Monster plants: the vegetal political ecology of Lacandonia schismatica

Leticia Durand[1]

Juanita Sundberg

Universidad Nacional Autónoma de México, México

University of British Columbia, Canada

Abstract

This article presents a story about a plant – Lacandonia schismatica – who subverted disciplinary traditions in botany and reconfigured its geopolitical orders of knowledge. To tell this story, we focus on Lacandonia's plantiness, Lesley Head and colleagues' (2012) concept to signify each kind of plant's unique biophysical characteristics, capacities, and potentialities, and through which they co-produce the world. We trace how L. schismatica intervened in, and (re)configured processes of knowledge production, environmental politics, and identity formation in the Lacandon Forest, Chiapas, Mexico, where it was found. Lacandonia's plantiness came into being through sudden macromutations; this unexpected but viable plant species participated in reviving an old debate in evolutionary biology: macroevolution versus gradualism. We also analyze how Lacandonia's plantiness compelled shifts in environmental politics in Chiapas and identity formation in Frontera Corozal, the Chol community where L. schismatica was first located. We conclude with a brief reflection on the implications of vegetal ethics for addressing contemporary environmental crises.

Key words: Plantiness, political ecology, non-human, Lacandon Forest, Mexico

Résumé

Cet article décrit l'histoire de Lacandonia schismatica, une plante qui a subverti les traditions disciplinaires de la botanique et reconfiguré la structure géopolitique de la connaissance. Pour raconter cette histoire, nous nous concentrons sur la plantiness de Lacandonia, un concept développé par Lesley Head et ses collègues (2012) qui fait référence à la matérialité biophysique unique de chaque espèce, y compris ses capacités et ses potentialités, avec lesquelles les plantes coproduisent le monde. Nous expliquons comment L. schismatica est intervenue et (re)configuré les processus de production de connaissances, la politique environnementale et la formation des identités dans la jungle de Lacandona au Chiapas, au Mexique, où elle a été trouvée. La plantiness de Lacandonia, produit de macromutations soudaines, a donné lieu à une espèce végétale inattendue mais viable qui a relancé un vieux débat en biologie évolutive: celui de la macroévolution par rapport au gradualisme. Nous analysons également les changements que Lacandonia a provoqués dans la politique environnementale dans la Jungle et dans l'identité des habitants de Frontera Corozal, la communauté Chol où elle a été localisée pour la première fois. Nous concluons par une brève réflexion sur les implications de l'éthique végétale pour faire face à la crise environnementale contemporaine.

Mots clés: Plantiness, ecologie politique, non humain, jungle de Lacandone, Mexique

---

[1] Dr. Leticia Durand, Centro Regional de Investigaciones Multidisciplinarias, Universidad Nacional Autónoma de México, México. Email: leticiad "at" unam.mx. Dr. Juanita Sundberg, Department of Geography, University of British Columbia, Vancouver, Canada. Email: juanita.sundberg "at" ubc.ca. We owe special thanks to the referees, and all the people who shared with us their experiences with Lacandonia, especially to Daniel Gómez at Frontera Corozal and his family. This work was supported by Dirección General de Asuntos del Personal Académico (DGAPA UNAM) [PAPIIT IN400217].

Resumen

Este artículo describe la historia de Lacandonia schismatica, una planta que subvirtió las tradiciones disciplinarias de la botánica y reconfiguró la estructura geopolítica del conocimiento. Para contar esta historia, nos centramos en el plantiness de Lacandonia, un concepto desarrollado por Lesley Head y colegas (2012) que hace referencia a la materialidad biofísica única de cada especie, incluyendo sus capacidades y potencialidades, con las que las que las plantas coproducen el mundo. Explicamos cómo L. schismatica intervino y (re)configuró los procesos de producción de conocimiento, la política ambiental y la formación de las identidades en la Selva Lacandona en Chiapas, México, donde fue encontrada. El plantiness de Lacandonia, producto de macromutaciones repentinas, dio lugar a una inesperada pero viable especie vegetal que reactivó un viejo debate en biología evolutiva: el de la macroevolución versus el gradualismo. También analizamos los cambios que Lacandonia indujo en la política ambiental en la Selva y en la identidad de los pobladores de Frontera Corozal, la comunidad Chol donde, por primera vez, fue localizada. Concluimos con una breve reflexión sobre las implicaciones de la ética vegetal para hacer frente a la crisis ambiental contemporánea.

Palabras clave: Plantiness, ecología política, no-humano, Selva Lacandona, México

1. Introduction

This is a story about a plant who subverted disciplinary traditions in botany and reconfigured its geopolitical orders of knowledge. Previously unknown to botanical science, Lacandonia schismatica was found in 1985 in the Lacandon Forest, in the southern Mexican state of Chiapas (Figure 1). Though a tiny flower, L. schismatica prompted big changes in the lives of those it touched, both materially and figuratively. To tell this story, we focus on L. schismatica's plantiness, a concept advanced by Lesley Head and colleagues (2012b, 29) ″to consider the specifics of plant agency" by accounting for the common material capacities of plants along with the particular characteristics of distinct kinds of plants. Head *et al.* (2012b, 29) frame 'plantiness' as an assemblage of material properties and expressive capacities that "prefigures [plant] relations with people." Plantiness directs our attention to plants "in their own terms" (Head *et al.* 2012b, 33).

The concept of plantiness is indicative of a big shift in Western thought, as philosophers and plant physiologists move away from treating the human animal as the primary referent for studying intelligence, volition, mobility, and communication (Marder, 2012; 2013; Witzany, 2006). Recent research demonstrates how particular plants perceive and share signals, collaborate, learn, and adapt their form to changing conditions (Trewavas, 2002, 2003; Hathaway, 2018).

Postconstructivist approaches to political ecology consider agency to be a relational property and frame the world as embedded and networked, providing new elements to question the nature-culture divide and the binary opposition between human and non-human (Menon & Karthik, 2017; Escobar, 2010; Rocheleau, 2007). In this article, we embrace plantiness as an indispensable conceptual tool to advance a vegetal political ecology that is interested in the analysis of "human-plants encounters" and its "impact to resource politics and other broader environmental contestations" (Fleming, 2017, 27). By drawing attention to the agency of plants in socioenvironmental scenarios, vegetal political ecology responds to the "ethical imperative" facing more-than-human geographies more generally: "to counter a habit of regarding flora as passive and insentient" (Pitt, 2015, 49). Not only do plants sustain human life on earth, they also are "agentic and active participants in socioecological systems" (Ryan, 2012, 110), including knowledge production. Plantiness, we argue, invites us – as humans, and political ecology as a discipline – to re-examine our relations with other than human actors such as plants, to challenge human-centric onto-epistemologies, and, ultimately, to more fully comprehend the serious ecological repercussions of human exceptionalism.

To elaborate this story of vegetal agency, we trace how L. schismatica intervened in, and (re)configured processes of knowledge production, environmental politics, and identity formation. We first outline our research methodology. Next, we turn to Chiapas, the place where L. schismatica was found. We outline how Lacandonia's plantiness, which came into being through sudden macromutations, subverted disciplinary traditions in botany and induced affective and material changes in the lives of scientists who initially described the tiny flower. An unexpected but viable plant species, this "hopeful monster" – as such unexpected beings are called – participated in reviving an old debate in evolutionary biology: macroevolution versus gradualism.

Finally, we return to Chiapas to analyze how Lacandonia's plantiness compelled shifts in environmental politics in Chiapas and identity formation in Frontera Corozal, the Chol community where L. schismatica was first located. We conclude with a brief reflection on the implications of vegetal ethics for addressing contemporary environmental crises.

