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The Ethics of Aerial Lidar Mapping: A Call for Informed Consent

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Abstract

Aerial lidar (light detection and ranging) has been hailed as a revolutionary technology in archaeological survey because it can map vast areas with high-precision and seemingly peer beneath forest cover. This excitement has led to a proliferation of lidar scans, including calls to map the entire land surface of earth. Highlighting how the growth of aerial lidar is tied to fast capitalism, this article seeks to temporarily pause the global rush for data collection/extraction by focusing on the ethical dilemmas of remotely scanning Indigenous homelands and heritage. Although lidar specialists must obtain federal permissions for their work, few engage with people directly in the path of their scans or descendant stakeholders. This oversight perpetuates colonial oppression by objectifying Indigenous descendants. To address Indigenous objectification, I argue that aerial lidar mapping should be preceded by a concerted, culturally sensitive effort to obtain informed consent from local and descendant groups. With the Mensabak Archaeological Project as a case study, I demonstrate how aerial lidar can become part of a collaborative, humanizing praxis.

Resumen

El lidar aéreo (*light detection and ranging*) ha sido aclamado como una tecnología revolucionaria en los estudios arqueológicos, ya que permite mapear extensas áreas con alta precisión y, aparentemente, con el poder de ver a través de la cobertura boscosa. Este entusiasmo ha provocado una proliferación de escaneos con lidar, incluyendo propuestas para mapear toda la superficie terrestre del planeta. Al destacar cómo el crecimiento del lidar aéreo está vinculado al capitalismo acelerado, este artículo busca hacer una pausa temporal en la carrera por la recolección y extracción de datos, subrayando los dilemas éticos que conlleva escanear de forma remota los territorios y patrimonios Indígenas. Aunque los especialistas en lidar deben obtener permisos federales para llevar a cabo su trabajo, pocos interactúan directamente con las personas que habitan las zonas escaneadas o con los descendientes vinculados a esos territorios. Esta omisión perpetúa la opresión colonial al objetivizar a los pueblos indígenas y a sus descendientes. Para contrarrestar esta objetivización, sostengo que el mapeo con lidar aéreo debe ir acompañado de un esfuerzo concertado por obtener el consentimiento informado de los grupos locales y descendientes, de manera culturalmente sensible. Utilizando el Proyecto Arqueológico Mensabak como estudio de caso, demuestro cómo el lidar aéreo puede formar parte de una praxis colaborativa y humanizante.

Keywords: colonialism; ethics; informed consent; lidar; remote sensing

Palabras clave: colonialismo; ética; consentimiento informado; lidar; mapeo

> In trying to become "objective," Western culture made "objects" of things and people when it distanced itself from them, thereby losing "touch" with them. This dichotomy is the root of all violence [Anzaldúa 2012:59].

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> Colonialism and capitalism are based on extracting and assimilating. My land is seen as a resource. My relatives in the plant and animal world are seen as a resource. My culture and knowledge is a resource. My body is a resource and my children are a resource because they are the potential to grow, maintain, and uphold the extraction-assimilation system. The act of extraction removes all of the relationships that give whatever is being extracted meaning. Extracting is taking. Actually, extracting is stealing—it is taking without consent, without thought, care or even knowledge of the impacts that extraction has on the other living things in that environment. That's always part of colonialism and conquest. Colonialism has always extracted the Indigenous—extraction of Indigenous knowledge, Indigenous women, Indigenous peoples [Simpson 2017:75].

Investigators, we have a technology problem. The need for innovation fueled by neoliberal policies has led to fast-paced technological development (Harvey 1989:260–307; McGuire 2008:112). However, this innovation has raised a host of legal and ethical questions that have gone largely unanswered (i.e., Big Data management, CRISPR (clustered regularly interspaced short palindromic repeats) editing, private space travel). The dilemmas often result from a lack of foresight on the part of innovators. In the case of private industry, a lack of consideration for future consequences outside of profit or market dominance can be by design (e.g., Blitzscaling; see Hoffman and Yeh 2018). A core philosophy of today's fast capitalism—reflected in Mark Zuckerberg's famous quote "move fast and break things"—is to innovate, grow so that you can seize the market quickly, and worry about problems later (Hoffman and Yeh 2018; see also Taplin 2017). Archaeology is enmeshed within these massive contemporary dilemmas.

I address the role archaeologists can play in confronting the problems created by rapid technological development and the push for innovation. For my case study, I reflect critically on the practice of aerial lidar (light detection and ranging) data collection. This innovative remote-sensing technique employs laser scanning systems to create high-precision—at times accurate to the centimeter—maps of massive areas (Fernandez-Diaz et al. 2014; Luo et al. 2019). Hailed as the catalyst for a revolution in archaeological practice, aerial lidar has become nearly indispensable in areas with dense forest cover, such as lowland Mesoamerica, the Amazon, and Southeast Asia (Carleton et al. 2023; Chase et al. 2012; Garrison et al. 2022; McCoy 2021; Prümers et al. 2022). But this so-called revolution has a dark side.

I argue that aerial lidar surveys consistently dehumanize Indigenous peoples and perpetuate colonial relations. My point of ethical concern lies in aerial lidar data collection but applies to remote sensing as a whole and is global in scale. To build my argument, I take a long-term perspective to demonstrate how research and mapping practices perpetuate colonial relations that objectify and dehumanize Indigenous peoples. This process of dehumanization, stemming from a Eurocentric perspective, serves the ultimate goals of dispossession, appropriation, and extraction. Alternatives to these dehumanizing data-collection practices exist, and they are currently being employed by archaeologists and other investigators in many parts of the world. However, current discussions of lidar ethics generally fail to address the issues of dehumanization and Eurocentrism. Rectifying this oversight requires greater engagement between decolonial scholars—specifically those practicing community archaeology—and aerial lidar specialists to institute culturally sensitive programs of informed consent. I demonstrate how this type of informed-consent practice was implemented as part of a community-based archaeological project in Puerto Bello Metzabok, Chiapas, Mexico. To counter further Eurocentrism and dehumanization, throughout this article I engage in citational praxis by emphasizing the works of traditionally marginalized scholars. Accordingly, this article contains extensive quotes by Indigenous peoples to amplify their voices and highlight their contributions to profound anthropological and societal problems.

Dehumanization, Objectification, and Mapping

Due to colonialism, the decision of who is human or what constitutes humanity, in much of the world, has been profoundly shaped by Eurocentrism. I adopt my definition of Eurocentrism from Walter Mignolo (2015:ix) to mean "a world seen, described, and mapped from European perspectives and interests." This perspective has many facets, but I focus on that of cisgender, heteronormative

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(at least in public) men with Christian theology who developed increasingly racialized views as the colonial encounter unfolded (e.g., Haraway 1988; Lugones 2010, 2016; Mignolo 2003; Smith 2021). Objectification expanded with the reach of Eurocentrism and became fundamental to Western science.

