NATURAL RESOURCES JOURNAL

Volume 59
Issue 2 *Summer 2019*

Summer 2019

New Materialism: An Ontology for the Anthropocene

Melinda Harm Benson
University of New Mexico - Main Campus

Melinda H. Benson*

NEW MATERIALISM: AN ONTOLOGY FOR THE ANTHROPOCENE

I. INTRODUCTION

The Anthropocene is here. What this actually *means* is the subject of some debate.[1] Environmental writer Andrew Revkin observes that the term "Anthropocene" seems to demonstrate Rorschach-like plasticity—simply reinforcing the beliefs of those who employ it.[2] At its core, the term "Anthropocene" is an acknowledgment that human action has become an important driver—arguably *the* most important driver—of change on Earth.[3] The actual, geological determination of whether the earth has entered a new epoch called "Anthropocene" has been discussed elsewhere.[4] Among legal scholars and others, the "[A]nthropocene has become the closest thing there is to common shorthand for this turbulent, momentous, unpredictable, hopeless, hopeful time—duration and scope still unknown."[5]

---

* Melinda Harm Benson is Dean, professor and a Wyoming Excellence Chair at the Haub School of Environment and Natural Resources at the University of Wyoming. Her research and scholarship focus on emerging environmental governance paradigms. At the time of this writing, she is transitioning back to faculty at the University of New Mexico and can be reached at mhbenson@unm.edu.

1. *See* Paul Robbins & Sarah A. Moore, *Ecological Anxiety Disorder: Diagnosing the Politics of the Anthropocene*, 20 CULTURAL GEOGRAPHIES 3, 5-7 (2012); *see also contra* LESLEY HEAD, HOPE AND GRIEF IN THE ANTHROPOCENE: RE-CONCEPTUALISING HUMAN–NATURE RELATIONS 4 (2016).

2. Andrew C. Revkin, Opinion, *An Anthropocene Journey*, N.Y. TIMES (Nov. 8, 2016), http://dotearth.blogs.nytimes.com/2016/11/08/an-anthropocene-journey/?_r=0; *c.f.* DONNA J. HARAWAY, STAYING WITH THE TROUBLE: MAKING KIN IN THE CHTHULUCENE 100 (2016) (Haraway prefers the term Chthulucene, which she defines as where refugees from environmental disaster, both human and non-human, will come together. She writes, "[the Anthropocene is] a boundary event more than an epoch. . . . between the Cretaceous and the Paleogene. The Anthropocene marks severe discontinuities; what comes after will not be like what came before. I think our job is to make the Anthropocene as short/thin as possible and to cultivate with each other in every way imaginable epochs that come that can replenish refuge."). *Id.*

3. The most authoritative definitions of Anthropocene come from the International Union of Geological Sciences, the international scientific organization that is in charge of officially designating and naming geological time periods, and the International Commission on Stratigraphy (ICS), which evaluates the scientific evidence in support of new geological period designations. On August 29, 2016, the ICS's Working Group on the Anthropocene recommended that the current interval be recognized as a new epoch, the Anthropocene. *See generally* Paul J Crutzen & Eugene F Stoermer, *The "Anthropocene,"* 41 GLOBAL CHANGE NEWSL. (Int'l Council for Sci., Stockholm, Swed.), May 2011, at 17-18; *see also* Paul J. Crutzen, *The Effects of Industrial and Agricultural Practices on Atmospheric Chemistry and Climate during the Anthropocene*, 37 J. ENVTL. SCI. & HEALTH 423, 423 (2002).

4. *See, e.g.*, Simon L. Lewis & Mark A. Maslin, *Defining the Anthropocene*, 519 NATURE 171, 171 (2015).

5. Shalanda H. Baker, *Adaptive Law in the Anthropocene*, 90 CHI.-KENT L. REV. 563, 567 (2015); *see also* Revkin, *supra* note 2; *see, e.g.*, Louis J Kotzé, *Rethinking Global Environmental Law and Governance in the Anthropocene***,** 32 J. ENERGY & NAT. RESOURCES L. 121, 137-39 **(**2014).

This article argues that the Anthropocene is not simply a new geologic epoch; it is an opportunity to embrace a new ontology. In it, we can reconfigure our orientation to the material world. The current, dominant ontology casts humans as villains responsible for mass extinctions,[6] polluted oceans,[7] and climate change.[8] This ontology reinforces a familiar binary—one in which humans are separate *from* and doing things *to* nature. Humans are ruining the planet, causing it to fundamentally change in ways that are not "natural" precisely *because* humans are the agent of change. This view is perhaps best described by environmentalist Bill McKibben in his book *The End of Nature* in which he argues that "nature" is no longer anywhere because humans (via climate change) are now everywhere.[9]

This belief—that humans are separate *from* and doing things *to* nature—is an ontological stance that is embedded within the environmental and natural resource laws of the United States.[10] Unfortunately, this perception is not only inaccurate, it is also largely responsible for the situation in which we now find ourselves. Our oceans *are* polluted, rates of biodiversity loss are so high many experts believe we are living through the sixth major mass extinction,[11] and the climate is changing.[12] The point of this article is not to defend the human actions that created the Anthropocene but instead to identify the core conditions that created it and investigate how our natural resource and environmental laws entrench these conditions rather than address them.

The perception that humans are separate from and doing things to nature reflects a particular, historically situated view of the material world. It is a legacy of the Enlightenment, the very same era during which many elements of our current legal system were established.[13] As a result, most natural resource and environmental law is based upon two critical ontological assumptions common to Enlightenment-based thought.[14] One involves the notion of agency—what it is and who has it. Agency, defined here as the capacity to *act*, is, generally speaking, a capacity

6. *See* Gerardo Ceballos et al., *Accelerated Modern Human–Induced Species Losses: Entering the Sixth Mass Extinction*, SCI. ADVANCES, June 19, 2015, at 1, http://advances.sciencemag.org/lens/advances/1/5/e1400253.

7. *See generally* John E. Elliott & Kyle H. Elliott, *Tracking Marine Pollution*, 340 SCIENCE 556, 556 (2013).

8. *See generally* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE [IPCC], CLIMATE CHANGE 2007: SYNTHESIS REPORT, 5 (2008), https://digital.library.unt.edu/ark:/67531/metadc29351/m2/1/high_res_d/climate%20change%20synthesis.pdf [hereinafter 2007 IPCC SYNTHESIS REPORT].

9. *See also, e.g.*, Howard Wolinsky, *Will We Wake up to Biodiversity?*, 12 EMBO REP. 1226, 1226-28 (2011), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3245706/; Osvaldo E. Sala et al., *Global Biodiversity Scenarios for the Year 2100*, 287 SCIENCE 1770, 1770 (2000).

10. *See* Melinda Harm Benson, *Reconceptualizing Environmental Challenges—Is Resilience the New Narrative?*, 21 J. ENVTL. & SUSTAINABILITY L. 99, 109 (2015).

11. *See* Ceballos et al., *supra* note 6, at 3-4 (detailing estimates revealing an exceptionally rapid loss of biodiversity over the last few centuries, indicating that a sixth mass extinction is already underway).

12. *See* 2007 IPCC SYNTHESIS REPORT, *supra* note 8, at v.

13. *See* NICOLE GRAHAM, LAWSCAPE: PROPERTY, ENVIRONMENT, LAW xiii (2011).

14. *See* Kay Anderson, *Mind Over Matter? On Decentring the Human in Human Geography*, 21 CULTURAL GEOGRAPHIES 3, 13 (2014) (providing a detailed contextualization of Cartesian epistemology).

presumed to belong only to human beings.[15] The second assumption is human exceptionalism and, relatedly, the unfortunately narrow and anthropocentric ways in which we conceptualize environmental challenges. Both assumptions have had cascading affects, creating and operationalizing legal processes that have deeply reinforced an unfortunate and erroneous perception of the material world. These beliefs are *ontological* because they cause us to experience reality in ways that, upon reflection, are hard to justify.[16]

This article examines these beliefs, employing an emerging field of scholarship across the humanities and social sciences called new materialism.[17] Research and scholarship in this field have many names—post-humanism, agential realism, and new or vital materialism are a few examples. Collectively, they represent a move away from the centrality of the human and toward a more complex and relational perspective of art, literature, politics and other elements of lived experience. This work offers nothing less than an ontological reconceptualization of the material world, i.e., a *new* materialism. A new materialist approach begins with a different set of assumptions. Rather than seeing wildfire, flooding, and other events as problems to be solved, there would be first a recognition of these events as actors within a complex and dynamic system. Similarly, humans are actors within the system, but not necessarily at the center.

Insights from new materialist scholarship are many, yet their implications for law have, to date, been relatively unexamined.[18] The core argument of this article is that the Anthropocene is an opportunity to embrace alternative environmental governance approaches using ideas emerging from new materialist scholarship. After a brief introduction to this research and scholarship, this article uses the ontology offered by new materialism to discuss what a new approach to environmental and natural resource law might look like. Finally, it provides an example, examining existing environmental governance approaches to drought, climate change, and wildfire in the American Southwest.[19] The headwaters of the Rio Grande and the downstream communities of Albuquerque and Santa Fe provide an example of a watershed experiencing enormous challenges, as increased temperatures push forest systems across an ecological threshold.[20] Existing governance strategies have a limited capacity to effectively engage the environmental challenges in the watershed, in large part because they employ a human-centered, Enlightenment-based view of the world.

---

15. Angga Dwiartama & Christopher Rosin, *Exploring Agency Beyond Humans: The Compatibility of Actor-Network Theory (ANT) and Resilience Thinking*, 19 ECOLOGY & SOC'Y 1, 2 (2014).

16. Adeline Johns-Putra, *Environmental Care Ethics: Notes Toward a New Materialist Critique*, 21 SYMPLOKĒ 125, 125 (2013) (noting the general "lack of ontological scrutiny" in conversations involving environmental ethics).

17. *See generally* RICHARD GRUSIN, THE NONHUMAN TURN vii-viii (2015).

18. *See* Laura A. Foster, *The Making and Unmaking of Patent Ownership: Technicalities, Materialities, and Subjectivities*, 39 POLAR, 127, 129 (2016) (providing the one account of engagement with new materialism the author was able find in her research).

