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Digital biopiracy and the (dis)assembling of the Nagoya Protocol

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\textbf{ARTICLE INFO}

\textbf{Keywords:}
Assemblage
Genetic resources
Materiality
Nagoya Protocol
Biopiracy
Environmental governance

\textbf{ABSTRACT}

Technological leaps in DNA sequencing and synthesis are disrupting tenuous access and benefit-sharing (ABS) arrangements between ‘users’ and ‘providers’ of genetic resources. For some this signals a new era of open-source gene banks to address global challenges, but to others it threatens a new wave of unjust digital biopiracy. This paper explores the issue of digital sequence information (DSI) at the 2016 Cancun negotiations of the UN Convention on Biological Diversity and its Nagoya Protocol on ABS, and its continued relevance today. While some research has addressed potential solutions to digital sequencing and ABS, little attention has been paid to the problematization of the issue itself. This paper addresses this gap with a fine-grained view of the negotiations as an ethnographic site of contestation.

We approach the Nagoya Protocol as an assemblage seeking to govern ABS. We trace how the unruly component of DSI threatens this already fragile assemblage by disrupting simplified notions of genetic resources, scientific discovery, and R&D. Our data from the negotiations reveals three major points of tension: the materiality of genetic resources; the problem’s novelty; and the problem’s urgency. Two opposing solutions raised in response to these contestations reveal underlying faultlines that we argue will continue to destabilise the broader ABS assemblage if left unresolved. Our attention to processes of assemblage (trans)formation offers insights to the historically fragile arrangements of ABS and, more broadly, assemblages of global environmental governance in the context of rapid technological change.

1. Introduction

When it comes to DNA, is a soft copy equivalent to a hard copy? This question represents one of the most polarizing issues faced by negotiators at the UN Convention on Biological Diversity (CBD) amid fears a new wave of ‘digital biopiracy’ is underway. Genetic resources have long been understood by their physical materiality; however, with recent leaps in mass digital sequencing of DNA (reading), DNA synthesis (writing), and gene/genome ‘editing’, the question of equivalency has moved to the centre of debates over the global governance of genetic resources. The stakes on demarcating material from digital are high; in an age of expanding bioeconomies\textsuperscript{1}, the utilisation of genetic resources is moving to the heart of capital accumulation strategies. This could have transformative implications for existing access and benefit-sharing (ABS) arrangements, intended to ensure that the providers of genetic material and holders of traditional knowledge related to genetic material fairly and equitably share in the benefits of scientific discoveries and commercial developments.

The 2016 UN Biodiversity Conference (COP13) was a watershed moment for the issue of how digital sequence information (DSI) might interact with the ABS system. After being downplayed or ignored for years, the question ‘if and how digital sequence information [DSI] relates to benefit-sharing’ moved to the very top of the agenda. State delegates at COP13 deemed the issue of DSI so crucial that it threatened to bring the negotiations to a standstill. Some governments argued that, if unaddressed, DSI could undermine the Nagoya Protocol on ABS, while others attempted to dismiss the issue as outside the remit of the Protocol and CBD treaty altogether.

This paper focuses on the conflict that arose between so-called users and providers of genetic resources at COP13 over the problematization of DSI. We adopt assemblage theory to interrogate the emergence of DSI as a disruptive element affecting established understandings of genetic

\footnotetext{\textsuperscript{1} See Staffas et al 2013 for a comparative overview of bioeconomy strategies across Europe, USA, Canada, and Australia.}

https://doi.org/10.1016/j.geoforum.2020.09.001

Received 28 October 2019; Received in revised form 22 June 2020; Accepted 2 September 2020
Available online 06 October 2020

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resources and fragile assemblages of governance. We draw upon ethnographic data collected at COP13 and the CBD scientific advisory body (SBSTTA20), as well as related policy events, interviews and formal discussions between policy-makers, scientists and NGOs (Bond, 2016; Scott and Bond, 2016; Scott and Berry, 2018). The political decision-making bodies of the CBD and its two Protocols - the COP and COP-MOP - only come into being every two years. We approach those negotiations as an ethnographic object, physically temporary but bringing together narratives and ideas that eventually become institutionalized into a field of governance (Corson et al., 2014; Eastwood, 2019).

Our examination unpacks how DSI at COP13 was problematized around three central contestations: the materiality of genetic resources, the novelty of DSI, and the urgency of the problem. We also analyse two possible solutions raised during the negotiations, which we argue reveal unresolved underlying faultlines that will continue to destabilise the broader ABS assemblage if left unaddressed. In the lead up to COP15 in China,2 these issues remain pertinent; the negotiations are still in deadlock, the problem of DSI unresolved. The data gleaned from COP13 records a significant moment in the global debate around genetic resources, and remains relevant to ongoing negotiations which continue to revolve around the controversies that erupted in Cancun.

While a small but growing number of scholars have highlighted contradictions between emerging biotechnologies and bio-industrial strategies with biodiversity and ABS agendas (McAfee, 1999, 2003; Oldham, 2006; Smilker, 2008; Parry, 2004; Hayden, 2011), very few have focused on the disruptive potential of DSI to ABS (Laird and Wynberg, 2016; Wynberg and Laird, 2018; Bagley, 2018). Publications that specifically address DSI focus on offering solutions; little attention has been paid to the process of problematization itself, and how different problematizations lead to different solutions. With a fine-grained view of the negotiations as a site of contestation themselves, we draw upon and contribute to analyses of CBD politics, knowledge production and decision-making (Corson et al., 2019; Escobar, 1998; Jasanoﬀ and Martello, 2004; Kutting and Lipschutz, 2009). Escobar (1998, 55) conceptualised a biodiversity production network as “chains of sites characterized by a set of heterogeneous parameters, practices and actors.” Indeed, CBD negotiations bring together a motley crew of actors, objects and concepts, including: emerging technoscientific capabilities; notions of scientiﬁc progress and socio-environmental justice; organisms, genes, and DNA; economic discourses; culturally diverse groups of people; and the institutional processes and norms that shape knowledge and produce decisions. Building on Escobar’s network approach, we join a growing number of social scientists who argue that such a dynamic and heterogeneous grouping of ‘material and semiotic elements’ cannot be deﬁned as a coherent whole, but is best understood as an assemblage (Sohn, 2016, 184; Anderson et al., 2012; Lorimer, 2006; McConnell and Ditmer, 2018; Corson et al., 2019).