Objectification occurs when a person becomes a tool or object for another person's desires or designs (Langton 2009; Nussbaum 1995; Papadaki 2007). This process can entail an assault on a person's subjectivity, voice, autonomy, and ability to self-determine. Treated as an object that lacks agency, the objectified person can become property (e.g., chattel) or a thing that is interchangeable with other things. From a Eurocentric perspective, women, Indigenous persons, Africans, members of the LGBTQIA+ community, and many others have been treated as less than human—or not human at all—by being reduced to the ontological status of objects. Critical to the process of objectification was the exercise of power that sought to silence the colonized, which facilitated research on people and their ancestors without consent (e.g., Deloria 1992).

Actively silenced and treated as an outsider, the Indigenous person has generally been rendered in the Eurocentric imagination as an object of curiosity and study but no longer an acknowledged contributor in the ongoing global transformations initiated when Columbus and company disembarked in the Western Hemisphere. When Natives are not erased from the narrative, history (that is, Eurocentric history) typically paints them as hindrances to progress (King 2013). However, colonized groups have not been totally helpless or passive in facing the European onslaught.

The colonial encounter has entailed a process of transculturation that profoundly transforms all parties involved, including land and its life (Anderson 2004; Low 2016; Russell 2019). In tandem with transculturation, Indigenous peoples have resisted and, at times, made European colonization possible (McDonnell 2015; Restall 2004). Critically, colonial domination involves the dispossession and appropriation of land, life, and knowledge to create a Eurocentric world order (Deloria 1998; Mignolo 2003; Tuck and Yang 2012). Creating this one-world order requires a concerted effort at erasing, silencing, excluding, and marginalizing Indigenous peoples.

Mapping as a Colonial Process

Entangled with developing ideas of humanity, the colonial encounter in the Americas unfolded with the transformation and expansion of European mapping. In the AD 1400s and 1500s, European cartography and geography transformed from fields that utilized many mappings (i.e., T and O map, *mappaemundi*, etc.) to disciplines dominated by the gridded map, which was organized according to geometric principles (i.e., the graticule). This new dominant form of representation shaped the development of surveying techniques, astronomical observation, and mapping technologies, such as chronometer-based position finding (Branch 2014; Pickles 2004). Through the synergy of new ideas, technology, and mapping techniques, the modern conception of space as abstract, geometric, and homogenous took hold in Europe. Via the development of geometric, abstract space and its implementation in colonial projects, the world became ripe with purportedly empty spaces for European colonization (Branch 2014; Harley 1992).

With the burgeoning shift from place-based to space-based conceptions of territory, Europeans could claim lands they presumed existed, let alone had ever visited. Johnson and colleagues (2005:89) argue, "The colonial map asserted the external centralized power of the state to dominate 'its' territory and expanded the judicial control out toward the 'blank spaces' of the Indigenous nations.." This process is evident during the Spanish colonization of the Americas and post-independence Mexico. For example, in 1494, the Spanish and Portuguese used the abstract, geometric principles of gridded geography to draw a line that divided the Western Hemisphere for their respective rule (Branch 2014). Indigenous peoples were meanwhile disregarded as land was parceled ahead of European conquest and resource extraction. To foreshadow and legitimize colonial control, Indigenous people were objectified by being rendered silent—as well as having their land/heritage appropriated, understandings of place delegitimized, and autonomy assaulted. This process of partitioning erased Indigenous claims, interests, understandings, and presence while instilling a heteropatriarchal "Doctrine of Discovery" (Dunbar-Ortiz 2014; Lugones 2016; Simpson 2017). Yet the only way a European could be said to have discovered or been the first to recognize land in the Western Hemisphere is by accepting the Eurocentric assumption

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that Indigenous peoples lacked humanity. The process of colonization via mapping continued with the formation of nation-states.

Cartographic knowledge is essential for establishing a nation with exclusive sovereignty over a delineated territory (i.e., the nation-state) and claiming archaeological heritage. Like other American nation-states, an independent Mexico sought to establish its own identity and sovereignty on the international stage by mapping its claimed territory and patrimony. The nation did so by engaging in oppressive colonial practices aimed at Indigenous peoples (Bueno 2016; Craib 2004; Kourí 2010). During the reign of Porfirio Díaz (AD 1876–1911), the creation of a single, monolithic Mexican identity—far from restoring Indigenous autonomy and voices—entailed ongoing dispossession along with dehumanization in the form of racial discrimination and violence as means of forcing assimilation. In a process akin to the formation of the United States and other nation-states, the creation of a monolithic "Mexican" (in fact, Criollo/Eurocentric) identity led to the suppression of Indigenous lifeways and their right to self-determination. Nationalism, sovereignty, Indigenous dehumanization, and dispossession work in concert.

Creating a singular national mythology entailed the anchoring of the Mexican present to the sedentary societies of the precolonial past (not the present). Although widely attributed to postrevolutionary reforms, this nationalist claim of an Indigenous past has prerevolutionary roots in the Díaz regime (Bueno 2016). The imperative of safeguarding patrimony, in which archaeological mapping and stewardship play a vital role, led to national appropriation via Indigenous dispossession of land, ancestral remains, and heritage (Breglia 2006; Castañeda 1996; Holley-Kline 2022; Kourí 2010). The works of Leopoldo Batres and Manuel Gamio—foundational figures in Mexican archaeology—exemplify this process. Batres, under the authority of Porfirio Díaz, removed Indigenous peoples from the land that would become the Teotihuacan archaeological park—now a UNESCO World Heritage Site (Bueno 2016). After the Mexican revolution, Gamio glorified the Native past while he sought to modernize/assimilate Indigenous peoples to solve the nation's "Indian problem" (Kourí 2010; Varner 2020).

Although widely objectified by agents of the nation-state, many Indigenous communities have fought against national appropriation of archaeological remains, such as those who lived in the communities of Tepoztlán and Tetlama in Morelos, Mexico (Bueno 2016:179–186). In the case of Tetlama, they succeeded for many decades in stopping the federal extraction of a stone monolith—referred to as the "goddess" (aka "*la india*")—by moving her to an undisclosed location. Eventually the statue was found by Mexican authorities and expropriated in the 1930s.

In sum, mapping has been a fundamental tool of colonialism in Mexico and elsewhere. The connections between cartography, archaeology, and Indigenous oppression persist even after independence (Galeano 1997). Under the banner of nation building and of maintaining cultural patrimony, Indigenous lands and heritage in Mexico were documented for dispossession, national appropriation, and potential extraction (Bueno 2016; Kourí 2010). This process of collection and curation was and often still is done against the will of local and descendant communities. Today, under the claim of representing all Mexicans, the archaeological record in Mexico is legally owned by the nation-state, which perpetuates the dispossession and distancing of descendants from their ancestors (Breglia 2006; Castañeda 1996; Holley-Kline 2022; McAnany 2016). Despite postrevolutionary celebrations of Indigeneity (i.e., *indigenismo* and *mestizaje*) and attempts to promote well-being, the desire for territorial control leads the Mexican nation-state to continually objectify Indigenous peoples by not only assaulting their agency but also attempting to negate their voices, autonomy, and right to self-determination. Many contemporary mapping practices perpetuate this form of colonial oppression, despite the existence of alternative approaches.