19. This case study was highlighted in a book I co-authored with Robin Craig on environmental governance in the Anthropocene. *See generally* MELINDA HARM BENSON & ROBIN KUNDIS CRAIG, THE END OF SUSTAINABILITY: RESILIENCE AND THE FUTURE OF ENVIRONMENTAL GOVERNANCE IN THE ANTHROPOCENE 82 (Kimberly K. Smith ed., 2017).

20. *Id*. at 81.

Comparing current human-centered and nonhuman approaches demonstrates that our current approach to climate change in the American Southwest mirrors our collective beliefs about nature and relationships with natural processes. By contrast, a new materialist approach to law would reexamine these relationships and create legal forms and processes that more accurately reflect our lived experience of the material world. It would take a more nuanced perspective regarding the nature of agency, dispel the myth of human exceptionalism, and, more accurately, capture the dynamism and complexity of the future we face.

II. NEW MATERIALISM AND THE NONHUMAN TURN

The emerging field of new materialism has many intellectual crosscurrents; it is a genuinely transdisciplinary area of scholarship. Collectively, it shares an interest in critically examining the legacy of Enlightenment thinking using a variety of intellectual and theoretical approaches.[21] In *The NonHuman Turn*, Richard Grusin identifies several strands of literature challenging the centrality of the human,[22] including actor-network theory[23] from science-technology studies[24] and the work of Bruno Latour;[25] affect theory and its emphasis on the non-rational, often unconscious forces driving both human and nonhuman relations;[26] animal studies and its study of

21. *See generally* GRUSIN, *supra* note 17 (an edited volume providing engagement of new materialism and related scholarship from a variety of perspectives). *Id*. at ix; *see also* Sarah Whatmore, *Earthly Powers and Affective Environments: An Ontological Politics of Flood Risk*, 30 THEORY, CULTURE & SOC'Y 30, 34 (2013). Whatmore identifies two main genres: "The first is fueled by the promiscuous inventiveness of the life sciences and its implications for repopulating the body politic in mundane and monstrous ways. The second is the latest in a line of contrapuntal intellectual energies associated with the prefix 'post' that ostensibly work against the philosophical legacy of the Enlightenment, but which surpass and sustain in the same breath whatever went 'before.'" *Id.* (citations omitted).

22. GRUSIN, *supra* note 17, at viii.

23. BRUNO LATOUR, REASSEMBLING THE SOCIAL: AN INTRODUCTION TO ACTOR-NETWORK THEORY 9 (2005) (noting that "'actor-network-theory,' a name that is so awkward, so confusing, so meaningless that it deserves to be kept"); *see also* Edwin Sayes, *Actor–Network Theory Methodology: Just What Does it Mean to Say that Nonhumans Have Agency?*, 44 SOC. STUD. SCI. 134, 134 (2014) (interrogating the multiple layers of this declaration to understand what it means to assert with Actor–Network Theory that nonhumans exercise agency).

24. Broadly speaking, Science Technology Society [hereinafter STS] is an interdisciplinary approach that investigates both the ways in which social, political, and cultural values science and technology and, in turn, how scientific research and technological innovation influence society, politics, and culture. This reflexive relationship recognizes the role of culturally embedded practices and epistemologies involved in the production of seemingly "objective" knowledge production and "neutral" employment of technology. *See* THE SOCIAL CONSTRUCTION OF TECHNOLOGICAL SYSTEMS 11 (Wiebe Bijker et al. eds., 1989); DAVID J. HESS, SCIENCE STUDIES: AN ADVANCED INTRODUCTION 1-5 (1997).

25. *See* LATOUR, *supra* note 23, at 23-24. Latour is considered the leading voice of ANT. For a more complete genealogy: *see* John Law, *Actor Network Theory and Material Semiotics*, *in* THE NEW BLACKWELL COMPANION TO SOCIAL THEORY 141, 141 (Bryan S. Turner ed., 2009); *see also* BRUNO LATOUR, SCIENCE IN ACTION: HOW TO FOLLOW SCIENTISTS AND ENGINEERS THROUGH SOCIETY 15-17 (1987).

26. *See generally* THE AFFECT THEORY READER 1 (Melissa Gregg & Gregory J. Seigworth eds., 2010). Affect theory challenges the primacy of language and reason, emphasizing nonlinguistic ways of knowing, including emotions and sensory experiences.

human and other-than-human relations;[27] assemblage theory as developed by Manuel DeLanda;[28] and reflecting Gilles Deleuze and Félix Guattari's dynamical theory;[29] new brain sciences and insights from research into neuro-plasticity and cognitive processes;[30] new materialism[31] (also referred to as vital materialism[32]) which is squarely concerned with the ontological implications of more inclusive and dynamic theories of mind and materiality;[33] new media theory and its investigation of the complex and rapidly changing socio-cultural dynamics of digital realities;[34] speculative realism,[35] a category of philosophy concerned mainly with a metaphysics that explicitly rejects the centrality of Kantian correlationism;[36] object-oriented

27. *See* DONNA HARAWAY, WHEN SPECIES MEET 5, 9 (2008); *see also* COLLEEN GLENNEY BOGGS, ANIMALIA AMERICANA: ANIMAL REPRESENTATIONS AND BIOPOLITICAL SUBJECTIVITY 3 (2013).

28. *See* MANUEL DELANDA, A NEW PHILOSOPHY OF SOCIETY: ASSEMBLAGE THEORY AND SOCIAL COMPLEXITY 3 (2006) (DeLanda unpacks Deleuze's notion of assemblages—an ontological framework for conceptualizing social complexity by emphasizing fluidity, exchangeability, and multiple functionalities); *see also* GILLES DELEUZE AND FELIX GUATTARI, A THOUSAND PLATEAUS: CAPITALISM AND SCHIZOPHRENIA 2 (2006).

29. *See generally* DELEUZE & GUATTARI, *supra* note 28, at 104, 221, 237, 271 (working with broader concepts from systems theory, which, at the time was principally mathematical, to conceive dynamical systems theory of social processes and events, including linguistics, philosophy, etc., in which rejects placement of categories into binaries (subject-object); the system should stay open so as to allow free flow of process and interactions).

30. *See generally* Eberhard Fuchs & Gabriele Flügge, *Adult Neuroplasticity: More Than 40 Years of Research*, 2014 NEURAL PLASTICITY 1 (2014), http://dx.doi.org/10.1155/2014/541870; *see also* DANIEL J. SIEGEL, POCKET GUIDE TO INTERPERSONAL NEUROBIOLOGY: AN INTEGRATIVE HANDBOOK OF THE MIND 40-44 (2012) (a 560-page "pocket guide" taking insights from neuroscience and other fields to provide an interpersonal neurobiology approach to understanding the human experience).

31. *See generally* NEW MATERIALISMS: ONTOLOGY, AGENCY, AND POLITICS 1 (Diana Coole & Samantha Frost eds., 2010).

32. *See* JANE BENNETT, VIBRANT MATTER: A POLITICAL ECOLOGY OF THINGS 3, 109 (2010) (arguing that political theory needs to do a better job of recognizing the active participation of nonhuman forces in events and theorizing a "vital materiality" that runs through and across bodies, both human and nonhuman, and exploring how political analyses of public events might change were we to acknowledge that agency always emerges as the effect of ad hoc configurations of human and nonhuman forces).

33. *See generally* JAY DAVID BOLTER & RICHARD GRUSIN, REMEDIATION UNDERSTANDING NEW MEDIA (1998); NICK COULDRY, MEDIA, SOCIETY, WORLD: SOCIAL THEORY AND DIGITAL MEDIA PRACTICE (2012).

34. *See generally* LEVI BRYANT, ONTO-CARTOGRAPHY: AN ONTOLOGY OF MACHINES AND MEDIA (2014).

35. *See generally* Steven Shaviro, *The Actual Volcano: Whitehead, Harman, and the Problem of Relations*, *in* THE SPECULATIVE TURN: CONTINENTAL MATERIALISM AND REALISM 279 (Levi Bryant et al., eds., 2011).

36. Correlationism relies on human perception to interpret reality—being is experienced through thinking. *See* QUENTIN MEILLASSOUX, AFTER FINITUDE: AN ESSAY ON THE NECESSITY OF CONTINGENCY 5 (2010) (defining correlationism as "the idea according to which we only ever have access to the correlation between thinking and being, and never to either term considered apart from the other.").

ontology;[37] and panpsychism.[38] Grusin also notes the nonhuman elements of systems theory.[39] To this list, I add non-representational theory, and its emphasis on performativity,[40] and, finally quantum physics[41] and Karen Barad's related new materialist approach she refers to as agential realism.[42] While helpful in some ways, these categories create artificial intellectual boundaries. Scholarship and research in this area tends to intersect and overlap, collectively sharing a desire to "rethink the political, political agency and subjectivity beyond anthropocentrism."[43]

New materialism is particularly helpful in the context of natural resources and environmental law because it reveals ontological assumptions about the material world, *i.e.*, what is "natural" and what is not. Systems theory and its capacity to embrace the complex and dynamic nature of reality is particularly relevant and, to some extent, currently employed in the environmental governance context with the relatively recent embrace of resilience as a management paradigm.[44]

---

37. Object-oriented ontology rejects the privileging of human existence over the existence of everything else. *See* Graham Harman, *On the Undermining of Objects: Grant, Bruno and Radical Philosophy*, *in* THE SPECULATIVE TURN: CONTINENTAL MATERIALISM AND REALISM 26 (Levi Bryant et al., eds., 2011) ("The world is not the world as manifest to humans; to think a reality beyond our thinking is not nonsense, but obligatory.").

38. Steven Shaviro, *Consequences of Panpsychism*, *in* THE NONHUMAN TURN, 19 (2015). Panpsychism extends the capacity for *thought*. "From the pre-Socratics, on through Baruch Spinoza and Gottfried Wilhelm Leibniz, and down to William James and Alfred North Whitehead, panpsychism is a recurring underground motif in the history of Western thought." *Id*. at 20.

39. *See* GRUSIN, *supra* note 17, at ix. System theory is a transdisciplinary field that takes a complex and holistic approach to understanding phenomena and their interrelated parts.

