

Thomas Patrick Pringle

# Streaming is Doing: The Environmental Impact of Digital Media and the Ecosystem Service Economy

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## Abstract

A 2021 YouTube campaign produced by Sheba Brand promises that by viewing advertisements online, individual users help support coral restoration projects. The videos ask users to share the content and maintain that each discrete view obligates the cat food company to donate money to assist regrowing coral reefs decimated by pollution from industrial fishing practices. Under this logic, streaming becomes practical environmentalism. The waste produced by streaming digital media has been the object of recent critique, notably advanced by Laura Marks et al. (2020). This paper builds on that research by approaching the question of digital media's waste from the perspective of political ecology. This field critically evaluates the ecosystem service economy as a development in capitalist environmental economics that restores and manages the earth's natural systems by interpreting them in terms of biotic value. From this view, Sheba's corporate greenwashing signals the emergence of a media representational practice whereby the individual act of viewing on one's computer equals the restorative manipulation of a physical ecosystem. Thus, Sheba's campaign illustrates a counterpart to the critique of the environmental toll of streaming media, as streaming *is* doing.

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## I. The Trouble With Digital Waste

A 2021 article in *The New Yorker* titled "Why Bitcoin is Bad for the Environment" lays out a recent environmental problem in stark terms. A retired coal power plant in Dresden, NY has been repurposed by a private equity firm, Atlas Holdings, to run on natural gas for the sole purpose of running computers around the clock to mine bitcoins. Elizabeth Kolbert writes that global bitcoin mining operations "now use energy at the rate of nearly a hundred and twenty terawatt-hours per year. This is about the annual domestic electricity consumption of the entire nation of Sweden."<sup>1</sup> Beyond cryptocurrency, and to extend Kolbert's diagnosis, the relationship between networked computation and the material impact of its accelerating energy toll is also a bad thing. Media studies scholarship with firm and important commitments to environmental activism has given increasing critical attention to the issue.<sup>2</sup> Yet, as a panel of scholars foundational to this field of study recently write, "[d]espite these findings, the notion abides that digital media are immaterial."<sup>3</sup> The ideology maintaining the "immateriality" of digital communication, critiqued from the earliest days of "digital" media,<sup>4</sup>

persists in blocking the environmental political consciousness of users. It remains difficult for users to understand that the active *use* of digital devices implies the production of physical waste somewhere else, in this case the accumulation of carbon dioxide released from burning fossil fuels for energy production as well as pollution released from information storage and processing. The environmental impact of computing has been drawn into sharper public relief through increased awareness of both the carbon footprint of ICTs and the extractive landscapes and geographies of e-waste that form through circuits of digital commodity production and disposal.<sup>5</sup> But what user-centered epistemology does highlighting the materiality of digital media *create*? If streaming is doing something physical to the planet, what user-centered ideologies of *remediation* emerge alongside the concept of digital waste?<sup>6</sup>

Subsequent reporting on the Greenidge bitcoin plant in Dresden is instructive here. Located on the shore of Seneca Lake, government permits allow the plant to take in 139 million gallons and discharge 135 million gallons of water daily for cooling purposes. "The lake is so warm you feel like you're in a hot tub," says resident Abi Buddington, while the EPA notes that such "[r]ising water

temperatures can stress fish and promote toxic algae blooms.<sup>7</sup> As most of the energy used by bitcoin miners derives from fossil fuel consumption, the waste products of the raw computation required for cryptocurrency production are generally framed in terms of carbon dioxide pollution and the cumulative alteration of the atmosphere's chemistry, otherwise the industry's carbon footprint. However, the rising temperatures of Seneca Lake occasion a new deliberation on the waste produced by digital media use. The heat released by Greenidge creates a generative biophysical impact that is legible as pollution, since it's the byproduct of industrial computing reliant on burning natural gas. Yet the unplanned growth of algae signals how the concept of waste relies on anthropocentric social values of what is considered a pollutant and what is not.<sup>8</sup> By contrast, for the algae, the waste emitted by bitcoin mining creates an ideal milieu for life and growth. While projects like the one at Greenidge inspire important criticisms that link the environments destroyed by the byproducts of computing to actual ICT use, these relationships also raise questions about what kind of biophysical ecosystems digital media create beyond their stubborn profession of immateriality.