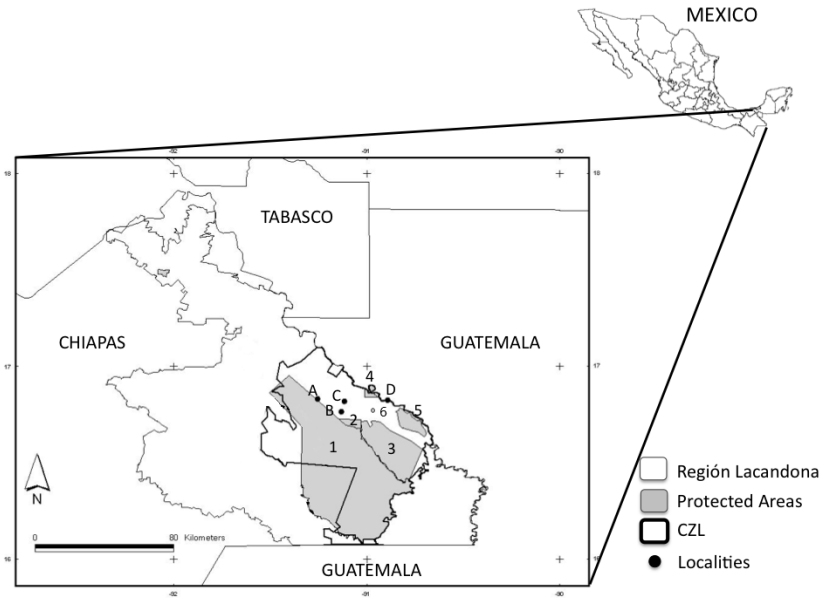

Figure 1: Lacandon Rainforest region. Protected Areas: 1. Montes Azules Biosphere Reserve. 2. Bonampak Natural Monument. 3. Lacantun Biosphere Reserve. 4. Yaxchilán Natural Monument. 5. Chan Kin Flora and Fauna Protection Area. 6. Flor Schismatica Protection Area. Localities: A. Nueva Palestina (Tzeltal community), B. Lacanjá Chansayab (Lacandon community), C. San Javier (Lacandon community), D. Frontera Corozal (Chol community). Source: Modified from Durand, 2019.

2. More-than-human research methodologies for vegetal politics

If methodology indicates the conjuncture of one's epistemology, or theory of knowledge, with the methods or procedures chosen to produce knowledge that will count as legitimate, a more-than-human methodology implies humans cannot be regarded as the only actors of epistemological significance. In other words, a more-than-human methodology implies decentering the human without disregarding the place of humans in world making projects. To this end, the human is situated as one actor in relation to a multiplicity of beings and entities without whom the human could not even live, let alone accomplish anything. The purpose of more-than-human methodologies, then, is to produce knowledge that refuses to rely on a human/nonhuman binary, which situates the human as superior and all-knowing. Instead, this approach assumes all beings have particular properties and capacities that allow them to do certain things, including the ability to use other things to extend their own capacities, i.e. a twig for digging, or a microscope for enhanced seeing. When beings are in relation, they affect each other's properties and capacities in unpredictable ways, potentially generating new or unique effects.

More-than-human methodologies are at the heart of vegetal political ecology, which, Jake Fleming (2017, 27) argues, takes "political ecology further from its humanist roots." By this, Fleming is not abandoning the human; rather, he suggests researchers focus on human relations with plants to understand how plants shape

particular political ecological configurations. Plants have this capacity by virtue of their plantiness: the unique biophysical characteristics, capacities, and potentialities that constitute each kind of plant (Head *et al.* 2012; 2014). It is through their plantiness that plants actively coproduce the world. For instance, Fleming (2017) demonstrates how some tree's capacity for graftability enabled particular relationships with people, which, in turn, led to the destabilization of political ecological hierarchies in post-Soviet Kyrgyzstan. Graftability, Fleming (2017, 33) argues, is "a small biological determinism in favor of decentralized politics."

To discern plantiness, human researchers cannot use human or animal properties and capacities as frames of reference. Instead, our focus must shift to plants themselves, to determine how specifically they emerge in, and engage with their worlds. Although humans may subject plants to their will, transforming aspects of their properties to extend their capacities for the purposes of agriculture, forestry, medicine, etc., "All plants, even agricultural ones, have some plantiness that is independent of humans, or at least beyond the control of humans" (Head *et al.* 2012b, 33). In our view, political ecology moves away from its humanist roots by attending to plantiness in the making of more-than-human worlds.

An important dimension of plantiness is charisma. We make this argument based on Jamie Lorimer's (2015, 39) elaboration of nonhuman charisma, as "the features of a particular organism or ecological process that configure its perception and subsequent evaluation." Plant charisma emerges relationally between plants with plantiness and humans with particular, limited corporeal properties and capacities that can be enhanced through training or other objects. Plant charisma may be aesthetic, meaning the extent to which a plant's visual appearance appeals to the human eye. Lorimer (2015, 40) also refers to ecological charisma, which, in this case, indicates the relationship between a plant's properties – "anatomical, geographical, and temporal" – and human sensorial perception. Lorimer (2015, 40) suggests the specificities of human embodiment "puts in place a range of filtering mechanisms that disproportionately endow certain nonhumans with ecological charisma." Nonetheless, humans are able to cultivate dispositions that allow them to tune in to a range of plant traits. Finally, corporeal charisma refers to "the feelings, moods, and emotions experienced in embodied encounters" (Lorimer, 2015, 45). Despite the objectivity of scientific narratives, the practice of science is marinated in and built on affective encounters driven by passion and generative of joy or disappointment (Despret, 2004). Plant charisma informs our analysis of the various ways distinct people relate with Lacandonia.

In the story we tell here, we center Lacandonia schismatica's plantiness to trace how this tiny flower touched people and in so doing, intervened in, and (re)configured processes of knowledge production, environmental politics, and identity formation. In so doing, we mobilize a more-than-human methodology, as described above, to narrate a story about L. schismatica and how this flower intervened in peoples' lives. Our methods are mixed. To comprehend L. schismatica's plantiness, we consulted expert knowledge published in scientific journals. "Guidance from experts", Hannah Pitt (2015, 48) suggests, "fine-tunes the researcher's perception." To discern how Lacandonia intervened in the lives of those who found and studied the plant, Durand conducted interviews with scientists in Mexico City. To complement those interviews, we reviewed archival materials like videos, texts for diffusion, and newspaper articles. In addition, we traveled to the Lacandon Forest multiple times – in August, 2017; December, 2017 and December 2018 – spending 7 to 10 days in Frontera Corozal during each visit. There, we conducted interviews with community authorities, *comuneros*, tourist guides, and men and women whose lives Lacandonia has touched, materially and figuratively. Twice, we walked to the plot where Lacandonia was found in the company of local experts who could identify the plant; we wanted to observe the plant in its ecological world. Finally, our analysis relies extensively on Durand's qualitative research in the Lacandon Forest since 2009.

We do not attempt to discern what it means to be and live sensorially as Lacandonia schismatica. Nor do we demonstrate how this plant "interpret[s] the world and interact[s] with" other organisms (Hathaway, 2018, 39). Ultimately, as political ecologists, our goal is to trace how L. schismatica intervened in and reconfigured relations at multiple scales.

3. Lacandonia schismatica and the Lacandon Forest

As noted, Lacandonia schismatica was found in the Lacandon Forest, which covers a wide area of Chiapas, Mexico. The Lacandon Forest has been the site of environmental struggles for over a century (De Vos, 2005; O'Brien 1998) (Figure 1). In the eighteenth century, the abundance of mahogany drew explorers and

traders to the area. Timber merchants called it the "Desert of Solitude" (De Vos, 2003, 11) as they saw nothing but trees. Due to its distance and isolation, the region appeared on nineteenth century maps as "a white patch with the inscription 'unknown desert inhabited by *Lacandones*'" (De Vos 1991, 39). Later, archaeologists and anthropologists would flock to important Maya ruins such as Palenque and Bonampak. In the twentieth century, thousands of impoverished Indigenous peasants colonized parts of the vast and relatively uninhabited forest. Decades later, the Zapatista Army of National Liberation (EZLN) warned the Mexican State of the region's enormous social inequalities, which long had been ignored (De Vos, 2005). More recently, the area has gained worldwide attention for its enormous biological diversity and endemic species. The Lacandon Forest is the largest remnant of tropical rainforest in North America and, although it represents less than 0.5% of the country's territory, the region contains more than 3,000 species of vascular plants, almost a third of the known species of birds and mammals, and 11% of amphibians and reptiles in Mexico (Mendoza & Dirzo, 1999; Lazcano Barrero *et al.* 1992).

In the mid twentieth century, the Chol, an Indigenous community from northeast Chiapas migrated to the Lacandon Forest. In 1976, the Mexican State founded the Comunidad Zona Lancandona (CZL) to entitle land rights to Chol, Lacandon and Tzeltal peasants (Figure 1). Chol people were placed in Frontera Corozal to accommodate their needs (Tejeda Cruz, 2002). Currently, the town has approximately 5,200 inhabitants (INEGI, 2012). There are 601 co-proprietor community members (*comuneros*) who have property rights over an area of about 130,000 hectares, of which some 55% has been decreed protected in some form (Tejeda Cruz, 2002, 2007). The inhabitants have access to electricity, piped water, mobile phones, schooling up to high school, and a health clinic, as well as a number of small shops, chemists, shoe shops, etc. Most of the population is dedicated to extensive cattle ranching and *milpa* farming – maize, beans, squash and chiles. The harvesting and sale of *xate* palm (Chamaedora sp.) also is an important activity (Hernández Cruz *et al.* 2005; Rahder, 2014; Reygadas *et al.* n/d). Prior to the COVID-19 pandemic, around 20% of the economically active population in Frontera Corozal worked in the service sector, including restaurants, transport companies, and ecotourist centers. Most of this sector was dedicated to national and international visitors who arrive to visit the Mayan ruins of Yaxchilán on the Usumacinta River.

