has led to the downgrading of technocratic knowledge coupled with an increasing role for private knowledge claims (DuPuis & Gareau 2008; Lave 2012; Gareau 2013). I haven't seen that in the CBD NEI process. When it comes to synthetic biology and biofuels, the private sector's knowledge continues to be proprietary – for example, a report on the global market of synthetic biology costs $5000. In fact, because of the cost of academic journals, peer-reviewed literature is only partially accessible to the Secretariat, and then through a web of interns, personal subscriptions, and various round-about strategies. The knowledge source that is the most accessible and acceptable at the SCBD is government reports. These are "public," but hardly neutral.

2. Deliberative democracy.

Clark Miller describes international knowledge institutions such as multilateral environmental agreements as "novel deliberative forums" in which the epistemic foundations of global policy can be openly debated (2009, 150). Indeed, as described in this dissertation, the CBD's bodies have provided forums for intense debate on the epistemic base for decision-making. Under deliberative democracy, these debates should unfold as deliberation among competing ideas, informed by “knowledge and reason” (Miller 2007, 350). Ideally, this deliberation shifts the “calculus of power” away from the most powerful, as the logic of states “pursuing arbitrary and ad hoc national interests” is replaced with a logic of deliberative legitimacy (Ibid, 328). Furthermore, Miller (2007) argues that this can lend support to marginal voices, either through evidence legitimating their claims or if the value of local knowledge is recognized and drawn upon.

The CBD could aim to cultivate deliberative democracy. This model for democratic decision-making fits well with certain understandings of framework agreements. Under a convention/protocol model meant to promote cognitive and normative consensus (Bodansky 1999), a framework agreement provides almost an ideal setting for deliberation, giving space to processes for reaching consensus through reasoned debate rather than power politics. As Miller (2007 & 2009) calls for, the CBD has been a forum where marginalized communities can bring forward scientific evidence and their own experiences to advocate for their positions. Going by deliberative democracy, 1) the biofuel negotiations have failed because they have not been based on sufficient public evidence for reasoned deliberation, and 2) the synthetic biology AHTEG provides an excellent opportunity for rational, objective, scientific debate over differing knowledge claims, as represented by different knowledge communities.

Yet, the issues examined through the NEI mechanism thus far raise an important challenge to this model: what happens in cases of uncertainty and controversy that can not be resolved by rational, objective, scientific debate? What happens when there is insufficient information on which to base a scientific debate? When outstanding indeterminacies resist objective closure? What happens to kinds of knowledge that don't register as rational, that don't make universal claims, such as traditional ecological knowledge? Are all of these issues illegible to a treaty based in deliberative democratic decision-making?

In writing of the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), Scoones describes how struggles over knowledge and politics were obscured by a focus on constructing a "view from everywhere" through representation of different interest groups (2009, 567). Indeed, from the perspective of deliberative democracy, participation of a broad spectrum of perspectives and knowledges is enough, so long as each point on the spectrum has the fair opportunity to make their case and be heard and considered by the others (Dryzek 2006; Dryzek & Stevenson 2011). In a way, the political is addressed through representation, beyond that it's a matter of whose reasoning is the most compelling. Scoones argues that this model "suppresses, diverts, and bottles up" tensions over the "knowledge, identity and construction of futures" – knowledge politics (2009, 568).[260] These tensions do not go away, but rather find expression behind the scenes.

So long as deliberative democracy is interpreted as applying "rational, objective scientific debate" in order to resolve scientific uncertainties and confront controversies, such deliberation will downplay the politics of deciding what knowledge counts, what meaning to ascribe to scientific uncertainty, and who gets to establish an issue's identity

[260] I had a small role in the IAASTD process as one of the reviewers of the Africa report on behalf of ACORD, the pan-African NGO I worked for as part of the advocacy team on food sovereignty. My experience aligns with Scoones' description of the suppression and diversion of knowledge politics. As a pan-African NGO, ACORD was enrolled to provide representational legitimacy to the process. The fact that I was the main agriculture policy advisor but was not African was a complication, as it potentially threatened ACORD's grounds for legitimacy. Another complication was that European-based NGOs helpfully suggested certain messages for our review; these NGOs were not only coalition partners of ACORD but also our funders. So yes, there were unacknowledged tensions around knowledge politics.

and scope. In the case of the CBD's NEI mechanism, it could easily lead to invocations of "sound science" to push out indeterminacies and intractable uncertainties, and technical arguments to narrow the scope of the treaty's engagement. This could facilitate the continued suppression of tensions around knowledge politics.