40. Initially proposed by Nigel Thrift, non-representational theory comes primarily from the field of human geography and seeks to move cultural geography beyond fixed identities and forms (much like the closed categories rejected by DELEUZE AND GUATTARI, *supra* note 28) and toward an emphasis on the practice, embodiment and performativity within lived geographies. *See* Nigel Thrift, *The Still Point: Resistance, Expressive Embodiment and Dance*, *in* GEOGRAPHIES OF RESISTANCE 132-133 (Steve Pile & Michael Keith eds., 1997); *see generally* NIGEL THRIFT, NON-REPRESENTATIONAL THEORY: SPACE, POLITICS, AFFECT 24 (2008); Ben Anderson & Paul Harrison, *The Promise of Non-Representational Theories*, *in* TAKING-PLACE: NON-REPRESENTATIONAL THEORIES AND GEOGRAPHY 2 (Ben Anderson & Paul Harrison eds., 2010); SARAH WHATMORE, HYBRID GEOGRAPHIES: NATURES, CULTURES, SPACES 4-5 (2002).

41. *See* ALEXANDER WENDT, QUANTUM MIND AND SOCIAL SCIENCE: UNIFYING PHYSICAL AND SOCIAL ONTOLOGY 137 (2015) (extending insights from quantum physics to understand human consciousness as a macroscopic quantum process); s*ee also* Karen Barad, *Transmaterialities: Trans/Matter/Realities and Queer Political Imaginings*, 21 GLQ: J. LESBIAN & GAY STUD. 387, 387 (Barad explains this as "an experimental article about matter's experimental nature — its propensity to test out every un/imaginable path, every im/possibility. Matter is promiscuous and inventive in its agential wanderings: one might even dare say, imaginative.").

42. *See* KAREN BARAD, MEETING THE UNIVERSE HALFWAY: QUANTUM PHYSICS AND THE ENTANGLEMENT OF MATTER AND MEANING 66 (2007). Barad coins the term agential realism, which is "an epistemological-ontological-ethical framework that provides an understanding of the role of human and nonhuman, material and discursive, and natural and cultural factors in scientific and other social-material practices, thereby moving such considerations beyond the well-worn debates that pit constructivism against realism, agency against structure, and idealism against materialism." *Id.* at 26.

43. Jessica Schmidt, *The Empirical Falsity of the Human Subject: New Materialism, Climate Change and the Shared Critique of Artifice*, 1 RESILIENCE 174, 179 (2013).

44. *See* Melinda Harm Benson et al., *Water Governance Challenges in New Mexico's Middle Rio Grande Valley: A Resilience Assessment*, 51 IDAHO L. REV., 195, 197-99 (2014).

As will be discussed in the section on the implications of new materialism for environmental governance, systems theory is now embraced by ecology and other natural sciences, and efforts are being made to integrate systems thinking into natural resource and environmental law. Unfortunately, as currently employed, use of systems-based approaches is not living up to systems theory's potential to collapse the nature/society binary.

A. New versus old materialism

Any examination of the new materialism must first acknowledge the *old* materialism that currently dominates Western thought. The old materialism prescribes to the deterministic, mechanistic view of matter created during the Enlightenment. It is grounded in Newtonian physics and Cartesian epistemology.[45] Matter is seen as passive, "behaving according to fixed, universal, timeless laws, or as the product of accidental interactions with other matter also behaving in accordance with these laws."[46] In the absence of sentience, matter is seen as inert.[47] Rachel Tillman observes that technological mastery of matter is an intended and logical consequence of the mechanistic view: "Matter's openness to being shaped at our will, its lack of agency, implies that we can safely consider its desire, will, or volition not to be an impediment to accomplishing what we will, if only because matter has neither desire, will, nor volition."[48] This facilitates the nature/society binary, allowing nature to become property.[49]

New materialism challenges a mechanistic view of reality. The Newtonian-Cartesian paradigm reflects a belief that the world and its operation are knowable, predictable and controllable. By contrast, new materialists argue that matter is neither inert nor mechanistic; it is dynamic and relational.[50] The predictability found

45. *See* Anderson & Harrison, *supra* note 40, at 17.

46. Rachel Tillman, *Toward a New Materialism: Matter as Dynamic*, 8 MINDING NATURE 30, 30 (2015).

47. *See* Karen Barad, *Posthumanist Performativity: Toward an Understanding of How Matter Comes to Matter*, 28 SIGNS: J. WOMEN CULTURE & SOC'Y 801, 813 (2003):

> Physicist Niels Bohr won the Nobel Prize for his quantum model of the atom, which marks the beginning of his seminal contributions to the development of the quantum theory. Bohr's philosophy-physics (the two were inseparable for him) poses a radical challenge not only to Newtonian physics but also to Cartesian epistemology and its representationalist triadic structure of words, knowers, and things. Crucially, in a stunning reversal of his intellectual forefather's schema, Bohr rejects the atomistic metaphysics that takes "things" as ontologically basic entities. For Bohr, things do not have inherently determinate boundaries or properties, and words do not have inherently determinate meanings. Bohr also calls into question the related Cartesian belief in the inherent distinction between subject and object, and knower and known.

Id. at 813.

48. Tillman, *supra* note 46, at 31.

49. *See* GRAHAM, *supra* note 13, at 4-5.

50. BARAD, *supra* note 42, at 93.

in Newtonian (classical) physics is not the result of a deterministic world.[51] Rather, it reflects the reflection-correspondence perception of reality.[52]

According to the old materialism, knowledge is the product of investigation (usually by deductive reasoning or the scientific method) of reality.[53] By contrast, knowledge is seen by new materialism as a dynamic reflection of the particular arrangements of matter.[54] When the other (the observer) influences where something actually goes (the observed), the idea that matter is inert or pre-determined goes out the window.[55] Ontology (what is) and epistemology (how we know what is) are *not* two separate things.[56] The implications of this collapse of ontology and epistemology are profound. There are no binaries; there are ongoing, dynamic relations. "It is through specific agential intra-actions that the boundaries and properties of the 'components' of phenomena become determinate and that particular embodied concepts become meaningful."[57] Reality is relational.[58]

This dynamic view of materiality brings forward a related insight from new materialist scholarship regarding the nature of agency. Agency—defined in the most basic sense as the capacity to act—configures both more broadly and more

---

51. WENDT, *supra* note 41, at 29 (stating that "since the quantum revolution we have known that sub-atomic level matter in the classical materialist sense breaks down in to wave functions. Indeed, it is not just that which breaks down, but the whole classical worldview, which is also atomist, determinist, mechanist and objectivist").

52. *See* Tillman, *supra* note 46, at 33 (exploring interactionist ontology).

53. *See generally* WENDT, *supra* note 41, at 58-62.

54. *See* Tillman, *supra* note 46, at 30.

55. Instead of fixed outcomes, there are fluid tendencies. The natural world behaves probabilistically when seen at the quantum scale. In his book, QUANTUM MIND AND SOCIAL SCIENCE: UNIFYING PHYSICAL AND SOCIAL ONTOLOGY, Alexander Wendt explains the implications:

> The probabilistic behavior of quantum systems poses a . . . serious threat to determinism . . . . Early in the quantum revolution this led to much hand wringing, especially by convinced determinists like Einstein, who concluded that quantum mechanics could not be a fundamental theory. The problem is rooted in the collapse of wave function. Before measurement the wave function evolves deterministically, just like a classical system; the Schrodinger equation yields precise values that enable us to predict its motion over time. However, as soon as we perform a measurement it collapses instantaneously into a particle whose location cannot be predicted in advance; all we can know is the probability that it will be in once place or another.

WENDT, *supra* note 41, at 62. Known as the "observer effect," this finding from quantum physics reveals that "[t]here is no unambiguous way to differentiate between the "object" and the 'agencies of observation.'" BARAD, *supra* note 42, at 196. The observer influences what is observed, and there is no ability to separate the two.

56. *See* Tillman, *supra* note 46, at 33 ("Recent feminist work on the dynamism of matter begins by locating and challenging two key presuppositions of the mechanistic view of matter: that matter is "passive," and that matter is "separable.").

57. Barad, *supra* note 47, at 815.

58. One of the more startling elements of quantum theory is called quantum entanglement, a phenomenon in which the quantum states of two or more objects must be described with reference to each other, even though the individual objects may be spatially separated. This leads to correlations between observable physical properties of the systems. Quantum entanglement is a phenomenon that Einstein himself theorized yet found difficult to believe—he called it "spooky action at a distance." Decades after Einstein's postulation, physicists proved the existence of quantum entanglement in various experiments, including those where the objects in question were separated by extreme distances. WENDT, *supra* note 41, at 51-54.

relationally than generally assumed in western thought.[59] The old materialist understanding of agency ascribes it as something that belongs only to humans. Human exceptionalism—the idea that humans are a priori different from other things–is centered on a narrow definition of agency. Specifically, human exceptionalism is based on the assumption that humans are somehow unique in terms of our capacity to act. This is again a product of a Cartesian worldview, *i.e.,* that it is our capacity for rational thought that creates the basis for privileged ontological status.[60]

Professor Ana Tsing sees human exceptionalism at the root of our limited perception of the material world, "*Human exceptionalism blinds us*. Science has inherited stories about human mastery from the great monotheistic religions. These stories fuel assumptions about human autonomy, and they direct questions to the human *control* of nature, on the one hand, or human *impact* on nature, on the other, rather than to species interdependence."[61] Tsing argues that one of the many limitations of this heritage is a belief that humans are a constant across culture and history:

> The idea of *human nature* has been given over to social conservatives and sociobiologists, who use assumptions of human constancy and autonomy to endorse the most autocratic and militaristic ideologies. What if we imagined a human nature that shifted historically together with varied webs of interspecies dependence? *Human nature is an interspecies relationship.* Far from challenging genetics, an interspecies frame for our species opens possibilities for biological as well as cultural research trajectories. We might understand more, for example, about the various webs of domestication in which we humans have entangled ourselves.[62]

From a new materialist perspective, any sense that humans are separate or exceptional is simply false. Decentering the human, new materialism broadens the conception of agency—both what it is and who has it. New materialists extend agency to not only other sentient beings but to everything that influences and interacts,[63] as well as the processes by which interaction occurs.[64] In this sense, within this concept of agency there are no "individuals" *per se*. There are networks and assemblages. The omission of separate, autonomous individuals obviates the

---

59. *See, e.g.*, Dwiartama & Rosin, *supra* note 15 (exploring the notion of agency within the context of resilience theory and concluding agency comprises something more complex than pure intentionality).

60. *See, e.g.*, Eckhart Tolle explains "The philosopher Descartes believed he had found the most fundamental truth when he made his famous statement: 'I think, therefore I am.' He had, in fact, given expression to the most basic error: to equate thinking with Being and identity with thinking." ECKHART TOLLE, THE POWER OF NOW 15 (1997).