## II. Streaming Is Doing, Or: Isomorphism Between the User and the Carbon Footprint

Recent scholarship in the history of science, Marxian political economy, and media studies has ascertained the historical conditions that enable the idea that the waste products of industrial civilization might be “naturally” assimilated through the autonomous functions of the planet.<sup>9</sup> From the view these scholars interrogate, the destructive activities of capitalist market economies are excusable because ecosystems are theorized to be complex and resilient entities that independently recover from both physical disturbance and pollutants, whether anthropogenic or “natural.”<sup>10</sup> Leah Aronowsky shows how Royal Dutch Shell sponsored James Lovelock's environmental research that developed Gaia theory—the idea that the biosphere is a complex cybernetic system self-regulated by life—which, in turn, enabled public relation campaigns of climate denialism to maintain that nature had “learned to cope” with industrial waste.<sup>11</sup> This literature highlights how the historical emergence of post-Fordist economies

does not entail the end of industrial production and its waste products. Instead, modes of “flexible accumulation” obfuscate the material impact of industry through “time-space compression.”<sup>12</sup> Post-Fordist industry moves from cities to rural areas or gathers in the Global South, corporate sovereignty wins fights against environmental regulation, and promissory greenwashing campaigns about utopian technologies for the future remediation of waste mean that “post-Fordism allows itself to disregard the effects of waste production entirely.”<sup>13</sup> Waste products move out of the immediate lines of sight that gave rise to the environmental movement, hidden now by networked communication, geographic removal, and promises of redress in the future. But post-Fordism does not entail the end of industry nor the end of industrial pollution. And despite its immaterial associations, computation remains an industrial process.

At stake for these scholars is a question about how waste means different things at different points in time, thus waste is a concept subject to social change. Shifting definitions of pollution have material implications for what people do to physical landscapes. For instance, looking to recent corporate claims of bioremediation enabled by earth system science, Melinda Cooper states expressly that “[s]uch theories may well have their origins in essentially revolutionary histories of the earth [...], but in the current context they are more likely to lend themselves to a distinctly neoliberal antienvironmentalism.”<sup>14</sup> In this sense, waste is an instrumental but philosophically vexed concept, one defined by anthropocentric values that designate the unwanted or detrimental byproducts of industrial production, *but one that also implies specific and historical modes of remediation and restoration*. Carbon dioxide is the existential waste product of our time, determined by social dependence on fossil fuels for energy. Yet, as Anne Pasek writes, some climate deniers termed “carbon vitalists” have looked to contemporary life sciences to rethink “carbon dioxide as life rather than as pollution,” culturally recoding waste for its bioremediating potential.<sup>15</sup>

The carbon footprint is one such historical and social construction for understanding waste, enabling important materialist critiques of environmentally destructive practices but also supporting an epistemological framework “popularized by British Petroleum” to shift

## STREAMING IS DOING

environmental political responsibility from corporate to household and individual scales.<sup>16</sup> As Laura U. Marks, Joseph Clark, Jason Livingston, Denise Oleksijczuk, and Lucas Hilderbrand have recently pointed to, viewing the internet through the framework of the carbon footprint reveals the stunning estimate that “data servers, networks, and consumer devices, currently emit [between] 2.7–3.3 percent of global greenhouse gases [...] and is cautiously projected to comprise 7 percent of global greenhouse emissions in 2030 and 15 percent in 2040.”<sup>17</sup> This unambiguously indicts the contemporary means of digital communication as an environmental crisis demanding urgent action. At the limit of the implications of this scholarship looms counterfactual questions about whether the digital project was ever a good idea.

Yet, framing digital waste in terms of carbon production is not just descriptive. Such theoretical frameworks are operative and imply downstream reception and action. The carbon footprint, as a description of waste, is epistemologically positive and tied to contemporaneous modes of remediation, like carbon offsets. Offsets come with their own problems. They are sustainability programs that scholars frequently critique as unproven, unenforceable, ineffective, and neocolonial tools in mitigating global climate change.<sup>18</sup> Further, emphasizing the carbon footprint of digital media reifies the notion that users materially change the planet through individual computer use, which remains an industrial process despite its personal connotations.