Through an assemblage lens, we see access and beneﬁt sharing (ABS) as a series of relations, a composition of things, forms and processes. This composition is an active achievement, not a natural state; the assemblage concept of ‘territorialization’ describes the production of a distinct order of norms and legalities, actants, artefacts and abilities that constantly rework, (re)produce, sustain and/or transform socio-material relations within and beyond an assemblage. Assemblage theory is rooted in attention to the constant potentiality for emergence, rupture and transformation, and hence the de- or re-territorialization of an assemblage (Anderson et al., 2012; Herman, 2018; Sohn, 2016; Robbins and Marks, 2010). This approach lends itself to examining how an unruly component such as DSI emerges within the territory of a semi-stable assemblage such as ABS and aﬀects and is aﬀected by other assemblages. We also draw on assemblage theories’ conceptual distinction between the actual and virtual capacities of components in an assemblage - i.e., the known stable state of an assemblage versus the potential of what it could be. We use these distinctions to illuminate the ways in which multiple potentialities for change and transformation emerge (Anderson et al., 2012). In adopting an assemblage approach, a particular ethos and ontology of materiality is assumed, which we ﬁnd particularly useful for grappling with the looming question of equiv- alency between the material and the digital.

This paper contributes to a better understanding of the precarity and durability of the Nagoya Protocol and ABS in light of DSI. While assemblage thinking is often used to highlight the contingency of seemingly permanent societal institutions and arrangements, we are interested in what insights it can bring to the historically fragile arrangements of ABS and more broadly what this says about assemblages of global environmental governance in the context of rapid technological change. Hence this article is structured around the (de/re)territorialization of the ABS assemblage.

First we outline the Nagoya Protocol’s attempt to territorialize a global ABS assemblage with a legal instrument, before looking at why the protocol is now perceived to be undermined by DSI and the threat of digital biopiracy. We then turn to the COP13 multilateral negotiations, drawn from our observations within the small negotiating rooms. Part 3 describes the problematization and contestations over DSI that threatened the “absolute de-territorialization” of the ABS assemblage (a change so destabilizing it could dissipate the entire assemblage). Part 4 follows attempts to stabilise the ABS assemblage by establishing a process to deal with DSI and debating two possible solutions. These opposing solutions reveal the dynamics between the actual and virtual capacities the assemblage holds to “re-territorialize” ABS (reconfiguring or transforming the relations and productive capacity of the assemblage) (Sohn, 2016; DeLanda, 2006). Our conclusions lay out three faultlines DSI has made visible in the ABS assemblage, representing unresolved frictions that will continue to rupture and destabilize ABS if they remain unaddressed.

Our objective in this paper is not only to unpack the way DSI emerged as a problem to the cohesion of the global ABS assemblage, but also to provide new perspectives on entrenched and polarized positions, which may help forge new solutions.

2. Analogue to digital biopiracy: assembling ABS

From cacao to quinine, turmeric rhizomes to frog skins, access to biodiversity and associated traditional ecological knowledge from (sub) tropical regions has long been a source of new drug and product discovery for the industries of the Global North. In the late 1980s, environmental justice scholars and NGOs coined the term biopiracy to describe the act of proﬁteering from biological matter and associated ecological knowledge without consulting, compensating or sharing beneﬁts with the community from which they originate (RAFI, 1994; Shiva, 1997). This pejorative term was meant to counter the prevailing narrative of ‘green genetic gold’ waiting to be ‘discovered’ by bio-prospects, and instead draw attention to centuries of unequal exchange between the so-called providers of the biodiverse South and users of the colonial North (Shiva, 1997; McAfee, 1999).

Leading up to the 1992 Rio Earth Summit, the value of genetic resources was in the spotlight. Ecosystems were framed as depositories of vast biological intellectual property, positioned to pay for their own conservation as well as provide a means of development (McAfee, 1999; McConnell, 1996). Southern countries demanded compensation for previous and future conservation and for acting as stewards of their genetic resources. It was in this context that the ‘grand bargain’ of the
UN Convention on Biological Diversity (CBD) was achieved (Wynberg and Laird, 2009). The CBD treaty entered into force in 1993; its 3 major objectives including not just conservation of biological diversity and its sustainable use, but also ‘the fair and equitable sharing of the benefits arising out of the utilization of genetic resources’, often more simply referred to as the ABS objective (Access and Benefit-Sharing) (CBD, 1992).

The CBD treaty put in place an international system for ABS based on bilateral contracts between ‘users’ and ‘providers’ of genetic material and/or associated traditional knowledge. An assemblage of dispersed components, actors, objects and ideas were brought together under the remit of ‘ABS’, including: genetic resources; knowledges, recipes and formulas of indigenous peoples; local communities, scientists, lawyers, healers and crafters; biopolitical and bioeconomic agendas of policymakers; bioprospectors, traders, producers, and consumers of genetic resources; transfer agreements; and the places and spaces in which these entities traverse, from labs to jungles to boardrooms and back again.