61. Anna L. Tsing, *Unruly Edges: Mushrooms as Companion Species*, 1 ENVTL. HUMANITIES 141, 144 (2012); *see generally* ANNA L. TSING, THE MUSHROOM AT THE END OF THE WORLD: ON THE POSSIBILITY OF LIFE IN CAPITALIST RUINS 144 (2015) (providing a book length account of the argument).

62. Tsing, *supra* note 61, at 144.

63. *See* Bruno Latour, *Agency at the Time of the Anthropocene*, 45 NEW LITERARY HIST. 1, 10, 13-15 (2014) (exploring what sort of agency the earth is granted in the Anthropocene).

64. *See* BENNETT, *supra* note 32, at 11.

need for stable boundaries and binaries. In fact, from this perspective, humans are not even *human*, as such. They are (as with all materiality) temporal expressions of ongoing entanglements.[65]

In *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*, Karen Barad proposed the term "agential realism," to describe this ontological inseparability.[66] Agential realism recognizes that "Matter is neither fixed and given nor the mere end result of different processes. Matter is produced and productive, generated and generative. Matter is agentive, not a fixed essence or property of things."[67]

What does new materialism tell us about the Anthropocene? It means that, despite a new label, we have always profoundly influenced (and been influenced by) the earth system, simply by being a part of it. It is true that over the past fifty years, humans have "changed ecosystems more rapidly and extensively than in any comparable period of time in human history."[68] But those actions cannot be isolated from a myriad of other human and nonhuman actions. We have been, and continue to be, since our creation, part of an interconnected, complex and dynamic web of materiality. Our perception of the material world as solid and unchanging is just that—a perception. A richer account of the material acknowledges the limits of human perception, including perceptions that are shaped and informed by cultural norms and historically contingent ontological accounts.

Hints of this richer account of the material exist at the edges of what is usually acknowledged by the dominant culture. Research by new materialists—into everything from forests[69] to rice,[70] omega-3 fatty acids[71] to ships[72]—challenges what it means to be an actor within ongoing and dynamic interactions and assemblages. We know that our own senses share with us only part of what is experienced as materiality. Yet, the old materialism remains dominant and is embedded in all sorts of human action—including law-making.

---

65. Anyone who has succumbed to the current probiotic craze is familiar with the fact that the human body is comprised of mostly *nonhuman* organisms. Our relationships (*i.e.*, entanglements) with these bacteria are a complex and dynamic assemblage. *See generally* Michael Greshko, *How Many Cells Are in the Human Body—And How Many Microbes?*, NAT'L GEOGRAPHIC, Jan. 13, 2016 (noting that the average human male is made of 30 trillion cells and contains about 40 trillion bacteria, most of which reside in his digestive tract).

66. BARAD, *supra* note 42, at 137.

67. *Id.* (using the work of Nobel Prize winning physicist Neils Bohr, Barad explores the ontological implications of agential realism).

68. *Id.* at 4; *see also* WALTER REID ET AL., MILLENNIUM ECOSYSTEM ASSESSMENT, ECOSYSTEMS AND HUMAN WELL-BEING: SYNTHESIS 1 (2005) (stating that this change occurred "largely to meet rapidly growing demands for food, fresh water, timber, fiber, and fuel.").

69. *See generally* EDUARDO KOHN, HOW FORESTS THINK: TOWARD AN ANTHROPOLOGY BEYOND THE HUMAN 7, 29 (2013) (exploring an anthropology that investigates "something about how we can move beyond understanding the human in terms of the 'complex wholes' that make us who we are. In sum, appreciating what it might mean 'to live' . . . in worlds that are open to that which extends beyond the human might just allow us to become a little more 'worldly.'").

70. *See generally* Dwiartama & Rosin, *supra* note 15, at 1.

71. *See* BENNETT, *supra* note 32, at 41-42.

72. *See* John Law, *On the Methods of Long-Distance Control: Vessels, Navigation and the Portuguese Route to India*, *in* POWER, ACTION, AND BELIEF: A NEW SOCIOLOGY OF KNOWLEDGE? 257-58 (John Law ed., 1986).

III. IMPLICATIONS OF NEW MATERIALISM FOR ENVIRONMENTAL GOVERNANCE

Insights from new materialism have implications for law that go well beyond natural resource and environmental management. Perhaps the most obvious and daunting realization is that, while law is all about assigning duties and responsibility, the relational, complex, and dynamic nature of the material world makes this task difficult if not impossible. Law is predicated upon the idea that causality can be located and assigned to individuals, entities, etc. Yet causality is often difficult to locate in the old materialism, let alone a new material one, where causality is widely distributed among a variety of actors and interactions among them. In the strictest sense, it is difficult to even draw an indelible boundary around something and call it "an actor." There is no actor outside relationship.[73] In short, new materialism provides an alternative (richer) account of reality with ramifications for virtually all areas of law beyond what can be explored here. Examining the subset of environmental and natural resources law, the immediate and profound implication is that the material world does not behave mechanistically, nor does it operate according to some "balance of nature."

Happily, the "equilibrium" view of nature has already been debunked within biology, ecology and other fields that are increasingly embracing the notion of dynamic and complex systems. Complex systems theory emphasizes interactions between the agents within a system, and emergent properties that arise from such dynamics at various scales.[74] It supplants linear conceptions of cause and effect, instead describing relationships among elements that are always interacting with and adapting to each other, leading to descriptions of a world that is always moving and changing, rather than remaining static.[75]

The phrase social-ecological systems (SES) is now commonly invoked regarding environmental challenges, and the concept of system resilience is now often referred to when identifying environmental and natural resource management goals.[76] Legal scholars have considered the implications of this work for law.[77]

---

73. *See* Dwiartama & Rosin, *supra* note 15, at 2 (examining the concept of agency, which in social sciences is used to distinguish the capacity for humans to actively control its own well-being).

74. *See* M. MITCHELL WALDROP, COMPLEXITY: THE EMERGING SCIENCE AT THE EDGE OF ORDER AND CHAOS 11 (1993) (Waldrop explains: "Organisms constantly adapt to each other through evolution, thereby organizing themselves into an exquisitely tuned ecosystem. Atoms search for a minimum energy state by forming chemical bonds with each other, thereby organizing themselves into structures known as molecules. In every case, groups of agents seeking mutual accommodation and self-consistency somehow manage to transcend themselves, acquiring collective properties such as life, thought, and purpose that they might have never possessed individually.").

75. *See id.* at 11-13.

76. Elinor Ostrom, *A General Framework for Analyzing Sustainability of Social-Ecological Systems*, 325 SCIENCE 419, 419 (2009) ("All humanly used resources are embedded in complex, social-ecological systems (SESs). SESs are composed of multiple subsystems and internal variables within these subsystems at multiple levels analogous to organisms composed of organs, organs of tissues, tissues of cells, cells of proteins, etc."); *see also* Carl Folke, *Resilience: The Emergence of a Perspective for Social–Ecological Systems Analyses*, 16 GLOBAL ENVTL. CHANGE 253, 253 (2006) (providing the origin of the resilience perspective and provides an overview of its development).

77. *See, e.g.*, J.B. Ruhl, *General Design Principles for Resilience and Adaptive Capacity in Legal Systems: Applications to Climate Change Adaptation*, 89 N.C. L. REV. 1373, 1373 (2011); Olivia Green

C.S. "Buzz" Holling's ecological resilience theory is one subset of systems theory.[78] Brian Walker and David Salt characterize resilience as "the capacity of a system to absorb a spectrum of disturbance and reorganize so as to retain essentially the same function, structure, and feedbacks—to have the same identity."[79] Resilience-based management involves 1) evaluating the current trajectory of the system state, and 2) fostering the capacity of the system to resist perturbations.[80] A combination of the social and ecological aspects of a system determine its ability to influence these factors. High adaptive capacity enables systems to "reconfigure themselves while maintaining crucial functions such as primary productivity, hydrological cycles, social relations, and economic prosperity."[81]

Resilience theory acknowledges unpredictability, and the nonlinear qualities of SESs.[82] A critical component of a resilience orientation is the recognition that regime shifts can occur. As a result, a resilience-based approach to management is more realistic than traditional approaches because it acknowledges nonlinear change and provides a way of thinking about how to foster the SES components and dynamics we value and want to protect. The emphasis of resilience-based management is on building adaptive capacity rather than maintaining stationarity.[83]

Unfortunately, most of the scholarship exploring resilience and SES dynamics is anthropocentrically focused on SES functions needed to support human well-being. Like the old materialism, much of SES theory is born of the humanist, Enlightenment paradigm that informs the natural sciences more generally, despite the reality that many of its ideas undermine that paradigm's legitimacy. Systems theory acknowledges the complexities and dynamics of systems that necessarily vitiate overly simplistic notions of agency. It has the potential to radically reconfigure our notion of the material world.[84] Theorists have noted the resonance between new materialism and SES approaches, noting that actor-network theory (ANT) in particular shares.

> ANT focuses on the relationships in which agents participate and how these are used to influence the shape of a network of related relationships. This focus corresponds well with that on process in a social-ecological system (SES) and is more sensitive to emergent properties within systems. ANT is also distinguished by its attribution of agency to nonhumans, including animals, materials, ideas, and concepts, acknowledging the ability of any entity (or actant) to make itself indispensable to its relationships with others and, by extension, to the continuation of the network.[85]

---

et al., *Barriers and Bridges to the Integration of Social-Ecological Resilience and Law*, 13 FRONTIERS ECOLOGY & ENV'T 332, 333 (2015).

78. Benson et al., *supra* note 44, at 197-98.

79. *Id.* at 198.