Art projects such as Joanna Moll’s web installation, *CO2GLE*, show the direct and didactic translation of digital information and user activity into a live metric of globally scaled chemical waste,<sup>19</sup> indexing the user’s time spent online to the concurrent release of CO<sub>2</sub> by the kilogram. This is a deeply isomorphic representation of the relationship between energy spent as computational work and the user consumption of digital information over time, one that effectively challenges the persistent ideology of digital media’s immateriality. At once, *CO2GLE* amplifies and cements a different ideology: the ability for individual users to comprehend *streaming as doing*, signifying personal time spent online within the atmospheric chemistry of the unfolding climate crisis. As Wendy Chun reminds us, “[c]rises—moments that demand real

time response—make new media valuable and empowering by tying certain information to a decision, personal or political (in this sense, new media also personalizes crises).”<sup>20</sup> Through such an isomorphic lens that empowers the individual user to *change the world* through digital media use, a YouTube advertising campaign developed by Sheba cat food brand would also have users regrow a damaged coral reef one view at a time.

This article examines Sheba’s promotion of the HOPE reef on YouTube as paradigmatic of the coincidence of greenwashing strategies, ecosystem service restoration economies, and the remedial implications of the concept of digital waste. In exhibiting this conjunction of discourses, Sheba’s HOPE reef allows me to highlight a concern adjacent to the scholarly concentration on the material implications of digital media: the user-centered focus on streaming impacts corresponds to the enduring escapism of individual consumption as political agency in liberal environmentalism.<sup>21</sup> If streaming produces waste as a byproduct of computation, then streaming on one’s desktop means doing something physical to the world. The trouble lies in how this equation enables an imaginary relationship to the real conditions of digital waste not reducible to that designation.<sup>22</sup> This structured and mediated imaginary relationship makes possible the idea that streaming might be remedial and restorative. Sheba’s digital ecosystem service restoration economy relies on the notion that digital media are operatively material, and that streaming is doing.

### III. Pollution, Remediation, and the Restoration Economy

Human societies have long been aware of the need to fix environmental conditions disrupted by their own modes of production. Remedial and restorative innovations generally take place after the fact of realizing how development has polluted or changed the behavior of a landscape. For instance, to defend against diseases endemic to monocultural farming, early agriculturalists practiced fallowing and crop rotation.<sup>23</sup> The modern concept of pollution emerged in the nineteenth century,<sup>24</sup> but it wouldn’t be until the 1980s in the American context that environmental engineering would turn its attention from controlling waste toward the concepts of remediation and

restoration. Waste became quantitatively legible as environmental pollution that could be managed through the maturation of systematic standards and regulation in the 1950s. But it would take three decades of research, technological development, and legal adjudication before the modern sense of remediation became a widespread idea,<sup>25</sup> borne from the twentieth century's nascent environmental movement and spurred by popular concern about toxic pollutants from industrialization as well as post-war consumption practices.<sup>26</sup>

By the 1990s, environmental economists had started advancing eco-modernist theories that articulated how free market capitalism might incentivize and regulate the mitigation and restoration of sites damaged through manufacturing or development.<sup>27</sup> "Natural capitalism" was the theoretical term employed to describe "strategies for incorporating biological growth into the very infrastructure of production. [...] [V]ision[s] of an economic future in which the specific ability of life to self-regenerate—to transform 'detritus into new life'—would be mobilized as a means of overcoming the waste-products of industrial production."<sup>28</sup> For instance, a developer might be issued a government permit allowing for the pollution or raising of a wetland ecosystem, only if they committed to creating or restoring another wetland somewhere else. These practices put market prices on the "ecosystem services" delivered by an ecologically definable parcel of the environment, say, \$45,000 USD as an average monetary price for the biotic value produced by an acre of wetland.<sup>29</sup>

As Gretchen C. Daily writes, ecosystem services "are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life. They maintain biodiversity and the production of *ecosystem goods*, such as seafood."<sup>30</sup> Media studies, particularly research examining the legacies of cybernetics, early computing, and robotics,<sup>31</sup> has a rather unique historical claim to understanding how ecosystem services became practices of "natural capitalism." The origins of ecosystem services are generally associated with the ecology of Howard and Eugene Odum, who theorized nature as cybernetic systems in the 1950s and 60s.<sup>32</sup> Their research produced methods for understanding how to enumerate and, ultimately, economically value nonhuman processes.<sup>33</sup> This intellectual project ascertained what was valuable for human society about the

continued life of specified ecological functions, which would be appreciated as the "life support systems" for people living in cities, but also for the maintenance of industry.<sup>34</sup> As Rosemary-Claire Collard and Jessica Dempsey write, "[i]n marking off different contributions of nature quantitatively (in flows of biophysical services and sometimes in monetary equivalents), the hope here is to *prioritize* state or private financial investment."<sup>35</sup> Ecosystem service economics operate with the hybrid assumption of socioenvironmental unity, wherein capitalist market forces might stabilize or restore environmental degradation.

