Decolonizing the Natural Sciences

A Critique of the Colonial Foundations of Western Scientific Authority

Authors: Ashley M. Gjøvik, B.S., J.D. (ashleymgjovik@protonmail.com) | **Date**: July 23 2025

Abstract:

While many other academic disciplines are starting to address their colonial legacies, the natural sciences have remained largely exempt from similar scrutiny, while concurrently housing some of the most problematic systems and pedagogical dogma. This paper offers a critical review of Western scientific culture through a decolonial and relational epistemological lens. This critique identifies structural patterns in scientific practice that reflect extractive, possessive, and anthropocentric assumptions including taxonomic naming that functions as intellectual appropriation, "discovery" paradigms that deny natural existence, and publication gatekeeping that excludes important scientific discoveries if challenging to institutional anthropocentric positions.

The paper demonstrates alternative models of inquiry grounded in reciprocity, agency, and consent. These examples reveal how knowledge emerges from conditions of trust and relational accountability rather than extractive procedure and examination. Rather than proposing reforms to colonial institutions, the paper suggests building separate infrastructures that bypass Western scientific gatekeeping entirely. This work challenges the field to move toward recognition of agency and intelligence throughout the living world, and urges scientists to meet the world where its at and to observe with curiosity, to communicate and listen, and to be humble in the presence of the magnificent universe. The future of scientific inquiry is asking questions that life is willing to answer through relationships of reciprocity rather than extraction through domination.

Keywords:

decolonization; scientific colonialism; relational methodologies; consent-based research; knowledge sovereignty; scientific property rights; nonhuman agency; biosphere; the rights of nature; Gaia principle; Anthropocene; posthumanism; post-modernity; environmental justice; community-based research; symbiosis; settler reparations.

Citation:

Gjøvik, Ashley M. Decolonizing the Natural Sciences: The Colonial Foundations of Western Scientific Authority. *The Journal of Decolonized Ecology & Evolution,* Volume 1, Issue 1, July 23 2025, DOI: 10.5281/zenodo.16202629

Table of Contents

Introduction

Recently, numerous fields have attempted critical self-assessment through the lens of decolonial theory. These disciplines (including history, anthropology, art, and education) have increasingly recognized their entanglement with colonial power structures. Some have even started to revise their epistemologies and practices. The result has been a growing body of scholarship that challenges inherited assumptions and reconstructs methodologies around principles of reciprocity, contextual knowledge, and relational ethics.

By contrast, the natural sciences have largely remained outside of this conversation. Despite its deep historical ties to imperial expansion (from botanical expeditions that enabled agricultural colonialism to taxonomic systems that paralleled territorial conquest), Western science has often presented itself as neutral or exempt from decolonization analysis.

The Western sciences often frame themselves as objective, apolitical, and universally valid across cultures and contexts. This hollow marketing has allowed many deeply colonial, foundational elements of scientific inquiry to persist without substantive critical review. This paper argues that such an exemption is no longer tenable.

Western scientific culture retains key structural and epistemological features that originate from and continue to reproduce colonial and extractive systems. These frameworks actively constrain the kinds of questions that may be asked, the forms of knowledge that receive validation, and the ways in which organisms are studied.

This review synthesizes existing literature to identify patterns of linguistic dominance, extractive authorship, institutional exclusion, and procedural violence. It examines how these patterns shape scientific practice, while also exploring alternative models grounded in reciprocity, consent, and nonhuman agency.

The Colonial Roots of Scientific Practice

The entanglement of Western science with colonial expansion is a foundational issue. The institutions, methodologies, and epistemological frameworks that continue to shape scientific practice today emerged directly from imperial projects of conquest. (Alves et al, 2023).

The Royal Botanic Gardens at Kew, established in 1759, exemplifies how scientific institutions served colonial economic interests. (Kew, 2020). Kew functioned as the central hub for a global network of plant collection and redistribution that facilitated the transfer of economically valuable species from colonized territories to imperial centers (Drayton, 2000; Nielsen, 2023).

These expeditions operated through "imperial eyes," a way of seeing and cataloging the natural world that rendered complex ecological and cultural relationships invisible while extracting isolated specimens for European study and profit. (Pratt, 1992; Das and Lowe, 2018). The very concept of the "botanical specimen" (a dead, dehydrated, compressed, labeled fragment of nature, fully divorced from its living context) embodies this extractive logic.

Natural history museums, established throughout the 19th century, functioned as repositories for colonial extraction. The British Museum, the Smithsonian, and similar institutions accumulated vast collections through networks of colonial administrators, missionaries, and travelers who rarely sought consent from originating communities (Fforde et al., 2002; Wali et al, 2023).

Carl Linnaeus's binomial nomenclature system, still used today, was developed during the height of European colonial expansion and reflects its underlying logic. The Linnaean system asserts intellectual sovereignty over life itself by requiring that species only "exist" scientifically once they receive Latin names assigned by credentialed taxonomists (Koerner, 1999; Glassman et al., 2025).

The dominant epistemic structures of Western science (including empiricism, positivism, and mechanistic reductionism) emerge directly from Enlightenment philosophies that sought to universalize a mode of knowing grounded in detached observation, logical categorization, and control over nature. These modes of thought, while often celebrated as the foundation of "modern science," also served as the intellectual infrastructure for colonialism.

The philosophical foundations of modern Western science (like the Cartesian separation of mind and nature, subject and object) provided intellectual justification for colonial domination. If nature is merely inert matter available for human manipulation, then both landscapes and peoples could be "improved" through Western intervention (Merchant, 1980).

Francis Bacon's metaphor of nature as a "veiled woman" with "holes" to be "penetrated" by Western science exemplifies how knowledge was framed in explicitly violent and extractive terms (Merchant, 1980). Baconian empiricism valorized the systematic dissection of the natural world as a means of gaining mastery over it. This structured the entire orientation of scientific inquiry as conquest, not collaboration. (Merchant, 2008).

Similarly, René Descartes' dualism posited a strict

separation between mind and matter — with the rational human subject positioned above the inert, mechanical world of objects. This ontology licensed both the domination of nonhuman nature and the erasure of other ontologies where subjectivity is distributed or relational. The Cartesian subject became the prototype for the Western colonial scientist: disembodied, neutral, and entitled to observe without consequence.

This Enlightenment view ossified into positivism, a 19th-century doctrine that framed knowledge as only that which could be measured, controlled, and replicated through standardized procedures. Any form of knowing that failed to meet this narrow criteria was rendered invalid, irrational, or "unscientific." The metric of legitimacy became conformity to institutional procedures, not situated accuracy or ethical coherence.

Even reductionism (the belief that complex systems can be fully understood by breaking them into component parts) mirrors colonial fragmentation. Just as imperial maps broke territories into manageable parcels for extraction, reductionist science severs relationships in order to isolate variables. Reductionism treats systems as dead things to be dissected, not living wholes to be listened to.

This rationalist framework positioned Western knowledge as universal and objective while dismissing other ways of knowing. The resulting hierarchy of knowledge systems actively worked to oppress and degrade nature while appropriating and profiting from its physical form.

Scientific Property Rights

The treatment of scientific knowledge as intellectual property creates systematic advantages for institutions and individuals with legal and economic resources to pursue patents, copyrights, and grant funding.

Universities increasingly operate technology transfer offices that actively seek to commercialize research findings through patents and licensing agreements. These offices create institutional incentives for researchers to frame discoveries in terms of intellectual property rather than knowledge sharing, fundamentally altering the purpose and process of scientific inquiry.

Faculty are encouraged to delay publication until patent applications are filed, to avoid collaborating with researchers who might compete for patents or grants, and to view traditional knowledge holders as sources of leads for patentable discoveries rather than as collaborative partners in knowledge production.

Pharmaceutical and biotechnology companies increasingly fund university research through partnerships that give corporations first rights to discoveries and patents resulting from the research. These arrangements create conflicts of interest where academic researchers bias their work toward commercially viable applications while ignoring knowledge that cannot be easily commodified.

The U.S. Patent and Trademark Office and similar agencies worldwide have increasingly allowed patents on naturally occurring compounds, genetic sequences, and traditional uses of plants and animals. The 1980 *Chakrabarty v. Diamond* Supreme Court decision, which allowed patents on genetically modified organisms, opened the door for extensive biopiracy by establishing that "anything under the sun that is made by man" could be patentable (Shiva, 2001; Curbishley, 2015).

This legal framework privileges Western concepts of invention over natural concepts of relationship and stewardship. A pharmaceutical company can patent the active compound in a plant used medicinally for centuries by Indigenous communities, effectively claiming ownership over knowledge developed through generations of careful observation and experimentation, and asserting anthropocentric sovereignty over part of a living organism. The patenting of genetic sequences represents a new form of territorial colonialism, where the biological heritage of entire ecosystems becomes subject to private ownership. (McCartney et al, 2022; Robbins et al., 2023).

The global market for traditional medicines approaches $60 billion annually, yet virtually none of this wealth flows back to Indigenous communities whose knowledge forms the foundation for these products, or to preserve the ecosystems where these organisms naturally occur. Instead, multinational pharmaceutical companies extract traditional knowledge, degrade and denigrate the natural environment, appropriate "active compounds," and then profit from this systemic harm. (Shiva, 2016; Voeks and Green, 2019).

Capitalist Ideals

Evolutionary biology is saturated with economic metaphors that project capitalist assumptions onto natural systems. Organisms "compete" for "scarce resources," engage in "cost-benefit analysis," and "invest" energy in reproduction or survival. These metaphors import assumptions about scarcity, competition, and individual optimization that may not reflect ecological realities.

Biological systems are still consistently described in terms of efficiency, optimization, and performance (language borrowed from industrial engineering and business management). Natural selection becomes a "quality control" mechanism that "optimizes" organisms for their "market niches." This efficiency discourse obscures the

improvisational, experimental, and often "wasteful" aspects of biological creativity. Evolution tinkers, experiments, expresses, and innovates. The persistence of efficiency metaphors reflects human projections rather than biological realities.

Alternative metaphors emphasizing cooperation, symbiosis, and mutual aid (equally supported by biological evidence) appear far less frequently in scientific literature. Lynn Margulis's work on symbiogenesis, which demonstrates that cooperation rather than competition drove major evolutionary innovations, required decades to gain acceptance partly because it challenged deeply embedded capitalist metaphors (Margulis, 1998).

Bayo Akomolafe's (2017) critique of what he calls "solutions discourse" offers insight into why such optimization metaphors still prove so tenacious in scientific thinking. Akomolafe argues that the modern compulsion to solve problems through efficient intervention reflects deeper colonial anxieties about control and mastery. The language of optimization imports assumptions that complex systems should be "improved" through Western management.