3. Agonism

Under a model of agonism, the political dimensions of decisions are explicitly acknowledged, and debate is between competing visions of political relations rather than among rational options (Mouffe 2005). The "framing assumptions around diverse positions and knowledge claims" are front and center, rather than relegated to behind the scenes (Scoones 2009, 568). The CBD NEI deliberations have not fit such a model: political clashes have been reframed as technical debates; confrontations have been avoided through reliance on formal text; and when the neutrality or universality of science is questioned, it is essentially thrown out rather than engaged.

If the CBD's engagement with NEI was modeled on agonism, the political stakes of the creation and use of knowledge would be highlighted. The first half of this dissertation's chapters on biofuels and synthetic biology – the economic, legal and political contexts for these emerging technosciences – would be explicitly acknowledged in the treaty's deliberations. The assumptions and values undergirding imaginaries of the technosciences and of the CBD would be open for debate. The act of drawing boundaries, whether between science and non-science or between legitimate and illegitimate publics, would have to be explicit. The political implications of different framings of scientific uncertainties would be acknowledged, and the political possibilities of precaution explored.

There are dangers to following an agonistic model. If international environmental decision-making is conducted on an explicitly political register, this could open the CBD to "power politics," where the actors with the most geopolitical power get to frame the debate, choose which sources will be authoritative, and close controversies. Another criticism is that agonism fails to lead to action; collective decisions are always necessarily open to further contestation (Dryzek 2006). Rather than resolving dissent, institutions and processes facilitate the on-going negotiation of difference.[261]

These are real dangers. But there are also aspects of the CBD that make it particularly well suited to an agonistic approach. Mouffe (2005) notes that agonism requires a real commitment to pluralism to avoid hegemonic powers always setting the terms of the debate. From the start, the CBD has been a forum for "mega-diverse" States such as India and Brazil to establish and exert geopolitical power on the geopolitical stage (McConnell 1996). Compared to other treaties, developing countries take a particularly strong and active role. Delegates invoke the history of colonialism to warn against on-going unjust power relations. The exertion of hegemonic power is likely to be challenged as such. Furthermore, with the soft legal nature of COP outcomes, unclosed controversies are not necessarily a problem. In fact, a precautionary approach that responds to outstanding scientific uncertainties and indeterminacies requires an iterative process, returning to see whether the types of scientific uncertainties have shifted, whether new publics have formed that transform a situation. The CBD, particularly in its engagement with NEI, is an apt forum for experimenting with agonism.

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[261] Thanks to Rutgers Planning PhD candidate Ryan Good for sharing this phrasing with me.

5.3 CBD-specific findings.

i. The work of the synthetic biology AHTEG.

The COP 12 Decision on NEI establishes an AHTEG on synthetic biology and directs it to develop a “working definition” for synthetic biology (Decision XII/24, Annex). In interviews that I conducted after COP 12, observers’ responses ranged from scorn to bafflement. “Why do they think it’s possible?” asked one. “There isn’t one [a definition] and they won’t get one,” flatly stated another (Observer interviews 2014 & 2015).