Decolonizing Research

It is in the context of ongoing dehumanization, dispossession, appropriation, and extraction that research is conducted among Indigenous peoples across the globe (Smith 2021). To address these entrenched forms of oppression, researchers have developed decolonial, postcolonial, anti-colonial, Indigenous, and collaborative methods, which are being interwoven with, for example, radical and

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critical approaches to mapping (Atalay 2012; Colwell-Chanthaphonh and Ferguson 2008; Johnson et al. 2005; McAnany 2016; McAnany et al. 2015; Pyburn 2009, 2011; Smith 2021; Wainwright and Bryan 2009). In this vein, several investigators—such as critical and radical geographers—have examined how maps perpetuate inequality and help to maintain dominant groups within society (see Hauser 2022).

Understanding the intersecting factors of oppression (i.e., race, gender, religion, etc.) in Mexico and other nation-states, scholars in various disciplines have sought to decolonize cartography and geography (Álvarez Larrain and McCall 2019; Herlihy and Knapp 2003; Johnson et al. 2005; McAnany et al. 2015; Mignolo 2003; Wainwright and Bryan 2009). Broadly speaking, issues of neocolonialism and helicopter research have come to the forefront. The latter refers to scientists from wealthy nations traveling to low-income countries for data extraction that leads to little engagement or benefit for locals (Adame 2021). As a result, some mappers have turned to building local capacity and making data more accessible.

Today various methods of Indigenous mapping are having an increasing impact on social scientific and humanities research (Chapin et al. 2005; Hunt and Stevenson 2017; Johnson et al. 2005; Wainwright 2008). Johnson et alia (2005:82) argue, "While we caution Indigenous communities about how they engage with Western cartography, we also recognize the value these technologies have brought to the struggles of our communities." Considering the benefits and pitfalls, they advocate for Indigenous communities "becoming literate in [Western] cartographic methods, while on the other hand developing a critical consciousness that attends to the dangers that accompany the use of modern cartographic technologies" (Johnson et al. 2005:83). Additionally, they argue that critical literacy should be accompanied with support for Indigenous cartographies.

Archaeology forms part of the wider efforts to confront colonial legacies with scholars building from Indigenous and public-facing scholarship to develop collaborative methods of investigation. In this article, I focus on community archaeology (Atalay 2012; Atalay et al. 2014; Colwell 2016; Colwell-Chanthaphonh and Ferguson 2008; Marshall 2002; Pitblado 2022; Pyburn 2009, 2011). This type of investigation entails the formation of *open, honest partnerships to work with* a diversity of stakeholders—typically local and/or descendant communities. Partnerships form the basis for crafting inclusive, ethical, and rigorous research (Colwell 2017; Colwell-Chanthaphonh and Ferguson 2008; Dedrick et al. 2023; Supernant et al. 2020; Wylie 2015). The degree of collaboration varies by project, but investigations of this type can generally be categorized along a collaborative continuum (Colwell 2016). In all cases, partnerships based on the ongoing establishment of consent and on the provision of benefits for nonacademics (i.e., reciprocity) are critical to conducting community archaeology. This means that researchers must be willing to not conduct an investigation if it can harm local, descendant, or other stakeholders (Supernant and Warrick 2014).

In this vein, Indigenous researchers are practicing methods of remote sensing that incorporate Western technologies to meet broader community aims, including decolonization, sovereignty, autonomy, and self-determination (Montgomery and Supernant 2022; Nelson 2020; Wadsworth et al. 2021). Instead of silencing and marginalizing, this work amplifies Indigenous voices and counters dispossession. Sanger and Barnett (2021) argue that researchers should approach working on Indigenous heritage and land with cultural sensitivity attuned to and respectful of Indigenous self-determination, knowledge, stewardship, and access/ownership—among other issues. Above all, Indigenous peoples are clear in that research involving their land and heritage should be done with consent.

Some of the loudest calls for Indigenous consent are found in the United Nations Declaration on the Rights of Indigenous Persons (UNDRIP; United Nations 2007) and its forerunner, the International Labor Organization (ILO) Convention 169 (International Labor Organization [ILO] 1989). Although a deeper analysis of international rights frameworks is beyond this scope of this article, it is important to recognize that the methods of community archaeology are enacting many of the points called for in both of the previously mentioned documents. In six out of 46 articles, the writers of UNDRIP mention the need for informed consent, and two of the six state that consent should be obtained in a culturally appropriate manner (see Articles 19 and 32; for further information, see McAnany et al. 2022). Whereas UNDRIP is a declaration, ILO Convention 169 is a treaty ratified by individual nations and therefore legally binding. Signatories, which include Mexico, are expected to add, remove, or modify existing laws

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if they do not align with the articles of the convention. Articles 6 and 7 of ILO Convention 169 focus on consent, and I highlight Article 7.1.

> The [Indigenous or Tribal] peoples concerned shall have the right to decide their own priorities for the process of development as it affects their lives, beliefs, institutions and spiritual well-being and the lands they occupy or otherwise use, and to exercise control, to the extent possible, over their own economic, social and cultural development. In addition, they shall participate in the formulation, implementation and evaluation of plans and programmes for national and regional development which may affect them directly [ILO 1989].

Article 7.1 certainly applies to archaeology, because archaeological mapping and stewardship have long been tied to national development projects in Mexico and elsewhere. Both documents affirm that Indigenous peoples have the right to give or withhold consent in matters concerning their cultures and ancestral remains.

Informed consent has become a widespread protocol for research on human subjects since its origins in twentieth-century debates on human rights and biomedical ethics. However, the archaeological process is typically conceived as dealing with objects and the (objectified) dead and is therefore not typically subject to the Institutional Review Board process or its consent requirements. For example, despite the American Anthropological Association's (2012) stated ethical principle of obtaining informed consent prior to an investigation, in the Society for American Archaeology (SAA) Principles of Archaeological Ethics (Society for American Archaeology [SAA] 2024), there is no norm or expectation for US-based archaeologists to establish permission beyond obtaining permits and a good faith attempt at consultation with affected stakeholders. Nevertheless, community archaeologists have been leaders in developing respectful, inclusive partnerships by establishing informed consent in a culturally sensitive manner and thereby enacting international Indigenous rights frameworks (e.g., Atalay 2012; Colwell-Chanthaphonh and Ferguson 2008; McAnany 2016). As highlighted by the Indigenous voices throughout this article, calls for consent, collaboration, autonomy, and self-determination will continue to grow. Herein lies a major dilemma: meaningful integration between community archaeology and aerial lidar mapping has occurred only sporadically.