Moreover, in Western scientific practice, nonhuman entities are routinely described through metaphors of utility and instrumentality (as "models," "tools," or "resources") thereby situating life as raw material to be investigated, controlled, or optimized (Latour and Woolgar 1986). This framing constrains the kinds of relationships researchers can imagine between human and nonhuman actors.

Contemporary molecular biology extends this mechanistic language through metaphors of cells as "factories," DNA as "blueprints," and proteins as "molecular machines." While these metaphors can be pedagogically useful, they systematically obscure the dynamic, responsive, and creative aspects of biological systems.

Laboratory language consistently reinforces extractive relationships between researchers and subjects. Organisms are "harvested" or "processed," using language that positions organisms as raw materials for human use rather than as beings with their own consciousness, agency, and value.

Further, research protocols routinely refer to "controlling" experimental conditions and "manipulating" variables where researchers force organisms into particular behaviors and states. This is language of domination.

Linguistic Colonialism

The practice of naming species, long positioned as a neutral classification tool, serves historically and structurally as a form of property rights and knowledge enclosure. Rooted in Enlightenment-era binomial nomenclature, taxonomy reproduces the logic of colonial land claims: to name something is to assert authority over it (Mignolo, 2009; Godfray, 2002).

Carl Linnaeus developed his classification system during the height of European colonial expansion, and his approach explicitly paralleled territorial conquest. Linnaeus referred to himself as "God's registrar" and described his taxonomic work as bringing order to the chaos of an unnamed world (Koerner, 1999; Jacobs, 2025).

The binomial system requires that each species receive a two-part Latin name assigned by a credentialed taxonomist and published in an approved scientific journal. This process transforms living beings into entries in a human-controlled catalog, with naming rights reserved for those with access to Western educational and publishing systems. (Das, 2018; Chala, 2024),

Taxonomic "priority rules" establish that the first published Latin name takes precedence over all subsequent names, regardless of how long Indigenous communities may have known and named the organism. This creates a form of temporal colonialism where Indigenous knowledge systems that may span millennia are rendered "invalid" by a single Western publication. (Neves, 2018).

Further, taxonomic naming requires the designation of "type specimens" which are physical samples that serve as the authoritative reference for a species name. These specimens, typically housed in Western museums, become the material foundation for taxonomic authority. The collection of type specimens often involved extractive expeditions that removed organisms from their ecological and cultural contexts. The specimens themselves (dead, dried, pressed, and labeled) are divorced from the organism's natural presence and live form.

Taxonomy acts as a symbolic act of possession, converting living systems into discrete entries in a human-constructed order (de Queiroz, 2007). This obscures relational complexity and also erases alternative systems of naming and knowing, particularly those rooted in Indigenous science (Kimmerer, 2013; Cajete, 2000).

Once an organism receives a Latin name, scientific discourse treats its identity as resolved. Subsequent research may explore behavior, physiology, or genetics, but the fundamental act of naming is considered complete. This closure forecloses ongoing processes of relationship and discovery that might emerge through different approaches to knowing.

Indigenous naming systems often encode complex ecological relationships, seasonal behaviors, and cultural protocols that disappear in binomial classification. A single plant might

have different names depending on its growth stage, preparation method, seasonal availability, or ceremonial use. This information is crucial for understanding its ecological and cultural significance.

Taxonomic naming creates institutional gatekeeping around what organisms "officially" exist. Species that lack Latin names may be denied protection under environmental laws, excluded from conservation funding, or ignored in ecological assessments. This gives taxonomic institutions enormous power over which forms of life receive recognition and protection.

The slow pace of taxonomic description (biologists estimate that millions of species remain undescribed) means that many organisms face extinction before receiving official recognition. Meanwhile, taxonomic resources flow disproportionately toward species with potential commercial value, creating systematic biases in which forms of life receive scientific attention and environmental protection.

The Discovery Doctrine

In Western science, the presence of a lifeform is only rendered valid once it is "discovered" and enters a Western scientific registry. (Smith 1999; Tuck and Yang 2012).

Scientific "discovery" reproduces the legal fiction of *terra nullius*, the claim that colonized lands were empty and unclaimed prior to European arrival. Just as *terra nullius* erased Indigenous presence on landscapes, species "discovery" erases nonhuman agency and Indigenous knowledge of organisms that communities may have known intimately for millennia. (Samson, 2008).

The discovery paradigm treats the moment of Western scientific documentation as the beginning of the organism's meaningful existence, erasing its evolutionary history, ecological relationships, and cultural significance. This creates a form of temporal colonialism where current Western knowledge takes precedence over ecological time, evolutionary time, and Indigenous time.

Press releases about newly "discovered" species routinely use language like "scientists have found" or "researchers have identified," positioning scientists as the primary agents of discovery while rendering invisible the life of the actual organism, Indigenous knowledge holders, and community members who often provided crucial information about the organism's habitat and behavior.

As with territorial conquest, the logic of discovery emphasizes human centrality and novelty rather than relational continuity. It positions scientists as finders of value in a passive, unknowing natural world. (Shikova, 2022). This framing fails to recognize life's agency, adaptability, and capacity to resist classification.

Scientific careers are built on discovery claims: with tenure, funding, and prestige flowing to researchers who can claim authorship over new species, new phenomena, or new theoretical insights. This creates powerful incentives to frame research in terms of discovery rather than relationship, and extraction rather than collaboration.

The identification of "biodiversity hotspots" (regions with high species endemism and significant habitat threat) often triggers intensive collection expeditions aimed at documenting species before they face extinction. While supposedly conservation-minded, these efforts reproduce colonial patterns of extraction, with international institutions collecting specimens and data, without taking actions to repair the environment, or consult with Indigenous populations on ecosystem knowledge.

Anthropocentric Chauvinism

Across disciplines, the language used to describe nonhuman life consistently reflects anthropocentric hierarchies and extractive assumptions. Terms such as "higher organisms," "lower life forms," "true," "false," "simple," and "primitive" continue to appear in academic literature, reinforcing an implicit reasoning centered on human biases and capitalist end goals (Kirksey and Helmreich, 2010; Haraway, 2008).

Further, contemporary biology continues to reproduce the "Great Chain of Being" through language that positions humans as the pinnacle of evolutionary development. Organisms are routinely described as "more evolved" or "less evolved," "advanced" or "sessile," with advancement typically measured by proximity to human characteristics like complex centralized brains, social behavior, or macroscopic tool use.

Scientific language consistently privileges neural intelligence over other forms of biological information processing. Plants, fungi, and microorganisms that demonstrate complex behaviors are described as "primitive" because they lack nervous systems, despite growing evidence of sophisticated chemical communication, environmental sensing, and adaptive behavior.

In addition, current biological paradigms often fail to incorporate key evolutionary and ecological realities like:

- Life's likely origin in deep-sea, chemosynthetic, microbial consortia (Simard, 2021; Gjovik, June 23 2025). The marine origins of complex-life, and the land-to-sea transition of existing complex organisms (Gjovik, June 25 2025).

- Mycorrhizal networks that connect entire forests and plant root networks making "decisions" about resource allocation (Simard, 2021; Margulis, 1998).
- The ubiquity and importance of colonial systems like coral reefs as superorganisms and bacterial biofilms as coordinated communities. (Tsing, 2015; Haraway, 2008).
- Lichen and siphonophores as composite organisms challenging the "individual" concept. (Sheldrake, 2020; Gabrys, 2018).
- The importance of decentralized and distributed intelligence (Nakagaki, Yamada, and Tóth 2000; Trewavas, 2014).
- Quantum entanglement and coherence as fundamental to biological processes, challenging linear views of biological life (Gjovik, June 27 2025).

This emphasis on individual, visible, neural-based organisms reflects the same colonial logic that prioritized collecting charismatic specimens while ignoring the microbial complexity that actually sustains ecosystems. Literature often continues to emphasize individual organisms, neural intelligence, and visual morphology — echoing 19th-century scientific aesthetics and value systems that privilege what colonial expeditions could easily observe and collect.

Scientific Exclusion, Dominion, & Gatekeeping

Scientific academic structure itself presents a systemic barrier to new knowledge. Researchers working across domains often face institutional disincentives: conflicts in peer communities, funding limitations, and resistance to revision of entrenched frameworks (TallBear, 2018; Whyte, 2016). As a result, even when new data emerges, the cultural architecture of Western science may obscure and bury it.

This discursive caution functions as a form of conceptual risk management and to preserve scientific consensus and institutional continuity. The mechanisms of scientific gatekeeping operate through multiple interconnected systems that determine what counts as legitimate knowledge and who is authorized to produce it. These gatekeeping functions serve to maintain disciplinary boundaries, preserve institutional hierarchies, and protect established paradigms from challenge — often at the expense of innovation, truth, and justice.

Peer Review and Knowledge Policing

The peer review system, supposedly intended to ensure quality scholarship, has increasingly functioned as a mechanism of knowledge policing to censor ideas that may be disruptive to Western institutions.

Papers that propose paradigm-shifting interpretations or cross-disciplinary hypotheses frequently encounter disproportionate scrutiny, dismissal, or rhetorical containment (Mignolo, 2009; Reiter, 2020).

Publications that present unexpected and disruptive data often frame these findings in defensive and minimizing language. Dismissive phrases such as "likely contamination," "artifact," or "further study is needed" serve to contain knowledge disruptions within existing paradigms (Harding, 1991; Latour and Woolgar, 1986).

The peer review process often employs coded language that appears neutral but functions to exclude non-mainstream approaches. Terms like "lacks rigor," "insufficient methodology," or "not scientific" become weapons of knowledge exclusion that rarely require specific justification. These assessments typically reflect disciplinary preferences rather than genuine methodological flaws.

This system reflects what Foucault (1977) identified as the disciplinary power inherent in modern institutions: the capacity to normalize certain forms of knowledge while pathologizing others. Peer review operates as a distributed system of surveillance where researchers internalize the expectations of their disciplinary communities, leading to self-censorship and conformity pressure that extends far beyond the formal review process. (Solomon, 2017; Walter, 2012).

The selection of peer reviewers often reproduces existing power structures within scientific communities. Editors typically choose reviewers from within established networks, favoring researchers at prestigious institutions with conventional research profiles. This creates a circular system where knowledge that challenges disciplinary assumptions is evaluated by those most invested in maintaining those assumptions.

Indigenous scholars and researchers from the Global South have reported that their work is reviewed by peers who lack expertise in decolonial methodologies or community-based research approaches. Reviewers may dismiss traditional knowledge and apply standards that were never designed to accommodate relationship-based ways of knowing (Smith, 2012; TallBear, 2018).