Considering the rapid development of synthetic biology research and commercialization, any concrete definition risks rapidly becoming obsolete. There are different potential approaches to dealing with this challenge. One option is to set a very broad scope. The EC has recently set its Scientific Committees with the task of developing an operational definition for synthetic biology. They settled on synthetic biology as “the application of science, technology and engineering to facilitate and accelerate the design, manufacture and/or modification of genetic materials in living organisms” (SCHER et al. 2014, 5). Because the relationship between genetic modification and synthetic biology cannot be accurately defined in quantifiable and measurable ways, the definition basically encompasses *all* genetic modification techniques (SCHER et al. 2014). In this way, synthetic biology is normalized as continuing on an established trajectory and not requiring any new regulatory responses.

Another option is to provide a more loose definition. In the realm of nanotechnology, a leading commentator argues in *Nature* against defining nanomaterials even for regulatory purposes (Maynard 2011). Maynard notes that a strict definition would allow too many anomalies to slip through the regulatory net. Instead, he recommends developing a flexible list of attributes that would trigger regulatory action (*Ibid*). CSOs proposed a similar approach at SBSTTA 18, with a broad definition of synthetic biology that "involves various techniques of modern biotechnology that exercise control in the design, synthesis or redesign of new biological organisms, parts, devices and systems at the organismal, cellular or sub cellular level for applied purposes," and then includes an Annex of common techniques and approaches.[262] A third option is to find that synthetic biology is too diffuse and prospective of a field to be defined at this time.

For the purposes of the CBD's protocols, the most important question is whether synthetic biology falls within the protocols' existing definitions, such as LMOs and modern biotechnology. This does not necessarily require a definition of synthetic biology as a whole. For the purposes of the CBD itself, future COP Decisions and any potential guidelines that may be developed will be soft governing mechanisms. Soft law can be open and non-specific; it provides guidance, not oversight. Arguably, such guidance could be developed that responds to certain types of research and aims of projects without a strict definition for synthetic biology.

I am not saying that the AHTEG should not develop an operational definition for synthetic biology. Rather, whichever approach the AHTEG decides upon, I suggest that they keep in mind what work they want an "operational definition" to do. There are dangers in treating a definition as a tool to stabilize "synthetic biology." Mahony (2013) writes about how the 2 degree Celsius target became black boxed as a political imperative in the climate negotiations. Any destabilization of the scientific consensus around this

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[262] See PowerPoint slide from the pre-SBSTTA training on synthetic biology by Jim Thomas, ETC Group. In author's possession.

target then risked destabilizing the political process. Linking the CBD's engagement to a scientific consensus for a definition (that does not exist) risks black-boxing synthetic biology and obscuring its controversies. And it is the controversies of synthetic biology that raise political questions of relevance to the CBD.

ii. The meaning of a "New and Emerging Issue."

In 2003, important STS scholars David Winickoff, Sheila Jasanoff, Lawrence Busch, Robin Grove-White, and Brian Wynne proposed that the WTO SPS Agreement dispute settlement process use a "certainty-consensus continuum" for determining the standards by which domestic measures should be judged. Cases would be characterized by 1) their level of certainty "with respect to the knowledge base to be relied upon and the analytic methods to be applied," and 2) their level of consensus "with respect to the framing of the scientific issues to be addressed and the values to be protected through public policy" (Ibid, 104). They offer cigarettes as an example of a case that would occupy a high/high place on the continuum, and therefore precautionary regulations would be inappropriate. They determine that GMOs, the issue under discussion by the SPS Committee, are low certainty and low consensus, and that therefore the EU's precautionary regulations should be allowed.

This spectrum could be usefully applied to the process for identifying NEI, and could be done without changing the existing NEI criteria of Decision IX/29 para. 12, which were so fiercely negotiated in 2007 and 2008. The spectrum would be used in interpreting those criteria. For example, when considering para. 12(a), "new evidence of unexpected and significant impacts on biodiversity," it would not be a question of whether new evidence existed or not. Instead, it would be a question of the degree of scientific certainty and consensus of meaning around such evidence.