All assemblages are contingent and impermanent, but the ABS composition was perceived as particularly frail from its early days. Parties to the CBD have broad discretion in the implementation of the treaties’ objectives and no formal compliance mechanism to keep them in line. In the decade that followed the treaty’s passage, Northern patent offices received record applications on biological materials, while NGOs and academics reported continued access of indigenous peoples’ and local communities’ traditional knowledge, plants, crops, and natural remedies by commercial users (Oldham, 2006). At the same time, the World Trade Organization’s agreement on Trade-related Aspects of Intellectual Property Rights (TRIPS) had set a precedent for treating genetic materials as standard commodities to be patented and traded, without any reference to ABS (Oldham, 2006). While not part of the global assemblage of ABS governance, this agreement had an enduring effect by solidifying trends to “reclass(ify) nature as a form of industrial property on the international level” (Oldham, 2006, 126). In the struggle between the CBD and WTO’s approaches to genetic resources, the WTO Agreement tended to dominate; unlike the CBD, it had both specific, precise language on legal obligations and a compliance mechanism.

In 2010, the Nagoya Protocol was adopted amid great hope and exultation (Jungcurt et al., 2010). The Nagoya Protocol can be seen as an attempt to territorialize the ABS assemblage, to stabilize and solidify the fragile relations between components with more specific legal commitments. The Nagoya Protocol is not the only international ABS instrument - agreements exist to provide access to and share the benefits of genetic materials of key crops and viruses and perhaps soon in areas beyond national jurisdiction in oceans. But the CBD established the principles of ABS on the global stage, and the Nagoya Protocol was expected to carry that torch.

The jubilation, however, was short lived. Social scientists noted that the Protocol treated research and development (R&D) as a linear process of discovery-research-innovation, which was an uncomfortable fit with the messy and complex realities of science (see Dutfield in Scott and Berry, 2018; Dutfield, 2013). The Protocol sets out different regulatory paths for commercial and non-commercial research, but in practice the boundaries between these easily blur (Greiber et al., 2012). At numerous points in the negotiations, Parties had side-stepped controversy by using non-specific language. These so-called ‘strategic ambiguities’ had made an agreed legal text possible despite a lack of consensus (Bavikatte and Robinson, 2011), but they left in place open questions, such as the geographic and temporal scope of the Protocol and whether the definition of genetic resources encompassed only its physical form or also its information (Greiber et al., 2012; Scott, 2015).

This last question has taken on increasing importance as scientific leaps in digital genetic sequencing and synthesis technologies shift traditional sites of exploration. Reduced costs and increasing technical abilities now allow researchers to sequence DNA, share this digital sequence information (DSI) via online gene-banks or email, and then synthesise the sequence information back into physical DNA. While these advances in sequencing and synthesis are neither effortless nor always reliable, they are shifting landscapes of practice, bolstering the ambitions of many private and public genebanks to capitalize their existing stores. Vaults of material samples and databases of genetic information have become the next great frontier for exploration (Parry, 2004; Rossi, 2014). While physical samples continue to be important to R&D, increasingly bioprospectors can discover useful genetic materials without entering the field or negotiating local knowledge (SCBD, 2018).

Within the CBD, examination of such changes in research practices has been conducted through its negotiations on synthetic biology, one of the most polarizing issues of the treaty’s recent past. The CBD’s operational definition of synthetic biology is ‘a further development and new dimension of modern biotechnology that combines science, technology and engineering to facilitate and accelerate the understanding, design, redesign, manufacture and/or modification of genetic materials, living organisms and biological systems’ (CBD, 2016). Synthetic biology enables DSI to be utilised and exploited in new and ever more expansive and efficient ways. For advocates of a bio-industrial revolution, genetic information will be a fundamental component of a bio-economic boom (Carlson, 2011). Critics raise concerns about the implications of this so-called “dematerialization of biology” on in-situ stewardship of biodiversity, socio-ecological relationships, and unequal ownership and access to technology (Parry, 2004; Muller, 2018; Nijjar, 2016). As new genetic techniques and technologies moved from scientific hype to commercial reality, questions began to be raised about what this might mean for ABS governance. Was the Nagoya Protocol nimble enough to encompass these changing practices, or was it, as some analogized, like “regulat(ing) VCR technology in the era of YouTube”? (Servick, 2016) Were these changes significant enough to destabilize the ABS assemblage?

In the two years before the 2016 Cancun negotiations, the question of “if and how the use of digital sequence information on genetic resources relates to access and benefit-sharing” gained momentum. Civil society groups coined the term digital biopiracy to describe new scientific practices being used to bypass the established mechanisms for fair and equitable benefit-sharing (Hammond, 2013). The Third World Network (TWN) pointed to projects such as DivSeek, a mass genome sequencing project targeting crops and wild relatives (ICSWGSB, 2016). Articles in scientific publications raised concern that, if ABS regulations encompassed DSI, this would burden business’ bottom-line and, rather than deterring biopiracy, deter well-meaning scientists from pursuing biotechnological solutions to global problems (Cressey, 2014; Servick, 2016; Manheim, 2016).

Despite this increasing buzz in the lead up to COP13, DSI’s central role in the negotiations took almost everyone by surprise.

3. The de-territorialization of ABS at the CBD

DSI became one of the most important issues of the Cancun negotiations. As the two weeks of negotiations unfolded, DSI gained
momentum, breaking away from synthetic biology to stand as an issue relevant to the treaty and protocols in its own right. It was framed as critical to the cohesion of not only the ABS assemblage but also wider assemblages of global natural resource governance, from other international ABS agreements to the UN’s Sustainable Development Goals.8

Our analysis in the following sections focuses on verbal debates within the event’s formal negotiating spaces and the resulting negotiated text.9 We acknowledge what this leaves out: the global ABS assemblage goes far beyond the confines of these negotiations, and while only party delegates had the right to verbally participate in Contact Groups, they were far from the only actors of importance. Groups including iGEM students (the international Genetically Engineered Machine competition), DIY-bio hacktivists, industry lobby groups, philanthropic donors, and pro- and anti-biotech NGOs mobilised around the issue of DSI at COP13. These actors brought new values, politics, ontologies and epistemologies, through organizing and attending others’ side events, passing out printed materials, quietly lobbying and holding press conferences. While in other work we draw on data that includes such voices (Scott and Bond, 2016; Bond, 2016; Scott, 2015; Scott, 2016), in this paper we focus on the negotiators as central “assemblage converters,” i.e. well-placed components capable of mediating, transforming and stabilising the assemblage (DeLanda, 2006).