80. *Id.*

81. *Id.*

82. *Id.*

83. *Id.*

84. Bruce Braun, *New Materialisms and Neoliberal Natures*, 47 ANTIPODE 1, 2 (2015).

85. Dwiartama & Rosin, *supra* note 15 (citations omitted).

The reality of agency is contingent upon the dynamics inherent in relationship.[86]

Geographer Bruce Braun, while noting the potential synergies between SES and ANT school of thought, notes that most work engaging SES theory fails to problematize its humanist, Enlightenment origins and that "by failing to reflect on the history of its own ideas risk[s] failing to distinguish between the original critical impulses of complex systems theory and its notions of non-deterministic nature, and modes of neoliberal governance in which these ideas are absorbed and redeployed."[87] The "modes of neoliberal governance" Braun refers to include payments for ecosystem services projects, the privatization of land and water, and other related management approaches that increasingly dominate environmental governance in the Anthropocene. Nature is seen as "capital" and ecosystems as a source of capital providing "services" for humanity.[88]

Unfortunately, the laws and policies governing human engagement with the natural world in the United States still reflect both an antiquated, equilibrium based view of nature[89] and an anthropocentric view of nature as either source to exploit or a threat to control. In the following case study, both of these beliefs are at work. Recognition and identification of these belief systems and the ways in which they are reflected in law and policy is nothing new. What is new is both the grounding of these ideas in the ontology of the old materialism and the introduction of an alternative approach grounded in the new one.

IV: CASE STUDY: NEW MEXICO'S RIO GRANDE FOREST SYSTEM

When most people conjure images of the American Southwest, they see deserts. And while desert ecosystems dominate much of this landscape, upland forests play a critical role.[90] Precipitation in the form of snow at higher elevations during the winter months feeds creeks and streams over the course of the spring and summer.[91] In turn, they provide habitat for fish and other aquatic species. Associated wetlands and riparian areas are also critical to biological diversity.[92] In New Mexico, rivers, wetlands, and riparian areas compose a very small part of the landscape—only about 1 percent.[93] Yet these places play an essential role sustaining the web of

86. *Id.* at 3 ("Actor-network theory asserts that agency is manifest only in the relation of actors to each other. Within this framing, material objects exert agency in a similar manner to humans.").

87. Braun, *supra* note 84, at 12. Other scholars have also noted possible synergies. "Rather than being juxtaposed, and contrary to new materialism's self-understanding, problematisations at play in climate change as an increasingly dominant [resilience] framing of international policy concerns and the radically new political ontology proposed by new materialists share central outlooks and concerns." Jessica Schmidt, *The Empirical Falsity of the Human Subject: New Materialism, Climate Change and the Shared Critique of Artifice*, 1 RESILIENCE 174, 174 (2013).

88. Braun, *supra* note 84, at 12.

89. The failure of environmental and natural resource law to keep up insights from the natural sciences has been well explored. *See* BENSON & CRAIG, *supra* note 19, at 22.

90. *See id.* at 88-89.

91. *See id.* at 81.

92. *See id.*

93. *See id.* at 85.

life.[94] Eighty percent of all sensitive vertebrate species in New Mexico use riparian or aquatic habitats at some time during their life cycle.[95]

Temperatures in the American Southwest are increasing at twice the global average.[96] The resulting changes in the ecological characteristics in New Mexico's forest headwaters have cascading implications for both the supply and quality of water flowing downstream. The headwaters of the Rio Grande Basin in northern New Mexico are a key source of water supply and storage for the downstream cities of Santa Fe and Albuquerque.

This section first provides a basic overview of the changes these forests are facing. It then outlines the approaches of the current governance strategies in this system to land, water, wildfire, and flooding—all of which are approached both narrowly and separately. They are also deeply anthropocentric. Finally, this section proposes strategies of governance that emerge from a new materialism, examining what a more dynamic and relational approach to governance might look like.

A. Forests in the process of change.

Regime change in New Mexico's forest systems has three interrelated ecological drivers. "The first is temperature."[97] Increased annual temperatures impact the system by creating longer growing seasons, resulting in greater demands from both agricultural users and city residents whose crops and landscapes need water both earlier and later in the season.[98] Higher temperatures dry the soil, increasing the threat of erosion, and requiring more water to meet existing needs.[99] Rising annual temperatures also stress the forest system with trees that require more water for longer growing seasons, and higher erosion rates.[100] These higher temperatures also result in a phenomenon called Vapor Pressure Deficit.[101] The difference between the actual moisture in the air and the amount the air can hold before becoming saturated is the Vapor Pressure Deficit (VPD). Once saturated, water vapor condenses and forms clouds. Warmer air holds more water, and the more water in the air, the greater the vapor pressure. This higher capacity for holding water creates a corresponding pressure "deficit." In this situation, the air is so dry that it sucks the moisture out of the soil and trees. Anyone who has attempted to ripen peaches and other fruits or vegetables during a dry summer has experienced VPD.[102] High summer temperatures make the air so dry that peaches or tomatoes left to ripen

94. *See id.*

95. *See id.*

96. DAGMAR LLEWELLYN ET AL., CITY OF ALBUQUERQUE BUREAU OF RECLAMATION, UPPER RIO GRANDE IMPACTS ASSESSMENT: AN ACTIVITY OF THE WEST WIDE CLIMATE RISK ASSESSMENT S-iii (2013).

97. *See* BENSON & CRAIG, *supra* note 19, at 85.

98. *See id.*

99. *See id.*

100. *See id.*

101. A. Park Williams et al., *Temperature as a Potent Driver of Regional Forest Drought Stress and Tree Mortality*, 3 NATURE CLIMATE CHANGE 292, 293 (2012).

102. *See* BENSON & CRAIG, *supra* note 19, at 86.

will often get wrinkled and pruned instead. The dry air pulls moisture from the fruit to address its VPD.[103]

Higher temperatures and associated VPD are placing an incredible stress on trees in the forests of northern New Mexico. Tree ring data and climate models lead researchers to estimate that by the 2050s, even the average drought stress will match that of the very driest years of the worst mega-droughts of the past 1000 years.[104] They note that these results foreshadow twenty-first-century changes in forest structures and compositions: "Given the reproductive and dispersal limitations of dominant native tree species, climate-driven amplification of forest drought-stress and associated disturbance processes can be expected to force many landscapes in the [Southwest United States] and probably elsewhere towards vegetation-type conversions, with species distributions quite different from those familiar to modern civilization."[105]

Bark beetle infestation and catastrophic wildfire are two of these "associated disturbances." As a natural part of many forest systems, bark beetles inhabit many forests in the American Southwest.[106] Due to climate change, however, bark beetles are playing a new role. With higher average temperatures, "springs come earlier and summers last longer."[107] This extra time gives bark beetles a longer season to feed on trees already weakened by drought stress. More than 162,000 acres of pinyon pine, ponderosa pine, and Douglas fir forest experienced mortality due to one or more species of bark beetle in 2012 alone.[108]

The combination of VPD and bark beetle infestation amplify the vulnerability of forest systems to the third ecological driver—wildfire. Susceptibility to wildland fire is increased when beetle outbreaks create large-scale forest dieback and leave behind massive amounts of biofuel,[109] with the greatest wildfire risk occurring shortly after the infestation and dropping off thereafter.[110] When combined with the drought conditions currently gripping the American Southwest, feedback loops are created between bark beetle outbreaks, forest stress and die off from VPD, and forest fires, leading to greater areas of forest mortality.[111] This feedback loop has resulted in a dramatic increase in fire frequency, severity, and size over the past decade,[112] and the threat of fires is expected to increase due to climate shifts in the

103. *See id.*

104. *See* Williams et al., *supra* note 101, at 295.

105. *Id.* at 296.

106. *See* BENSON & CRAIG, *supra* note 19, at 86.

107. *See id.*

108. *See* U.S. DEP'T OF AGRIC., PR-R3-16-8, FOREST INSECT AND DISEASE CONDITIONS IN THE SOUTHWESTERN REGION 3 (2012), http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5406441.pdf.

109. *See* Craig D. Allen, *Interactions Across Spatial Scales Among Forest Dieback, Fire, and Erosion in Northern New Mexico Landscapes*, 10 ECOSYSTEMS 797, 798, 801 (2007).

110. *See* Jeffrey A. Hicke et al., *Effects of Bark Beetle-Caused Tree Mortality on Wildfire*, 271 FOREST ECOLOGY & MGMT. 81, 84 (2012).

111. *See* Allen, *supra* note 109, at 801.

112. Tania Schoennagel et al., *The Interaction of Fire, Fuels, and Climate Across Rocky Mountain Forests*, 54 BIOSCIENCE 661, 666 (2004).

future.[113] Warmer temperatures also mean that this feedback loop takes place for a longer period of time; the fire season in New Mexico is now 2 months longer than it was 30 years ago.[114]

Fire has always been a significant actor in New Mexico's forests, but it is now also playing a new role.[115] Tree ring data tells us that, before the late 1800s, low intensity ground fires moved through the landscape every 5-15 years, effectively reducing overall fuel loads.[116] The 1890s brought the arrival of the railroad in northern New Mexico, and with it came unintentional fire suppression through intensified livestock grazing.[117] Once ranchers had a means to transport their product to market, they embarked on cattle and sheep grazing on an unprecedented scale.[118] By 1910, livestock inadvertently prevented natural fire migration patterns by denuding the landscape of vegetation.[119] While livestock numbers eventually declined, soon thereafter the Forest Service began its fire suppression efforts in earnest.[120] This approach allowed new trees to replace meadows and grasslands, producing unprecedented tree density, and creating "ladder fuels"—trees that can carry fire up to the crowns of mature trees. By 1990, New Mexico forests achieved a maximum density of biomass.[121]

Prior to human-induced fire suppression, low intensity fire was a frequent actor in the ecosystem. Fires seldom burned an entire landscape but instead created a mosaic pattern with patches of conifer forest complemented by aspen groves, scrub oak, and open meadows. Extremely dry conditions caused by sustained drought and the current high fuel loads are resulting in fires often called "mega fires." These high severity burns leave nothing living in their wake, including the microbial soils and other elements of the ecosystem required for regeneration of new plant and tree species.[122]

The 2011 Las Conchas fire provides an example of the combined results of all these factors. [123] The fire started during a prolonged drought when a tree fell on a power line.[124] Driven by strong and unpredictable winds, the fire burned 43,000 acres the first day—a rate of about an acre per second.[125] It was the largest fire ever recorded in the Rio Grande watershed, eventually burning over 156,000 acres.[126] The nearby community of Los Alamos and Los Alamos National Laboratory were under mandatory evacuation, and the fire impacted several other local communities,