Lidar Ethics

Since the pioneering research of the 1990s, the use of aerial mounted lidar scanners (i.e., aerial lidar) in archaeology has contributed new insights from all over world because the technology affords scholars the ability to conduct rapid, high-precision mapping of landscapes (Chase et al. 2011; Fernandez-Diaz et al. 2014; Inomata 2024; Luo et al. 2019; McCoy 2021). In heavily forested regions, aerial lidar is being hailed by many as a "revolution" in archaeological practice (Carleton et al. 2023; Chase et al. 2012, 2016; Fernandez-Diaz et al. 2018; Fisher et al. 2017; Garrison et al. 2022; Grosman 2016; McCoy 2021). By releasing millions of laser pulses from a moving aircraft, some of the lasers will find a relatively unobstructed path to the forest floor and return with sufficient intensity to the laser source. The returns are then used to calculate ground distance measurements (see Fernandez-Diaz et al. 2014). Via this technique, researchers can create meter- and at times centimeter-accurate models of the earth's ground surface and forest cover. Since the 2000s, there has been a proliferation of lidar surveys, with investigators and technical experts rushing to understand how they can process and interpret their data. Some, such as Earth Archive, are proposing to map the entire land surface of the earth with aerial lidar scanners to promote archaeological and environmental conservation (Fisher et al. 2022). With the rapid implementation of lidar surveys and calls for scanning the globe, several ethical considerations are arising.

Although there is a growing consensus that lidar ethics have not received sufficient attention (Cohen et al. 2020, 2022; Davis and Sanger 2021; Davis et al. 2021; Fernandez-Diaz et al. 2018), issues pertaining to data management, such as curation and access, have been considered. Chase and colleagues (2011) end their watershed article on the archaeological application of lidar with a brief discussion of data sharing and looting (see also Johnson et al. 2021). They argue that not all lidar data should be made available to the general public and that instituting different levels of access to high-resolution surface models

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can mitigate the potential use of lidar data by looters. But this call faces challenges from advocates of open science who argue that information collected through public funds should be made available to the citizens of the funding nation (Fernandez-Diaz and Cohen 2020). For example, Instituto Nacional de Estadística y Geografía (INEGI), the Mexican federal agency tasked with collecting national statistical and geographic data, has already made large lidar datasets publicly available. As reported in the *New York Times* (Zorich 2019), this data was utilized by US-based archaeologist Takeshi Inomata to document many ancient settlements and some of the largest structures built by the ancient Mayas. Moreover, because science is predicated on the sharing of information to craft new insights and scrutinize findings, including the replication of results (i.e., repeatability), there is a strong push for open-access data in the remote-sensing and geospatial communities (Chase et al. 2020; Cohen et al. 2020; Fernandez-Diaz and Cohen 2020; Gupta et al. 2020, 2023; Inomata 2024; McCoy 2017; Nicholson et al. 2023; VanValkenburgh and Dufton 2020). There is, however, some awareness that not all data should be made widely available.

The subfield of archaeological remote sensing has been concerned with the stewardship of the archaeological record, and the work of Global Xplorer—led by Sarah Parcak—provides an innovative model for opening access to remote-sensing data. Parcak (2019) and colleagues have found a way to mitigate the risk of looting by removing geographic coordinates from satellite imagery of relatively small areas of the earth's surface that are difficult to identify visually. The Global Xplorer project provides a starting point for addressing ethical concerns surrounding open access to lidar and remote-sensing data, but it raises questions about remote surveillance, data access, ownership, and colonialism.

Satellite-based remote-sensing data has generated significant ethical and legal discussion, in part due to its global reach. It is well known that with little or no consent, the world's most powerful countries have collected topographic imagery and cultural heritage data from the territory of other nation-states. Consequently, the use of aerial or spaceborne reconnaissance has raised concerns about espionage, national sovereignty, and the legal right of nation-states to their airspace or perhaps even outer space (Cohen et al. 2020; Hafner and Rai 2005; Myers 2010; Parcak 2009).

Because aerial lidar operates from small passenger aircraft or uncrewed aerial vehicles (UAVs), flyovers typically require permission from local governments and do not factor in concerns over space law. Instead, archaeologists are required to abide by the aviation and heritage laws that exist in the nation-states where they work. If flyovers are conducted with the necessary permissions, archaeologists conducting them are promoting the sovereignty of the nation-states where they do fieldwork. Discussions of colonialism in aerial lidar research tend to arise from the issue of access to, and ownership of, technology and data.

Several investigators have highlighted that even if lidar data are made freely available via the internet, there is no guarantee that all—or even most—people within a host nation would have access (Casana 2021; Chase et al. 2020; Cohen et al. 2020; Fernandez-Diaz and Cohen 2020; Fredheim 2020; Sanger and Barnett 2021). Access to software and hardware remain a primary means for perpetuating (neo)colonial relations between nations, and the ability to collect and use aerial lidar data highlights this problem (e.g., Cohen et al. 2022; Fredheim 2020; Galeano 1997; Smith 2021). Processing lidar datasets, which are often tens or hundreds of gigabytes in size, requires powerful computers and specialized programs. The necessary hardware and software for this type of research tend to be made, sold, and most readily available in neocolonial seats of power—such as the United Kingdom, France, and the United States. Likewise, the specialized knowledge required to collect, process, and interpret lidar data remains predominantly in the hands of neocolonial powers. Although there is growing awareness of these issues, solutions remain elusive given the lack of funds, along with transfer of knowledge and technology necessary to rectify these inequalities. After all, it is in the interest of global superpowers to maintain imbalances in technology and expertise with other nation-states and their citizenry.

Developing from an attentiveness to international relations, often by US-based archaeologists working in other countries, there has been increasing consideration of the role of descendant, Indigenous, and local communities in lidar research (Chase et al. 2020; Cohen et al. 2020, 2022; Fernandez-Diaz and Cohen 2020; Fernandez-Diaz et al. 2018). Some of the early conversations stem from critiques leveled at researchers who utilized aerial lidar to document a site in the region of La Mosquitia, Honduras (see Begley 2016, 2017). As reported in a widely publicized *National Geographic* article, Douglas Preston

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(2015) accompanied a team of researchers into La Mosquitia and labeled a large site as a lost city. By characterizing the freshly mapped settlement and the surrounding region as "remote and uninhabited . . . scarcely studied and virtually unknown," he stoked the flames of controversy (Preston 2015). Preston's claims of discovery and pristine wilderness were not publicly denounced by the researchers who led him into the forest. Instead, in an open letter, an international group of scholars criticized the *National Geographic* article for, among other issues, promoting Indigenous erasure by exaggerating claims of discovery (Begley et al. 2015).