Issues that *clearly* pose a new and significant threat to biodiversity – an issue such as coral bleaching, perhaps – would therefore *not* be introduced to the CBD's agenda through the NEI mechanism. Such issues would be introduced to the CBD just as they have been since biofuels "poisoned" the NEI mechanism: the COP would add them to existing Programmes of Work. The NEI mechanism would be used specifically to address emerging issues saddled with intrinsic scientific and social uncertainties. It would explicitly take on the role that it has implicitly played.

Adapting the process of identifying an NEI would need to occur in parallel with adapting the response to a "New and Emerging Issue." Once identified, an NEI would not simply be added to the agenda of the CBD like any other issue, but would trigger a specific type of engagement. The Nuffield Council on Bioethics recommends that in situations of exposure to scientific uncertainties beyond risk, there is a responsibility to gather deeper and more extensive knowledge, particularly through broadening the array of issues considered, gathering a diversity of relevant knowledges, engaging a plurality of different perspectives, interrogating the full range of alternative options, and exploring a variety of potential scenarios (2012, 71). This is an apt description of what CBD bodies could do for NEI, through processes such as Secretariat information documents, SBSTTA deliberations, and, as the most significant dedication of time and resources, an AHTEG.

Eventually, an issue could transition from an NEI to an issue on the agenda of the CBD like any other. But while it was an NEI, it would be recognized on the international stage as an issue requiring further research, deliberation, and exploration – an issue triggering a precautionary stance. Again, this is not fundamentally different from what the NEI mechanism has come to mean through the experience of biofuels. The difference would be in the explicit acceptance of this meaning.

iii. Exploring the possibilities and power of soft law.

As much as the editors of *Nature* and the IAP act as though the CBD's deliberations could result in stifling international regulations, this is highly unlikely. Rather, at stake is the shaping of international political pressure and the development of international norms around emerging technosciences – high stakes, to be sure, but not a binding moratorium on an entire subfield of biotechnology.

Agonism is about exposing alternative political visions of how we should be in the world, and recognizing that rational deliberation often cannot bring these contending visions into one harmonious consensus. Such engagement could be greatly facilitated by the CBD's bodies explicitly embracing the soft nature of their outputs.

Koetz et al. draw on Mouffe in their call for SBSTTA to "keep room for 'the political'," providing room for different types of knowledge, explicit acknowledgment of values, ethics, and interests of knowledge holders, and transparent negotiation among different standpoints (2008, 512-513). I would like to expand this call beyond SBSTTA to the other CBD permanent bodies. The Secretariat's information documents should not argue for any particular political outcomes, but "neutrality" could be expressed through explicit inclusion of different types of knowledge and acknowledgement of the underlying assumptions and values of the sources of knowledge. The COP could then be a forum for "transparent negotiation," navigating among alternative political visions, rather than rendering political debates technical.

In responding to uncertainty, Callon, Lascoumes, and Barthe (2009) call for an understanding of "decisions" that breaks from traditional meanings in three ways: a transition from a decision as a singular act to a repeated activity; an individual decision expanded to the decision of a network of diversified actors; and decisions as remaining open to revision rather than claiming to close controversies. This iterative model to decision-making is based on the precautionary principle. The CBD's processes would not need to be legislatively changed to adapt such a stance. Instead, it would be a matter of adjusting the culture of COP negotiations: engaging with controversies rather than relying on past COP language to avoid them; enabling the formation of a network of diverse actors through facilitating tough conversations; seriously considering the possibility of changing previous COP suggestions and guidelines in response to changing understandings of the situation. Rather than attempting to close controversies, COP Decisions might identify particularly important aspects that should be considered at various levels of policy and law making.

With these changes, the soft legal outputs of the CBD could be seen as affording a kind of power to the CBD. Because the CBD has been a space of soft power, it has had room to develop a more open culture, with greater participation by countries perceived as geopolitically marginal in spaces such as the UNFCCC and by ILCs and CSOs representing concerns of some vulnerable communities. Thus, it is more likely that a broad range of perspectives will be voiced at the CBD, and even heard. The lower legal stakes of COP outcomes also provide flexibility to experiment with keeping COP Decisions open to the possibility of change. In these ways, the aspects that make the CBD and its outputs unique could be utilized as a "revolving door" for forms of power and knowledge different from those of the UNFCCC, IPBES, or TEEB (de Sousa Santos 1995).