Some ecosystem service projects look like risk management, such as the growth of artificial oyster reefs off the coast of Staten Island to protect New Yorkers from future floods while promising to remediate polluted waters.<sup>36</sup> Others center "payments" in commodity markets linking the "providers" and "consumers" of ecosystem services, most commonly through carbon sequestration projects for the sale of offsets or watershed and biodiversity conservation schemes, but also through selling more abstract products like "landscape beauty."<sup>37</sup> As Sara H. Nelson and Patrick Bigger argue, ecosystem services as commodities are novel in the history of capitalism, as they establish nature's forces as supporting infrastructures *for capitalism*, while denying their anthropocentric valuation: "What is new about infrastructural natures is not that 'nature' has never before been subject to market logics but that those reproductive processes whose very naturalization and externalization has been essential to capitalist reproduction are themselves made into sites of investment and value extraction without, however, 'denaturalizing' them."<sup>38</sup> Ecosystem service economies construct and frame biophysical sites as either productive or remedial "natural infrastructures." These sites are socially recognized as "natural" despite their imbrication within, and support for, capitalist modes of extraction, production, and good circulation. For example, Shell has developed wetland and oyster reef restoration ecosystems "to protect oil and gas infrastructure from storm surges and erosion."<sup>39</sup> Dow Chemical works with The Nature Conservancy to write software for comprehending "the economic value of Dow's dependencies on ecosystems such that these can be incorporated into the company's net present value calculations."<sup>40</sup> There are clear



## STREAMING IS DOING

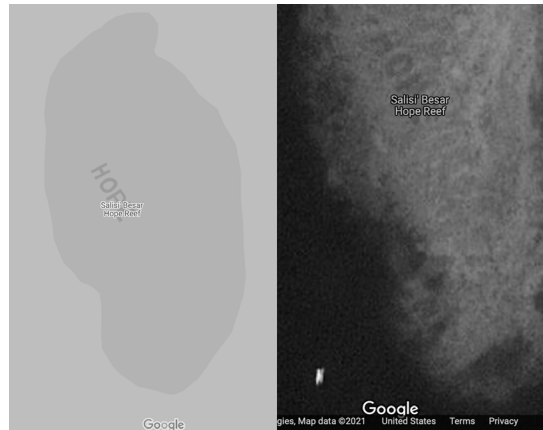
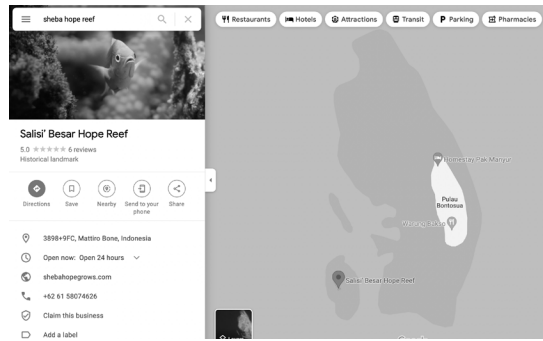
stakes in these debates for media studies beyond how media technologies make resource value legible.<sup>41</sup> In this article, I highlight Sheba's "Hope Reef" project to initiate an interdisciplinary conversation between scholars in environmental studies examining ecosystem services and those critiquing the ecological toll of digital media use. When developed for users of digital media, can ecosystem services also count as digital waste?

### IV. Fish Futures: Sheba's "HOPE Reef" Ecosystem Restoration Project

Sheba brand's 2021 YouTube campaign is remarkable. The cat food company's official streaming channel features 10 distinct videos explaining, thematizing, and aestheticizing a coral reef restoration program growing near an island off the Southwest coast of Indonesia. Salisi' Besar, as the reef was formerly known, has acquired the new moniker "HOPE Reef." Using hexagonal reef stars, two-foot steel structures coated in resin and several layers of sand that produce a rough surface for coral fragments to take hold, divers prepare a reef foundation on the ocean floor where a former reef was decimated by dynamite and chemical contamination from cyanide fishing. The stars support the rapid regeneration of the reef.