4. Encountering Lacandonia schismatica

Lacandonia schismatica was found in 1985 on a small plot of land in the Chol community of Frontera Corozal (Figure 2). The find was hailed by the Botanical Garden of Missouri as "the greatest discovery of the Twentieth Century" (Ciencias 1989, 40). Despite its small stature – 10 cms in height – it possesses some remarkable features. L. schismatica has no leaves or chlorophyll and lives off decomposing organic material in symbiosis with a fungus. But its most important property is the inverted location of its sexual organs – stamens in the center, carpel around that – something never registered before amongst the more than 250,000 angiosperm plants known to science (Ciencias, 1989; Martínez & Ramos, 1989).

As the story goes, Esteban Martínez, a biologist from the National Herbarium at the National Autonomous University of Mexico (UNAM), was in the area in 1984, to oversee the collection of vascular plants for the *Flora Mesoamericana* (Mesoamerican Flora) project sponsored by the Missouri Botanical Garden, the Natural History Museum in London, and the Institute of Biology of the UNAM, amongst other institutions. The aim was to create a detailed inventory of vascular plants from southern Mexico to Panama (Magaña 1994). Working in Frontera Corozal, Esteban Martínez got to know Gabriel Aguilar Méndez or Don Gabriel, a Guatemalan refugee based in Frontera Corozal, who became his fieldwork assistant.[2]

In December 1984, on the outskirts of a place known as Cruzero Corozal, which usually floods for several months a year, Esteban Martínez and Don Gabriel came across Lacandonia schismatica amongst the leaf litter on the forest floor. The encounter between humans and such a small plant was only possible due to

[2] After 1981, some 100,000 indigenous people from Guatemala fled to Chiapas to escape the military regime's lethal repression; the military believed they provided support to the guerilla movement (Ruiz Lagier, 2018). "Don" is a title of respect used throughout Latin America.

the concurrence between the two men whose vision is trained to detect plants and the plant's own properties.[3] In other words, Lacandonia's ecological charisma is dependent on humans who have learned "to be affected" (Despret, 2004, 131).[4] As Mario Souza, a renowned Mexican botanist noted, "for the untrained eye, this small inconspicuous plant would have passed unnoticed" (Ciencias 1989, 41). Esteban and Don Gabriel were people whose sensibilities had been cultivated by plants. Their work as collectors demanded a daily relationship with plants and through these relations, both developed a fine and precise sensibility to detect plants (Brice, 2014; Lorimer, 2015; Poe *et al.* 2014).

Figure 2: Lacandonia schismatica. Photo by Juan Pablo Abascal Aguirre. Source: Banco de Imágenes/CONABIO, 2021. http://creativecommons.org/licenses/by-nc-nd/4.0

According to Don Gabriel, they found the plant whilst looking for fungi; "I thought it was a fungus but when I showed it to Esteban, he said it wasn't" (Videoservicios Profesionales, 2005). In a video, Esteban explains that upon observing the plant with a magnifying glass, he believed it was a plant with flowers, but he really didn't know the kind of plant (Videoservicios Profesionales & CONABIO, 2004). So began a long series of taxonomic and morphological studies, which went on for several years until Esteban and his colleague Clara Ramos published their finding and described Lacandonia's unique features, its plantiness (Martínez & Ramos 1989).

When Esteban and Don Gabriel came upon this plant, it was unknown to the Chol community. Apparently, it also was unknown to the Lacandon. Rodolfo and Hilario[5], two of Frontera Corozal's founders, said Lacandonia schismatica was unknown to them, because it "was difficult to see" and "we only got to know it when Don Gabriel found it." Others in the community also indicated they learned about Lacandonia when it was found by botanists and collectors working in the region. One of Frontera Corozal's inhabitants said:

[3] Jamie Lorimer (2015, 42) uses the word *concurrence* to indicate the moment when a human's capacities and space-time rhythms coincide with those of an organism, allowing for an encounter between the two. Plant detectability is "influenced by a range of parameters, including size, color, shape" (Lorimer, 2015, 42).

[4] Lorimer (2015) builds on Vinciane Despret's elaboration of learning to be affected. As Despret (2004, 131) notes, "learning how to address the creatures being studied is not the result of scientific theoretical understanding, it is the condition of this understanding."

[5] We use pseudonyms to ensure the anonymity of people interviewed. We use the actual names of public figures whose identity is revealed in documents and public sources, except for statements made during our interviews.

> As far as I know, no one knew, no one knew. People didn't know that plant. We didn't have the slightest idea there was something important living there in that small area of jungle. It is a muddy swamp. No one knew anything.

Lacandonia, the destabilization of botany, and the resurgence of macroevolution

When Esteban used laboratory equipment in the UNAM's Institute of Biology to analyze the samples he had collected, he initially thought Lacandonia belonged to the Triuridales order. Nevertheless, this theory was rejected after more detailed studies. Instead, the plant was considered to be a new species, but also a new family. This was very significant news. For more than 50 years, no new family had been described in botanical taxonomy (Ciencias 1989).

Using a microscope to study more than 3,000 flowers, botanists at the UNAM established the plant's distinctive features, including the inversion of the sexual organs; the stamen is positioned in the flower's center (Martínez & Ramos 1989; Márquez Guzmán *et al.* 1989). Martínez and Ramos then sent a manuscript to the *Annals of the Missouri Botanical Garden*, one of the most important North American scientific journals dedicated to botanical taxonomy (Videoservicios Profesionales, 2004). In their article, Martínez and Ramos proposed the existence of the genus Lacandonia and the family Lacandoniaceae within the order Triuridales (Ciencias 1989).[6] However, reviewers responded, stating such a plant could not exist, and instead suggested the plant corresponded to the genus Sciaphila (Ciencias 1989). The reviewers rejected the existence of a new species. The journal's editor asked the authors to compile new evidence to support their findings.

In 1986, Martínez and Ramos sought the opinion of other specialists within the UNAM Science Faculty. They used laboratory equipment to study the anatomy of the flower, the origin of the inversion of the anthers, and the morphology of its cell nucleus (Márquez Guzman *et al.* 1989; Jiménez Garcia *et al.* 1992). The study of Lacandonia's flower buds revealed that the inverted position of the reproductive organs did not correspond to a torsion during growth; the flower's anthers were in a central position from the beginning of embryonic development. With this information, Martínez and Ramos resubmitted their article to the same journal, once more proposing the existence of a new family and a new species. The article was accepted and published in 1989, together with Judith Márquez's work, which demonstrated the central position of the androecium (Martínez & Ramos 1989; Márquez Guzmán *et al.* 1989). Lacandonia's charismatic plantiness was introduced to the world.

Although both articles appeared in the *Annals of the Missouri Botanical Garden,* they were not published in English, the language of the journal and most other relevant scientific journals. Instead, the papers were published in Spanish, the language of the scientists who had made the discovery of the century. The Mexican botanists' encounter with Lacandonia and study of its plantiness enabled them to demonstrate the existence of an organism previously unknown to science. Furthermore, the flower's unusual plantiness enabled them to subvert the geopolitics of disciplinary tradition in botany. Lacandonia allowed Spanish to be affirmed as a valid language in which to communicate science. With Lacandonia as evidence, the articles asserted the value of Mexican scientists who "can also make great discoveries like those that occur in northern countries" (Videoservicios Profesionales & CONABIO, 2004). One of the scientists interviewed for this project remembers:

> Our article came out first, where we demonstrated that there was no torsion and then their article (Martínez & Ramos) was published where Lacandonia was shown to the world…Let me tell you, that article was published in Spanish. I don't know what that means, but it was published in Spanish. We wanted it to be in Spanish and yes, the journal accepted it and so the first publication of Lacandonia was in Spanish. We were very young, and we thought that it was such a discovery and that it should be in our own language. Everything else we did was published in English, but the first article was in Spanish.

[6] Currently the family Lacandoniacea has disappeared and Lacandonia schismatica is considered to be part of the Triuridaceae family.