5.4 Reflections on methods.

i. Playing an active role in the co-production of international knowledge and governance.

From my study of the CBD, I developed a sense of the politically sensitive role of the SCBD, particularly in synthesizing, analyzing, and creating knowledge. I was keen to not jeopardize the status of "my" documents by associating them with a particular political stance. Of course, I was also well aware that the production of knowledge on synthetic biology for the CBD was inherently political. My strategy was thus to try to perform neutrality as I saw it expressed within the Secretariat. Based on interviews, this means grounding work in the "literature," not advocating for any particular "side" or political outcome, and taking an active role in guiding Parties towards consensus (Secretariat interviews 2012, 2013). As everyone involved is well aware, each of these requires the exercise of a certain political stance. Determining what makes up "the literature" sets boundaries on the types and expressions of concerns that will be reflected. The act of expressing every side of an issue can legitimate and highlight minority perspectives – not just political minorities but also what could be described as hype. Setting one's goals by what seems like a plausible consensus can often mean avoiding contentious issues, aiming for the lowest common denominator. I found it challenging to navigate each of these aspects.

Additionally, I felt that I could not undertake the tasks appointed by the COP without exercising a greater degree of independent analysis and political framing than Secretariat staff members admitted to in interviews. Le Prestre wrote in 2002 that the OECD feared a gradual transfer of power from the COP to the Secretariat and acted to keep the Secretariat from operating as an "independent source of expertise entrusted with synthesizing available knowledge or promoting a specific methodology" (2002b, 101). The COP's reluctance to entrust the SCBD with doing anything more than collating submissions seemed to continue to display this. The two information documents provided different sets of challenges for me in walking this line.

Because there had been very little legal analysis conducted around synthetic biology, my draft of *Gaps and Overlaps* contained original legal analysis of the potential application of the CBD and its protocols to different aspects of synthetic biology research, components, and products. As was discussed, this was a point of contention for some Parties. Yet there didn't seem to be any way to get around it – the Secretariat had been asked by the COP to "consider possible gaps and overlaps" with the CBD, its protocols, and other relevant agreements. If no one else had considered this, the Secretariat would need to do so to some degree. Throughout the analysis, I attempted to be explicit about the different results that would arise from deploying different understandings of the scope of synthetic biology and of the treaty and its protocols.

On its face, the *Impacts* document was a simple endeavor – an extended literature review on everything written about synthetic biology and its impacts. But even if I could have written on everything (and I couldn't), *should* I? What about the processes and products that seemed to be synthetic biology in advertising only? What should I do with the reams of hype? Did I have the authority to frame literature around questions of the distribution of possible benefits and burdens? How was I to determine which forms of "risk" were relevant? Questions of property rights, of ethical implications for humanity's relationship with nature, of existential risks – not only was there no definitive scientific way to resolve those questions (Felt & Wynne 2007), I felt that choosing among them and determining how to frame them necessarily took me beyond the realm of "neutrality."

Mol notes that "generalizations about 'the literature' always draw together disparate writings that have different souls, different concerns of their own" (2002, 6). I felt this keenly in trying to chart a narrative through the literatures on and about synthetic biology. The production of synthetic biology as a discipline and a commercial endeavor has been performed in the wake of global controversies around GMOs. Hopes and fears for synthetic biology are deeply influenced by beliefs around GMOs – not just of whether they represent "real" risks or not, but of what actually happened. One of the social scientists that I interviewed described the experience of working with synthetic biologists who believe that conventional GMOs have been restricted to relatively few agricultural crops because public fear prevented further research and commercialization (Social scientist interview 2014). Another version is that more dramatic modifications were never commercialized because they simply did not work; GM micro-organisms were never sufficiently hardy to survive. This informs expectations of what synthetic biology will be able to accomplish, as well as what impacts regulation could have. And all of that is apart from the difference between those who see the GMO controversies as debates around safety as opposed to those who see them as debates on profit, corporate control, and political power (Nuffield 2012; Observer interview 2013).