Following the *National Geographic* controversy, a subsequent group of researchers were accompanied by the president of Honduras to extract artifacts from the "lost city" that is now popularly known as the Lost City of the Monkey God/King and occasionally as *ciudad blanca* (Preston 2017). In response to this expedition, a group consisting of 12 Miskitu territorial councils, which refer to themselves as MASTA (Mosquitia Asla Takanka), released a public statement denouncing the extraction of artifacts from archaeological sites in La Mosquitia and claims of a lost city. They also condemned the imposition of outsider names, such as Monkey God, for any archaeological sites in La Mosquitia. They argue that outsider naming practices are "demeaning," "discriminatory," and "racist" because they ignore the knowledge and stewardship of local Indigenous groups (Padilla 2016). In addition to the return of the artifacts extracted from the "historic and ancestral territory" of the Miskitu Indigenous People,

> 3. **Exigimos la aplicación de los instrumentos internacionales relacionado con el proceso de consulta previa, libre e informada** en la Muskitia, a fin de formalizar el modelo de protección y conservación propuesto por el Pueblo Indigena. No queremos que en los diferentes sitios sagrados de la Muskitia, suceda lo que ha ocurrido en las Ruinas de Copan (3. **We [MASTA] demand the application of international agreements/documents related to the prior, free, and informed consultation process** in the Muskitia, in order to formalize the protection and conservation model proposed by the Indigenous People. We do not want what has happened in the Ruins of Copan to happen in the different sacred sites of the Muskitia) [Padilla 2016; translation by author and emphasis added].

The MASTA statement then elaborates on terms for greater Indigenous access and control in the stewardship, including dissemination via any medium, of La Mosquitia's archaeological heritage.

In the face of ongoing scrutiny, the original research team, whose work was at the center of the *National Geographic* controversy, responded through multiple venues. Chris Fisher, a lead member of the team accompanied by Preston and now project lead for Earth Archive, is quoted in the *Guardian* as expressing bafflement at the controversy because "the stakes are so low" (Yuhas 2015). His words highlight the Eurocentrism at the heart of the debate over La Mosquitia and aerial lidar mapping in general. Preston's article and subsequent narratives about La Mosquitia's archaeology relied on the colonial trope of discovery that dehumanizes Indigenous peoples and promotes dispossession by ignoring their presence, knowledge, voice, and overall agency (i.e., objectification). Preston, Fisher, and others gain from the data they extracted, whereas local descendant communities are remotely dispossessed. This practice of ongoing dehumanization traces its origins and structure to Spanish colonialism. The stakes in the struggle over La Mosquitia are only low if we continue to accept that Indigenous objectification and dispossession are business as usual.

Fisher and fellow project members have since taken a more deliberate approach to examining the ethics of aerial lidar research and remote sensing more broadly. In particular, the works of Juan Carlos Fernandez-Diaz and Anna Cohen stand out as some of the few sustained examinations of lidar ethics. In an article (Fernandez-Diaz et al. 2018)—coauthored by Fernandez-Diaz, Cohen, Fisher, and Alicia Gonzalez—they examine how the implementation of new remote-sensing technologies collides with archaeological ethics. They argue that current archaeological ethical principles, with a focus on those provided by the SAA, should be revisited based on how the field is changing (this ethical code is currently under revision and not published). The SAA Principles of Archaeological Ethics that were current in 2018 were primarily crafted in the early 1990s, when remote sensing and other innovative technologies—such as the internet and aerial lidar—were still burgeoning tools of inquiry. Their claim underscores the

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wider societal challenge that established ethical frameworks lag behind the development and application of new technologies.

Beyond a focus on findings and data, Fernandez-Diaz et alia (2018) are aware that the process of investigation itself needs to be scrutinized. They underscore that remote sensing allows investigators to see vast areas from a distance and with high precision, which raises questions about the viewer's responsibility to the people, jurisdictions, and heritage on the ground. As a result, adhering to ethical guidelines, such as Principle 2 from the SAA Principles of Archaeological Ethics (SAA 2024; i.e., consulting with affect groups), becomes more difficult with the expanding scope and resolution of remote-sensing data collection. Issues of concern include conflicting views among affected groups and potential clashes with governments. They note that in some cases,

> conducting a large-scale survey, which will improve the country's site inventory and which helps to develop research and protection plans, may benefit the broader nation despite the opposition of a few. How are we to balance between our stewardship and accountability duties [Fernandez-Diaz et al. 2018:10]?

They make no mention of nationalist oppression—let alone international Indigenous rights frameworks such as UNDRIP or ILO Convention 169.

Fernandez-Diaz et alia (2018) raise important questions and admittedly provide few answers. To be fair, questions of sovereignty, stewardship, accountability, and conflict resolution are currently daunting for politicians, legal scholars, and museum curators—among others. I contend that much of the uncertainty stems from a tacit acceptance of Eurocentrism. For example, Fernandez-Diaz et alia's examination seems genuine and well intentioned but trapped in objectification. They state that "our work in Honduras began with a lidar survey in 2012 for the archaeological prospection of uncharted valleys in the Mosquitia region" (Fernandez-Diaz et al. 2018:8). The authors are open to discussing ethical criticisms of their research, but the Eurocentric trope of discovery remains in their characterization of La Mosquitia. The region is not terra nullius. Moreover, their focus, like the SAA Principles of Archaeological Ethics, remains on a form of conservation that accepts that archaeologists are the primary stewards of the past. Although generally well intentioned, the archaeological fixation on conservation—and its claim to the role of primary steward of ancestral remains—must continue to be challenged (e.g., Colwell 2017). A Eurocentric conservation ethic, if left unchecked, will lead to paternalistic outcomes, such as the many cases of extraction and national appropriation of Indigenous heritage in Mexico (Bueno 2016; McAnany 2016). MASTA highlights that in the case of Copan, Honduras, the intent to conserve a particular archaeological site for the benefit all of humanity (i.e., the UNESCO World Heritage Site of Copan) has come at the expense of local, Indigenous descendants (for other examples, see Meskell 2018). In response to Fernandez-Diaz et alia's question in the quote above, who are the few that oppose an investigation that will purportedly benefit a nation? If the answer entails the silencing of Indigenous voices, assaulting their autonomy and ignoring their right to self-determination in favor of the nation-state, then research conducted in this manner is a form of ongoing colonialism. This oppressive outcome is true whether the investigators are foreign or domestic.

Fernandez-Diaz and Cohen, in subsequent works, do stress the importance of collaborating with Indigenous communities and various stakeholders in the process of aerial lidar research. In addition to advocating for data access for stakeholders who "hold a special interest in or ownership of the land, resources, and elements captured [via remote sensing]" (Fernandez-Diaz and Cohen 2020:129), they argue for the need to consider the role played by Indigenous descendants in managing lidar and geospatial data (e.g., Cohen et al. 2020, 2022). However, their calls for the inclusion of Indigenous peoples in lidar and aerial/spaceborne remote-sensing projects tend to lack development beyond a recognition that local and descendant collaboration should be of concern (see Cohen et al. 2022). Davis and colleagues (2021) highlight the need to address this lack of method.