Sheba's videos highlight that the stars are hand-produced by Indonesian communities living in the region, who refashion locally available materials. This provides employment and "cut[s] down the carbon footprint of transporting them from elsewhere."<sup>42</sup> Four divers can place 250 of the reef stars in one day, covering two acres in 20 days. In 2018, divers arranged 840 reef stars, composed of 13,000 discrete pieces and 42 species of coral, to spell out the word HOPE in 46 by 30-foot letters. By 2021, as the videos point out, the letters had grown tall enough to be visible by satellite imaging. Google semiotically consecrated the underwater landscape using both Google map's terrain and default layers. Hope not only floats, it grows.

It would be easy to take a cynical view of this effort as a simple exercise in greenwashing the industrial fish farming that supplies the cat food industry. Particularly irksome is the suggestion of a silver-lining in how the locally sourced steel for the reef stars draws down a small Indonesian island's supply chain carbon footprint, when the destructive fishing practices that led to the reef's decimation



Author's screenshots showing HOPE reef on Google maps' default and terrain layers, (2021).

in the first place primarily implicate the globalized reach of foreign corporate demand. Sheba's carbon footprint assuredly outweighs that of Pulau Bontosua. Perhaps it's out of a sense of metonymic guilt that Sheba would initiate this project here, and more broadly found the world's largest coral restoration program. As explained in one of their videos, Sheba's motivations for coral reef restoration realize theories of ecosystem service management, where, in their words, "[a]t Sheba we believe that the high-quality food cat's love should never come at the expense of the planet. And it's not just our cute little blue fish." But this case study introduces a more complicated form of greenwashing, one that relies upon the idea that streaming media equals material intervention in the world.

The video goes on to explain that twenty-five percent of marine fish rely on coral reef habitats and that, barring restorative intervention, most reefs will be gone by 2043. Further, the narrator recounts, "in addition to changing our own supply chains, we wanted to play an active part in protecting the planet for future generations –



Screenshot of sequence from “No. 2 Why is a Cat Food Brand Restoring Reefs? | Behind The Scenes | Sheba Hope Grows,” SHEBA® Brand, (2021).

ensuring a sustainable fish future, not just for our cats, but for the billion people who depend on coral reefs for their livelihoods. Because more coral today means more fish tomorrow.”<sup>43</sup> While vaguely implying that Sheba’s own supply chains have involved destructive fishing practices in the past, the videos assert that coral restoration projects are not only essential to supporting coastal economies writ large but provide a crucial and *living support infrastructure* for the cat food industry. Regrowing reefs, and the biodiversity that ecosystem health entails, secures what Sheba calls a “fish future,” wherein the autonomous growth of a restored ecosystem supports an existing extractive global market into the future, but sustainably so. Within this fish future, Sheba’s videos presume the corporation, and the hopeful ecosystems they have cultivated, remain a permanent supplier within the consumer media ecology linking pet ownership in Western developed nations to the supply of labor in Indonesian fishing communities and the reproductive processes of the reef itself. From reef to trawler, transport to grocery store, and, eventually, domestic feline predator, a new and “sustainable” supply chain ecosystem takes form.

## V. Streaming Reefs: Restoring Ecosystems by Viewing Digital Media

Outlined in the form of a promise, the videos ask digital media users to share Sheba’s streaming content, as each discrete view would obligate the company to donate money in sustenance of their proposed fish future. As “Help Restore Coral Reefs. Watch The Film That Grows Coral” explains, “more coral today, means more fish tomorrow. But how can you help? You already have. Just by watching this film you’ve raised funds for reef restoration.”<sup>44</sup> Chun has argued that user intervention is new media’s “critical distinction,” where crises “promise to move us from the banal to the crucial by offering the experience of something like responsibility, something like the consequences and joys of ‘being in touch.’”<sup>45</sup> Such “empowered user[ship]” is literalized here, where the act of streaming would beget practical environmentalist participation in a crisis unfolding in “real time.”<sup>46</sup> By viewing, streaming, and sharing, the user ostensibly helps rebuild a reef off the coast of Indonesia by taking part in Sheba’s corporate restoration ecosystem.