While synthetic biology is a particularly controversial topic in the context of the

CBD, these challenges are not unique to that issue; each time the CBD Secretariat is asked to take on yet another topic, the staff must navigate conflicting literatures, interests, and political powers in guiding the other treaty bodies' deliberations. They are tasked with providing "neutral" support to processes fraught with politics. Although a few of the staff members described themselves as playing an "objective" role, I believe that the SCBD is most successful when it is transparent about the situated nature of its own outcomes. To me, part of what made the biofuels *Technical Series* so powerful was its explicit reframing of the debate in terms of how biofuels are evaluated, the scale at which they are considered, and the need to acknowledge difficult scientific uncertainties that evade measurement. This work was based in the authority of the scientific literature. I do not think that agonism means depriving the Secretariat of the authority of scientific literature; rather it means being explicit about the frame being used, acknowledging the basis for other framings, and being transparent about their differing political implications. If neutrality is to be found apart from the final authority of a universal modern science, perhaps it is in the attempt to transparently convey what Stirling describes as the "plural, conditional nature of knowledge" (2010, 1029).

ii. Approaches to studying global environmental governance.

Writing about our CEE, Corson, Campbell and MacDonald (2014) make the case that a collaborative approach to mega-events such as a CBD COP helps to identify cross-cutting themes and develop a comprehensive understanding of the event – essentially, the compressed time during which the ethnographic field exists is compensated for by thoroughly covering its breadth. Having experienced two COPs, one as a CEE member and one as a lone researcher, and two SBSTTAs, one as a lone researcher and one as a consultant to the SCBD, I have a slightly different perspective on this ethnographic field and the implications of different approaches to it.

Being part of the COP 10 CEE was an incredibly valuable experience. The CEE Principal Investigators and fellow researchers taught me how to approach a negotiating event as a social scientist rather than a lawyer or an advocate. They showed me how to gain purchase on an unwieldy event such as a CBD COP, how to apply theory to develop methodological tools, how to work with others out of a shared theoretical framework. All of my subsequent research on the CBD, especially on events, was informed by this experience.

Ethnographer Marilyn Strathern (2004) notes that we perceive uses through the tools we have at our disposal. At the time of the CEE, I was in the first semester of my second year of graduate school. I had no experience as an ethnographer, but I did have a well-developed ability to engage with legal and policy text. I found within the CEE, and particularly within my sub-groups, that I was interested in different things than my fellow researchers. Above all, I cared about the transformation of COP text, while others were more interested in capturing the broader discourse, exploring geo-political tensions, or tracing the performance of political positions. I always valued negotiations over side events, and I always wanted to capture everything that happened in a negotiation session. My fellow CEE biofuels group members did not share those priorities. As a result, being part of the CEE meant that I ultimately got less data from the biofuel negotiations than I likely would have collected on my own. For me, the group’s breadth came at the expense of depth of data in my issue area.

More generally, by the end of two weeks, our CEE group acknowledged that we had at various points been caught up in the illusion that we could “cover” the COP – after all, there were enough of us, and we had a *very* well developed matrix (Campbell et al. 2014). Campbell et al. (2014) argue that coverage was less important than our ability to contextualize the meeting, which we were able to do because of our combined perspectives, our understanding of policy processes, and our connections with the issues being negotiated from other settings.

The publications and scholarship that have resulted from the CBD COP 10 CEE are high quality and insightful, and I am proud to be associated with them. However, as someone studying *the treaty processes themselves* as opposed to biofuel politics (or ecosystem services, or ecosystem restoration, etc.) more generally, the depth that I was able to achieve in the course of one negotiating event was insufficient to constitute an “ethnography.” The breadth of our collective coverage of the event did not make up for the lack of time that I engaged with it. It has taken time and continued engagement for me to understand the context of the treaty bodies, their cultures, their histories, and their political tensions, to the point that I feel comfortable using the term “ethnography” in relation to my work. Thus, I see the Collaborative Event Ethnography approach as an extremely valuable method to studying global environmental governance, but best undertaken by researchers already very familiar with the institution and issues at hand. Otherwise, the breakneck speed of an event does not allow enough time to understand its nuances.