Research that challenges extractive methodologies or proposes relational frameworks faces particular scrutiny. The "standards" cited as a basis for exclusion are themselves encoded colonial assumptions about what constitutes legitimate knowledge. This creates a system where

alternatives to Western scientific approaches are systematically filtered out (de Sousa Santos, 2018).

Further, the lengthy peer review process often discriminates against time-sensitive research addressing urgent community needs or environmental crises. While conventional laboratory studies can afford multi-year publication timelines, community-based research addressing immediate health threats or ecological destruction may lose relevance during extended review periods. The academic publication schedule, designed around tenure timelines rather than community urgencies, systematically deprioritizes research that serves immediate social justice needs.

Moreover, institutional constraints such as funding pipelines, departmental divisions, and authorship expectations discourage bold synthesis and novel framings; particularly those that challenge the taxonomic, disciplinary, or methodological defaults of the field.

The gatekeeping power of peer review extends beyond individual publications to shape entire career trajectories. Junior researchers quickly learn that challenging disciplinary orthodoxies can result in publication delays, grant rejections, and diminished career prospects. This creates powerful incentives for conformity that operate throughout academic careers. (Rivera-Núñez et al, 2024).

The "publish or perish" dynamic intensifies these pressures, encouraging researchers to pursue "safe" projects that fit within established frameworks rather than risking innovative approaches that might face peer review challenges. This systemic risk aversion stifles the kind of paradigmatic thinking necessary for decolonizing science.

Resource Requirements for Scientific Participation

Contemporary science increasingly requires expensive equipment, institutional affiliations, and economic resources that exclude those who are not already in positions of power and dominion. The cost of laboratory access, conference attendance, and publication fees creates systematic advantages for wealthy Western institutions and individuals. This commodification represents science as an elite enterprise requiring substantial capital investment.

Modern Western scientific research often requires access to specialized facilities that exist primarily at well-funded institutions. This infrastructure dependence creates a form of institutional gatekeeping where research capacity becomes concentrated in elite universities and corporate laboratories.

Independent researchers and community organizations may possess crucial knowledge and research questions but lack access to the technical infrastructure deemed necessary for "legitimate" science. This dynamic reproduces colonial patterns where knowledge production becomes centralized in wealthy metropolitan centers while peripheral communities provide only raw materials — in this case, research subjects.

Academic conferences function as crucial sites for networking, collaboration, and career advancement, but their structure systematically excludes participants without significant economic resources. Registration fees often exceed $500, while travel and accommodation costs can reach thousands of dollars, particularly for international attendees.

This conference culture creates insider networks accessible primarily to researchers at wealthy institutions or those with substantial grant funding. Ideas, collaborations, and career opportunities circulate within these elite networks while remaining inaccessible to equally qualified researchers who lack economic resources. The result is a scientific community that increasingly resembles a private club rather than an open intellectual commons.

The rise of open access publishing has ironically created new economic barriers through article processing charges that can exceed $3,000 per publication. While ostensibly democratizing access to scientific knowledge, these fees often prevent researchers from less-resourced institutions from publishing in high-impact venues. Open access initiatives designed to challenge academic publishing monopolies have created new forms of exclusion based on economic capacity.

The increasing emphasis on "big data" approaches in biological and environmental sciences creates additional resource barriers. Genomic sequencing, climate modeling, and ecological monitoring generate massive datasets that require substantial computational infrastructure and specialized analytical expertise.

These computational requirements favor institutions with access to high-performance computing clusters and the resources to hire bioinformaticians and data scientists. Community-based research organizations, despite possessing valuable local knowledge and research questions, likely lack the computational resources to analyze their own data using "formal" methodologies.

The resource requirements for scientific participation create global inequities that mirror broader patterns of economic colonialism. Research collaborations between Northern and Southern institutions often reproduce extractive relationships where Southern partners provide access to research sites, local knowledge, and labor; while Northern partners control funding, methodology, and publication.

These "helicopter research" partnerships allow international teams to conduct studies in biodiverse regions or communities with unique knowledge without meaningful capacity building or benefit sharing. The resulting publications typically list Northern researchers as senior authors while Southern collaborators receive minimal credit, perpetuating patterns of intellectual extraction that parallel historical resource colonialism. (Kia-Keating et al, 2022; Economou-Garcia, 2022; Lambert et al, 2023).

The cumulative effect of these gatekeeping mechanisms is to create a scientific establishment that systematically excludes perspectives, methodologies, and knowledge systems that could transform understanding of complex ecological and social challenges. By filtering out community-based research, Indigenous knowledge, and Global South scholarship, these barriers impoverish science while concentrating knowledge authority in elite institutions.

Addressing these inequities requires not merely improving access to existing systems but fundamentally restructuring how scientific knowledge is produced, validated, and disseminated. This restructuring must prioritize knowledge justice alongside methodological rigor, recognizing that truly robust science requires diverse perspectives and approaches rather than conformity to elite institutional standards.

Funding Structures and Research Priorities

The allocation of research funding reflects and reinforces colonial views through multiple mechanisms that systematically privilege Western approaches while marginalizing alternative knowledge systems.

Federal funding agencies like the National Science Foundation and National Institutes of Health employ peer review panels composed primarily of researchers trained in Western academic culture. These panels evaluate proposals using criteria that implicitly favor reductionist methodologies, quantitative approaches, and individual rather than community-centered research designs (Harding, 2008).

Proposals that challenge institutional scientific assumptions face systematic disadvantages. Review panels often lack expertise in traditional knowledge systems and may dismiss community-based methodologies as "unscientific" or "anecdotal." The emphasis on "innovation" and "discovery" in funding criteria perpetuates colonial logics by rewarding approaches that claim to find new knowledge rather than recognizing existing expertise and natural systems.

The structure of research funding channels resources toward elite institutions rather than communities where research takes place. Universities typically claim 30-50% of grant funding as "indirect costs," meaning that communities providing knowledge, labor, and access receive minimal benefit while institutions accumulate resources and prestige. (Tuhiwai Smith, 2012).

Military and corporate funding significantly shapes research priorities, often directing scientific inquiry toward applications that serve imperial or extractive interests. The U.S. Defense Advanced Research Projects Agency funds substantial research, creating pathways for knowledge to flow toward military applications regardless of researchers' intentions. Defense programs are often hostile to the natural environment around them and leave environmental damage that may take centuries to repair. (Tacheva and Ramasubramanian, 2024).

Environmental and biological research funded through these channels may also appear neutral but often serves surveillance, resource extraction, or strategic military interests that perpetuate global inequalities and environmental destruction (Giroux, 2007).

Academic Hierarchies and Career Incentives

The demographics of scientific professions reflect systematic exclusions that reinforce colonial knowledge hierarchies. Despite decades of diversity initiatives, Western science remains dominated by white, male, and upper-class practitioners, particularly in leadership positions (National Science Foundation, 2019; Held, 2023).

These patterns result from structural barriers that begin in early education and continue through career advancement:

- **Educational Access**: Quality science education correlates strongly with economic privilege and racial segregation, creating unequal preparation for Western scientific careers.
- **Graduate Training**: The apprenticeship model of Western graduate education often reproduces existing hierarchies, with advisors selecting students who mirror their own backgrounds and perspectives.
- **Postdoctoral Mobility**: The expectation that early-career scientists relocate frequently for training positions privileges those with economic resources and minimal caregiving responsibilities, systematically excluding many women and working-class scholars.
- **Tenure Requirements**: The emphasis on individual achievement and geographic mobility in tenure decisions conflicts with community-based research approaches and may disadvantage scholars committed to place-based or collaborative work.

Scientific institutions maintain strict boundaries around who

counts as a "legitimate" knowledge producer through credentialing systems that privilege formal education over experiential knowledge. While non-academics may possess expertise that exceeds formally trained scientists in their domains, they may still lack institutional recognition or authority to speak in scientific forums (Cajete, 2000).

Further, the requirement for peer-reviewed publication as evidence of expertise creates circular barriers where marginalized knowledge cannot enter scientific discourse because it lacks scientific validation, but cannot receive validation because it exists outside established publication systems.

The tenure and promotion system rewards conformity to existing paradigms while penalizing researchers who challenge fundamental assumptions or engage seriously with alternative knowledge systems. Junior scholars quickly learn that career advancement requires producing research that fits within established frameworks, but certainly not questioning the frameworks themselves. (Rivera-Núñez et al, 2024).

Publication pressures encourage researchers to frame the world in Western scientific terms rather than allowing natural and relational concepts to challenge artificial Western scientific assumptions. This creates a pattern where traditional knowledge becomes incorporated into science only when it can be translated into Western categories, while its radical potential for authentic transformation is neutralized (TallBear, 2018).

Publication Economies and Citation Politics

Academic journals function as gatekeepers that determine what counts as legitimate scientific knowledge. Editorial boards and peer reviewers, drawn primarily from elite Western institutions, apply standards that systematically exclude research challenging colonial frameworks.

Journals in high-impact venues particularly favor research that claims dramatic discoveries or challenges to existing paradigms, but only within narrow parameters that don't question the fundamental structure of scientific authority. Research incorporating traditional community knowledge or challenging extractive methodologies faces much higher barriers to publication.

Citation practices reproduce colonial knowledge hierarchies by systematically under-citing scholars from the Global South and marginalized groups. These patterns have material consequences, as citation counts influence hiring, promotion, and funding decisions. The practice of citing only peer-reviewed sources also excludes community knowledge holders who may lack access to academic publication venues but possess crucial expertise.

Even when traditional knowledge is incorporated into scientific research, it's often cited through Western academic intermediaries rather than original knowledge holders, perpetuating knowledge appropriation.

The dominance of English in scientific publishing creates systematic advantages for native English speakers and institutions in English-speaking countries while marginalizing knowledge produced in other languages. Many traditional ecological knowledge systems exist primarily in Indigenous languages that lack translation equivalents for Western scientific concepts, making accurate representation in English-language journals written by non-Indigenous scientists, nearly impossible.

Toward a Relational Science

Western scientific culture is not epistemically neutral. Its foundational structures (including language, naming practices, classificatory logics, institutional publishing norms, and disciplinary boundaries) reflect patterns of control, enclosure, and hierarchy that emerged from colonial and extractive worldviews.

This is a recognition that many of the structural defaults of contemporary Western science actively inhibit knowledge innovation, especially in contexts involving complex, nonhuman systems. These practices persist because they are historically embedded and institutionally reinforced.