By examining how they frame issues and refute each other’s facts and logics, we can trace the dynamic performance of governance.

Unlike other treaties, such as the UN Climate Change Convention, the CBD has established the norm of allowing observers to be present during Contact Group negotiations (Scott, 2015). To preserve these crucial observation rights, we took notes but did not record the sessions, and we do not ascribe any statement made in the Contact Groups to a specific delegation.

### 3.1. Problematising DSI

Deleuze (1990, 54) wrote, “(A) problem always finds the solution it merits, according to the conditions which determine it as a problem.” The opening Working Group session on synthetic biology made it clear that there was no consensus on what the problem of digital sequence information (DSI) and ABS was, let alone a solution. There was disagreement on the very basic question of whether it was even an issue, either for the entire treaty or for the Nagoya Protocol. Canada’s position was that the entire issue should be deleted because “the Nagoya Protocol is about the ABS of genetic material only” and DSI did not fall within the scope of either Nagoya or the CBD (Canada, WGII COP13). Few countries openly aligned with Canada, and many self-identified ‘provider-country’ delegations echoed the Namibian delegation’s assertion that ‘the use of genetic sequence data is an example of a new and emerging issue that cuts right across the CBD and both protocols in a very fundamental way’ (Namibia, COP13 WGII). In their opening statements, these parties referenced a desire to protect the sovereignty of their resources, “our genetic and chemical information of plants, animals and microorganisms” (Indonesia, WGII COP13). The Democratic Republic of Congo, reflecting the Africa-group’s joint position, stated, “we would like to stress the fact that resources are precious due to information that they contain” (D.R.C. WGII COP13). After almost fifty polarised positions on DSI and synthetic biology were voiced in the Working Group, the debate was moved to a Contact Group. Seven Contact Group sessions debating DSI convened over the two weeks, each lasting multiple hours. Negotiators mobilized problem-solution framings around three major areas of contestation: the equivalence of DSI and physical genetic resources; the novelty of the problem; and the urgency of the problem. We unpack how these contestations were problematized and ruptured the already shaky foundations of the ABS assemblage.

### 3.2. Contested materiality

The CBD defines genetic resources as the ‘actual or potential value of genetic material’ (CBD, 1992, Art. 2). Genetic material is defined as ‘any material of plant, animal, microbial or other origin containing functional units of heredity’ (Ibid). ABS commitments are triggered by the ‘utilization of genetic resources.’ It is therefore a key question whether the ‘utilization of genetic resources’ is equivalent to utilizing digital sequence information.

The issue of DSI has thrust the distinction between the genetic code and the materiality of life to the forefront of political decision-making. Adopting assemblage theory as a conceptual tool leads to a particular ethos and politics of materiality. Assemblage theory is defined by a distinct ontology of materiality, or a political ecology of what Bennett (2010) calls “vibrant matter,” where materiality “is as much energy, process, flow and intensity as entity and extension” (in Anderson et al., 2012, 181). Rather than a stable thing, matter is understood as a “substance in its intra-active becoming - not a thing but a doing, a congealing of [human and non-human] agency” (Barad, 2007, 151 in Anderson et al., 2012, 1818). This perspective raises slightly different questions around the materiality of DSI than those asked by COP13’s delegates.

“Hard copy is equivalent to soft copy” is how one delegate framed the problem on the materiality of genetic resources and its equivalence to DSI, on the first night of the Contact Group. The delegate carried on: “it doesn’t need profound discussion or analysis that a book you take off your shelf or a book you are reading on your ipad are the same thing”. Analogies of hard and soft copies, metaphors of equivalency and tussles over tangibility went back and forth for hours over the Contact Group sessions. One delegate asserted it was “disingenuous” to say that information was different from the material; another described digital sequences as a “mirror of reality.”

Other delegations aligned with Canada’s opening statement that the definition of genetic resources could only ever include physical, tangible material. They rejected the hard/soft copy analogy, or at least its implied equivalence. One negotiator argued: “I prefer the image of a bushel of yellow thumb drives and of corn, they’re not the same.” The delegate reasoned while both corn and thumb drive contain a lot of genetic information, “you can’t eat the thumb drives.” Another negotiator added “I just don’t understand how it can be the same. How can information have genes that can be replicated?” Another pointed to this debate as demonstrating the need for further work, as it might not be “black and white...soft copy may not be the equivalent of a hard copy.”.

Rather than focusing on the question of equivalency between the physical and digital, assemblage thinking provides a different approach. DeLanda (2006) describes a “material/expressive axis,” on which any assemblage component may play a mixture of material and expressive roles by exercising different sets of capacities. The rise in the use of DSI in research and innovation practices can be seen as a shift in the mix of material and expressive roles being played by DNA. Rather than questioning whether the Nagoya Protocol’s legal framework can cover a fundamentally different thing (information as opposed to physical samples), one might ask whether it can encompass a shift along the material/expressive axis.

Furthermore, assemblage thinking draws attention to the fact that physical DNA is only one of the material components of the assemblage, alongside hardware for databases, the servers the information is stored upon, the equipment used to sequence DNA, and so on. Celebratory

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8 Two Sustainable Development Goals (SDGs) – SDG 2 on zero hunger and SDG 15 on life on land – contain targets on ABS.