While studies of Lacandonia's charismatic plantiness continued, new connections between the plant and scientists were brought into being. In interviews, scientists who studied or continued to study Lacandonia articulated affective narratives about the discoveries derived from Lacandonia and the impact and meaning the plant had in their personal lives and professional careers.[7] One scientist said, "Lacandonia has been fundamental for this laboratory and for my life. I discovered a new organelle… that's very exciting." Another stated:

> Lacandonia saved my life… There was a meeting of the Biology Department to see which projects everyone had and I said: the Lacandonia project. That's why I say that it saved my life, because it helped me build up this laboratory; from there the laboratory started to take off.

In short, finding and studying Lacandonia affected numerous botanists and biologists, generating feelings of excitement and inducing changes in the course of their lives.

A hopeful monster debated

L. schismatica appeared on the scientific scene in the 1980s, just when debates about macroevolution were taking on renewed strength. The unique spatial position of Lacandonia's reproductive organs was difficult to explain in the light of what, in the eighties, was known about the evolution of angiosperm plants. As Donoghue & Alverson (2000, 113) note, the finding was astonishing, as "nothing about the other 250,000 (approx.) species of angiosperms predicted this brand-new flora architecture." Lacandonia is "schismatica" because the originality of its plantiness produced a schism, a rupture with previous suppositions in botany, which posited an (evolutionary) reality wherein a plant of this type could not exist.

As the prevailing theory, gradualism indicates that evolution results from the continuous and slow accumulation of adaptive modifications within a population, which eventually gives rise to new species. Over time, the process known as microevolution leads to macroevolution, which is the origin not only of new species but of higher taxa. However, for some evolutionary biologists, micro and macroevolution are not coupled because the gradual and sustained change of microevolution is not enough to explain "key innovations and novel body plans" (Theissen, 2006; Reznikc & Ricklefs, 2009). Macroevolution, as a different process, is linked to large mutations which produce drastic transformations. From this perspective, the process of evolution is more about leaps from one state to another, than slow, gradual change (Vergara Silva, 2002; Theiβen, 2006). Although most macromutations produce monsters – individuals with severe defects in morphology and function – strong genetic changes occasionally produce "hopeful monsters", organisms with unusual features but apt for survival, viable in reproductive terms, and capable of producing a new species (Gould 1988; Rodríguez Mega & Hernández Marroquin, 2013; Theiβen, 2006).

Since 1940, when Richard Goldschmidt mentioned the possible occurrence of hopeful monsters for the first time, the idea has been rejected by Neo-Darwinist theories of evolution. Hopeful monsters were reborn around 1980, with the emergence of evolutionary developmental biology (evo-devo), a discipline that attempts to explain "how embryonic development influence or direct evolutionary changes" (Hall, 2012, 184; Theiβen, 2006; Gould 1988; Vergara Silva, 2002; Müller, 2007). One of the most significant discoveries in the field of evo-devo is the recognition that events important for development are controlled by a limited number of genes and changes in these genes "can bring about profound, yet coordinated morphological changes" (Theiβen, 2006, 357), making possible the existence of viable unusual beings, or "hopeful monsters."

Lacandonia schismatica offered the unique opportunity to understand both the process of macroevolution as well as the genetics of the flower's development. For the first time, a wild organism came to the attention of humans, with features that had only been produced in laboratories previously (Piñeyro Nelson *et al.* 2010).

[7] After its initial description, many other researchers became interested in the study of Lacandonia and the plant's many other unusual characteristics were discovered and described. Amongst these were its cleistogamic pollinization, the existence of a special embryonic sac called the Lacandonia type sac, and the presence of a new extranuclear particle called "Lacandonia granules", speaking here of genetic and homeosis studies (Jiménez García *et al.* 1992; Marques Guzmán *et al.* 1993; Vázquez Santana *et al.* 1998).

Numerous studies carried out to explain the origin of Lacandonia's floral morphology suggest the strange flower actually is a hopeful monster, the product of a macroevolutionary event that involved the spatial displacement of the expression of a single gene (Álvarez Buylla *et al.* 2010; Piñeyro Nelson *et al.* 2010; Vergara Silva *et al.* 2003). Lacandonia intervened in discussions about the mechanisms of evolutionary biology. As Piñeyro Nelson *et al.* (2010, 95) state, "L. schismatica is keeping another old debate in evolutionary biology alive; the gradualist versus saltational nature of major morphological transitions during evolution." (Figure 3)

In sum, Lacandonia's charismatic plantiness not only destabilized the geopolitics of botanical knowledge and transformed the personal lives of researchers who had turned their attention to it, it also participated in reconfiguring theories of evolution.

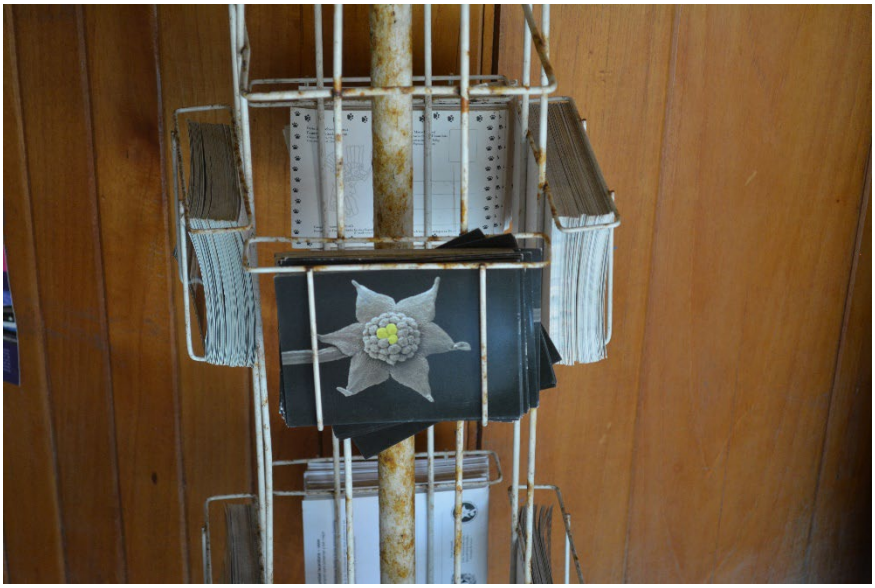

Figure 3: A photo of Lacandonia schismatica sold as a postcard in the community Museum. Photo by the authors.

Lacandonia: re-stabilizing the Lacandon Forest as an exceptional place

Until the mid-twentieth century, the Lacandon Forest was inhabited by small communities of Lacandon people (De Vos 1991). From 1950 onwards, hundreds of Indigenous and non-Indigenous colonists entered the Lacandon, which the government opened to colonization. Together with timber merchants and cattle ranchers, they quickly deforested the northern and eastern part of the jungle (De Vos, 2003, 2004; O'Brien 1998). The destruction caused alarm in government and intellectual circles. For instance, Gertrude Duby and Miguel Álvarez del Toro started efforts to protect the forests as well as Lacandon communities overrun by colonists (De Vos 1991). The government eventually created the Lagunas de Montebello National Park (1958) and the Montes Azules Biosphere Reserve (1978) (De Vos, 2003, 2004; O'Brien 1998; Villalobos Cavazos, 2016). Since then, the forest's vocation as a region dedicated to biodiversity conservation has been strengthened by the activism of diverse social sectors. Multiple local, regional, and international conservation projects have been implemented and new protected areas have been created, currently covering some 450,000 hectares of forest (Legorreta Díaz & Márquez Rosano, 2014).

When the discovery of Lacandonia schismatica was published, the Lacandon Forest was experiencing a particularly complex moment. Severe land conflicts were occurring in the Montes Azules Biosphere Reserve, the most important in the region and the nation. The government categorized numerous communities as illegal squatters and intended to relocate them. The reserve functioned with some difficulty as it lacked a management

plan and operational funding. Settlements were growing rapidly, as was the rate of deforestation (De Vos, 2003; O'Brien 1998). By 1990, the Lacandon Forest was considered an ecosystem under threat, a region with extraordinary attributes and enormous biological relevance that should be preserved. The Lacandon forest was called the "last refuge" of an irreplaceable natural heritage in Mexico (Ortíz Espejel & Toledo 1998; Sarukhán 1991, 19).

When scientists concerned about the forest's devastation encountered Lacandonia, the plant's charismatic plantiness began to orient human action and influence the social and political construction of the forest (Notzke, 2013). Lacandonia strengthened perceptions of the forest as a place of unequalled biological richness whose conservation was imperative for the nation. According to Lesher Treviño (2015, 256), "the rarity of this species constitutes one of the most important arguments towards the necessity of protection of this area." Ortiz & Toledo (1998, 319) also claim "the existence in the Lacandon Forest of a plant that is unique in the world (Lacandonia schismatica) shook up national and international academic circles and ended up confirming the biological importance of the region." Other scholars go even further, and by invoking the plant's agency, hope that "that rare star of Lacandon soils" acts as a "spotlight which draws efforts for the conservation of the Chiapas forest" (Álvarez Buylla Roces, 2001, 206).