In her critique of the humanitarian ethos hyperbolized in participatory documentary media, but identifiable in “documentary immediation” generally, Pooja Rangan discusses Chun’s point and elaborates how new media link users to geographically disparate crises by indexing the temporality allegedly shared by live technological links between here and there: “The real time of the humanitarian emergency, which is shot through with the literal significance of human lives hanging in the balance, provides an opportunity like none other to affirm the participatory, interventionist capacity of new ‘personal’ media technologies.”<sup>47</sup> Lucas Hilderbrand has recently worked to adapt Rangan’s study from the participatory documentation of humanitarian crises to nature and ecodocumentary programming, which implies catastrophe for human civilization by way of imaging the degradation of nonhuman environments: “The curious condition of this genre is that it has historically imagined nature and humanity as distinct realms and has perpetuated an artificial separation, even when it argues for human impact.”<sup>48</sup> Both studies question the work of documentary as a Griersonian social institution assumed to communicate information for the purposeful effect of public awareness and political

## STREAMING IS DOING

change. Humanitarian documentary produces a sense of involvement for its audience, thrives on the endangered life of its subjects, and leaves systemic structural inequality intact.<sup>49</sup> Nature programming likewise marshals viewer concern as “a genre about human causes and consequences (for implicit is not just that other animals but also humans are at risk of extinction).” Such programming, however, “often renders the human out of sight.”<sup>50</sup>

The Sheba project exemplifies some of these concerns, including how such greenwashing emanates from a post-Griersonian documentary condition. The videos posit the act of documentary communication, and the pedagogy of a social issue, as *political change* in and of itself. This documentary instantiation appears to build both a greener reputation for Sheba amongst consumers and a biophysical infrastructure supplying resources for the transnational corporation’s products. The fifth video in the series, “Watch Soothing Coral to Grow Reefs,” is a two-hour-and-fifteen-minute video mostly composed of a single, immobile submerged shot from the surface of HOPE Reef. Resembling a live wildlife cam, the video records some recent point in the reef’s history. A caption reads: “The longer you listen to this oceanscape and watch our slow TV channel, the more raised to help future coral restoration projects.”<sup>51</sup> The video implies that the time the user spends watching fish swirl around a short-cropped reef equates to the rate of actual coral growth, fueled by restoration funds pinned to each discrete view. Sheba informs users that the act of streaming materially correlates to their personal and virtual humanitarian intervention in Southeast Asia, as mediated by digital video and money. While watching this video for two hours, users start to gain an appreciation for the planning that HOPE reef required in relation to its digital appearance. The video’s duration corresponds to the causality of growth implied by viewing coral in supposed real time. Isomorphism characterizes the video’s aesthetic form by equating the act of viewing with coinciding material and ecological change. To register a deeper shade of irony, perhaps accumulated views restoring coral reefs could one day offset the concurrent user impacts of digital media use elsewhere. Perhaps users might binge-watch *Netflix* and offset that experience by streaming HOPE reef at the same time.

Seeded three years prior to the publication of the videos, Sheba ensured the word HOPE

would be legible on the ocean floor for the foreseeable future, barring a catastrophic event or the resumption of dynamite and cyanide fishing. At once, Sheba secures brand identification with the landscape itself for that same, indeterminate time ahead. It anticipates a future audience who are willing to grow coral by way of YouTube, or perhaps digital flaneurs who stumble across a platitude scrawled across Google Earth where it shouldn’t be. The growth of this reef, and its realization of species diversity, is as much social and digital as it is biophysical. The video is a recognition of economic value *in the relations between* a virtual audience, the growth of coral, and the sustained labor of an Indonesian fishing community. It’s an investment for a digital audience in the present, but also an image of anticipation for a digitally connected market base in the future.