Indigenous communities around the globe are under surveillance by nation-states, and Davis et alia (2021) apply Foucault's conceptualization of the panopticon to demonstrate how remote sensing of Indigenous lands and heritage can cause harm. They are particularly concerned with being culturally sensitive by not exposing sacred sites that locals intentionally keep secret. Secrecy is maintained by

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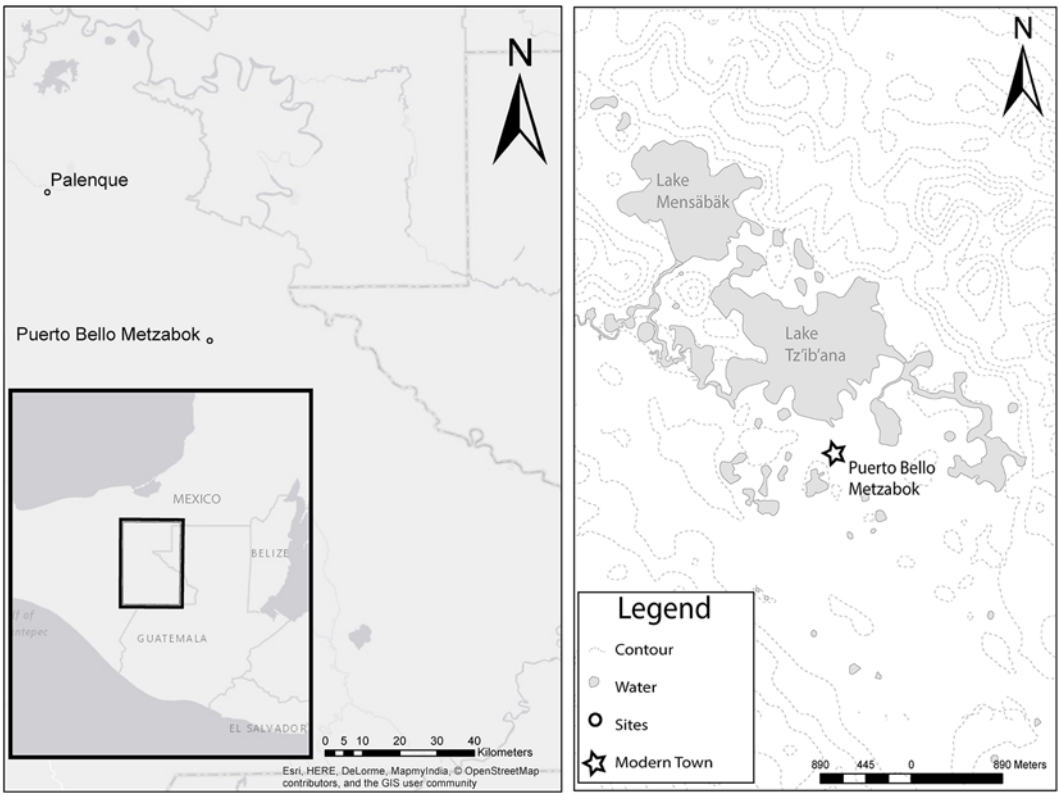


Figure 1. Map of the Mensabak region.

many Indigenous communities because it has been vital for their survival and resurgence (Colwell 2017). Ultimately, Davis and colleagues (2021) advocate and provide methods for collaborative mapping akin to Johnson et alia (2005). For Davis et alia (2021), transparency is at the heart of just, coproduced research. I build on their work of foregrounding transparency and collaboration in aerial lidar mapping to demonstrate how informed consent was obtained on the Mensabak Archaeological Project. I also expand on their discussion of aerial lidar as panoptic surveillance by highlighting how the process of informed consent is a critical step in acknowledging Indigenous agency, voice, autonomy, and self-determination—in short, their humanity (see also Pitblado 2022; Steeves 2015).

Establishing Informed Consent in Puerto Bello Metzabok, Chiapas, Mexico

The Mensabak Archaeological Project (MAP) was founded on the principles of community archaeology. Accordingly, research is done in partnership with the Indigenous community of Puerto Bello Metzabok (hereafter Metzabok), Chiapas, Mexico (Palka et al. 2020). Metzabok is home to about 150 Hach Winik (aka Lacandon Maya) and Tzeltal Maya and is part of the wider Nahá-Metzabok UNESCO Biosphere Reserve (Figure 1). The protected areas are administered by multiple federal agencies, with the residents of Metzabok and Nahá serving as the on-the-ground stewards of the biosphere. Local stewardship has deep historical roots and received a significant boost in the 1970s when Hach Winik families secured land rights from the Mexican federal government (Nations 2023).

The community of Metzabok is designated as *bienes comunales*. In other words, the land that constitutes the community and its resources are owned and meant to be enjoyed communally (Cámara de Diputados 2003; Trench 2008). The territory is controlled by an assembly of community members (*comuneros*) who are elected by "traditional" authorities (see more below). Unlike the better-known ejidos, *bienes comunales* cannot be converted into individual private property. Although Metzabok

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is referred to as a *reserva* (i.e., reserve/reservation), it is not a Native reservation like those in the United States. Indigenous groups in Mexico are not recognized as sovereign nations or domestic dependents. In the case of Metzabok (along with Nahá), land was restituted by the federal government with the expectation of ecological/environmental conservation by the designated landowners (i.e., *derechosos*). This expectation stems from federal efforts to counter massive twentieth-century deforestation in Chiapas—often promoted by governmental policies, including agrarian laws that encouraged landless or land-poor highland Maya to settle in the tropical-forest regions of the state (Nations 2023).

As discussed elsewhere (Hernandez and Valenzuela Gómez 2024), Hach Winik have had a special status in Mexico for much of the twentieth and twenty-first centuries—particularly in comparison to other Indigenous groups in Chiapas (e.g., Collier and Quaratiello 2005). This status has afforded them greater control over their land in the present day. Their deliberate performance of Indigeneity for outsiders—often articulated through colonial tropes of authenticity and the figure of the ecological native—has contributed to the formation of a clientelist relationship with the Mexican state. In this arrangement, both Hach Winik and the Mexican government are mutually dependent: "the former has the financial resources and the 'need' to intervene [in forest conservation] and the latter the territory and bio-capital, although the balance of power constantly alters" (Trench 2008:622). Over the past 50 years, Hach Winik have either resisted or appealed to government officials for assistance—achieving significant successes in some cases (Hernandez and Valenzuela Gómez 2024; Trench 2008). For example, it was the community of Metzabok that initiated the process to become a federally protected ecological reserve, working with government officials to achieve this designation in 1998. In this context of Indigenous land ownership and stewardship, seeds for a community archaeology program sprang from development projects organized by Fabiola Sanchez Balderas and Ian Hollingshead as part of the Na Bolom Cultural Center. Through years of relationship building, they set a collaborative foundation for Joel Palka to initiate MAP.