The plant mobilized ecologists and biologists who, a few years after its discovery, traveled to Frontera Corozal with the intention of studying it and protecting the region's biodiversity. Lacandonia's charismatic plantiness enabled the collaboration of distinct social groups, who worked together for several years despite cultural, political and epistemological differences (Lorimer, 2015; Sheridan, 2016).

In 2002, researchers from the UNAM started a project related to Lacandonia in Frontera Corozal. The objective was to widen knowledge about the plant's molecular genetics, cell biology, and development, and to identify areas for Lacandonia's conservation. In addition, the UNAM sought to generate environmental education and training programs to contribute to "the development of the self-management capacities of the Chol community of the Lacandon Forest in terms of sustainable development and conservation" (ARIES, 2019; Instituto de Ecología, 2003). The project's director explained that her arrival in Frontera Corozal "was initially motivated because there is this flower very close to the community… that we have been studying"; the project was organized to work with the Chol of this community "because they are the ones who had control of the lands where Lacandonia schismatica can be found" (Lesher Treviño, 2015, 257).

To generate employment and income opportunities to prevent the forest from being felled for agriculture and cattle ranching, the researchers decided to recuperate the Regional Museum of the Usumacinta River Basin (Figure 4). Although built in 2001 by the National Institute of Anthropology and History (INAH), the museum lacked funding to operate.[8] By 2004, the museum was remodeled, the restaurant was reopened, and a botanical garden "Gabriel Aguilar Méndez" was established to honor Don Gabriel with an important display of regional orchids. A new room was built to highlight the forest's biological diversity and included a collection of animals and plants collected during the project. In the museum's new room, Lacandonia schismatica was given central place. The materials on display included the story of its discovery and a photo of Esteban Martínez. The plant's unique anatomy was described and, as if it were a jewel, an example of the strange flower was displayed in a glass jar. Lacandonia was represented as a charismatic and unique species whose peculiar features highlighted the Lacandon Forest's biological importance. Lacandonia schismatica spoke for the whole forest, as articulated in the text that accompanies one of the room's panels:

> The relatively recent discovery (20 years ago) of the marvelous and unique Lacandonia schismatica in fields close to this room is a sign of the need to get to know, value and respect the still little studied biological wealth of the forest… This plant represents only one of the many

[8] The Regional Museum of the Usumacinta River Basin was built in 2001 by the National Institute of Anthropology and History (INAH) to house two Mayan stelae (monuments) which had been discovered in Dos Caobas, a nearby locality. For Lesher Treviño (2015) the museum originated in the desire of the inhabitants of Frontera Corozal to conserve their heritage but was also an act of resistance against federal authorities, who the inhabitants considered were continuously robbing them of their resources and not keeping promises.

> treasures hidden in this territory, which, given its ecological fragility, should be looked after in an integral way.

Figure 4: The Regional Museum of the Usumacinta River Basin. Photo by the authors.

Several people in Frontera Corozal participated in the UNAM's project to run the museum. They received training and some were able to improve their living conditions. This was the case for Susana, who ran the restaurant for several years.

> I was asked if I wanted to work and I was the administrator of the restaurant at that time. We managed several projects and talked to the authorities. After a year the restaurant was set up and we could open. We managed to get some resources for the botanical garden…

By 2007, the restaurant was functioning well as a business. There were two work shifts and several customers per day, the project was generating income. In those years, and as a result of her participation in the project, Susana learned how to formulate projects and manage funding from federal agencies such as the National Commission for Protected Areas (CONANP) and the National Commission for the Development of Indigenous People (CDI). Shortly afterwards, using her new knowledge of public administration, she created a women's group to apply for funding for different projects.

> In the museum, I had already learned how to create projects… *Las Rosas*[9] was a group I created; we were three women. The restaurant [I have] also came out of that. After that, I opened my corner shop and I helped other groups to form.

Later, Susana's interest in obtaining a teaching post in a nearby city as well as some conflicts with the authorities in Frontera Corozal led her to distance herself from the restaurant and the museum. However, the years spent collaborating with the UNAM biologists proved important, as she told us: "I put a lot of effort into

[9] Name was changed to preserve anonymity.

that job… in the time that we worked together, I learned a lot from them." The restaurant and corner shop created with *Las Rosas* were still running in 2017 and without a doubt are the outcome of the scientific interest generated by Lacandonia's plantiness, as well as the projects generated for its conservation.

However, the last time we visited Frontera Corozal in 2018, the museum was in disrepair. The installations still existed, but they were dusty and had deteriorated. Few of the objects and biological specimens that had been on display were to be found.[10] The glass jar with the Lacandonia flower had disappeared and the panels explaining its discovery and importance lay strewn on the floor. Little was left of the botanical garden. *Comuneros* in Frontera Corozal explained the museum's failure by pointing to the community's way of running it; membership on the committee that was mandated to manage the museum changed every year or second year, making project continuity difficult. Some years, committees were more committed to the museum and had managed to keep it in good condition, whereas in other years, committee members lacked any real interest. Little by little, both the museum and the restaurant had been abandoned. There was a lot of mistrust, we were told; in the words of one person, "when money started to circulate, many misunderstandings arose." Another said, "you see, when there is a little progress in the community, a little success, there is always jealousy." The academics involved also explained the museum's failure in terms of community organization. From their perspective, the UNAM project had been a "gift", which the Chol of Frontera Corozal had not known how to build on. As one of the project staff stated, the failures arose because the project's goals were diverted, from supporting sustainable livelihood alternatives to making business deals; "the community authorities destroyed the [project's] foundation, distorted it, expanded the restaurant to increase profits, and abandoned the original idea for the project." We don't have data to support or deny this claim, but it is important to considered that blaming community members for conservation and development failures is a practice that often ignores how factors at multiple scales inform such outcomes.

The scientists drawn to Frontera Corozal by Lacandonia schismatica also sought to protect the area where the plant had been found and collected. According to one of the ecologists who visited the community after the discovery, the Chol were very suspicious of the academics' intentions (Ciencias 1989, 42).

> [They] didn't think that such a thing as Lacandonia schismatica even existed, thinking that it was just another lie like so many others… [but] when they saw the plant, they changed their attitude completely and were prepared to collaborate and conserve the area, fencing it off and putting up signs and making sure no one entered.

According to our interviews, Esteban and some of his collaborators installed the first fence to protect the area where Lacandonia had been collected. Part of this area was the property of a community co-owner who had died, "and whose son was young and couldn't make any decisions for himself." The community decided to expropriate three hectares of this plot to be dedicated to the flower's conservation. Afterwards this area was amplified with community lands and additional plots were expropriated near the collection area. These actions provoked some anger and distrust from the individuals who lost land. In the words of one man:

> They told me I would have to stop working there [on my field], because there is a spring there producing water that is important for the plant… We fought for three years over that. Biologists explained to me that we could have projects there [in the reserve], but I have no education. They say that we are rich, that [the flower] is like gold, but I didn't make any money, nothing.

We were unable to find out when exactly the *Reserva Comunal Flor Schismatica* (Communal Schismatica Flower Reserve) was established in Frontera Corozal, although some authors mention it was around

[10] The valuable stelas are still to be found in the museum.

1992 (Tejeda Cruz, 2002).[11] The reserve is approximately 30 hectares (Figure 1). Although it is a well demarcated and fenced off site, there is no management plan to govern its usage. A committee of 28 people oversees the community reserve's surveillance and maintenance, but they lack resources and do not carry out regular maintenance activities. Representatives at the local CONANP office explained that there is no specific strategy for the conservation of the flower, adding, "sometimes we get some funding to repair the fence, but in the last three years we haven't."

Lacandonia's charisma and identity formation

The specific properties characterizing Lacandonia's charismatic plantiness affected ecologists and biologists, driving them into action to develop strategies to study and protect the plant. But Lacandonia also touched the Indigenous inhabitants of Frontera Corozal, contributing to a re-orientation in identity. We suggest L. schismatica offers the Chol of Frontera Corozal a particular way of representing themselves and their community in the Lacandon Forest, establishing boundaries around what distinguishes the Chol from other Indigenous communities in the region (Quintana, 2010; Sheridan, 2016).