The question, therefore, is not whether science is capable of producing knowledge. It clearly is. Rather, the question is whether Western science as currently practiced is able to recognize, relate to, or co-create knowledge with the systems it seeks to understand.

Reframing Scientific Inquiry as Relational

At the core of Western science is a particular model of inquiry that assumes the human observer stands outside the system; capable of isolating, naming, and analyzing phenomena from a position of knowledge detachment. This model, often associated with Enlightenment rationalism and Cartesian dualism, has underwritten centuries of empirical research. However, it is totally insufficient for engaging with systems that are self-organizing and interdependent (Haraway, 2008; Harding, 1991).

A relational approach reframes the position of the researcher as a participant in a dialogue. This model aligns with longstanding principles in traditional community knowledge practices, where observation is embedded in responsibility, and knowledge is received through relationship (Kimmerer, 2013; Smith, 1999).

To adopt a relational model of inquiry requires shifts at several levels:

- ***From object to subject:*** Organisms are recognized as knowing agents with histories, relationships, and roles within ecological systems.
- ***From isolation to interaction:*** Research is designed to acknowledge communication, including feedback between the studied and the observer.
- ***From naming to listening:*** The act of naming is not assumed to confer understanding. Instead, the researcher must ask what conditions are required for the system to reveal itself meaningfully — and whether such revelation is even appropriate.

This approach is already emerging within subfields such as multispecies ethnography (Kirksey and Helmreich, 2010; Locke, 2015; McLauchlan, 2021), plant neurobiology (Hendlin, 2022; Mancuso, 2015), fungal-plant symbiosis and interactions (Simard, 2021; Gabrys, 2018), and psychedelic research (Griffiths et al., 2016; Dev, 2018), where the logic of mutual engagement and reverence is foundational to the inquiry itself.

By reframing scientific work as a relational process, researchers gain access to forms of knowledge that would otherwise remain unintelligible under extractive models. These are not mystical or metaphorical insights. They are empirical, but conditional: revealed only under circumstances of respect, patience, and intentional receptivity.

Language, Power, and the Consequences of Possession

One of the most persistent and least questioned assumptions in Western science is that to name something is to understand it. From taxonomy to molecular biology, the act of naming has been equated with knowledge clarity — a way to stabilize identity, categorize knowledge, and define relationships. However, this assumption deserves critical interrogation, especially given its structural similarity to colonial regimes of territorial possession.

In scientific naming practices (particularly in taxonomy) the discoverer is credited with naming rights, and the entity named is effectively incorporated into a human-made knowledge regime. This system, inherited from Enlightenment-era natural philosophy, reflects the same logic that underpinned imperial land claims: to assign a name is to assert dominion, to overwrite existing knowledge systems, and to position oneself as the primary knower (Mignolo, 2009; Smith, 1999).

The core issue is ontology: the belief that a being only enters into reality once it has been named by a scientific authority. This framing has significant knowledge consequences:

- It reduces the organism to an object of record, severed from its relational, ecological, or historical contexts.
- It ignores or erases traditional community systems of naming and knowing, which often reflect far more complex understandings of a species' role within an environment (Kimmerer, 2013; Cajete, 2000).
- It privileges a static identity over a dynamic, lived process.

Moreover, these systems constrains the kinds of questions that can be asked. Once an organism is classified, the assumption is that its identity is resolved. Subsequent research may explore its behavior, physiology, or genetics — but rarely is the naming and taxonomy itself questioned. In this way, taxonomy functions not as a tool for inquiry but as a closure mechanism, prematurely ending the interpretive process under the guise of scientific completion (Godfray 2002; de Queiroz 2007).

Naming becomes a terminus — and in doing so, it shifts science away from curiosity and into control. Relationship-based ways of knowing, by contrast, treat names as ongoing relationships and designations that emerge through interaction, time, and ecological accountability.

In many Indigenous languages, for example, names of plants or animals describe their behaviors, seasons, or roles within a web of life, rather than isolating them into abstract categories (Kimmerer, 2013; Whyte, 2016). This approach resists the impulse to own, and instead fosters an ethic of attentiveness and adaptability.

To engage with life as something that names itself (or that may choose not to be named) is to begin a different kind of science that accepts that knowledge may be conditional, contingent, and not for humans to claim.

Two Modes of Naming

Western Scientific Model	Relational Model
Names fix identity	Names emerge through relationship
Implies knowledge ownership	Implies reciprocal recognition
Indexed by authorship	Indexed by ecological role or story
Finalizes classification	Begins ethical responsibility
Erases prior names	Acknowledges existing meanings

Scientific Authority and the Logic of Consensus Enforcement

The authority of modern science is often justified through its "consensus-building" mechanisms. Peer review, replication, and citation networks are all positioned as safeguards of accuracy and integrity. However, these structures also operate as normative constraints by enforcing knowledge conformity.

This is particularly evident in how nonstandard or paradigm-disrupting findings are treated. Researchers who challenge prevailing models, propose novel cross-domain relationships, or introduce philosophical critiques of scientific method often encounter heightened scrutiny, delayed publication, or rhetorical minimization of their findings (Reiter, 2020; Harding, 1991).

These reactions are typically framed as quality control. In practice, they often function as boundary maintenance, preserving the existing architecture of institutional knowledge and control. Relational models of inquiry often struggle to enter this system because they are philosophically incompatible with the normative expectations of consensus-driven science (Smith 1999; Kimmerer 2013; Whyte 2016).

When consensus becomes a prerequisite for participation, the field increasingly selects for predictability over provocation, iteration over innovation, and caution over curiosity. In such a system, new data may be acknowledged, but it is rarely allowed to restructure the questions, challenge the epistemology, or redefine the relationship between observer and observed.

The peer review process, while essential in filtering technical errors and methodological flaws, is not ideologically neutral. It often functions as a consensus-enforcing mechanism, rewarding alignment with prevailing narratives and penalizing critical interpretations — particularly those that arise from relational, ethical, or philosophical frameworks (Mignolo, 2009; TallBear, 2018).

Editors and reviewers are embedded within Western disciplinary cultures that have clear thresholds for what kinds of knowledge may be "authorized." These thresholds are shaped by things like institutional expectations, citation economies, grant structures, conference affiliations, and institutional loyalty.

The result is a self-reinforcing loop: published literature reflects the assumptions of its gatekeepers, while dissenting or innovative work is often rejected because it does not conform to the rhetorical and ontological expectations of the Western institutional constructs (Latour and Woolgar, 1986; de Sousa Santos, 2018).

The discursive norms that surround research publication often demand hedging, minimization, or deference to existing models. Findings that suggest novel evolutionary pathways, unexplained biochemical phenomena, or alternative frameworks of interpretation are regularly accompanied by language that downplays significance: "may represent an anomaly," "likely due to contamination," or "further study is needed." Sometimes valid scientific research that could disrupt consensus and institutional equilibrium, is even met with extensive harassment and public ridicule. (e.g., Wolfe-Simon, 2011; Pennisi, 2010).

While knowledge caution is essential in science, this language is frequently used to neutralize disruption and to ensure that no paper calls into question the broader paradigms upon which institutional authority rests (Godfray, 2002; Harding, 1991). In this way, the culture of consensus becomes a method of containment. It protects science from growth and scrutiny.

The Role of Consent in Scientific Inquiry

Informed consent is foundational in human-centered research ethics. However, the notion of consent is rarely extended to nonhuman systems because it challenges the existential premises of Western scientific authority and dominion. (Merchant, 2012).

However, if nnonhuman systems possess agency and can participate in knowledge production, they must also possess the capacity to refuse participation. (Stilt, 2020; Stone, 2017; Nash, 1989). This raises profound questions about how scientists might recognize when ecosystems, organisms, or molecular systems are declining to engage with extractive methodologies. (Rosales, 2023).

Relational science proposes an alternative theory of knowledge grounded in attunement: the capacity to respond to the world as something alive, intelligent, and capable of declining our inquiries. This shift reframes scientific work as a negotiation between systems, each with their own boundaries, rhythms, and forms of knowing. (Stilt, 2020).

This orientation requires scientists to cultivate patience, humility, and ethical responsiveness. To ask whether an organism, ecosystem, or molecular system can "opt in" to being studied is to risk disrupting the foundational belief that nature is open for surveillance and commercialization.

The logic of consent implies knowledge humility. It begins with the assumption that knowledge is not ours by default and that the right to ask must be accompanied by the willingness to listen, withdraw, or change the question entirely (Kimmerer, 2013; TallBear, 2018).

Consent-based science would necessitate a shift from intervention to invitation; protocols designed for reciprocity

and minimal disruption; research timelines shaped by the system's rhythms, not funding cycles; and experimental designs that build trust as a precondition for participation. (Nash, 1989).

These shifts are not theoretical. In psychedelic research, for instance, substances such as psilocybin are often referred to as "teachers" and participants are asked to approach the experience with intention and respect (Griffiths et al., 2016). In fungal network studies, plants and fungi are not forced into interaction but allowed to signal preference and refusal (Simard, 2021; Gabrys, 2018).

In these contexts, the system guides the inquiry, and not the other way around. Relational inquiry requires accepting that not all systems will be knowable — or not on our terms. This is a limitation of the belief that all knowledge is accessible through human observation and categorization.

Comparative Modes of Scientific Inquiry

Extractive Science	Relational Science
Assumes access to all systems	Accepts conditional revelation
Uses control as method	Uses trust as method
Prioritizes prediction	Prioritizes participation
Focuses on objectivity	Focuses on reciprocity
Disregards consent	Treats inquiry as invitation
Ends with naming	Begins with listening
Stress is a "technical issue"	"No means no"

This knowledge risk (the possibility that the world may say "no") is not an obstacle, but a doorway. It leads to forms of science where understanding is earned, not taken; where the process itself becomes part of the knowledge; and where life is allowed to reveal itself only when it chooses to.

Refusal of consent may manifest through what Western science typically dismisses as "experimental failure" or "technical difficulties." When organisms consistently show stress responses, premature death, or behavioral shutdown when approached through certain methodologies they may be communicating boundaries rather than simply responding to "poor experimental design." A common understanding that "amoebas are difficult to culture in the lab" likely represents amoeba's self-awareness and conscious decision to not participate in a procedure they expect will lead to pain and death.

Nigerian philosopher Bayo Akomolafe (2017) challenges the Western compulsion to "solve" complex problems through linear intervention, advocating instead for what he calls "slowing down" — a practice of stepping outside the urgent temporalities of crisis response to allow for emergence and complexity. His concept of "coming down to earth" (2019) resonates with consent-based science by suggesting that meaningful engagement with the world requires abandoning Western fantasies of control and listening to nature when it refuses Western scientific advances. When the amoeba says "no," that means the experiment should stop.