5.5 Concluding thoughts.

I may continue to consult for the SCBD and help facilitate the AHTEG process. If so, I will, of course, follow the COP's directions and provide neutral aid to AHTEG members. While I have provided some suggestions in these conclusions to the CBD bodies, I would not unilaterally act on them.

The prospect of jumping back into the world of the CBD and synthetic biology elicits multiple feelings. It would be extremely interesting to see the operations of an AHTEG up-close – yet another angle on the co-production of knowledge and governance on synthetic biology. I found it exhilarating to be part of a process of international deliberation on an issue as important and complicated as synthetic biology. I also found it extremely taxing to feel responsible for producing knowledge for these processes. To study knowledge politics and then step into the role of "expert" is to set oneself a high bar for transparency, accuracy, and providing space for relevant voices, perspectives, and kinds of knowledge. Perhaps it is not surprising that I felt I did not succeed in performing a different, less problematic version of "expertise"; as critical scholars, we set high standards for how the world should be. In this dissertation, I have attempted to follow the lead of de Sousa Santos (2005, 2007) in looking for and making visible spaces where counter-hegemonic forms of global governance could be or are being developed. If I apply this lens to my own work for the treaty, I can see it as a hopeful attempt rather than a failure.

In China's peer review comments to the *Impacts* draft, the Ministry of Environmental Protection wrote that, just as with GMOs, synthetic biology will always encounter some oppositions. Nonetheless, synthetic biology is "the trend of scientific development…it can't be stopped" by policy.[263] This sense of inevitability permeates much of debate around technosciences, confining discussions of risks to finding ways to balance benefits against negative impacts (Stirling 2008). Indeed, the CBD has not "stopped" biofuels, and it will not "stop" synthetic biology. CBD bodies can, however, frame these as issues with political implications that must be dealt with in political terms (de Sousa Santos 2005). By introducing issues with intractable uncertainties and controversies, the NEI mechanism could push the treaty towards playing a unique role on the international stage. The CBD is situated to become a major international treaty that recognizes the plural, conditional nature of knowledge. Rather than a poisoned chalice, New and Emerging Issues could chart a new future, not just for the CBD but for global environmental governance as a whole.

[263] See: http://www.cbd.int/doc/emerging-issues/China-reviewcomments-SBImpacts-2013-09-en.doc (last accessed 20 February 2015.

Appendix I.

Table 2: Substantive overview of the pre-COP 10 biofuel negotiations at the CBD

	Role of CBD	**Sources and kinds of information**	**Scope of definition of "biofuels"**	**Precautionary principle / approach**
SBSTTA 12 (July 2007)[264]	*EU States* – CBD should develop biodiversity-specific standards *Brazil, Indonesia, Malaysia, Argentina* - CBD should at most collect information, respect UNFCCC and WTO processes on biofuels *Civil society* (IIFB) – CBD should ban agrofuel exports	***Sources of information*** *Brazil and Indonesia* – Secretariat note not credible because of "limited bibliography" *Mexico* – need for clarity on what are proper sources of information for NEI identification ***Response to lack of information*** *EU States*– CBD should compile information and provide scientific guidance *China* – take time to consider issue in light of lack of knowledge *"many" Parties* - requested a scientific conference on biofuels, opposed by "biofuel-producing countries"	*EU* – CBD should consider biomass in addition to liquid biofuels *Haiti* – solid as well as liquid biofuels	

[264] Analysis of SBSTTA 12 draws on the *Earth Negotiations Bulletin* issues (Scanlon et al. 2007a, b, c, & d) and the official report of SBSTTA 12 to COP 9 (CBD 2007).