9 The Plenary and Working Group sessions have the greatest accessibility and transparency; the proceedings are simultaneously translated in the six UN languages and web-cast. Much of the negotiation over specific language happens in the Contact Groups and Friends of the Chair meetings, in smaller rooms where parties can debate less hindered by public scrutiny, with no recording or social media.
narratives of the de-materialization of biology seem to suggest that, once sequence information is on the internet, it negates or transcends the physical plane. While DNA's expressible capacities may continue to grow while the material capacities of physical samples become less central, it won't stop being both. Perhaps the question is whether this shift along the material/expressive axis for one component is so destabilizing that the global ABS assemblage can no longer hold. Does the rise of DSI necessitate the absolute de-territorialization of the ABS assemblage?

The negotiations repeatedly stalled over the stumbling block of equivalence, treating the material and expressive as binaries. Eventually, delegates turned to the novelty of DSI - i.e., was this really something new demanding action and, possibly, change?

3.3. Contested novelty

Dispute over how the problem itself should be phrased seemed to indicate its novelty to the CBD. Some referred to 'genetic sequence data', while others referred to 'natural information.' Parties compromised on Digital Sequence Information as a 'placeholder', signalling unease over concretising the term. Nonetheless, the novelty of DSI was a highly contested issue throughout the negotiations, even among parties arguing for the same outcome. Some of those who preferred to dismiss the issue pointed out that sequence information had been circulated and shared “for decades”, and thus it was unreasonable and unnecessary to suddenly demand action. Others argued for inaction on the basis that a decision would be “premature” - primarily because it hadn’t been clarified whether the Nagoya Protocol covered DSI, but also because its legal, technical and scientific aspects were still unknown.

Amongst those arguing for action, DSI was similarly posited as both new and old. One negotiator pointed out “when the Nagoya Protocol was being discussed, synthetic biology was not alive in our minds.” Another echoed this point, stating “the CBD overtaken by technology was not imagined when CBD was formulated. We live in a different world now.” Others argued that the issue had been known and discussed for years, “to say premature in 2016 is not reflective of what actually happened.” “This is not a new issue,” and “this is a clarification” said others. In a public side event, a veteran Philippine negotiator of the Nagoya Protocol asserted “I was there from the start” and that the issue of DSI was raised as early as 2004. He explained that there were texts on “genes in databases” during the SBSTTA in 2009, and that now “technology has gotten to the point where it cannot be ignored anymore” (12/14 TWN side event). Indeed, there is a clear paper trail of discussion on this issue within the CBD for over a decade before Cancun (SCBD, 2005, 2010, 2014a, 2014b, 2015; Laird and Wynberg, 2012). These papers flag the challenge of electronic transfer of data across borders and the question of whether “genetic material” includes information as well as physical material, demonstrating that there was an early awareness of the destabilizing potential of DSI for the Nagoya Protocol.

Why did delegates engage in such protracted debate on DSI’s novelty, and what did DSI’s novelty imply for the ABS assemblage? The argument that it was a new component in the ABS assemblage was double-edged in its implications for the Cancun negotiations. On the one hand, if it was novel, it could be argued that the protocol’s lack of explicit inclusion of DSI was inadvertent. By clarifying their interpretation of the treaty and protocol as including DSI, the treaty and protocol would be re-territorializing the global ABS assemblage, incorporating a key new component. However, if it was very novel, action might indeed be seen as “premature,” regulating an insufficiently understood phenomenon. Likewise, there were double-edged implications if it was not novel. If the CBD had actually recognized DSI as a challenge early on, then it was an established component of the global ABS assemblage, and couldn’t be cast out. Conversely, if it was a longstanding practice, perhaps it had deliberately been left out of the treaty and protocol, and in any case, would it then demand such urgent action?

3.4. Contested urgency

Those arguing against the equivalence of digital and physical resources claimed it was premature to take any decision on if - let alone how - DSI related to ABS. Some complained that the issue had been sprung on negotiators in Cancun, and that they had no mandate to make major decisions on it during this COP. Another said their delegation saw it as “important but not urgent,” and cautioned Parties not to rush into “rash decisions.” One negotiator said dealing with the issue would be “walking into a minefield,” for the “complexity is so huge…. I can’t even begin to think about how we can regulate digital sequences sent by emails.” This was countered by delegates noting the urgency of this issue for developing countries, and fearing that “delay will cost the further erosion of our genetic resources.” Dramatic imagery was deployed to describe the threat of delay. “Kicking the issue down the road” would allow more time for, one delegate analogised, a “big hoover going around sucking up genetic sequences” and uploading them to cloud databases where they could be utilised without benefit-sharing. Another painted a picture of “all those sequencers running day and night, all those biotech companies putting third world farmers out of business by the sequences they are stealing.” This sense of the “super-personal speed” of industry leaving policy lagging behind provided a drive to the negotiations.

In the corridors just outside the negotiating rooms, tensions flared between actors with a diversity of stakes riding on the talks’ outcome. The biannual NGO stunt ‘Captain Hook Awards for Biopiracy’,

10 a spoof award ceremony for multinational companies accused of committing biopiracy, resulted in emotional outbursts and confrontation between pirate-clad performers, young synthetic biology students, and youth representatives. The atmosphere both inside and outside the contact groups grew palpably tense, with one country delegate even expelled from the negotiations over aggressive behaviour.

Debates on urgency tapped into divergences between user and provider countries. While delegates from self-identified provider countries invoked the binary of ‘developing’ and ‘developed’ countries to assign certain moral or diplomatic responsibilities, delegates of some countries with more resources were careful to position themselves as “both” users and providers. This urgency was not just over indigenous and local communities potentially losing out on benefits of R&D; the issue of DSI rapidly escalated to threaten the downfall of the Nagoya Protocol and even the CBD itself. One delegate from a mega-diverse country explained that DSI opens “a way to completely bypass the agreement” that would “completely destroy the Nagoya Protocol,” one of the “fundamental things this convention was built on.” Numerous delegations noted the linking of the three CBD objectives - conservation, sustainable use, and fair and equitable benefit-sharing - and that, if everything was digitized and freely accessible, “the incentive to preserve and protect is lost.”