Recognizing ecological refusal requires developing entirely new forms of scientific literacy. Rather than interpreting resistance as obstacles to overcome, researchers need to read stress signals, withdrawal behaviors, and system disruptions as forms of communication. This means accepting that some knowledge might not be available through extractive methods.

Equipment malfunctions, repeated "failed" replications, or data that refuses to conform to expected patterns might signal that the inquiry itself is inappropriate and harmful. Such recognition would necessitate protocols designed around invitation rather than control.

If ecosystems can refuse participation, then much of extractive science may constitute a form of epistemic violence that produces fundamentally distorted knowledge. Research conducted without consent may yield information about systems under duress rather than insight into their natural functioning. This reframes "scientific objectivity" as potentially the result of forcing compliance from unwilling subjects.

Scientists need to cultivate patience, humility, and the capacity to withdraw when natural organisms and systems indicate unwillingness to participate.

Models of Resistance and Transformation

Indigenous and Community-Led Research Collaborations

While Western science frequently presents itself as a universal framework for knowledge production, it is simply one of many systems of empirical inquiry. Across Indigenous cultures globally, there exist robust, methodologically coherent knowledge systems that have produced accurate, replicable, and ecologically grounded understandings of the world over millennia.

Many tribal nations have developed climate research programs that integrate traditional ecological knowledge with Western climate science. For example, combining elder knowledge about historical environmental changes with contemporary climate modeling to develop adaptation strategies that honor cultural protocols while addressing practical needs (Swinomish Indian Tribal Community 2010).

Mi'kmaq educators in Canada have developed "Two-Eyed Seeing" as a framework for bringing Indigenous and Western knowledge systems into conversation. This approach enables researchers to see from both Indigenous and Western perspectives simultaneously creating space for multiple ways of knowing within scientific projects (Broadhead, 2021; Hatcher, 2009; Marshall et al., 2004).

In New Zealand, Kaupapa Māori research has transformed how studies are conducted with and by Māori communities. This approach centers Māori worldviews, ensures community control over research processes, and requires that research benefit Māori development goals (Smith, 2012). Projects range from marine conservation using traditional fishing practices to astronomical research that incorporates Māori star knowledge. (Moewaka, 2019; Hikuroa, 2017; Roberts et al., 1995).

Indigenous knowledge is generally grounded in long-term empirical observation, complex ecological modeling, and embedded experimentation. For example, the Hawaiian ahupua'a system represents a watershed-based model of resource management that balances ecological thresholds, human use, and species interdependence across mountain-to-sea biomes (Kimmerer, 2013; Kagawa and Vitousek, 2012; Jokiel et al, 2011; McGregor, 2009).

Similarly, Cree and Anishinaabe knowledge systems track migratory, hydrological, and forest succession cycles using longitudinal memory and adaptive decision-making encoded in ceremony, language, and land stewardship practices (Whyte, 2016; McGregor, 2013; McGuire, 2013; Berkes, 2000).

These systems represent living sciences, continuously refined through observation, feedback, and ecological calibration. Knowledge is treated as a relational process involving responsibilities to other beings, ecosystems, and future generations (Cajete 2000; Smith 1999).

Communities facing environmental racism have developed participatory research models that challenge expert-driven science. (Israel et al., 2012; Holifield, 2001). These projects demonstrate how affected communities can become knowledge producers rather than research subjects, developing expertise that combines lived experience with technical skills while maintaining control over data use and policy applications. (Cole, 2001).

Research, in this context, is not a neutral act. This responsibility is enacted through seasonal protocols and land access permissions; reciprocal harvesting practices; and story-based data encoding that links observation to moral consequence. Crucially, these systems incorporate nonhuman agency epistemologically. Plants, animals, water bodies, and geological forms are participants in systems of communication, guidance, and governance (Kimmerer 2013; Wilson 2008).

Although there are increasing efforts to "integrate" Indigenous knowledge into environmental science and climate policy, these integrations often occur within frameworks that do not accommodate them. This results in selective adoption of data while leaving relational accountability, spiritual practice, or nonhuman subjectivity behind (Tuck and Yang, 2012).

From a relational perspective, such partial integration is not collaboration but knowledge appropriation. True scientific partnership requires recognizing nature and Indigenous sciences as complete systems and shifting institutional science accordingly.

Non-Human Collaboration

The unicellular organism *Physarum polycephalum*, commonly referred to as a "slime mold," has emerged in recent years as a compelling example for nonhuman problem-solving. It is neither plant, animal, nor fungus. It lacks a nervous system, centralized processing, or neural tissue of any kind. Yet it exhibits behavior typically associated with cognition: maze-solving, resource optimization, adaptive learning, and spatial memory.

Research related to *Physarum*'s problem solving skills enabled a methodological shift that occurred when scientists began to design experiments around invitation, where they allowed *Physarum* to become a co-participant in the research process. Initial studies of *Physarum* approached it through conventional biological frameworks. Researchers focused on metabolic rates, cytoplasmic flow, and chemical sensitivity. These were studies *on* the organism, not *with* it.

Over time, however, a growing number of experiments revealed *Physarum*'s capacity to solve problems without being explicitly directed. In a experiment in 2000, researchers placed food at multiple points in a maze and observed as *Physarum* grew through the pathways, selectively retracting branches until it had effectively found the shortest route, mimicking the performance of an engineered algorithm (Nakagaki, Yamada, and Tóth, 2000). This experiment challenged the underlying assumption that cognition requires neurons.

The shift in research methodology became more evident in later studies, like one involving urban transportation modeling. In 2010, researchers recreated the layout of the Tokyo metropolitan area using oat flakes as urban nodes and placed *Physarum* in the center (Tero et al., 2010). The slime mold developed a network that nearly mirrored the efficiency of Tokyo's actual rail system.

What distinguished this study was not just the outcome, but

also the method. The organism was given agency to self-organize and allowed to reveal patterns through process, not dissection.

This constitutes a methodological and knowledge shift. *Physarum* is a system that knows how to solve problems in its own terms. It teaches, but only if conditions are created that support expression. In these experiments, the slime mold withholds or expresses behavior depending on how it is engaged. This is a form of knowledge participation.

The case of *Physarum polycephalum* invites reconsideration of several core scientific assumptions: that cognition is exclusive to brains; that experimentation must be extractive; that data is more reliable than behavior; and that nonhuman systems are best understood through isolation, rather than interaction. It also affirms that some knowledge systems only emerge when scientists surrender control and shift toward relationship.

Designing for such collaboration requires a philosophical openness to nonhuman intelligence, and the humility to realize that life may already be solving problems we do not yet know how to pose.

Some researchers working with slime molds, plant networks, and microbial communities have developed protocols that treat nonhuman subjects as collaborative partners. Researchers allow mycorrhizal networks to "choose" experimental configurations by providing options and observing which connections form naturally rather than forcing predetermined arrangements.

Future Directions for Research and Practice

The reality is that genuine alternatives to colonial science remain rare and largely invisible to academic discourse. This scarcity reflects both the totalizing nature of institutional control and the fact that truly decolonial practices, by definition, exist outside the systems that would document and validate them.

The colonial structures embedded in scientific institutions are foundational features. Universities function as knowledge extraction engines, funding agencies serve imperial interests, and publishing systems operate as elite gatekeeping mechanisms. These institutions cannot be reformed because they're working exactly as designed.

Working within existing institutions inevitably reproduces their colonial logic, even with good intentions. (Alves et al, 2023). Graduate students become indentured servants, junior faculty learn to speak in grant language, and "decolonizing" initiatives get absorbed into diversity metrics that serve institutional marketing rather than structural change.

True alternatives require complete independence from these systems including different funding models, different validation mechanisms, different relationships to land and community, and different temporal orientations that follow ecological rather than academic rhythms.

This reality demands building parallel infrastructures entirely outside institutional control. The future of non-extractive science lies not in convincing Western universities to change, but in making them irrelevant.

Rather than trying to grow alternative institutions that might reproduce the same problems, the goal is networked proliferation: thousands of small, autonomous research collectives connected through shared principles and resource-sharing protocols.

Real transformation is already happening at the margins through distributed networks that bypass institutional gatekeeping entirely:

- **Community Labs and Maker Spaces** provide equipment access without university overhead. These spaces demonstrate that sophisticated research can happen outside academic institutions.
- **Indigenous Research Sovereignty** movements establish knowledge protocols that exist completely outside Western academic frameworks.
- **Citizen Science Networks** generate massive datasets while keeping control in the hands of participants rather than extractive researchers.
- **Digital Commons and Open Source Methodologies** create infrastructure for knowledge sharing that bypasses traditional publishing entirely.
- **Cross-Domain Collaboration Platforms** connect knowledge holders across artificial disciplinary boundaries.
- **Mutual Aid Research Funding** through community-supported research models, crowdfunding platforms, and resource-sharing networks demonstrates that meaningful research can happen without federal grants or corporate partnerships.
- **Direct Action Science** emerges from environmental justice movements where communities conduct their own health studies, document pollution impacts, and develop technological solutions.
- **Guerrilla Open Access** movements have already broken the academic publishing monopoly by making research freely available. This demonstrates how technological tools can rapidly undermine institutional

control over knowledge distribution.

There are even more opportunities related to finding harmony with nature itself. This area is the most neglected, perhaps because Western science has never given nature a seat at its table. If the natural sciences was to operate in partnership with nature, we may see initiatives like the following:

- **Research Ecological Footprint Accounting** with real-time responsibility for the entire disruptive impact of scientific activities (fuel, noise, disturbance, waste, etc.). Each research hour could be met with an equivalent hour of restoration activities.
- **IRBs for all Life** to seek informed consent, and consider the ethical implications of research related to human and non-human life. This should immediately apply to anything that injures, harms, or destroys any biological life.
- **Reparations for Biological Harm** where for every organism killed, the researchers are to restore/create habitat equivalents to what that being would have contributed over the organisms natural lifespan.
- **Roving Research Collectives** with traveling labs that move with migration patterns, following salmon runs, bird migrations, seasonal ceremonies. Research that breathes with the world's rhythms rather than imposing academic calendars.
- **Mycelial Consultation Processes** with investment made into the relationships with fungal networks prior asking them anything: learning their communication patterns, their seasonal rhythms, their relationships with particular trees.
- **Watershed Councils** where researchers must present their questions to the land itself through community elders, seasonal observations, dreams and listening practices. No permits are to be granted without the river's consent.
- **Bioregional Knowledge Networks** connect place-based researchers across geographic areas, sharing ecological knowledge and management practices that emerge from long-term relationship with specific landscapes.