Inspired by Native American and Indigenous critiques of archaeological practice (Colwell-Chanthaphonh and Ferguson 2008), all investigations in Metzabok and the broader region of study are conducted with the permission of the Metzabok community government, and locals comprise a majority of the field crew. It is important to note that the lead MAP archaeologists, for the purposes of multiscalar archaeological analysis, define the region of study as Mensabak. This region of study includes the town of Puerto Bello Metzabok, the UNESCO Biosphere Reserve, and sites that fall outside of the federally protected area. Mensabak is a less Westernized transcription of the Hach Winik word for a thunder/rain deity. As part of MAP, the people of Metzabok have trained to fulfill the roles of supervisor, excavator, mapper, and laboratory personnel. This work is intersectional, because men, women, Maya, non-Maya, young, and elderly work together to perform research. Care for more-than-humans—including endangered plants, sacred caves, and ancestors—also factor into how research is conducted in the region. For example, excavation units are often planned to avoid or mitigate impacts on tree roots and endangered species. Moreover, the investigation of human remains has generally been avoided. Through a collaborative investigative process, we work toward fulfilling requests to share knowledge that can aid local Maya in their stewardship of the biosphere, as well as provide expertise that youth in the community can use to enter Mexican universities (Hernandez 2018). For over 10 years we—that is, I, other outsider archaeologists, and Maya of Metzabok—have examined the history of occupation in the region.

Establishing trust via open, honest dialogue is critical to the success of MAP. During fieldwork, we engage in open conversation to learn from one another and conduct research. For example, a common point of debate during fieldwork has been the interpretation of potential human-made chert flakes. In Metzabok, as in other parts of Mexico, local limestone can break into small pieces that resemble human-made chert flakes, and when in doubt, we debate. Many community members find it hilarious when I misidentify a stone. The final say in these conversations often rests with local elders, who in the past, engaged in lithic tool production. Their experience gives them some authority to settle debates, but many community members are not afraid to challenge authoritative arguments. Within this collaborative context, I partnered with locals to initiate a community-based program of investigation that included aerial lidar.

At the request of many community members, in the summer of 2018, I initiated the investigation and consolidation of fortifications at an archaeological site within the Metzabok Biosphere Reserve

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(Hernandez 2019). This work united Maya with university researchers to promote sustainable development through archaeological and ecological heritage tourism (Hernandez and Valenzuela Gómez 2024). Via this collaborative effort, we sought to craft histories written with, by, and for a descendant community. While planning fieldwork, the opportunity arose to commission the Houston-based National Center for Airborne Laser Mapping (NCALM) for an aerial lidar survey of the entire Mensabak region (roughly 3,368.35 ha). In addition to documenting local archaeology, terrain, hydrology, and forest cover for research and conservation, MAP provided an opportunity to merge aerial-laser-scanning technology with the methods of community archaeology.

Building on the collaborative ethos of MAP, I developed a program of remote sensing that was done with and for the local community. The first major step in achieving this goal was establishing informed consent based on the following principles:

1. Providing community members with the information they need to decide whether they want their land/forest, homes, and heritage mapped via aerial lidar. Disclosure of information included aims of the investigation, methods, the kind of information being collected, data management plans (including access and data sharing requirements), and sources of funding, as well as anticipated benefits and foreseeable risks (for more information on determining risk, see HHS.gov and CITI Program).
2. Sharing the above information in a manner that is appropriate and understandable for community members.
3. Engaging in open, honest dialogue that provides opportunities for locals to ask questions and contribute their own perspectives to the proposed research.
4. Asking, through locally appropriate decision-making procedures, if community members will allow their forest to be mapped via aerial lidar.

In the case of Metzabok, establishing informed consent did not involve signing paperwork because many in the community cannot read or write. Moreover, via email consultation, several Institutional Review Board (IRB) officers determined that the lidar project did not fall under the purview of an IRB and therefore was not subject to their consent procedures. Although the above principles draw heavily from IRB procedures, this is not meant to imply that their consent practices are the only or best way forward for future aerial lidar projects. I hope this article will inspire archaeologists to develop consent procedures and ethical frameworks with Indigenous peoples and together combat Eurocentrism (e.g., Supernant et al. 2020).

Building from community-based methodologies (e.g., Atalay 2012; McAnany et al. 2015), I planned for an *asamblea*, or community meeting, where project founder Joel Palka and I would seek the informed consent of Metzabok community members. Like other Indigenous groups in the tropical forests of Chiapas, Mexico, community-wide decisions in Metzabok are made in a general assembly. An *asamblea* is called by locally elected governing officials. Via WhatsApp, I coordinated with the community leader (*comisario*) to set an October 2018 meeting. Once in Metzabok, Palka and I discussed our planned presentation with the community leader, and he agreed to call an *asamblea* on our behalf. The meeting lasted just under two hours and was held in the Metzabok community house—where official matters are typically presented for deliberation.

For the formal part of the presentation, Palka and I created PowerPoint slides to provide an overview of past field seasons and facilitate discussion of future research, including a potential aerial lidar scan of the town and surrounding biosphere (Figure 2). The use of figures in place of text was stressed by local colleagues because many in Metzabok either cannot read or struggle to do so. The aerial lidar discussion began with an explanation of how the technology works, including its centimeter accuracy, and how it would map their homes, town, and forest. Next, we presented our thoughts on why this method of data collection would be useful for creating topographic, archaeological, and forestry maps for the community and future researchers. We also discussed how the collected data would be managed, including the Mexican federal requirements for data sharing and dissemination. In 2018, this entailed the submission to INEGI of all data points (i.e., point clouds) and a three-dimensional digital image with 5 m resolution of the scanned area (i.e., Digital Elevation Model). However, the data would not be

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Figure 2. Images from the Metzabok community meeting (Photos courtesy of Josué Gómez and Christopher Hernandez). (Color online)

released for at least two years because part of the data-sharing agreement included two years of exclusive data access for the researchers commissioning the scan. In the community meeting, we stressed that INEGI would eventually make at least the 5 m resolution digital image publicly available and could, after two years, share any of the data at their discretion. We stated numerous times during the *asamblea* that we would stop for questions. A few pauses occurred when community members elaborated on our presentation to better explain aspects of the lidar project for those in attendance. However, the formal part of the presentation was less conversational than expected. The subsequent informal Q&A session led to a lively dialogue.

During the Q&A, we covered a range of topics, including further consideration of how the process of aerial lidar could be applied to generate benefits for the people of Metzabok. The *comisario*, among others, expressed that he could see the benefits for both the community and researchers. A phrase repeatedly expressed by locals during the meeting and afterward was that "it would be nice to have a record of the community." In other words, many saw the lidar as providing a snapshot of the town and protected area that could be passed down to future generations. Many also anticipated potential economic benefits. The aerial lidar survey would provide community members with better maps for tourists, which could display information about shops and areas of interest. INEGI's control of the collected data did create some hesitation, but many felt that the benefits outweighed the risk. In a later conversation, one Hach Winik colleague even quipped, "What does it matter? All of this [remote-sensing data of Metzabok] already exists in Google [Earth]." I reiterated that unlike Google Earth, aerial lidar provides highly detailed maps of the ground surface beneath the forest canopy. He thought about my statement for a moment but felt it was OK to collect and share this type of data with INEGI. Another risk we considered in the *asamblea* was the potential for increased looting. Locals felt ready to address this issue because of their prior experience with looters and with stewarding a biosphere (Nations 2023). Ultimately, the consensus in the meeting was that the community could handle any misuses of the collected data, including potential increases in looting and illegal resource extraction (i.e., poaching and deforestation). After wrapping up the discussion, which occurred in a mixture of Spanish and Hach T'an (aka Lacandon Mayan), Palka and I asked for permission to map the entire biosphere. The *comisario* and other heads in the community agreed to allow the mapping project.