With the escalation of stakes, delegates threatened to take significant steps if their calls to address DSI were ignored. In the opening Working Group plenary, Bolivia and Venezuela had called for an outright moratorium on synthetic biology, but few considered this likely. Far more serious was the threat by certain provider countries to take unilateral action. As one delegate noted to the users in the room, “you’ll have to comply with national legislation whether parties to the Nagoya Protocol or not.” Another delegate threatened a coordinated provider-country “moratorium on digital genetic sequencing” while the process of CBD decision-making was ongoing. This threat of moratorium was met with gasps from observers and glances of disbelief between negotiators. A provider country also threatened to withhold consensus on all the COP decisions under negotiation at Cancun until a decision was

10 http://www.synbiowatch.org/captain-hook-awards-2016/.
taken on whether DSI was covered by the Nagoya Protocol.

A key characteristic of assemblages is their “relations of exteriority” - that its heterogeneous components are not fully defined by their relations within the assemblage. Components are impacted by being part of a given assemblage, but not fully determined by it (DeLanda, 2006; Anderson et al., 2012; Sohn, 2016). The negotiators drew upon the fact that the Nagoya Protocol, an independent legal instrument, exists alongside and is entwined with other components within and outside of the global ABS assemblage. Negotiators threatening to delay all COP decisions utilized the concurrent meetings of the CBD, Nagoya, and Cartagena Protocols11. The threat by provider countries to take unilateral action was a reminder that the Nagoya Protocol does not set a hard boundary around ABS. The Protocol establishes a minimum of regulatory assurances, but nothing prevents countries from establishing much more stringent ABS regulations. We can see how a component may be part of multiple assemblages, and its actions can “ripple through neighboring assemblages” (McConnell and Ditmer, 2018, 143).

3.5. Ruptures in the assemblage

All assemblages are contingent achievements; an assemblage approach often reveals the on-going need to produce what presents itself as natural and permanent. We see these contestations over materiality, novelty, and urgency as ruptures in the assemblage, moments in which the boundaries delineating the global ABS assemblage were at stake.

The entry into force of the Nagoya Protocol was a territorializing move, attempting to stabilize a nascent global ABS assemblage. But the Protocol was always perceived as particularly fragile. Based on simplified and linear versions of scientific exploration, research and innovation, the assemblage requires a series of idealized components: internally coherent, externally independent communities holding traditional knowledge; samples traceable to one politically-stable location; a sample crossing a physical border; innovation processes in which a sample clearly results in a scientific breakthrough which clearly leads to a final commercial product. The issue of DSI disrupts this narrative, but it is hardly the only component refusing to keep to its designated form.

In the different visions of potential forms the assemblage could take, DSI was framed as holding a multitude of essential properties and potential capacities: un-governable information that wants to be free; a shift in scientific practices calling for a shift in regulatory oversight; a wind of change making obsolete all efforts to establish lines of responsibility; an opportunity to align the principles of ABS to contemporary practices of bioprospecting. Most of these framings would mean major changes to the ABS assemblage; whether the Nagoya Protocol included DSI in its regulatory mandate or not, an official decision on this would significantly impact established relationships between assemblage components. Would this lead to an absolute de-territorialization - a destabilization of relations such that the assemblage fell apart? Would it open up a path to re-territorialization, in which the ABS assemblage reformed with a slightly different web of relations among its components? Or would negotiators find a way to stabilize the existing assemblage?

4. De-territorialize, re-territorialize, or kick it down the road: finding solutions in Cancun

After four long nights of Contact Group negotiations, heated side events and informal talks, it was clear that ‘if and how digital sequence information relates to ABS’ was deemed a crucial issue by the majority of parties. Indeed, it was so polarising and overarching that the issue broke away from the Synthetic Biology Contact Group and a separate group was established to produce a stand-alone COP decision on DSI. This move signalled a solidifying of the issue as something that had to be dealt with. The ‘if’ in “if and how” was removed, and a reluctant compromise was forged to establish a process to deal with the remaining question of ‘how.’ While the previous section described the destabilizing capacities of DSI, we now turn to the ways in which negotiators attempted to stabilize the ABS assemblage by debating a process to deal with the ‘problem of DSI,’ as well as solutions to potentially re-territorialize the Protocol by reforming it along two opposing lines.

4.1. Process as solution

The final three days of Contact Group negotiations revolved around the Parties attempting to find a solution through the process of process-building. The conversations to work this out were imbued with significantly less drama than earlier debates. But it’s in the exhaustive hammering down of such detail that we saw the politics of knowledge production, exposing fundamental questions of power within the ABS assemblage.

For example, negotiators agreed to establish an Ad Hoc Technical Expert Group (AHTEG) on DSI. But what information would the AHTEG group work with? Who would be trusted to provide that information? One prominent delegation wanted the Secretariat to just put out a call for submissions, which the Secretariat would compile. Another agreed that submissions were enough, but was willing to let the Secretariat make a “compilation and synthesis.” A developing country delegate countered that their government - and many others on their continent - had a small civil service that could neither handle the workload of submissions nor afford the cost of hiring consultants. They called for a study done by consultants to feed into the AHTEG deliberations. On the surface, these were disagreements about the money, cost and necessity of a study. But it was also about to whom and how much the Parties would relinquish control in shaping the knowledge that would be used in future negotiations.

Assumptions and contestation over the type of study and the role of ‘science’ repeatedly arose. Should the commissioned study restrict itself to “scientific” issues? If so, could the study assess the “extent and terms of use” of DSI, or was that a “legal” matter? When a delegate described the conditions of use for data as “not scientific,” another fired back: “How is that not scientific? …Science is not a subject matter, it is a methodology!” At various points, negotiators would confess “I’m not a lawyer” or “I’m not a scientist.” One developed country delegate responded: “A number of people said they aren’t scientists, this is shocking!…When we act in ignorance because we don’t have the science, we act in panic!” In counterpoint, another delegate insisted “not being a technical person helps me to focus on the process.” What was needed now, others responded, was not a “science-based discussion” but rather an “evidence-based discussion” - specifically, evidence of the impacts of DSI on ABS.