113. Max A. Moritz et al., *Climate Change and Disruptions to Global Fire Activity*, 3 ECOSPHERE 1, 18 (2012).

114. See BENSON & CRAIG, *supra* note 19, at 87.

115. *Id.*

116. *Id.*

117. *Id.*

118. *Id.*

119. *Id.*

120. *Id.*

121. *Id.*

122. *Id.*

123. *Id.*

124. *Id.*

125. *Id.*

126. *Id.*

including the native Santa Clara Pueblo.[127] Mega fires result in a highly degraded landscape subject to subsequent flooding events and erosion.[128] Extreme flooding events and severe water quality problems resulted from the Las Conchas fire, impacting both local and downstream communities.[129] The Albuquerque water utility, which takes water directly from the Rio Grande downstream, had to shut down its drinking water supply plant for several weeks when ash from the Las Conchas fire in the upper watershed overwhelmed the system's filtration capacity.[130] Monsoon rains from July through September follow the May through July wildfire season in the Rio Grande headwater watershed. [131] The timing of these seasons can cause extreme flash flooding resulting in debris slides and severely degraded water quality, with associated negative impacts on the natural and human systems that depend on the river and its tributaries.[132] After the Las Conchas fire, monsoon-fed peak flows in the Rio Grande have been shown to be ten- to one hundred-fold higher than baseline conditions.[133]

The dynamics and feedback loops associated with drought, bark-beetle infestation, and fire, are profoundly impacting New Mexico's forests. The Rio Grande watershed's upland forest system is already undergoing a regime change.[134] When the existing trees are gone, the forest will not regenerate with the same vegetation types.[135] The current mixed conifer forests may be replaced by the more temperature and drought tolerant pinyon and juniper forests typically associated with lower elevations.[136] Pinyon/juniper forests may no longer be forests at all, likely regenerating with oak scrub, sagebrush, and grasses.[137] Many factors will affect the mix of succession species in the uplands, including precipitation trends and the nature and extent of human influence on the system through reseeding and other forest restoration efforts.[138]

These challenges facing New Mexico's forests are a dramatic example of what is happening in the region more generally. The Union of Concerned Scientists reported in 2014 that tens of millions of trees died in the Rocky Mountains over 15 years, noting that climate change will significantly increase the impacts from higher temperatures, drought, and tree-killing insects in the years ahead.[139] They predict that

---

127. *Id.* at 87-88.

128. *Id.* at 88.

129. *Id.*

130. Sandra Postel, *Wildfires in the Western U.S. Are on the Rise, Posing Threats to Drinking Water*, NAT'L GEOGRAPHIC NEWSWATCH, Apr. 29, 2014.

131. *See* BENSON & CRAIG, *supra* note 19, at 88.

132. *See generally* Schoennagel et al., *supra* note 112.

133. Audiotape: Daniel G. Neary, 2nd International Wildland Fire Ecology and Fire Management Congress: Post-Wildfire Watershed Flood Responses (Nov. 17, 2003), https://ams.confex.com/ams/FIRE2003/techprogram/paper_65982.htm.

134. BENSON & CRAIG, *supra* note 19, at 88.

135. *Id.*

136. *Id.*

137. *Id.*

138. *Id.*

139. *See generally* JASON FUNK ET AL., UNION OF CONCERNED SCIENTISTS & THE ROCKY MOUNTAIN CLIMATE ORGANIZATION, ROCKY MOUNTAIN FORESTS AT RISK: CONFRONTING CLIMATE-DRIVEN IMPACTS FROM INSECTS, WILDFIRES, HEAT, AND DROUGHT 11, 26 (2014).

these stressors will dramatically reduce the ranges of iconic tree species and fundamentally alter Rocky Mountain forests. Mega fires will follow.[140]

Due to these changes in the upstream watershed, New Mexico communities are facing unprecedented water quality and quantity challenges.[141] Climate change impact projections indicate that the resilience of the region's water resources is in jeopardy, and the transformation of these headwater stream systems has already begun.[142] While other climate change scenarios are necessarily vague, observations and projections concerning increased temperatures are clear.[143] With increased temperatures, precipitation is more likely to be in the form of rain than snow, and snowmelt will occur earlier in the spring.[144] Warming temperatures influence both when and where snows fall, and how and when snowmelt finds its way—or doesn't—into springs, streams, rivers, and water storage reservoirs downstream.[145] These factors make it more difficult to predict how much water will be available through the spring and summer—when water demands are greatest.[146]

B. Governance strategies of the old materialism

Current management of the system described above reflects the old materialism. Humans are presumed to be the primary actors on the landscape, and management is focused on increasing control and reducing uncertainty. With humans at the center, natural processes become either an opportunity to exploit or a problem to be solved. The result is a fragmented approach that tends to focus on one aspect of the system at a time. It also leaves a lot of gaps.

Land, water, and wildlife are all managed separately, and there is no coordinated strategy for governing the upland forests and its associated water supply.[147] Land is managed differently according to ownership. Upstream, the U.S. Forest Service and National Park Service manage much of the land.[148] There are also native communities in the watershed, including the Santa Clara Pueblo and Jicarilla Apache tribe. Wildfire issues are generally regarded as the responsibility of landowners, with the federal government taking a leading role in situations where, as in this case study, multiple landowners co-exist in the same watershed.

---

140. *Id.* (citing the U.S. Geological Survey conclusions from a new analysis of the Western United States' landscapes, predicting that, as fires become more frequent and less controllable, they will impair the West's ability to absorb carbon and slow climate change); *see also* Tiffany Stecker, *Fires, Urbanization to Redraw Carbon Map of West*, ENV'T & ENERGY NEWS (Dec. 7, 2012), https://www.eenews.net/stories/1059973492 (explaining that the West's forests currently sequester more than 90 million metric tons of carbon dioxide per year, about 5 percent of total U.S. carbon emissions. The potential expansion of fires could increase carbon emissions by up to 56 percent by 2050, given future climate conditions, and threatens these forests' ability to sequester CO2 over the next 25 years).

141. BENSON & CRAIG, *supra* note 19, at 89.

142. LLEWELLYN ET AL. *supra* note 96, at vi.

143. BENSON & CRAIG, *supra* note 19, at 89.

144. *Id.*

145. *Id.*

146. *Id.* at 89-90.

147. *Id.* at 90.

148. *Id.*

The U.S. Forest Service, for example, manages the Santa Fe, Carson, and Cibola National Forests in northern New Mexico as authorized by the National Forest Management Act and Multiple Use Sustained Yield Act.[149] Both set forth "sustained yield" mandates on activities including timber harvest, grazing, mining and recreation.[150]

The planning process of the National Forest Management Act has become the primary basis for agency decision making.[151] The Forest Service put in place a new planning rule in 2015[152] which makes the planning process inherently cumbersome. Plans typically take several years to develop and are revised every fifteen years, [153] leaving many current forest plans sorely outdated.[154] The Santa Fe National Forest's current plan was written in 1987, has been amended several times, and as of this writing, is still under revision.[155] The Forest Service has several projects in development to address the increasing fire risks in the interim, even with its outdated management plan.[156] Planning requirements and regulatory processes, combined with lack of adequate funding, unquestionably hamper the Forest Service's ability to act quickly and decisively to address the ecological challenges ahead.[157]

1. Water

Water management is split into two categories: quality and quantity. Water quantity (allocation and supply) are under New Mexico's jurisdiction, and water quality issues are generally the responsibility of the Environmental Protection Agency.[158] With regard to water supply, most of the human water use in the system occurs downstream in the watershed. Water is used primarily by agriculture (84 percent). Within the agricultural sector, the main commodities are milk (49.15 percent), cattle (29.8 percent), and alfalfa (5.65 percent).[159] Municipalities, including Albuquerque and Santa Fe, compose a relatively small portion of water use in the state (8 percent).[160]

---

149. *Id.*

150. National Forest Management Act of 1976, 16 U.S.C §§ 1600-1687 (2012); Multiple-Use, Sustained-Yield Act of 1960, 16 U.S.C. §§ 528-531 (2012).

151. BENSON & CRAIG, *supra* note 19, at 91.

152. *Id.*

153. FS Directive FSH 1909.12, LAND MANAGEMENT PLANNING HANDBOOK 12 (U.S.D.A. 2013), https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5409939.pdf.

154. BENSON & CRAIG, *supra* note 19, at 91.

155. *Id.*

156. *Id.*

157. *Id.*

158. *See* Reed D. Benson, *Pollution Without Solution: Flow Impairment Problems Under Clean Water Act Section 303*, 24 STAN. ENVTL. L. SOC'Y 199, 200-215 (2005) (examining the relationship between water quantity and water quality and the Clean Water Act).

159. LONGINO BUSTILLOS & STEVE HOEL, U.S. DEP'T AGRIC., NEW MEXICO AGRICULTURAL STATISTICS 2014 ANNUAL BULLETIN 12 (2014), https://www.nass.usda.gov/Statistics_by_State/New_Mexico/Publications/Annual_Statistical_Bulletin/2014/2014_NM_Pub.pdf.

160. JOHN W. LONGWORTH ET AL., NEW MEXICO WATER USE BY CATEGORIES 2010, *NEW MEXICO STATE ENGINEER OFFICE, TECHNICAL REPORT 54, OCTOBER 2013 13, 17* (2013), http://

Like most western states, water allocation in New Mexico is governed by the prior appropriation doctrine.[161] Prior appropriation is a historically based allocation system that anticipates scarcity.[162] The doctrine of prior appropriation mandates that when shortages occur, the right to use water is determined by the chronological order in which the water was put to beneficial use with "senior" users being served first.[163] "Junior" users may receive a reduced amount or no water in a water-short year, depending on the supply.[164] Water rights are usufructuary,[165] and water rights must be applied to a beneficial use, broadly defined to include agriculture, municipalities, industry, and fish and wildlife.[166]

When New Mexico formally established the prior appropriation doctrine in 1891, there was no recognition of the values associated with leaving water in-stream for wildlife and other uses.[167] Until recently, leaving water in-stream for fish and wildlife was not recognized as a beneficial use.[168] Instream flow rights remain relatively limited and, to date, have been held only on a temporary leasing basis.[169]

In addition, water rights are subject to forfeiture and can be lost if not continually used.[170] The fear of losing a water right as a result of nonuse creates a general disincentive for conservation strategies.[171] A traditional system of gravity-fed flood irrigation serves most crop agricultural today.[172] The largest agricultural group is the Middle Rio Grande Conservancy District, which provides irrigation water for about 53,000 acres of crops, primarily alfalfa, and also supports a sizable local dairy industry.[173] Agriculture within the district is mainly small-scale or associated with the six native pueblo communities that are members of the irrigation district.[174]

Like much of the American West, this part of New Mexico has seen a steady increase in population growth, and, with that growth, an increasing municipal and

---

www.ose.state.nm.us/Pub/TechnicalReports/TechReport%2054NM%20Water%20Use%20by%20Categories%20.pdf.