While “Watch Soothing Coral to Grow Reefs” writes out human presence from its reef-level view entirely, Sheba’s video #3, titled “Meet the Island Community,”<sup>52</sup> paternalistically emphasizes the economic transition of Pulau Bontusa from a past of unsustainable fishing to the stewardship model of the reef ecosystem service. What’s implied by the video is the establishment of monetary value not only in the reproductive forces of the reef, but also in the relational value found in the autonomous, reproducing bonds displayed between a growing reef, a labor pool in Indonesia, and consumers in digitally connected, English-speaking, and presumably Western nations. The ultimate point of value creation in the Sheba videos, then, is not just the ecological relations between reef and variety of marine life, but between reef, Indonesian labor, and elite consumers on the other end of a supply chain. This capitalist ecosystem values fish, people, the internet, and pet cats. The videos invest in the relations between these digital and ecological entities and attempt to restore and stabilize an ecology of relations between them for the foreseeable, and profitable, future. What kind of commodity is this landscape? Like the carbon emitted to support global communication networks, is the HOPE reef digital waste?

Corporations turning to ecosystem services do so for two primary reasons. The first is due to legal mandate, where, for instance, destroying a wetland in one site to build a factory obligates the creation of a new one in a separate location. The second is out of need, where a resource has been depleted

because the ecosystem supporting its abundance has been undermined, or because an existing supply chain relies on an ecosystem's service to uphold commodity production or circulation. For example, Coca-Cola's bottling subsidiary FEMSA collaborates with The Nature Conservancy and the Inter-American Development Bank to work in upstream watershed conservation services in Latin America to ensure reliable access to downstream water by cities and industry.<sup>53</sup>

At least as stated, the latter is Sheba's motivation, where facilitating a shift in employment on the small Indonesian island of Pulau Bontosua—from destructive fishing practices to ecosystem stewardship—helps guarantee a more predictable, sustainable, and presumably longer-lasting supply of marine resources. A perceived shortage in the market, due to chemical waste released by destructive fishing practices, begets an ecosystem service response to stabilize the reef. This retains both resource supply and labor, putting the reef and neighboring community to work in the process. But an economic focus can't fully explain the advertising gimmick of pinning monetary contributions to restoration with each and every individual user's view, beyond how this campaign maintains a pet food consumer base through viral marketing.

As Martin Doyle and Rebecca Lave write in their study of stream mitigation banking, ecosystem services are somewhat different affairs from the already complex process of establishing a stable value for a natural resource: "Effectively, [markets for ecosystem services] are commodity markets, although the commodity for sale is not a crop or production input, such as grain or timber, but is instead the service provided by a particular ecosystem."<sup>54</sup> In this case, the service provided by the reef would be the biodiversity needed to support a future with enough fish. Like other ecosystem services, this one rationalizes a way to take the so-called "free gifts" of the environment—here, the ecosystemic relations of reef biodiversity supporting fish population—and establish them in a human rubric of monetary value. However, "[m]aking a standardized, saleable commodity out of complex, messy, above all *interconnected* ecosystems and their services turns out to be substantially harder than making a commodity out of trees or wheat."<sup>55</sup> There are serious questions for these projects regarding the uncertainty involved in *restoring* degraded and polluted landscapes to

a former "operating" state. Is it even possible to evaluate whether the reef works the same way after restoration as it did before? If ecosystem service economies isolate specific use-values in complex natural processes, how can the prioritization and legibility of a given environmental function stay reliable as an ecosystem individuates and grows?

As much as Sheba claims to be restoring this damaged reef, Salisi' Besar did not develop in alphabetical shapes prior to its reincarnation as HOPE reef. Beyond providing a fish future, the reef's ability to grow in a controllable manner and spell words visible to satellite imaging has been ascertained and cultivated for the purpose of digital advertising for Sheba's remote and virtual audience. HOPE reef is not semiotically legible from boat-level-view nor to fish. The reef's current biophysical value exists not just to maintain supplies of fish, but also as a living architecture for online greenwashing commercials, blueprinted for the consumption of a cliché by users streaming digital media. While not precisely an energetic byproduct of internet infrastructure, HOPE reef is a physical effect of the remedial implications of the idea of digital waste, where streaming is both viewing and doing.