For instance, in contrast to the stories scientists tell, giving credit to Esteban Martinez for discovering Lacandonia, community narratives feature the figure of Don Gabriel; he is given the starring role. In the words of one community member, "Don Gabriel was working with Esteban, collecting, and he noticed the plant first." Another said, "…it was Don Gabriel who discovered the plant, he showed it to Esteban." Still another said, "really it was a Guatemalan called Gabriel Aguilar Méndez who found it." Moreover, unlike other nearby villages where Lacandonia schismatica has also been collected, such as Crucero San Javier and Lacanjá Chansayab, inhabitants of Frontera Corozal claim this marvelous find for themselves and their community. Lacandonia schismatica now belongs to Frontera Corozal and Frontera Corozal is distinguished by the presence of Lacandonia; "a unique flower that represents the community", said a schoolteacher.

Although Lacandonia was not known to the community in times past, practically everyone in Frontera Corozal today knows or has heard about the charismatic flower. Everyone we asked, in interviews as well as casual conversation, could tell us something about the plant. In Frontera Corozal, Lacandonia schismatica is better known as "the schismatica flower" or simply as "the schismatica." The flower often is described with reference to its unique plantiness. "The plant is special because it lives in water and only in the Lacandon Jungle", said one person, while another told us "the plant is special because it is male and female together, not like humans who are separated." One person said simply: "the flower has two sexes, male and female." What is more, community members recognize the international importance of the flower and some noted that Lacandonia "has been published" [in international forums].

It is one thing is to know of the flower's existence. It is another thing altogether to have observed it. Although everyone in Frontera Corozal seems to know about the flower, few have actually seen it. There is no frequent physical contact, nor a meticulous knowledge of the plant. In other words, the Chol's relationship is informed by Lacandonia's aesthetic rather than ecological charisma (after Lorimer, 2015). This was the case, for example, with some members of the Taxi Cooperative "Flor Schismatica" (Shismatica flower) who formed the business in 2000 and used the image of the flower in their logo, which is placed on the taxi doors and their uniform tee-shirts. When asked, a few taxi drivers told us the story. They decided to name the business "Flor Schismatica" because it was found in Frontera Corozal. They hired a photographer, and "we went to look for the flower in the field to take the photo and put it on the taxis."

The aesthetic orientation to Lacandonia is likely due to the lack of concurrence between most Frontera Corozal residents' capacities and space-time rhythms and those of the flower. Few people would have reason to travel to Crucero Corozal, where the plant resides, and even fewer have eyes trained to detect the miniscule

[11] Communal reserves are pieces of land set aside for conservation and administered by rural communities. The communal reserves of Frontera Corozal are La Cojolita, El Cartón, Flor Schismatica, La Cruz and El Aguacate (Hernández Godoy, 2016).

plant.[12] The few interviewees who had seen the plant saw it when the museum still conserved a sample in a glass jar. Others had visited the plot of land with Esteban Martínez or on their own in search of the flower.

We experienced a lack of concurrence as well. We tried to see L. schismatica twice at the spot where it had been initially collected. Although we had the help of two elderly *comuneros* (communal land co-owners) who know the site well and have eyes trained to detect the flower, we searched for more than two hours amongst the humid leaf litter with no success. Our eyes were not attuned, and the timing of our visits may have been out of sync.

Despite the lack of embodied relations, Lacandonia's plantiness is so charismatic, it has touched Frontera Corozal. The community has transformed the flower into a powerful symbol of place (Notzke, 2013). A visitor to Frontera Corozal will see the image or name of the flower on posters, murals, advertisements, the names of shops, or logos. For instance, the embroidery workshop "*Flor de la Selva*" (Jungle Flower) features Lacandonia in their name, as does the association "*Akxim Lacandonia*", which supervises access to the ruins of Yaxchilán.

Other evidence of Lacandonia's aesthetic charisma is found on the arch the community erected at the town's entrance to welcome locals and visitors (Figure 5). The arch was inaugurated in December 2013 during an annual celebration commemorating the founding of Frontera Corozal. The arch is eight meters tall, and painted with images of "everything which has cultural value in the community", to quote Gonzalo, a school teacher. Featured are images of the two Maya stela found in the museum; Agustín Montejo, creator of the village's drinking water system; and Bárbara Díaz, the first woman with property rights in Frontera Corozal. Also illustrated are the embroidered patterns of the Chol's traditional costume; the ruins of Yaxchilán; the jaguar; cobs of multicolored maize; and the *flor schismatica*. Gonzalo, one of the individuals responsible for designing the arch, noted:

> We don't really know if the *schismatica* is really like this or not [referring to the drawing on the arch], but it's the only really different flower in the world, and by pure chance it's in Frontera Corozal. So, we couldn't let it go unnoticed and we put it there [on the arch].

The presence of Lacandonia schismatica in Frontera Corozal is also celebrated and remembered in the "*Miss Flor Schismatica*" pageant, held every year since 2007 during the town's commemoration. Some people said the pageant was an initiative of the CONANP to promote Lacandonia's importance and forest conservation more generally. Others claimed the idea came from primary and secondary school teachers, who frequently coordinate cultural events and other festivities in Frontera Corozal. Inspired by similar pageants in the region, some individuals decided it would be a good idea to name a Flor Schismatica Queen each year. To become Queen, Gonzalo explained, the young woman should be "beautiful, have both modern and Chol clothing, and speak Chol." Contestants are required to give a short speech in Chol on a topic chosen by the organizers. Our interviews with former pageant participants revealed they have been asked to talk about topics such as drug addiction in the community and the importance of conserving biodiversity. A jury made up of respected people from inside and outside the community chooses the Queen and gives the prize. The first *Flor Schismatica* Queen remembers:

> That time I was given a crown, as well as a monetary prize. I bought the evening dress and my shoes. That was the first time [the pageant was held] and the people here got very excited. I was very happy when I got the prize.

[12] In suggesting a lack of concurrence between L. schismatica and Frontera Corozal's residents, we are in no way suggesting that individuals in general lack the sensibility to attune to plants. Many men and women work closely with plants in kitchen gardens, *milpas*, pastures, and the forest; in such sites, people are attuned to a wide variety of other plants.

Figure 5: The arch at Frontera Corozal entrance with the representation of *Lacandonia schismatica* (upper right corner). Photo by the authors.

In sum, Lacandonia's aesthetic charisma has affected the townsfolk, transforming how the Chol have chosen to represent themselves to the outside world. Their relationship with Lacandonia stands in stark contrast to human – plants relations detailed in existing research, where intimate connections are developed through daily interactions in gardening, fruit and fungus collection, agriculture, amongst others (Poe *et al.* 2014; Brice, 2014; Doody *et al.* 2014; Flemming, 2017). In Frontera Corozal, the relationship is figurative, though by no means less significant.

5. Discussion

The plantiness characterizing Lacandonia has destabilized and restabilized hierarchical relations at multiple scales. For one, Lacandonia disturbed existing knowledge, and affirmed the existence of a hopeful monster, a plant that scientists thought could not exist. In so doing, the plant compelled the revival of theories in evolutionary biology that had been discredited. Furthermore, Lacandonia strengthened the confidence of Mexican botanists, who, in what can only be termed an act of rebellion, refused to publish their results in the dominant language of science, to underline the value of science produced in the global South. As such, Lacandonia disturbed the geopolitical order of scientific practice. Finally, our analysis shows that the production of knowledge is a more-than-human practice and that knowledge is relational and intimate, the product of collaborations between scientists, peasants, field assistants, and many non-humans (Atchison & Head, 2017; Raffles, 2002; Soto Laveaga, 2005).

Secondly, Lacandonia contributed to the collective creation of the Lacandon Forest as an exceptional region, whose principal vocation should be biodiversity conservation. Lacandonia's strange and charismatic plantiness stabilized an understanding of the forest as a fragile ecosystem of enormous biological value and, at the same time, turned it into a political ally of the Chol. Lacandonia brought a uniqueness and relevance to Frontera Corozal, in relation to other communities in the Lacandon Forest's complex conservation scene (Durand, 2019). The frequent presence of Lacandonia in Frontera Corozal's small workshops, restaurants, tourist companies, and community story is a way of building on the *flor schismatica's* aesthetic charisma and the plant's relevance to scientists and conservationists.

The meeting between Lacandonia schismatica, scientists, and the Chol community has produced a process of collective creation in which the plant cannot be backgrounded or considered as merely part of the

context. On the contrary, Lacandonia and its charismatic plantiness draws together beings with different interests and expectancies; together, they coproduce the world. However, even as Lacandonia prompts transformations in human sociality (including relations with plants), these were enabled by mutations that occurred with no input from humans (Clark & Gunarantman, 2017). The plant did/does its own things. Not all that is relational involves humans. As Donna Haraway (2017, 31) stated, "nothing is connected to everything; but everything is connecting to something."