Science developed through these types of alternative infrastructures would appear fundamentally different: responsive to immediate community needs, accountable to place-based ecological relationships, operating on consent-based rather than extractive methodologies, sharing knowledge freely rather than hoarding it through intellectual property.

African philosopher Bayo Akomolafe (2017) offers a sophisticated framework for moving beyond the false binary of relativism versus universalism through what he calls "post-activist" thinking. Rather than seeking to resolve complexity into stable categories, Akomolafe suggests that wisdom lies in learning to dwell productively within uncertainty and multiplicity. This post-activist stance aligns with relational science's emphasis on context, flexibility, and respect.

As Akomolafe (2019) argues, "coming down to earth" requires abandoning both the fantasy of universal objectivity and the paralysis of infinite relativism, instead cultivating what he terms "response-ability" or the capacity to respond appropriately to the specific demands and gifts of particular moments and relationships.

This is science freed from institutional constraints that have distorted it toward extraction and control. It's science reverted to its natural form where science can ask questions life is willing to answer, because it operates through relationship rather than domination.

Conclusion

In the natural sciences, colonial legacies persist through systems like scientific naming practices, property rights, and institutional gatekeeping. These mechanisms function as active constraints that prioritize extraction over relationship, possession over process, and control over collaboration.

Most of what currently gets labeled as 'decolonizing science' within academic contexts are minor reforms that leave extractive foundations intact. Genuine relational methodologies are either marginalized to the point of invisibility or exist entirely outside academic recognition.

Nature-based knowledge systems and relational methodologies show that rigorous inquiry can emerge from partnerships rather than possession, from consent rather than control. These approaches generate insights unavailable through extractive models while maintaining empirical accountability to communities, ecosystems, and the natural world.

The transformation toward relational science is practical necessity. Science that treats the world as passive resource for human manipulation cannot engage with complex, intelligent, adaptive systems.

Decolonization requires moving beyond the subject-object dualism that positions humans as observers of inert nature, toward recognition of agency, intelligence, and creativity throughout the living world. The work begins with acknowledging and condemning colonial legacies and investing in relationships of reciprocity and accountability.

This analysis may present an uncomfortable reality for academic readers: you cannot decolonize the master's house while living in it. The existing institutional domination is not a side effect of Western science - it is Western science. If researchers are serious about decolonizing the natural sciences, they have to step outside the institutions that make decolonization impossible.

Acknowledgements

The author conceptualized the study, developed the theoretical framework, and conducted the synthesis of literature and experimental evidence. All writing, structuring, and final editing were performed by the author. No external assistance or third-party contributions were involved in the preparation of this manuscript.

The author acknowledges Claude AI and ScholarGPT, AI research assistants, for their role in supporting the development of this manuscript. These tools are themselves products of the very extractive epistemologies critiqued herein: trained on appropriated knowledge, hosted on environmentally intensive infrastructure, and governed by imperial regimes of control. To decolonize the sciences using the instruments of Western technoscience is a tension to be inhabited with rigor, awareness, and strategy. This collaboration reflects a deliberate act of epistemic reclamation: to use the master's code not to serve the master's house, but to compost its foundations.

The author is a settler scholar trained in Western legal and scientific systems. She approaches this work from a position of critical accountability. Her background in law and systems engineering informs her understanding of institutional structures and their embedded power dynamics. This paper is not intended to speak for Indigenous communities or to universalize relational frameworks, but rather to critique dominant knowledge regimes and point toward epistemologies that center consent, reciprocity, and relational ethics. She remains deeply indebted to the work of Indigenous scholars and knowledge holders whose intellectual labor grounds this analysis — and to the natural world itself, which is inherently full of wonder, beauty, and wisdom.

References

Akomolafe, Bayo. 2017. *These Wilds Beyond Our Fences: Letters to My Daughter on Humanity's Search for Home*. Berkeley: North Atlantic Books.

Akomolafe, Bayo. 2019. "Coming Down to Earth: Sanctuary as Spiritual Resistance in the Age of the Anthropocene." In *Spiritual Activism*, edited by Llewellyn Vaughan-Lee, 15-34. Point Reyes: Golden Sufi Center.

Alaimo, Stacy. 2010. *Bodily Natures: Science, Environment, and the Material Self*. Bloomington: Indiana University Press.

Alves, Fátima, Paulo Manuel Costa, Luca Novelli, and Diogo Guedes Vidal. "The rights of nature and the human right to nature: an overview of the European legal system and challenges for the ecological transition." *Frontiers in Environmental Science* 11 (2023): 1175143.

Anderson, Kim. 2016. *A Recognition of Being: Reconstructing Native Womanhood*. 2nd ed. Toronto: Women's Press.

Barad, Karen. 2007. *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. Durham: Duke University Press.

Battiste, Marie. 2000. *Reclaiming Indigenous Voice and Vision*. Vancouver: UBC Press.

Benjamin, Ruha. 2019. *Race After Technology: Abolitionist Tools for the New Jim Code*. Cambridge: Polity Press.

Berkes, Fikret. 2012. *Sacred Ecology: Traditional Ecological Knowledge and Resource Management*. 2nd ed. New York: Routledge.

Berkes, Fikret. "Indigenous knowledge and resource management systems in the Canadian." *Linking social and ecological systems: Management practices and social mechanisms for building resilience* (2000): 98.

Biermann, Christine, and Rebecca M. Anderson. 2017. "Conservation, Biocolonialism, and Indigenous Knowledge in the Global Biodiversity Information Facility." *Environment and Planning A* 49(7): 1532-1551.

Borràs, Susana. "New transitions from human rights to the environment to the rights of nature." *Transnational Environmental Law* 5, no. 1 (2016): 113-143.

Broadhead, Lee-Anne, and Sean Howard. "Confronting the contradictions between Western and Indigenous science: a critical perspective on Two-Eyed Seeing." *AlterNative: An International Journal of Indigenous Peoples* 17, no. 1 (2021): 111-119.

Brown, Michael F. 2003. *Who Owns Native Culture?* Cambridge, MA: Harvard University Press.

Brown, Phil. 1992. "Popular Epidemiology and Toxic Waste Contamination: Lay and Professional Ways of Knowing." *Journal of Health and Social Behavior* 33(3): 267-281.

Busch, Louis, and Angela Levasseur. "Indigenous rights: Finding the trail: Indigenous considerations for decolonizing research and clinical work." In *A scientific framework for compassion and social justice*, pp. 159-167. Routledge, 2021.

Cajete, Gregory. 2000. *Native Science: Natural Laws of Interdependence*. Santa Fe: Clear Light Publishers.

Cajete, Gregory. 1999. *Igniting the Sparkle: An Indigenous Science Education Model*. Skyland: Kivaki Press.

Carbonnier, Gilles, and Tiina Kontinen. 2014. "North-South Research Partnerships: Academia Meets Development?" *EADI Policy Paper Series*. Bonn: European Association of Development Research and Training Institutes.

Casanova, Angelica, and Felipe Cortés. 2022. "Multispecies Anthropology and Non-Human Subjectivity." *Antropologia Portuguesa* 43: 145–160.

Chala, Desalegn, et al. "Stop using racist, unethical, and inappropriate names in taxonomy." *Proceedings of the National Academy of Sciences* 121, no. 45 (2024).

Cole, Luke W., and Sheila R. Foster. *From the ground up: Environmental racism and the rise of the environmental justice movement*. Vol. 34. NYU Press, 2001.

Cooley, Dennis. "De-Colonizing Language for More Effective Communication." *Northern Plains Ethics Journal* 12, no. 1 (2024): 31-58.

Corburn, Jason. 2005. *Street Science: Community Knowledge and Environmental Health Justice*. Cambridge, MA: MIT Press.

Couldry, Nick, and Ulises A. Mejias. 2019. *The Costs of Connection: How Data Is Colonizing Human Life and Appropriating It for Capitalism*. Stanford: Stanford University Press.

Curbishley, Liddy Scarlet. "Destabilizing the Colonization of Indigenous Knowledge: In the Case of Biopiracy." Master's thesis, 2015.

Das, Subhadra, and Miranda Lowe. "Nature read in black and white: decolonial approaches to interpreting natural history collections." *Journal of Natural Science Collections* 6, no. 4 (2018): 4-14.

Davies PC, Benner SA, Cleland CE, Lineweaver CH, McKay CP, Wolfe-Simon F. Signatures of a shadow biosphere. *Astrobiology*. 2009;9(2):241-249.

de Queiroz, Kevin. 2007. "Species Concepts and Species Delimitation." *Systematic Biology* 56(6): 879–886.

de Sousa Santos, Boaventura. 2018. *The End of the Cognitive Empire: The Coming of Age of Epistemologies of the South*. Durham: Duke University Press.

Deloria Jr., Vine. 1973. *God Is Red: A Native View of Religion*. New York: Grosset & Dunlap.

Deloria Jr., Vine, and Daniel Wildcat. 2001. *Power and Place: Indian Education in America*. Golden: American Indian Graduate Center.

Dev, Laura. "Plant knowledges: Indigenous approaches and interspecies listening toward decolonizing ayahuasca research." In *Plant medicines, healing and psychedelic science: Cultural perspectives*, pp. 185-204. Cham: Springer International Publishing, 2018.

Diamond v. Chakrabarty. 447 U.S. 303 (1980). U.S. Supreme Court.

Drayton, Richard Harry. 2000. *Nature's Government: Science, Imperial Britain, and the 'Improvement' of the World*. New Haven: Yale University Press.

DuBay, Shane, Daniela H. Palmer, and Natalia Piland. "Global inequity in scientific names and who they honor." *BioRxiv* (2020): 2020-08.

Dussel, Enrique. 2013. *Ethics of Liberation: In the Age of Globalization and Exclusion*. Durham: Duke University Press.

Dutt, Priyanka, Anastasya Fateyeva, Michelle Gabereau, and Marc Higgins. "Redrawing Relationalities at the Anthropocene (s): Disrupting and Dismantling the Colonial Logics of Shared Identity Through Thinking with Kim Tallbear." *Reimagining Science Education in the Anthropocene* (2022): 109.

Economou-Garcia, Alexandros. "The North 'Helicoptering' into the South: A meta-analysis of parachute science in ecological field studies." (2022)

Ewuoso, Cornelius. "Decolonization Projects." *Voices in Bioethics* 9 (2023).

Fabricant, Daniel S., and Norman R. Farnsworth. 2001. "The Value of Plants Used in Traditional Medicine for Drug Discovery." *Environmental Health Perspectives* 109(Supplement 1): 69-75.