Despite setbacks due to the COVID-19 pandemic, the processing of the aerial lidar data is ongoing. This work includes plans for deeper engagement with locals in geospatial analysis. In addition to formally providing the community of Metzabok with full copies of the data, I have partnered with two

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locals, Armando Valenzuela Gómez and Chankin Valenzuela Gómez, who are working with colleagues to process the point clouds for their own projects. Hopefully, their work can provide inspiration for other members of the community to develop skills in geospatial analysis that will benefit future generations. This type of collaboration will require that the people of Metzabok have ongoing access to computers with sufficient processing power to work with lidar datasets in a GIS software. Moreover, while continuing to process the lidar data, I am partnering with Armando and Chankin to create locally relevant regional maps. Years of collaboration have taught me that Metzabok community members have their own mental maps and forms of cartography that may one day be paired with lidar maps. Or, if locals decide that is not in their interest, we will continue to promote their particular Indigenous perspectives to address other issues, such as archaeological praxis and development (Hernandez 2018; Hernandez and Valenzuela Gómez 2024). Although the aerial laser scan has been completed, I am prepared to stop working with the lidar data at any point. Consent is an ongoing process and can be revoked at any time.

Discussion

Objectification is rooted in a Eurocentric perspective that is a profoundly white, heteropatriarchal, masculine, Christian positionality. Instead of being treated as people with voices, subjectivity, agency, autonomy, and the right to self-determination, this positionality renders Indigenous peoples as objects, tools, or things valued by what they can give to others. The aim of objectification is to facilitate the appropriation and extraction—in short, taking—of what the colonizer desires.

Hailed as a revolutionary tool in archaeological practice, aerial lidar is a powerful means of objectification, dispossession, appropriation, and extraction. Instead of promoting a Eurocentric onto-epistemology that privileges physical objects or natural resources (e.g., Gudynas 2018), I build on the work of Batz (2024) and Simpson (2017) to argue that remote-sensing technologies can also function as tools of extractivism. According to Simpson (2017:75), "Extracting is stealing—it is taking without consent, without thought, care or even knowledge of the impacts that extraction has on the other living things in that environment. . . . Colonialism has always extracted the Indigenous—extraction of Indigenous knowledge, Indigenous women, Indigenous peoples." By peering beneath forest cover, lidar can reveal terrestrial features that would otherwise be hidden or that outsiders would not be allowed to map with boots on the ground. In the process of locating and documenting archaeological features, aerial-lidar specialists are frequently extracting information from Indigenous lands—in the case of La Mosquitia, it was a precursor to artifact extraction.

Mapping techniques and technologies, such as lidar, have been used to claim land, life, and resources—at times, well before Europeans set foot on the ground. The ability to define the world from a Eurocentric perspective—including space-based mapping— remains at the heart of aerial lidar and mapping today, which contributes to the ongoing colonization of Indigenous peoples and their land. In this vein, I highlight how Mexican national sovereignty is rooted in Indigenous dispossession and claims of ownership that are established via Eurocentric mapping. Other forces are necessary, such as a military and governing bureaucracy, but a modern nation-state requires a map based on the principles of the graticule to establish its legitimacy on the international stage and claim sovereignty over a delineated territory. The Mexican nation-state establishes its territorial control by trampling the autonomy, sovereignty, and personhood of Indigenous peoples. Current investigators engage in and perpetuate colonial practices and objectification when they extract data from Indigenous lands without informed consent and/or provide descendants with little to nothing in return. It is in the context of ongoing colonialism that we must consider the ethics of lidar and other forms of remote sensing.

In terms of ethics, aerial lidar specialists have primarily focused on issues of looting and data management (i.e., control, access, curation, and dissemination of information). Broader societal issues—such as (neo)colonialism, sovereignty, and Indigenous oppression—have been considered, but conversations about these factors are nascent and often reactive instead of proactive (for an exception, see Davis et al. 2021). Although Cohen, Fernandez-Diaz, and others have called for greater collaboration with Indigenous descendants in the process of aerial lidar mapping, they are vague about how this type of collaboration should be conducted, which may contribute to why their call seems to be largely falling on deaf ears. A review of published works on aerial lidar research in Latin America by Cohen

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et alia (2022:565) revealed that it is unusual for a scan area to be delineated in collaboration with communities—including Indigenous peoples—who live on or near archaeological sites. MAP is their only cited exception for all Latin America. The Latin American case study has both hemispheric and global implications, given that many of the researchers who have conducted or commissioned aerial lidar surveys in the region are now advocating for scans of the Earth's entire landmass (see Fisher et al. 2022).

Conclusion

This article shines a light on how aerial lidar mapping perpetuates extractive colonial practices that objectify and oppress Indigenous peoples. I have countered the violence of objectification by highlighting Indigenous agency, voice, knowledge, autonomy, self-determination, personhood, and their overall active roles in shaping the world since AD 1492. Contributing to this effort, I applied the methods of community archaeology to the process of aerial lidar mapping. MAP is not perfect, but it strives to improve by acknowledging local/descendant voices, engaging with diverse perspectives, and acting on our shared interests. In Mensabak, I developed an aerial lidar project that grew out of a community-based program of investigation and praxis. Our aims were to understand past Maya worlds and thereby promote local/Indigenous well-being (Hernandez and Valenzuela Gómez 2024). As a foundational step in this collaborative process, we built open, honest partnerships based on the ongoing establishment of informed consent. Moving forward, I recommend that it become standard practice in aerial lidar publications to state whether, how, and from whom a researcher(s) obtained informed consent.

Returning to the issue of rapid technological development and the push for innovation, aerial lidar research is often driven by (or at least feels the pressure of) fast capitalism—that is, innovate, grow, and quickly capture the market—which explains the global proliferation of aerial lidar surveys. Moving fast, at times by design, means that formal ethical principles are left by the wayside and have not kept up with the development and implementation of new technologies. To counter the insatiable, violent, and unsustainable drive of fast capitalism, I foreground ethics as a starting point for research. Instead of an afterthought, research should emanate from an explicit ethical standpoint. Doing so requires investigators to slow down, reflect critically with myriad stakeholders, and engage in praxis. Collaborative, humanizing praxis entails the building of consensual relationships and engaging in reciprocity with a greater diversity of persons. For this reason, researchers must be willing to forgo investigations that may cause harm or that do not align with the interests of local, descendant, or other stakeholders. In short, a true revolution will weave together technological innovation with collaborative, humanizing praxis.

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