The collectives woven with and through Lacandonia are fluid and will continue to be so in the future, especially given the uncertainty of Lacandonia's survival. The plant's population appears to have diminished due to the transformation of its habitat, which today is warmer and less humid than a few years ago.[13] According to some estimates, approximately 2 million plants existed in 1985, but two decades later the population seems to have dwindled to a few dozen (Norandi, 2010). Even so, new species of Lacandonia have been found, such as the L. brasiliana registered in 2012 in northeastern Brazil's Atlantic Forest (Melo & Alvez, 2012). Together, these and other hopeful monsters continue to transgress our certainties, showing us humans that we are "intimately connected and coevolved beings", dependent on a multiplicity of other beings for our very existence and survival (Sundberg, 2011, 333; Notzke, 2013).

Our virtual encounters with Lacandonia compelled us to document the power of plants to affect others and co-produce the world. More-than-human methodologies enabled us to center Lacandonia in our analysis. To do otherwise would be to reproduce stories about the world as a human achievement and, ultimately, to uphold human exceptionalism (Whatmore, 2003; Jones & Cloke, 2008). In this era of climate change and other environmental crises, we scholars have an ethical responsibility to tell stories otherwise.

Bibliography

Álvarez Buylla Roces, M. E. (2001). La Lacandonia schismatica. *Luna córnea,* 21-22, 200-209.

Álvarez Buylla, M.E., Azpeitia, E., Barrio, R., Benítez, M. &Longoria Padilla, P. (2010). From ABC genes to regulatory networks. Epigenetic landscapes and flower morphogenesis: making biological sense of theoretical approaches. *Seminars in Cell and Development Biology,* 21, 108-117. https://doi.org/10.1016/j.semcdb.2009.11.010

Aries. (2019). Acervo de recursos de investigación en Educación Superior. Registro completo del proyecto Lacandonia schismatica: recursos genético estratégico para México y Conservación de la Selva Lacandona, Retrieved January 15, 2020, from http://www.aries.unam.mx/info-proyecto.php?id=15934

Atchison, J. & Head, L. (2017). Rethinking ethnobotany? A methodological reflection on human-plant research. In Bastian, M., Jones, O., Moore, N. & Roe, E. (Eds.) *Participatory Research in More-than-Human worlds.* (pp. 178-191). Routledge.

Brice, J. (2014). Attending to grape vines: perceptual practices, planty agencies and multiple temporalities in Australian viticulture. *Social & Cultural Geography,* 15(8), 942-965. https://doi.org/10.1080/14649365.2014.883637

Ciencias, (1989). Lacandonia schismatica. Un verdadero cisma. *Revista Ciencias,* 15, 39-42.

Clark, N. & Gunaratnam, Y. (2017). Earthing the Anthropos? From 'socializing the Anthropocene' to geologizing the social. *European Journal of Social Theory,* 20(1), 146-163. https://doi.org/10.1177%2F1368431016661337

CONAPO, (2005). *Índices de marginación*. CONAPO. México.

De Vos, J. (1991). Historia de la Selva. Crónica de una agresión. In Eccardi, F. (ed.) *Lacandonia. El último refugio*. (pp. 37-51). UNAM.

[13] "The flower needs a lot of humidity, very little light and not overly high temperatures. Average minimum temperature in December was 24 degrees [Celcius], and the maximum in May was 26.3 degrees. With only a difference of two degrees, the climate was perfect for Lacandonia. Now, however, maximum temperatures reach 30 degrees and the minimum is 24. This means there is less humidity, which in turn affects the plant" (Esteban Martínez, in Norandi 2010).

De Vos, J. (2003). Introducción. In De Vos, J. (comp.) *Viajes al desierto de la Soledad. Un retrato hablado de la Selva Lacandona*. (pp.11-40). CIESAS and Miguel Ángel Porrúa.

De Vos, J. (2004). El Lacandón: una introducción histórica. In Viqueira, J. P. & Ruz, M. H. *Chiapas. Los rumbos de otra historia*. (pp. 331-362). UNAM & CIESAS.

De Vos, J. (2005). *Una tierra para sembrar sueños. Historia reciente de la Selva Lacandona 1950-2000*. FCE & CIESAS.

Despret, V. (2004). The body we care for: figures of anthropo-zoo-genesis. *Body & Society,* 10(2–3), 111–134. https://doi.org/10.1177%2F1357034X04042938

Donoghue, M. J. & Alverson, W. S. (2000). A new age of discovery. *Annals of the Missouri Botanical Garden,* 87(1), 110-126. https://doi.org/10.2307/2666212

Doody, B. J., Perkins, H. C., Sullivan, J. J., Meurk, C. D. & Stewart, G. H. (2014). Performing weeds: gardening, plant agencies and urban plant conservation. *Geoforum,* 56, 124-136. https://doi.org/10.1016/j.geoforum.2014.07.001

Durand L., (2019) Power, identity and biodiversity conservation in the Montes Azules Biosphere Reserve, Chiapas, Mexico, *Journal of Political Ecology* 26(1), 19-37. https://doi.org/10.2458/v26i1.23160

Escobar, A. 2010. Postconstructivist political ecologies. In Redclift, R. & Woodgate, G. *The International Handbook of Environmental Sociology*. (pp. 91-105). Edward Elgar.

Fleming, J. (2017). Toward vegetal political ecology: Kyrgystan's walnut-fruit forest and the politics of graftability. *Geoforum,* 79, 26-35. https://doi.org/10.1016/j.geoforum.2016.12.009

Gould, S. J. (1988). *El pulgar del panda. Ensayo sobre evolución*. Editorial Orbis.

Hall, B. K. (2012). Evolutionary development biology (evo-devo). Past, present and future. *Evolution: Education and Outreach,* 5(2), 184-193. https://doi.org/10.1007/s12052-012-0418-x

Haraway, D. (2016). *Staying with the trouble. Making kin in the Chthulucene*. Duke University Press.

Hathaway, M. (2018). Elusive fungus? Forms of attraction in multispecies world making. *Social Analysis,* 62 (4), 37–53. https://doi.org/10.3167/sa.2018.620403

Head, L., Atchison, J. & Phillips, C. (2012). The distinctive capacities of plants: rethinking difference via invasive species. *Transactions of the Institute of British Geographers,* 40, 399-413. https://doi.org/10.1111/tran.12077

Head, L., Atchison, J. & Gates, A. (2012b). *Ingrained. A human biography of wheat*. Ashgate.

Head, L., Atchison, J., Phillips, C. & Buckingham, K. (2014). Vegetal politics: belonging, practices and places. *Social & Cultural Geography*, 15 (8), 861-870. https://doi.org/10.1080/14649365.2014.973900

Hernández Cruz, R. E., Bello Baltazar, E. E., Montoya Gómez, G. & Estrada Lugo E. I. J. (2005). Social adaptation. Ecotourism in the Lacandon Forest. *Annals of Tourism Research,* 32(3), 610-627.

Hernández Godoy, V. (2016). *El capital social para la conservación de la biodiversidad. Dos casos de estudio en la Selva Lacandona*. Master's thesis. El Colegio de la Frontera Norte & CISESE. https://www.colef.mx/posgrado/tesis/20141178/

Instituto de Ecología. (2003). *Informe de actividades*. UNAM, Unpublished.

Lazcano-Barrero, M. A., March I. J. & Vásquez-Sánchez, M.A. (1992). Importancia y situación actual de la Selva Lacandona: perspectivas para su conservación. In Vásquez-Sánchez M. A. & Ramos M. A. (Eds.) *Reserva de la Biosfera Montes Azules, Selva Lacandona: Investigación para su conservación*. (pp. 393-437), Ecosfera 1.

Legorreta Díaz, M. C. & Márquez Rosano, C. (2014). ¿Es posible la conservación de áreas protegidas por decreto? Retos sociopolíticos para la gestión ambiental demoscrática en las comunidades de Nueva Palestina y Frontera Corozal, Ocosingo Chiapas. In Legorreta Díaz, C., Márquez Rosano, C. & Trench, T. (Eds.) Paradojas de las tierras protegidas en Chiapas. (pp. 129-172), CEIICH & CRIM UNAM.

Lesher Treviño, A. C. (2015). *Community museums as potential instruments for social change and sustainable development in rural Mexico*. Ph. D. Thesis. Imperial College London. https://spiral.imperial.ac.uk/handle/10044/1/28963.