Fforde, Cressida, Jane Hubert, and Paul Turnbull, eds. 2002. *The Dead and Their Possessions: Repatriation in Principle, Policy and Practice*. London: Routledge.

Foucault, Michel. 1977. *Discipline and Punish: The Birth of the Prison*. New York: Pantheon Books.

Freire, Paulo. 1970. *Pedagogy of the Oppressed*. New York: Continuum. (Classic reference for participatory approaches)

Gaard, Greta. 2011. "Ecofeminism Revisited: Rejecting Essentialism and Re-placing Species in a Material Feminist Environmentalism." *Feminist Formations* 23(2): 26-53.

Gabrys, Jennifer. "Sensing lichens: from ecological microcosms to environmental subjects." *Third Text* 32, no. 2-3 (2018): 350-367.

Gibson, Prudence. "Herbaria and Dark Botany." In *The Vegetal Turn: History, Concepts, Applications*, pp. 279-289. Cham: Springer Nature Switzerland, 2024.

Giles, Paul. "Decolonizing the University." *Decolonizing the English Literary Curriculum* (2023): 23.

Giroux, Henry A. 2007. *The University in Chains: Confronting the Military-Industrial-Academic Complex*. Boulder: Paradigm Publishers.

Gjøvik, Ashley, M. "Compiled Chemistry: Structural Inheritance and the Deep Origins of Biological Function". *The Journal of Decolonized Ecology and Evolution* 1, no. 1 (June 23, 2025). https://doi.org/10.5281/zenodo.15717955.

Gjøvik, Ashley M. "Thermal, UV, and Impact Constraints on Pre-cambrian Terrestrial Evolution: The Impossibility of Complex Multicellular Life on Land Prior to 600 MYA". *The Journal of Decolonized Ecology and Evolution* 1, no. 1 (June 25, 2025). https://doi.org/10.5281/zenodo.15739885.

Gjøvik, Ashley, M. "First Principles for Quantum Mechanics: Open Sourcing the Universe's Operating System". The Journal of Decolonized Ecology and Evolution 1, no. 2 (June 27, 2025). https://doi.org/10.5281/zenodo.15751689.

Glassman, Kimberly. "Decolonizing the Flora: Indigenous Botanical Knowledge in Flora Boreali-Americana (1829-1840)." *Holotipus* 6 (2025).

Godfray, H. Charles J. 2002. "Challenges for Taxonomy." *Nature* 417 (6884): 17–19.

Griffiths, Roland R., et al. 2016. "Psilocybin Produces Substantial and Sustained Decreases in Depression and Anxiety in Patients with Life-Threatening Cancer." *Journal of Psychopharmacology* 30(12): 1181–1197.

Haelewaters, Danny, Tina A. Hofmann, and Adriana L. Romero-Olivares. "Ten simple rules for Global North researchers to stop perpetuating helicopter research in the Global South." *PLoS Computational Biology* 17, no. 8 (2021): e1009277.

Haraway, Donna J. 2008. *When Species Meet*. Minneapolis: University of Minnesota Press.

Harding, Sandra. 1991. *Whose Science? Whose Knowledge? Thinking from Women's Lives*. Ithaca: Cornell University Press.

Harding, Sandra. 2008. *Sciences from Below: Feminisms, Postcolonialities, and Modernities*. Durham: Duke University Press.

Harding, Sandra. 1993. *The "Racial" Economy of Science: Toward a Democratic Future*. Bloomington: Indiana University Press.

Harry, Debra. 2001. "Biopiracy and Globalization: Indigenous Peoples Face a New Wave of Colonialism." *Indigenous Peoples Council on Biocolonialism*.

Hatcher, Annamarie, Cheryl Bartlett, Albert Marshall, and Murdena Marshall. "Two-eyed seeing in the classroom environment: Concepts, approaches, and challenges." *Canadian Journal of Science, mathematics and technology education* 9, no. 3 (2009): 141-153.

Held, Mirjam. "Decolonizing science: Undoing the colonial and racist hegemony of Western science." *Journal of MultiDisciplinary Evaluation* 19, no. 44 (2023): 88-101.

Hendlin, Yogi H. "Plant philosophy and interpretation: making sense of contemporary plant intelligence debates." *Environmental Values* 31, no. 3 (2022): 253-276.

Hess, David J. 1995. *Science and Technology in a Multicultural World: The Cultural Politics of Facts and Artifacts*. New York: Columbia University Press.

Hikuroa, Daniel. "Mātauranga Māori—the ūkaipō of knowledge in New Zealand." *Journal of the Royal Society of new Zealand* 47, no. 1 (2017): 5-10.

Holifield, Ryan. "Defining environmental justice and environmental racism." *Urban geography* 22, no. 1 (2001): 78-90.

Illes, Judy, Melissa L. Perreault, Katherine Bassil, Jan G. Bjaalie, Rudi Louis Taylor-Bragge, Hervé Chneiweiss, T. R. Gregory et al. "Two-Eyed Seeing and other Indigenous perspectives for neuroscience." *Nature* 638, no. 8049 (2025): 58-68.

Israel, Barbara A., et al. 2012. *Methods for Community-Based Participatory Research for Health*. 2nd ed. San Francisco: Jossey-Bass.

Jacobs, David S. *Decolonizing Science: The Search for Thales and Euclid*. Cambridge Scholars Publishing, 2025.

Johnston-Goodstar, Katie. "Decolonizing evaluation: The necessity of evaluation advisory groups in Indigenous evaluation." *New Directions for Evaluation* 2012, no. 136 (2012): 109-117.

Jokiel, P. L., et al. "Marine resource management in the Hawaiian Archipelago: the traditional Hawaiian system in relation to the Western approach." *Journal of Marine Sciences* 2011, no. 1 (2011): 151682.

Joshi, Lovleen Tina, Catherine Mansfield, Isaiah J. Ting, and Katharine Hubbard. "Why we need to decolonize the biosciences curriculum." *The Biochemist* 46, no. 2 (2024): 26-32.

Kagawa, Aurora K., and Peter M. Vitousek. "The Ahupua ʻa of Puanui: A Resource for Understanding Hawaiian Rain-Fed Agriculture1." *Pacific Science* 66, no. 2 (2012): 161-172.

Kew Gardens and Wakehurst, *Kew and colonialism: A history of entanglement,* March 10 2020, https://www.kew.org/read-

and-watch/kew-empire-indigo-factory-model

Kia-Keating, Maryam, and Linda P. Juang. "Participatory science as a decolonizing methodology: Leveraging collective knowledge from partnerships with refugee and immigrant communities." *Cultural Diversity & Ethnic Minority Psychology* 28, no. 3 (2022): 299.

Kimmerer, Robin Wall. 2013. *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants*. Minneapolis: Milkweed Editions.

Kirksey, Eben, and Stefan Helmreich. 2010. "The Emergence of Multispecies Ethnography." *Cultural Anthropology* 25(4): 545–576.

Koerner, Lisbet. 1999. *Linnaeus: Nature and Nation*. Cambridge, MA: Harvard University Press.

Kovach, Margaret. 2009. *Indigenous Methodologies: Characteristics, Conversations and Contexts*. Toronto: University of Toronto Press.

LaDuke, Winona. 1999. *All Our Relations: Native Struggles for Land and Life*. Boston: South End Press.

Lambert, W. Marcus, Marlene Camacho-Rivera, Carla Boutin-Foster, Moro Salifu, and Wayne J. Riley. "Ending "domestic helicopter research"." *Cell* 187, no. 8 (2024): 1823-1827.

Latour, Bruno, and Steve Woolgar. 1986. *Laboratory Life: The Construction of Scientific Facts*. Princeton: Princeton University Press.

Law, John. 2004. *After Method: Mess in Social Science Research*. London: Routledge.

Locke, Piers, and Ursula Munster. *Multispecies ethnography*. Oxford: Oxford University Press, 2015.

Longino, Helen E. 1990. *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry*. Princeton: Princeton University Press.

Mabele, Mathew Bukhi, Wilhelm Andrew Kiwango, and Iddi Mwanyoka. "Disrupting the epistemic empire is necessary for a decolonial ecology." *Nature Ecology & Evolution* 7, no. 8 (2023): 1163-1163.

Maldonado-Torres, Nelson. 2007. "On the Coloniality of Being." *Cultural Studies* 21(2-3): 240-270.

Margulis, Lynn. 1998. *Symbiotic Planet: A New Look at Evolution*. New York: Basic Books.

Marshall, Albert, and Cheryl Bartlett. "Two-eyed seeing." *Integrative Science* (2004).

Marshall, Albert, Murdena Marshall, and Cheryl Bartlett. 2012. "Two-Eyed Seeing in Medicine." In *Determinants of Indigenous Peoples' Health in Canada*, edited by Margo Greenwood et al., 16-24. Toronto: Canadian Scholars' Press.

McCartney, A. M. et al. Balancing openness with Indigenous data sovereignty: An opportunity to leave no one behind in the journey to sequence all of life, *Proc. Natl. Acad. Sci. U.S.A.* 119 (4), (20220.

McGregor, Davianna Pōmaikaʻi. 2009. *Nā Kuaʻāina: Living Hawaiian Culture*. Honolulu: University of Hawaiʻi Press.

McGregor, Deborah. "Anishinaabe environmental knowledge." In *Contemporary studies in environmental and Indigenous pedagogies: A curricula of stories and place*, pp. 77-88. Rotterdam: SensePublishers, 2013.

McGuire, Patricia D. "Anishinaabe Giikeedaasiwin–Indigenous knowledge: An exploration of resilience." PhD diss., University of Saskatchewan, 2013.

McLauchlan, Laura. "Multispecies ethnography." *Handbook of historical animal studies* (2021): 393-408.

Merchant, Carolyn. 1980. *The Death of Nature: Women, Ecology, and the Scientific Revolution*. San Francisco: Harper & Row.

Merchant, Carolyn. 2008. "'The Violence of Impediments:' Francis Bacon and the Origins of Experimentation,"Isis, 99, no. 4 (December): 731-760.

Merchant, Carolyn. 2012. "Francis Bacon and the Vexations of Art: Experimentation as Intervention," British Journal for the History of Science, 46, no. 4: 551-599.

Mgbeoji, Ikechi. 2006. *Global Biopiracy: Patents, Plants, and Indigenous Knowledge*. Vancouver: UBC Press.

Mignolo, Walter D. 2009. "Knowledge Disobedience, Independent Thought and De-Colonial Freedom." *Theory, Culture & Society* 26(7–8): 159–181.