SBSTTA 13 (February 2008)[265]	*EU* – CBD should produce guidelines *Biofuel "producers"*[266] – other international forums should take precedence *Civil society* – moratorium on deforestation for biofuels; removal of perverse incentives	***Response to lack of information*** *Africa Group* – call for additional knowledge and guidance on bioenergy *Civil society* (Greenpeace) – reject targets prior to adequate impact evaluation	*Brazil* – biofuels are "multidimensional," "blanket treatment" is inappropriate	*Unclear who introduced* – Secretariat to develop a tool to "accurately assess" indirect impacts and requests that Parties "adopt a precautionary approach by suspending the introductions of any new supportive measures for the consumption of biofuels" until policy frameworks, guidelines, and an iLUC tool are effective
COP 9[267] **(May 2008)**	*EU* – CBD should establish AHTEG to develop industry guidelines *Brazil* – CBD should address "perverse incentives" to biofuel production (subsidies) *Civil society* – CBD should declare an immediate ban on agrofuels; call for an end to national supports		Emergency meeting on whether biofuel negotiations were within the programme on agricultural biodiversity or a separate agenda item	*Africa Group* – apply precaution to large-scale biofuel production, suspend new targets until risk and benefit assessments concluded *Brazil* – precaution unnecessary in the context of biofuels because no uncertainties[268]

[265] Analysis of SBSTTA 13 draws on the *Earth Negotiations Bulletin* issues (Appleton, Chiarolla, et al. 2008a, b, c, d, e) and the official report of SBSTTA 13 to COP 9 (CBD 2007).
[266] The phrases "biofuel-producing countries" and "biofuel producers" are used by Scanlon et al. (2007a-d) and Appleton et al. (2008a-e) throughout the *Earth Negotiations Bulletin* SBSTTA 12 & 13 reports. This phrase does not seem to include Canada, which is noted as calling for the CBD to produce guidelines, or the European Union itself, which is a major producer as well as consumer of biodiesel.
[267] This section on COP 9 draws on the *Earth Negotiations Bulletin* issues (Appleton, Jungcurt et al. 2008a, b, c, d, e, f, g, h) and the official report of COP 9 (CBD 2008).

SBSTTA 14[269] **(May 2010)**	*EU, Sweden, Kenya, Guinea, Switzerland, Norway, the Philippines* – CBD Secretariat should produce toolkits *Brazil, Argentina, Canada, New Zealand, Iran* – premature to develop a toolkit. *civil society (IIFB)* – no toolkit because that promotes biofuels *Canada* – assessing socioeconomic aspects goes outside of the scope of the CBD	***Assessments and monitoring*** *Sweden* – continuous monitoring and scientific assessments of socio-economic and environmental aspects *Canada* – oppose continuous monitoring *Brazil* – oppose ongoing assessments ***ILCs role in collaborating assessments*** *Norway, South Africa, Iran* – support ILC collaboration *UK and New Zealand* – oppose ILC collaboration	Prolonged discussions on whether to include biomass (no reported details in *ENB*)	*Brazil* – no references to precaution *Iran, Uganda, South Africa, Switzerland and the Philippines* – not only reference to precaution, but operative language should be included. Feedstock that may potentially become an invasive alien species (IAS) should be acknowledged as a threat before proven invasive. *Liberia & the Philippines* – request an AHTEG on synthetic biology and other technologies for next-generation biofuels, urge Parties not to allow environmental release of living organisms produced by synthetic biology.

[268] Although it is not reflected in the *Earth Negotiations Bulletin* reports, according to civil society observers (from interviews and side events at COP 10), Brazilian negotiations insisted that the Precautionary Approach was unnecessary in the context of biofuels.
[269] Analysis of SBSTTA 14 draws on the *Earth Negotiations Bulletin* issues (Appleton, Gnann et al. 2010a, b, c, d, e) and the official report of SBSTTA 14 to COP 10 (CBD 2010).

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