These debates over the scope and role of science in negotiations represent long-standing and incredibly contentious battles within the CBD (and beyond) over reliance on scientific knowledge and how to address its limitations (Gupta, 2013; McConnell, 1996). Nonetheless, wrangling over which components would be the appropriate and necessary ones for dealing with the disruptions of DSI in the assemblage allowed a small step forward. With the assemblage stabilized (for the time being), the delegates continued to negotiate, qualified by the fact that they were negotiating a process, not a scientific solution.

4.2. Open source or Article 10

Although the establishment of a process meant that the “ball was kicked down the road” at Cancun, as one delegate put it, the negotiations revealed two potential goals toward which that ball could be kicked. These two possible solutions to deal with DSI stand at opposite ends of the pitch, with one essentially advocating less regulation of the use of genetic resources and the other advocating more. As potential

11 Cancun was the first time all three meetings happened concurrently.
solutions to re-territorialize ABS, they highlight the assemblage concepts of the virtual and actual. The “actual” describes the stable state of an assemblage, in which components interact and display their “known features” or properties. The “virtual” is a “possibility space,” an “open-ended set of potentials” of what the assemblage could be; it is related to the idea of a component holding multiple capacities that are unpredictable and dependent on potential interactions with other components (Sohn, 2016, 186; DeLanda, 2006).

One potential solution put forward was ‘open source science.’ Some negotiators attempted to reframe DSI as a solution to biodiversity conservation rather than a problem for ABS. They mobilised idealised notions of democratic and deregulated access to DSI under open source platforms. Sequencing entire collections of genetic material was, one negotiator boasted, a “hugely positive thing we do, a way of acting as custodians.” Another appealed not to burden users’ “time in legal processes.” They rejoiced that, “today every student in every corner of the world with internet can access this information,” passionately declaring “digital genetic information is for everyone!” This framing of deregulated open-source platforms as a solution was countered by provider countries’ concerns that open-access data opened the door for bioprospectors to mine databases, bypassing benefit-sharing regulations. As one delegate put it, “We’re not against open source - we like it - but don’t sabotage and empty the protocol.”

Other negotiators pointed to concurrent Contact Group negotiations on the Nagoya Protocol’s Article 10 as potentially holding a solution. Article 10 acknowledges that the bilateral approach established by the Nagoya Protocol might not always be possible, such as when a resource stretches across country boundaries or when prior informed consent cannot be granted. Rather than establish an alternative mechanism for such instances, the negotiators of the Nagoya Protocol compromised on Article 10, which instructs Parties to “consider the need for and modalities of a global multilateral benefit-sharing mechanism” (Greiber et al., 2012). Global multilateral benefit-sharing mechanisms have been or are being established in other contexts, to share monetary and non-monetary benefits from deep-sea mining12 and from particular crop species used for food and agriculture13 (Morgera, 2015). Some countries pointed to Article 10 as a solution to DSI because, as one delegate put it, a “multilateral problem requires a multilateral solution.” Another agreed Article 10 was relevant, because “once all these sequences are digitized” and obtained or utilised without prior and informed consent “it’ll be too late” for benefit-sharing. Article 10 was not substantially debated within the DSI negotiations; our impression is that this was because its proponents were waging a staged battle, and first DSI had to be established as a ‘problem’ in and of itself.

Different understandings of both the established properties and the unexercised capacities of ABS components played out in attempts to reorient and re-territorialize ABS toward these two solutions. Attention to the virtual and actual capacities reveal different perceptions of the purpose of ABS. For example, those advocating for open source as a solution framed genetic material as closely mirroring the properties of information in capitalist society, drawing parallels to the music industry and its regulatory failures. This analogy puts emphasis on seemingly pre-existing properties of both genetic-material-as-information (information wants to be free) and regulatory regimes (which cannot stop the circulation of information). While certain properties of DNA and capitalism are perceived as fixed, this perspective has room for emerging capacities, such as re-purposing DNA as a mass storage device for data (Cumbers, 2019).

On the other hand, advocates of an Article 10 solution emphasize very different properties of the actual and seek to explore different capacities of the virtual. For example, at COP13’s High Level Panel and Interactive Dialogue on Living in Harmony with Nature, a Bolivian representative argued for a different ontology of life, emphasising that ‘pachamama’ (an Andean understanding of the natural world) cannot be reduced to a commodity to be sold as information; rather, in this “fundamentally non-anthropocentric relationship,” Earth is our collaborator. Accompanying this perspective on the actual properties of life was a different focus on the possible capacities of the global ABS assemblage going forward. We saw actors at COP13 framing a multilateral benefit-sharing mechanism as a potential tool of decolonization in struggles over fairer relations of extraction and development.

While open source and Article 10 were the most debated solutions, they certainly did not represent the only views on DSI at COP13. Some civil society organizations refused to engage with ABS as an inherently capitalist concept, while some delegates saw the issue as nothing but a distraction. We focus on the two primary framings because we see their ontologically opposed possibilities as demonstrating the power of the virtual to shift an assemblage towards re- or de-territorialization. They also demonstrate some rather stark faultlines between the different agendas for the future management of genetic resources, which we come to in closing.

In the end, the process itself was the only solution COP13 could reach - a process of fact-finding and scoping to support the next COP in 2018.