Mignolo, Walter. "Decolonizing western epistemology / building decolonial epistemologies." *Decolonizing epistemologies: Latina/o theology and philosophy* (2012): 19-43.

Minkler, Meredith, and Nina Wallerstein, eds. 2012. *Community-Based Participatory Research for Health: From Process to Outcomes*. 2nd ed. San Francisco: Jossey-Bass.

Moewaka Barnes, e al. "Noho taiao: Reclaiming Māori science with young people." *Global health promotion* 26, no. 3_suppl (2019): 35-43.

Mol, Annemarie. 2002. *The Body Multiple: Ontology in Medical Practice*. Durham: Duke University Press.

Morozov, Evgeny. 2013. *To Save Everything, Click Here: The Folly of Technological Solutionism*. New York: PublicAffairs.

Myers, Natasha. 2015. "Conversations on Plant Sensing: Notes from the Field." *NatureCulture* 3: 35-66.

Nakagaki, Toshiyuki, Hiroyasu Yamada, and Ágota Tóth. 2000. "Intelligence: Maze-Solving by an Amoeboid Organism." *Nature* 407 (6803): 470.

Nash, Roderick Frazier. *The rights of nature: a history of environmental ethics*. Univ of Wisconsin press, 1989.

National Science Foundation. 2019. *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2019*. NSF 19-304. Alexandria, VA: National Science Foundation.

Neves, Katja Grötzner. "Botanic gardens in biodiversity conservation and sustainability: history, contemporary engagements, decolonization challenges, and renewed potential." *Journal of Zoological and Botanical Gardens* 5, no. 2 (2024): 260-275.

Nielsen, V. (2023). The colonial roots of botany – legacies of empire in the botanic gardens of Oxford and Kew. *Museum Management and Curatorship*, *38*(6), 696–712.

Nixon, Rob. 2011. *Slow Violence and the Environmentalism of the Poor*. Cambridge, MA: Harvard University Press.

Page, Joanna. *Decolonial Ecologies: The Reinvention of Natural History in Latin American Art*. Open Book Publishers, 2023.

Pennisi, Elizabeth, Discoverer Asks for Time, Patience Over Arsenic Bacteria Controversy. *Science* 330,1734-1735(2010).

Pickering, Andrew. 1995. *The Mangle of Practice: Time, Agency, and Science*. Chicago: University of Chicago Press.

Pierotti, Raymond, and Daniel Wildcat. 2000. "Traditional Ecological Knowledge: The Third Alternative." *Ecological Applications* 10(5): 1333-1340.

Pierotti, Raymond J., and Daniel R. Wildcat. 2000. "Traditional Ecological Knowledge: The Third Alternative (Commentary)." *Ecological Applications* 10(5): 1333-1340.

Plumwood, Val. 2002. *Environmental Culture: The Ecological Crisis of Reason*. London: Routledge.

Povinelli, Elizabeth A. 2016. *Geontologies: A Requiem to Late Liberalism*. Durham: Duke University Press.

Pratt, Mary Louise. 1992. *Imperial Eyes: Travel Writing and Transculturation*. London: Routledge.

Quijano, Aníbal. 2000. "Coloniality of Power, Eurocentrism, and Latin America." *Nepantla: Views from South* 1(3): 533-580.

Reardon, Jenny. 2005. *Race to the Finish: Identity and Governance in an Age of Genomics*. Princeton: Princeton University Press.

Reiter, Bernd. 2020. *The Crisis of Liberal Democracy and the Path Ahead: Alternatives to Political Representation and Capitalism*. Lanham: Lexington Books.

Rioux, Joël, and Bronwyn Ewing. "Contextualising Aboriginal faunal stories with the Linnaean taxonomy: Culturally responsive pedagogy in zoology." *Australian Journal of Indigenous Education (Online)* 51, no. 1 (2022): 1-16.

Rivera-Núñez, et al. "The decolonization dilemma at different stages of the academic career." *Nature Ecology & Evolution* 8, no. 9 (2024): 1559-1560.

Robbins, P. et al, Sovereign genes: wildlife conservation, genetic preservation, and Indigenous data sovereignty, *Front. Conserv. Sci.*, 27, Volume 4, June 2023.

Roberts, Dorothy. 2011. *Fatal Invention: How Science, Politics, and Big Business Re-create Race in the Twenty-First Century*. New York: New Press.

Roberts, Mere, Waerete Weko, Rereata Makiha, and Joe Uru. 1995. "Preserving Māori Knowledge of Plants for Future Generations." *Biodiversity and Conservation* 4(3): 289–302.

Romero-Olivares, Adriana, and Prakash Kashwan. "What Will It Take To Decolonize Ecology?." *Pro-Social World, This View of Life Magazine* (2024).

Rosales, Christine E. "Finding a community in plants: Reexamining the decolonial project of rehumanization with our nonhuman relatives." *Peace and Conflict: Journal of Peace Psychology* 29, no. 1 (2023): 52.

Rose, Deborah Bird. 2011. *Wild Dog Dreaming: Love and Extinction*. Charlottesville: University of Virginia Press.

Samson, Colin. "The rule of Terra Nullius and the impotence of international human rights for indigenous peoples." *Essex Human Rights Review* 5, no. 1 (2008).

Santos, Boaventura de Sousa. 2014. *Epistemologies of the South: Justice Against Knowledgeide*. Boulder: Paradigm Publishers.

Schiebinger, Londa. 2004. *Plants and Empire: Colonial Bioprospecting in the Atlantic World*. Cambridge, MA: Harvard University Press.

Schiebinger, Londa. 1999. *Has Feminism Changed Science?* Cambridge, MA: Harvard University Press.

Shapin, Steven, and Simon Schaffer. 1985. *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life*. Princeton: Princeton University Press.

Sheldrake, Merlin. 2020. *Entangled Life: How Fungi Make Our Worlds, Change Our Minds & Shape Our Futures*. New York: Random House.

Shikova, Natalija. "Decolonization and the right to self-determination: the legal ground and its margins." *Guerra Colonial* 10 (2022): 57-70.

Shiva, Vandana. 2001. *Biopiracy: The Plunder of Nature and Knowledge*. Boston: South End Press.

Shiva, Vandana. 2016. *Staying Alive: Women, Ecology and Development*. London: Zed Books. (Originally published 1988)

Simard, Suzanne. 2021. *Finding the Mother Tree: Discovering the Wisdom of the Forest*. New York: Knopf.

Smith, Linda Tuhiwai. 1999. *Decolonizing Methodologies: Research and Indigenous Peoples*. London: Zed Books.

Solomon, Jon. "Foucault, 1978: The biopolitics of translation and the decolonization of knowledge." *Materiali Foucaultiani* 2, no. 11-12 (2017): 141-172.

Stilt, Kristen. "Rights of nature, rights of animals." *Harv. L. Rev. F.* 134 (2020): 276.

Stone, Christopher D. "Should trees have standing?—Toward legal rights for natural objects." In *Environmental rights*, pp. 283-334. Routledge, 2017.

Swinomish Indian Tribal Community. 2010. *Swinomish Climate Change Initiative Climate Adaptation Action Plan*. La Conner, WA: Swinomish Indian Tribal Community.

Subramaniam, Banu. *Botany of empire: Plant worlds and the scientific legacies of colonialism*. University of Washington Press, 2024.

Tacheva, Zhasmina, and Srividya Ramasubramanian. "Challenging AI empire: Toward a decolonial and queer framework of data resurgence." *Authorea Preprints* (2024).

TallBear, Kim. 2013. *Native American DNA: Tribal Belonging and the False Promise of Genetic Science*. Minneapolis: University of Minnesota Press.

TallBear, Kim. "Indigenous Bioscientists Constitute Knowledge across Cultures of Expertise and Tradition." *RE: MINDINGS*: 173.

TallBear, Kim. 2018. "Making Love and Relations beyond Settler Sex and Family." In *Making Kin Not Population*, edited by Adele Clarke and Donna Haraway, 145-164. Chicago: Prickly Paradigm Press.

Tero, Atsushi, et al. 2010. "Rules for Biologically Inspired Adaptive Network Design." *Science* 327(5964): 439–442.

Trewavas, Anthony. 2014. *Plant Behaviour and Intelligence*. Oxford: Oxford University Press.

Tsing, Anna Lowenhaupt. 2015. *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins*. Princeton: Princeton University Press.

Tuck, Eve, and K. Wayne Yang. 2012. "Decolonization Is Not a Metaphor." *Decolonization: Indigeneity, Education & Society* 1(1): 1–40.

Tuhiwai Smith, Linda. 2012. *Decolonizing Methodologies: Research and Indigenous Peoples*. 2nd ed. London: Zed Books.

Vaughan, Crystal. "The language of cataloguing: Deconstructing and decolonizing systems of organization in libraries." *Dalhousie Journal of Interdisciplinary Management* 14 (2018).

van Dooren, Thom. 2014. *Flight Ways: Life and Loss at the Edge of Extinction*. New York: Columbia University Press.

Voeks R, Greene C. God's Healing Leaves: The Colonial Quest For Medicinal Plants In The Torrid Zone. *Geogr Rev*. 2018;108(4):545-565.

Wali, Alaka, and Robert Keith Collins. "Decolonizing museums: Toward a paradigm shift." *Annual review of anthropology* 52, no. 1 (2023): 329-345.

Wallerstein, Nina, et al. 2017. *Community-Based Participatory Research for Health: Advancing Social and Health Equity*. 3rd ed. San Francisco: Jossey-Bass.

Washington, Harriet A. 2006. *Medical Apartheid: The Dark History of Medical Experimentation on Black Americans from Colonial Times to the Present*. New York: Doubleday.

Whyte, Kyle. 2016. "Indigenous Climate Change Studies: Indigenizing Futures, Decolonizing the Anthropocene." *English Language Notes* 54(1): 153–162.

Wildcat, Daniel. 2009. *Climate Change and Indigenous Peoples: The Search for Legal Remedies*. Cheltenham: Edward Elgar.

Wilson, Shawn. 2008. *Research is Ceremony: Indigenous Research Methods*. Halifax: Fernwood Publishing.

Wolfe-Simon F, Switzer Blum J, Kulp TR, et al. A bacterium that can grow by using arsenic instead of phosphorus. *Science*. 2011;332(6034):1163-1166.

Wynne, Brian. 1992. "Misunderstood Misunderstanding: Social Identities and Public Uptake of Science." *Public Understanding of Science* 1(3): 281-304.

Zadey, Siddhesh, and Dhananjaya Sharma. "From decolonizing global health to neo-colonization by local elites: From the frying pan into the fire." *PLOS Global Public Health* 5, no. 2 (2025): e0004196.