161. N.M. CONST. art. XVI, § 2 (stating: "The unappropriated water of every natural stream, perennial or torrential, within the state of New Mexico, is hereby declared to belong to the public and to be subject to appropriation for beneficial use, in accordance with the laws of the state. Priority of appropriation shall give the better right.").

162. *See* UTTON TRANSBOUNDARY RES. CTR., BASIC WATER LAW CONCEPTS, IN WATER MATTERS! 1-1, 1-3, 1-4 (9th ed. 2015), http://uttoncenter.unm.edu/pdfs/water-matters-2015/2015-water-matters.pdf.

163. *Id*. at 1-3.

164. *Id.*

165. An usufructory right is a right of *use* as opposed to ownership of the water itself. *See id.* at 1-4.

166. *Id*.

167. *See id*. at 1-3.

168. *See id.* at 17-1, 17-4.

169. *See id*. at 17-3 to 17-4.

170. *Id.* at 1-4.

171. *See id*. at 2-4.

172. *See generally* S. S. PAPADOPULOS & ASSOCS., INC., EVALUATION OF MIDDLE RIO GRANDE CONSERVANCY DISTRICT IRRIGATION SYSTEM AND MEASUREMENT PROGRAM VOLUME 1 ES-2 (2002), http://www.ose.state.nm.us/Pub?MRGCD/volume-1-rpt.pdf.

173. Douglas W. Strech & Tracy Scharp Matthews, Middle Rio Grande Vegetation Classification Summer 2000 (2001) (on file with author; this was a joint project between the Middle Rio Grande Conservancy District and the New Mexico Office of the State Engineer / Interstate Stream Commission).

174. *See* S. S. PAPADOPULOS & ASSOCS., INC., *supra* note 173, at 51.

industrial water demand.[175] Several municipalities in the area purchase water rights from farmers to meet their growing needs.[176] As a result, there has been a shift in many water rights from their original agricultural use to municipal use.[177] The impacts of municipal groundwater pumping on the river are often offset with purchases of senior surface water rights.[178] Between 1982 and 2011, 21,000 acre-feet of water rights were transferred,[179] most of which were transfers of agricultural rights to cities such as Belen, Rio Rancho, Albuquerque, and Santa Fe.[180] The competing demands for a limited water supply in this area were highlighted in the US Bureau of Reclamation's 2011 report which focused on areas of the western United States where existing water supplies are, or will be, inadequate to meet the water demands of people, cities, farms, and the environment even under normal water supply conditions.[181]

The third main social driver in the watershed involves the complex system of built infrastructure in the form of dams and reservoirs that control the flow of water from the upper watershed to the communities downstream.[182] This infrastructure is necessary for both the agricultural and municipal use of the watershed's historic floodplain. Both water delivery and flood control are dependent on a network of ditches, levees, and dams. Virtually all of the water storage for the system takes the form of on-channel surface reservoirs.[183]

Interstate compact agreements often determine how much water can be stored and where.[184] For example, the Rio Grande Compact between New Mexico and Texas requires New Mexico to deliver water to the more downstream Elephant Butte Reservoir, from which evaporation rates are extremely high.[185] Depending on their location, the evaporative losses over the course of a given year from *all* New Mexico reservoirs can be significant. Additionally, there are constraints on how the reservoirs are managed.[186] Many of the water projects are federally authorized for either temporary water storage or flood control, limiting management possibilities.[187] The total amount of water stored at any given time has legal limits which do not take

175. *See* Sarah Bates, *Bridging the Governance Gap: Emerging Strategies to Integrate Water and Land Use Planning*, 52 NAT. RES. J. 61, 61-62 (2012).

176. *See* Benson et al., *supra* note 44, at 209.

177. *See* BENSON & CRAIG, *supra* note 19, at 93.

178. *Id*.

179. *See* UTTON TRANSBOUNDARY RES. CTR., BASIC WATER LAW CONCEPTS, IN WATER MATTERS! 1-1, 1-3, 1-4 (9th ed. 2015), http://uttoncenter.unm.edu/pdfs/water-matters-2015/2015-water-matters.pdf. "Acre-feet" is the volume of one acre of surface area to a depth of one foot.

180. *See* BENSON & CRAIG, *supra* note 19, at 80, 81.

181. *See generally* U.S. BUREAU RECLAMATION, SECURE WATER ACT § 9503(C), RECLAMATION: CLIMATE CHANGE AND WATER (2011), https://www.usbr.gov/climate/secure/docs/SECUREWater Report.pdf; *see also* Reed D. Benson, *New Adventures of the Old Bureau: Modern-Day Reclamation Statutes and Congress' Unfinished Environmental Business*, 48 HARV. J. ON LEGIS. 137, 169–72 (2011).

182. *See* Benson et al., *supra* note 44, at 206.

183. *See* BENSON & CRAIG, *supra* note 19, at 93.

184. *See* Benson et al., *supra* note 44, at 201-202.

185. *See id.* at 220.

186. *See generally id.*

187. *Id.* at 197.

into account the reservoir's actual capacity.[188] Releases of water are often restricted because of the designated safe channel capacity of the river downstream of the dams.[189]

In sum, the social elements involved in New Mexico's water management are primarily based on inherited legal and institutional strategies and associated built infrastructure from decades long past. Land and water are managed separately. Land-use planning and water allocation are inextricably linked in reality but are only loosely associated in terms of actual governance. Prior appropriation, the main approach to water allocation, dates back to when New Mexico became a territory in the late 1800s and is based on historic uses rather than contemporary needs.[190] Conservation strategies by cities and towns are succeeding at reducing municipal demand, but agricultural uses, which compose the vast majority of water use in New Mexico, include no incentive to conserve.[191] Indeed, the incentives for agriculture are quite the opposite: fear of "forfeiting" water rights encourages users to take their full allocation of water each year, even if it is not needed.[192]

The law and policy governing land management in the headwaters is also outdated. The Forest Service is working with a management plan dating from the 1980s that is authorized by a statute from the 1970s. Fire suppression, the official policy approach to natural and human-caused wildfires alike for decades, is now part of the problem.

2. Floods

Issues related to flooding are managed by a variety of actors—the U.S. Army Corps of Engineers has jurisdiction over the operation of dams and levees,[193] and flooding events are handled by the Federal Emergency Management Agency[194] as well as private insurance agencies.[195] Following the Las Conchas fire, state and federal disaster declarations occurred as a result of flooding events moving tons of soil debris from the forest headwaters.[196] The Santa Clara Pueblo's experience is a startling example of what might become the future for the system as a whole. This

188. *See id.* at 218-219.

189. *See id.* at 219.

190. *See id.* at 208-209.

191. *See id.* at 209.

192. *See id.*

193. Ryan B. Stoa, *Droughts, Floods, and Wildfires: Paleo Perspectives on Disaster Law in the Anthropocene*, 27 GEO. INT'L ENVTL. L. REV. 393, 423 (2015); *See also* Dan Tarlock, *United States Flood Control Policy: The Incomplete Transition from the Illusion of Total Protection to Risk Management*, 23 DUKE ENVTL. L. & POL'Y F. 151, 159 (2012).

194. *See* Stoa, *supra* note 194, at 423 ("The Flood Control Act of 1928 assigned flood control to the Army Corps of Engineers, which remains the agency responsible for building infrastructure to protect floodplain communities and investments.").

195. *Id*. at 437 ("Flood law in the United States rests on three pillars: federal management of large infrastructural projects to control floods, an insurance program that spreads the cost of high-risk development across society, and disaster relief.").

196. Margaret Wright, *Santa Clara Strives to Build Resilience to Fires, Floods*, SANTA FE NEW MEXICAN (July 28, 2015), http://www.santafenewmexican.com/news/local_news/as-climate-changes-santa-clara-strives-to-become-resilient-to/article_d0bcb54c-fdca-557d-ba2b-cada3a56d7e3.html (debris removal constituted part of the extensive recovery efforts).

Native American community has lived in the Rio Grande watershed for hundreds of years. The Las Conchas fire burned approximately eighty percent of the community's watershed in 2011.[197] As a result, the community (numbering fewer than 1,000 full time residents) is now extremely vulnerable to flooding events.[198] For this reason, the pueblo was listed among the top 30 historic sites in the United States most at risk from climate change in a study by the Union of Concerned Scientists last year.[199]

The pueblo is located on a floodplain near the Rio Grande and water coming down in a nearby canyon can quickly flood the community with a torrent of debris, sediment and downed trees.[200] "We can't stop the floods, but we can put in different projects to slow it down," said Michael Chavarria, the governor of Santa Clara Pueblo, in an interview with the Santa Fe New Mexican.[201] The Pueblo is now working with the Army Corps of Engineers on a series of flood-control structures in an effort to build adaptive capacity within the system. The projects include putting immediate flood protection in place, dredging sediment, and installing stream bank protections.[202] The Pueblo is also addressing damaged bridges with the Federal Highway Administration and establishing an early warning system for impending floodwaters with the U.S. Geological Survey.[203]

Efforts to decrease the risk of future wildfires are being undertaken by the Pueblo and adjoining federal landowners such as the Santa Fe National Forest, Valles Caldera National Preserve, and Bandelier National Monument. Meaningful watershed-scale work will require collaborative multi-jurisdictional partnerships between multiple agencies and stakeholders. Multiple funding sources from the state and federal governments, downstream water utilities, and other users will be necessary for work on this scale.[204] Broadly speaking, flood control efforts that lack meaningful coordination with the land use policies exacerbate the problem. As Professor Stoa notes:

> An interesting aspect of flood policy in the United States is that while the federal government foots the bill for large flood control projects, insurance schemes, and disaster relief, decisions pertaining to city planning and management and therefore significant flood mitigation potential are left to local mayors, zoning boards, county commissions, and planning departments. For that reason, flood management approaches and vulnerabilities vary from one locality to another, creating a piecemeal web of local regulations and federal infrastructure projects.[205]

197. *Id*.
198. *Id*.
199. *Id*.
200. *Id*.
201. *Id*.
202. *Id*.
203. *Id*.
204. *Id*.
205. Stoa, *supra* note 194, at 420-21.