5. Concluding Cancun

In 2018, two years after the Cancun negotiations, the CBD’s Parties met in Sharm El Sheikh, Egypt for COP14. The relationship between DSI and ABS was a highly controversial issue yet again, “attract(ing) more attention than any other item under negotiation” (Tsioumani et al., 2018, 25). The fact-finding and scoping study commissioned in Cancun had not produced consensus (SCBD, 2018)14; if anything positions appeared to have hardened, with one Contact Group session lasting from 8 pm to 5am.15 The main outcome of the negotiations was, once again, a process: “...as there is a divergence of views among Parties regarding benefit-sharing from the use of digital sequence information on genetic resources, Parties commit to work towards resolving this divergence through the process established in the present decision” (CBD, 2018). And so, in the lead up to the COP15 negotiations in China, another process of information-gathering was set in motion. Thus far, the debate remains mired in entrenched positions. What light can our analysis shine on the possible paths forward for CBD negotiators and the broader ABS global assemblage?

DSI is only one of many unruly components of the ABS assemblage. Considering the tumultuous history preceding it, the Nagoya Protocol can be seen as a territorializing move, seeking to stabilize the assemblage by grounding the broad ABS principles established by the CBD in the specific framework of the Protocol. This was only possible, however, by relying on idealised notions of R&D and strategic ambiguities in the legal text. Even outside of those unresolved tensions, many components of the global ABS assemblage fail to hold distinct boundaries. Emerging technosciences such as synthetic biology are continually shifting practices in DNA sequencing, synthesising, editing, and bio-banking. Concepts such as “traditional ecological knowledge” and “non-commercial research” have proven slippery, with indistinct boundaries. As individual states pass domestic ABS legislation in the past few years, they codify different, sometimes conflicting interpretations of the Nagoya Protocol. The global ABS assemblage has thus far

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12 UNCLOS established the seabed and subsoil beyond national jurisdiction as a “common heritage of mankind.” Also see note 7.
13 See note 5.

14 Polarized positions can be seen in the peer-review responses to the fact-finding and scoping study, submitted by 11 Parties, 1 non-Party (the USA), and 26 organizations and stakeholders (available at: https://www.cbd.int/dsi-gr/2017–2018/#peerreview).
15 Bond was present for a week of COP14 as a researcher, following the DSI and synthetic biology negotiations.
endured such disruptions and challenges to its coherence.

So the question is not whether DSI destabilizes the Nagoya Protocol and broader ABS assemblage, but rather how significant of a disruption it represents and how best to respond. Almost all of the negotiators participating in the COP13 negotiations recognized DSI as a threat to the current global ABS assemblage, but their desired responses were quite different. Ruptures resulting from DSI could be seen clearly in the contestations over its novelty, urgency and materiality. Some sought stabilization by explicitly bringing DSI within the remit of the Protocol, fearing that ABS policy would cease to be meaningful without it. Others sought to keep DSI out of the Protocol, as it would radically destabilize the contract-based system, be impossible to address with existing policy and thus dissipate the fragile connections holding the assemblage together.

The central debate over equivalency between the digital and the material elements of genetic resources revealed how delegates aligned themselves on a stark digital/material binary. From our observations at COP13 and broader work engaging with NGOs, bioscience practitioners, and indigenous peoples’ and local community representatives, we have witnessed diversity in the epistemologies and ontologies of the materiality of life, and have seen genetic resources used in diverse economic practices. A binary of physical/dematerialized-information doesn’t adequately capture this diversity. Assemblage theory offers a more useful understanding of genetic resources as existing on a material/expressive axis rather than as a binary. Genetic resources may be located at different points along this axis over time, as their material and expressive roles change. Perhaps this approach could inform future studies commissioned by the CBD.

Whether genetic resources’ definition encompasses DSI is only one of the open questions facing the CBD posed by biotechnology’s changing capacities and practices. For example, as CRISPR Cas-9 gene-edited crops and organisms come onto the market (Bartkowksi et al., 2018), questions arise around the extent a natural genetic resource can be modified and still be subject to benefit-sharing obligations (SCBD, 2015)16. Laird and Wynberg warn “policy-makers are creating institutional and legal structures to make 1990s R&D more equitable and are missing the opportunities and threats of 2016 R&D” (193, 2016).

In a world in which scientific and commercial practices are constantly changing, at some point Nagoya Protocol parties will need to go beyond establishing process and make substantive decisions in the face of incomplete knowledge. In order to do this, they will need to address unresolved frictions we identify as “faultlines” in the ABS assemblage made visible by DSI. These faultlines centre around 3 major questions: how should we understand life?‘ (im)materiality?; how to reconcile ontological distinctions between understanding Earth as a resource and Earth as our collaborator?; and to what extent can ABS be a tool of both justice and conservation? Highlighting the need for future work in this area, we address these briefly in closing.

These faultlines were revealed in the virtual capacities of ABS represented by the two proposed solutions for the future management of genetic resources. Open-source-as-a-solution considers dematerialized information as a fundamentally different object than physical genetic resources, in which benefits accrue not through regulated chains of responsibility but because of the wealth of opportunities generated by open, globally accessible data. All versions of ABS are arguably based on a sustained relation between conservation and capitalism; embracing open source would allow DSI to set a further frontier for limitless growth in new initiatives such as an Earth Bank of Codes17, in which some form of ‘trickle-down’ benefit sharing will occur. Advocates of this approach focus on the potential benefits for all going forward, rather than seeking to rectify past injustices.

Credit author statement

Molly Bond and Deborah Scott are responsible for the data collection, research and authorship of this paper on equal terms.

Funding sources

Deborah Scott: the European Research Council (ERC) as part of the ‘Engineering Life’ project led by Principal Investigator Jane Calvert at the University of Edinburgh (grant number ERC 616510). Molly Bond: the Economic and Social Research Council (ESRC) as part of the South West Doctoral Training Partnership (SWDTP) supervised between the Universities of Bristol and Exeter (grant number: ES/J50015X/1).
Acknowledgements

We are very grateful to everyone who participated in this research. We would also like to thank Jane Calvert, Karen Tucker, Maria Fannin and Clare Saunders for their helpful and successful reviews, suggestions and comments. Many thanks also to the anonymous reviewers.

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M.R. Bond and D. Scott

Geoforum 117 (2020) 24–32