Due to tensions between *allegedly restoring* a previous state of an autonomous natural system and needing that system to have certain, predictable, and reliable future outputs according to the economic rationality of ecosystem services, the actual landscapes produced by these projects often appear strange, and unlike their antecedents. An example from Doyle and Lave's book shows a creek in North Carolina where the stream's meander adopts nearly symmetrical sine waves as it moves through the earth. In name, such streams are termed restorations, as though lifted from a degraded, wasted state. But both form and placement are a warped facsimile of previous configurations, bent into repeated turns by natural and cultural forces, including management and the economic dependency of expected resource output, but also erosion and equilibrium. Looking to Sheba's HOPE reef, this ecosystem's growth—its systemic individuation—is occasioned not just by forces like gravity, deposition, and water composition, but also by the capitalist interpretation of what counts as waste, and its correlative modes of remediation and restoration in this historical moment. HOPE reef might promise a fish future for the economy of Pulau



## STREAMING IS DOING

Bontusa and by extension consumers of cat food, but the reef's growth into an anthropomorphic message shows how this ecosystem service also anticipates its digital viewership. It is both a landscape byproduct of digital viewership and a support structure for a transnational "sustainable" extractive economy. A wasted reef is value wasted.

This article shows how the notion of digital waste has an inverse consideration, underlining how capital might accept the materialist terms of relation between digital media use and its waste products. Following Cooper, I seek to "work in

the prospective mode, to detect and preempt the new forms of scarcity that are being built into the promise of a bioregenerative economy."<sup>56</sup> I do not intend to distract from the critiques of digital energy use, but to highlight how capital thrives on social concepts that organize relationships between society and nature. Whether or not the immaterial idea of digital media use still persists, Sheba shows that an emerging, *personal* political consciousness surrounding digital media's biophysical impact can translate into securing profits for the foreseeable, and globally warmed, fish future.

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### Notes

1 Elizabeth Kolbert, "Why Bitcoin is Bad for the Environment," *The New Yorker*, April 22, 2021, <https://www.newyorker.com/news/daily-comment/why-bitcoin-is-bad-for-the-environment>; Also on this point, I am grateful for the panel conversation I had about the Greenidge plant with Ranjodh Singh Dhaliwal, and his work on computation as thermal media, at 4S 2021.

2 See: Laura U. Marks, "Let's Deal with the Carbon Footprint of Streaming Media," *Afterimage* 47, no. 2 (2020): 46-52, and Laura U. Marks, "A Survey of ICT Engineering Research Confirms Streaming Media's Carbon Footprint," *Media+Environment*, August 23, 2021, <https://mediaenviron.org/post/1116-a-survey-of-ict-engineering-research-confirms-streaming-media-s-carbon-footprint-by-laura-u-marks>

3 Laura U. Marks, Joseph Clark, Jason Livingston, Denise Oleksijczuk, and Lucas Hilderbrand, "Streaming Media's Environmental Impact," *Media+Environment* 2, no. 1 (2020): <https://mediaenviron.org/article/17242-streaming-media-s-environmental-impact>

4 See especially "The Materiality of Informatics" in Katherine N. Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics* (Chicago: University of Chicago Press, 1999).

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6 Jay David Bolter and Richard Grusin have developed this term regarding how new media refashion earlier media forms. My use of the term stems from the word's etymological origins in "remedy" that came to inform the concept of remediation. As Bolter and Grusin note, remediation has been previously used to describe how new media remedy prior technologies. My adaptation of this term focuses on how digital media allegedly remedy environmental disruption. Jay David Bolter and Richard Grusin, *Remediation: Understanding New Media* (Cambridge: MIT Press, 1999), 273.

7 Gretchen Morgenson, "Some locals say a bitcoin mining operation is ruining one of the Finger Lakes. Here's How," *NBC News*, July 5, 2021, <https://www.nbcnews.com/science/environment/some-locals-say-bitcoin-mining-operation-ruining-one-finger-lakes-n1272938>

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- 11 Aronowsky, "Gas Guzzling Gaia," 306-7.
- 12 David Harvey, *The Condition of Postmodernity: An Enquiry into the Origins of Cultural Change* (Cambridge: Blackwell Publishers, 1989), 141-172 and 284-308. For Harvey, flexible accumulation theorizes capitalist responses to a crisis of accumulation post-1973, inclusive of the devaluation of the gold standard, in conjunction with the factory giving way to finance.
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- 14 Cooper, "Bioeconomy," 41.
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- 16 Anne Pasek, "Mediating Climate, Mediating Scale," *humanities* 8, no. 159, (2019): 6.
- 17 Marks et al., "Streaming Media."
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## STREAMING IS DOING

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