Lorimer, J. (2015). Wildlife in the anthropocene: Conservation after nature. University of Minnesota Press.

Jiménez García, L. F., Agredano Moreno, L. T., Segura Valdez, M. L., Echeverría, O.M., Martínes, E., Ramos, C.H. & Hebert Vázquez, G. (1992). The ultrastructural study of the interphase cell nucleus of Lacandonia schismatica (Lacandoniaceae: Triuridales) reveals a non-typical extranucleolar particle. *Biology of the Cell,* 75(2), 10. https://doi.org/10.1016/0248-4900(92)90129-O

Magaña R., P. (1994). La flora de Mesoamérica. *Revista Ciencias,* 82-83.

Marder, M. (2012). Plant intentionality and the phenomenological framework of plant intelligence. *Plant Signaling and Behaviour,* 7(11), 1-8. https://doi.org/10.4161/psb.21954

Marder, M. (2013). Plant intelligence and attention. *Plant Signaling and Behaviour,* 8(5), e23902. https://doi.org/10.4161/psb.23902

Márquez Guzman, J., Engleman, M., Martínez Mena, A., Martínez, E. & Ramos, C. (1989). Anatomía reproductiva de Lacandonia schismatica (Lacandoniaceae). *Annals of the Missouri Botanical Garden*, 76(1), 124-127. https://doi.org/10.2307/2399345

Márquez Guzmán, J., Vázquez Santana, S., Engleman, E. M., Martínez Mena, A., Martínez, E. (1993). Pollen development and fertilization in Lacandonia schismatica (Lacandoniaceae). *Annals of the Missouri Botanical Garden*, 80(4), 891-897. https://doi.org/10.2307/2399935

Martínez, E., Ramos, C. H. 1989. Lacandoniaceae (triuridales): Una nueva familia de México. *Annals of the Missouri Botanical Garden* 76(1), 128-135. https://doi.org/10.2307/2399346

Melo A., Alves M. (2012). The discovery of Lacandonia (Triuridaceae) in Brazil. *Phytotaxa*, 40, 21-25. https://doi.org/10.11646/phytotaxa.40.1.3

Mendoza, E. & R. Dirzo. 1999. Deforestation in Lacandonia (southeast Mexico): evidence for the declaration of the northernmost tropical hotspot. *Biodiversity and Conservation,* 8, 1621-1641.

Müller, G. B. (2007). Evo-devo: extending the evolutionary synthesis. *Nature Reviews Genetics*, 8, 943-949. https://doi.org/10.1038/nrg2219

Norandi, M. (2010, June 10). Peligra la Lacandonia, planta única entre las que tienen flor. *La Jornada*, México.

Notzke, C. (2013). An exploration into political ecology and nonhuman agency: The case of the wild horse in western Canada. *The Canadian Geographer*, 57(4), 389-412. https://doi.org/10.1111/cag.12028

O'Brien, K. L. (1998). *Sacrificing the forest. Environmental struggles in Chiapas*. Westview.

Ortíz Espejel, B. & Toledo, V. M. (1998). Tendencias en la deforestación de la Selva Lacandona (Chiapas, México). El caso de Las Cañadas. *Interciencia*, 23(6), 318-327.

Piñeyro Nelson, A., Flores Sandoval, E., Garay Arroyo, A., Garcia Ponce, B. & Álvarez Buylla, E. R. (2010). Development and evolution of the unique floral organ arrangement of Lacandonia schismatica. *International Journal of Plant Development Biology*, 4(1), 86-97.

Pitt, H. (2015). On showing and being shown plants – a guide to methods for more-than-human geography. *Area*, 47(1), 48-55. https://doi.org/10.1111/area.12145

Poe, M. R., Le Compte, J., McLain, R. & Hurley, P. (2014). Urban foraging and the relational ecologies of belonging. *Social & Cultural Geography*, 15(8), 901-919. https://doi.org/10.1080/14649365.2014.908232

Quintana, L. (2010). Identidad sin sujeto: Arendt y el mutuo reconocimiento. *Ética & Política*, XII, 430-448.

Rahder, M., (2014). Caring for Xate, caring for Xateros: NGO monitoring, livelihoods, and plant-human relations in Uaxactún, Guatemala. *Journal of Political Ecology* 21(1), 372-388. https://doi.org/10.2458/v21i1.21141

Raffles, H. (2002). Intimate knowledge. *International Social Science Journal*, 53(173), 325-335.

Reygadas, L., Ramos, T. & Montoya, G. (n/d). Los dilemas del desarrollo territorial: repercusiones del zapatismo en la Selva Lacandona de Chiapas. Manuscript.

Rocheleau, D. & Roth, R. (2007). Rooted networks, relational webs and powers of connection: rethinking human and political ecologies. *Geoforum*, 38, 433–7.

Ruiz Lagier, V. (2018). Los refugiados guatemaltecos y la frontera-frente de discriminación, explotación y desigualdad. *Alteridades*. 28(56), 47-57.

Ryan, J. C. (2012). Passive flora? Reconsidering nature's agency through human-plant studies (HPS). *Societies*, 2, 101–121. https://doi.org/10.3390/soc2030101

Sarukhán, J. (1991). El último refugio. In Eccardi, F. (Ed.) *Lacandona, el último refugio*. UNAM.

Sheridan, M. (2016). Boundary plants, the social production of space, and vegetative agency in agrarian societies. *Environment and Society: Advances in Research*, 7, 29-49.

Soto Laveaga, G. (2005). Uncommon trajectories: steroid hormones, Mexican peasants, and the search for a wild yam. *Studies in History and Philosophy of Biological and Biomedical Sciences*, 36, 743–760.

Sundberg, J. (2011). Diabolic caminos in the desert & cat fights on the río: A post-humanist political ecology of boundary enforcement in the United States-Mexico borderlands. *Annals of the Association of American Geographers* 101(2), 318-336. https://doi.org/10.1080/00045608.2010.538323

Tejeda Cruz, C. (2002). *Apropiación social del territorio y política ambiental en la Selva Lacandona, Chiapas. El caso de Frontera Corozal, Comunidad Lacandona.* Masters thesis. Universidad Autónoma de Chapingo, Mexico.

Theiβen, G. (2006). The proper place of hopeful monsters in evolutionary biology. *Theory in Biosicences*, 124, 349-369. https://doi.org/10.1016/j.thbio.2005.11.002

Trewavas, A. (2002). Plant intelligence: Mindless mastery. *Nature*, 415, 841. https://doi.org/10.1038/415841a

Trewavas, A. (2003). Aspects of plant intelligence. *Annals of Botany,* 92, 1–20. https://doi.org/10.1093/aob/mcg101

Vázquez Santana, S., Engleman, M. E., Martínez Mena, A. & Márquez Guzmán, J. (1998). Ovule and seed development of Lacandonia schismatica (Lacandoniaceae). *American Journal of Botany*, 85(3), 299-304. https://doi.org/10.2307/2446320

Vergara Silva, F. (2002). La homeosis y la macroevolución. *Revista Ciencias,* 65, 45-50.

Vergara-Silva, F., Espinosa Matías, S., Ambrose, B. A., Vázquez Santana, S., Martínez-Mena, A., Márquez Guzmán, J., Martínez, E., Meyerowitz, E. M. & Alvarez-Buylla, E. R. (2003). Inside-out flowers characteristic of Lacandonia schismatica evolved at least before Its divergence from a closely related taxon, Triuris brevistylis. *International Journal of Plant Sciences*, 164(3), 345-357. https://doi.org/10.1086/368235

Videoservicios Profesionales & CONABIO. (2004). Lacandonia schismatica. Un acercamiento a su investigación. Video.

Videoservicios Profesionales. (2005). *La historia de Don Gabriel. Una vida de colecta en la Selva Lacandona* 1951-2005. Video.

Villalobos Cavazos, O. (2016). *Del Lacandón a la Selva Lacandona. La construcción de una región a través de sus representaciones y narrativas*. UNAM.

Whatmore, S. (2003). Culturenatures. Introduction: More than human geographies. In Anderson, K., Domosh, M., Pile, S. & Thrift, N. (Eds.) *Handbook of Cultural Geography* (pp. 165-167). Sage.

Witzany, G. (2006). Plant communication from biosemiotic perspective: Differences in abiotic and biotic signal perception determine content arrangement of response behavior. Context determines meaning of meta-, inter- and intraorganismic plant signaling. *Plant Signaling & Behavior*, 1(4), 169–178. https://doi.org/10.4161/psb.1.4.3163