The Santa Clara Pueblo represents an extreme scenario for the Anthropocene. Unlike their pre-puebloan ancestors, they cannot take the most obvious step and move to a new geographic location.[206]

3. Wildfire

Wildfire management comes in two main forms. The first, already discussed, involves suppression. For decades, this was the preferred management approach, and it came at the cost of fuel loading and mega fires.[207] In recent decades, even with a more ecologically sensitive policy that acknowledges the role of fire in the natural system, fire suppression has expanded from 13 percent to more than 40 percent of Forest Service's total budget.[208] As a result, the agency has run out of wildfire suppression funds repeatedly over the last decade.[209] This lack of funds further results in the "raiding" of other accounts within the Forest Service to make up the shortfall.[210] Stoa argues that this reflects gamesmanship the Forest Service is forced to play because of the strong societal preference for fire suppression over prescribed burns and other forms of prevention:

> Congressional preference for firefighting is so strong that agencies have a strong incentive to pursue wildfire suppression policies because they know their budget will be left alone or even increased: often funds budgeted for other programs, including fire prevention, are re-appropriated when fire suppression budgets run dry, and Congress later makes up the difference. The Forest Service's fiscal year 2015 proposed budget, for example, requests

206. *See generally* FRED M. PHILLIP ET AL., REINING IN THE RIO GRANDE: PEOPLE, LAND AND WATER 198 (2011). The first known human inhabitants of the Rio Grande Valley were likely climate refuges, fleeing drought in other parts of the Southwest. *Id.* at 24–33. The Chaco ancestors of the modern Pueblo people of the Middle Rio Grande (MRG), underwent several significant migrations, as they were plagued by prolonged droughts that decimated their subsistence corn-based agricultural system. Their style of habitation, in tight, protected communities in some areas and spread across the landscape in others, is a response to the need for access to water, as well as to inflows of other climate refugees. They brought with them sophisticated irrigation practices and adapted these strategies to take advantage of the MRG's monsoonal rain patterns and annual spring flooding events for subsistence agriculture within the floodplain. Today, the MRG is still home to several indigenous Pueblo communities. *Id.*

207. *See* BENSON & CRAIG, *supra* note 19, at 87.

208. STATEMENT OF TOM TIDWELL, CHIEF OF THE USDA FOREST SERVICE, BEFORE THE SENATE COMMITTEE ON ENERGY AND NATURAL RESOURCES CONCERNING PRESIDENT'S FISCAL YEAR 2016 PROPOSED BUDGET FOR THE USDA FOREST SERVICE FEBRUARY 26, 2015 (Feb. 26, 2015), https://www.fs.fed.us/sites/default/files/legacy_files/media/types/testimony/tidwell-FY16-02-24-15-fsbudget-testimony.pdf ("Increasingly severe fire seasons are one of the greatest challenges facing the Nation's forests," Tidwell said in a prepared statement. "The cost of fire suppression has soared in the past 20 years."); *see also* U.S. FS, THE U.S. FOREST SERVICE – AN OVERVIEW 23, https://www.fs.fed.us/sites/default/files/media/types/publication/field_pdf/USFS-overview-0106MJS.pdf.

209. STATEMENT OF TOM TIDWELL, *supra* note 209, at 5.

210. U.S. FS, 2013 FIRE TRANSFER ACTIVITY; DEFERRING OTHER FINANCIAL OBLIGATIONS 25 (2013), https://www.fs.fed.us/sites/default/files/media/types/publication/field_pdf/USFS-overview-0106 MJS.pdf.

> $708 million for fire suppression efforts when annual costs from 2011 to 2013 averaged closer to $1.7 billion.[211]

Strong incentives to suppress fire also come from the increase in human occupation of the wildland interface.[212] In 2014 forty-four million homes were located in fire-prone areas and it is estimated the number of homes in the wildland interface will increase to sixty million by 2030.[213] As with flooding, home ownership in wildfire prone areas is subsidized by federal insurance.[214]

The second management approach is mitigation, *i.e.,* attempts to make the landscape more resilient to mega fires through forest thinning, watershed restoration and other methods.[215] The types of actions necessary for watershed restoration are exemplified by The City of Santa Fe's work with the Bureau of Reclamation's Basin Study Program.[216] This federal initiative works with local and state governments, combining scientific information and resource management to develop climate adaptation strategies in a specific landscape.[217] In 2013, the City of Santa Fe developed a twenty-year Santa Fe Municipal Watershed Management Plan, establishing a protocol for water quality and quantity monitoring, authorizing forest thinning within the watershed, and recommending the establishment of a rate payer financed funding source for ongoing watershed protection.[218] The city initiated a municipal water user fee to collect funds for watershed protection that has resulted in $7 million in forest treatments.[219]

Recent wildfires in the basin have shown these investments to be well worthwhile.[220] "It is estimated that fire suppression and rehabilitation costs associated with a 10,000 to 40,000 acre wildfire impacting some portion of the Municipal Watershed could be between $11.9M and $48M."[221] In addition, "the cost to dredge, haul and dispose of 2,000 acre-feet of sediment and ash from the City's [water storage] reservoirs would likely be between $80M and $240M."[222] The city emphasizes that these costs do not include increased water treatment costs, impacts

---

211. Stoa, *supra* note 194, at 428.

212. *Id.*

213. *Id.*

214. *Id.*

215. *See* BENSON & ROBIN CRAIG, *supra* note 19, at 99.

216. *See id.* at 98; *See also* U.S. BUREAU RECLAMATION, SANTA FE BASIN STUDY: ADAPTATIONS TO PROJECTED CHANGES IN WATER SUPPLY AND DEMAND ES-16 (2015) https://www.usbr.gov /watersmart/bsp/docs/finalreport/SantaFe/Santa-Fe-Basin-Final.pdf.

217. The Landscape Conservation Cooperatives are collaborative, intergovernmental programs coordinated by the Fish and Wildlife Service, with assistance from other agencies, including Reclamation in the Desert and Southern Rockies. *See* U.S. FISH & WILDLIFE SERV., LANDSCAPE CONSERVATION COOPERATIVES: FREQUENTLY ASKED QUESTIONS (Feb. 2012), http://www.fws.gov/landscape-conservation/pdf/LCC_FAQs_2012.pdf (last visited Jan. 17, 2015).

218. *See* BENSON & CRAIG, *supra* note 19, at 98.

219. *See* Ellis Q. Margolis & Jeff Balmat, *Fire History and Fire Climate Relationships Along a Fire Regime Gradient in the Santa Fe Municipal Watershed, NM*, 258 FOREST ECOLOGY AND MGMT. 2416, 2417 (2009); *see generally* CITY OF SANTA FE, MUNICIPAL WATERSHED PLAN, NM, USA, http://www.santafenm.gov/municipal_watershed_plan (last visited Jan. 17, 2015).

220. *See* BENSON & CRAIG, *supra* note 19, at 98.

221. *See id.* (citations omitted).

222. *See id.*

to the local economy from loss of tourism income, etc.[223] It concludes that, "in comparison to these avoided costs, the cost to treat and maintain forests within the Municipal Watershed is expected to be $5.1 million over 20 years, an average of $258,000 per year."[224]

As Stoa summarizes, "that the basic framework of drought, flood, and wildfire laws has remained the same for the past several decades speaks to the disconnect between humans and the environment. Efforts to control nature necessarily rely on a belief that control is possible. But diminishing water supplies, deteriorating and failing infrastructure, and the rise of high-intensity fires reveal that belief to be premature at best."[225] Our policy infrastructure fails to appreciate the inevitability of large, natural events and the interconnected nature of these events.

C. A New Materialist Approach

Actual employment of new materialist concepts in environmental governance is no easy task. This is in large part due to the challenges associated with moving beyond the deeply ingrained nature/culture binaries in (Western, Euro-centric) thought. Yet it is a challenge worth taking on: "If the ideas of the 'non-human' and the 'post-human' are to avoid becoming mere clichés of contemporary social scientific discourse, the task remains to persist in refiguring our most classically humanist problems in other than human terms."[226]

A new materialist approach to the challenges facing forests in New Mexico and elsewhere (including its associated human and nonhuman elements) offers an innovative and potentially more efficacious approach to impending regime change. It begins with a different set of assumptions than those usually invoked. Rather than seeing wildfire, flooding and other events as problems to be solved or situations to be controlled, there is instead increased emphasis on the recognition of the roles they play.

---

223. *See id.*

224. *See* BENSON & CRAIG, *supra* note 19, at 98; *see also* Scott Streater, *Rio Grande: Conservation Group Backs N.M. Forest Thinning to Curb Wildfires*, GREENWIRE (Jul. 29, 2014), http://www.eenews.net/greenwire/stories/1060003703. Another promising effort in this regard is the Rio Grande Water Fund (RGWF). The RGWF is a multi-stakeholder, interagency, and trans-jurisdictional consortium that formed in 2012. Led by The Nature Conservancy, the consortium is working to raise the funds necessary for a twenty-year plan to restore roughly 1.7 million acres of overgrown forests around the Rio Grande and its tributaries that remain susceptible to wildfires and the kind of water-quality damage seen in the weeks after the Las Conchas fire. The RGWF's goal is to protect storage, delivery, and quality of Rio Grande water through landscape-scale forest restoration treatments in forested headwater watersheds. Funding would support stream restoration, forest-thinning projects, and post-fire rehabilitation covering as much as 600,000 acres in northern New Mexico over the next two decades. At the time of this writing, the RGWF is still seeking the necessary funding. Laura McCarthy, The Nature Conservancy's project leader explains, "We know thinning our forests makes them safer and healthier, but the 3,000 to 5,000 acres we treat each year, on average, is not enough to make a difference." The projected cost of the overall project is $15 million per year over twenty years. Despite the upfront cost, project backers say it makes sense to spend significant amounts of money on these kinds of wildfire prevention measures, noting that thinning an acre of dense forest costs around $700, whereas the economic impact of one acre of scorched land runs as high as $2,125. *Id.*

225. Stoa, *supra* note 194, at 432.

226. Maria Hynes, *Indifferent by Nature: A Post-Humanist Reframing of the Problem of Indifference*, 48 ENV'T AND PLAN. 24, 24 (2015).

Other actors within the system, in this case an assemblage that includes bark beetles, trees, temperature, and fire, are recognized as having agency—a capacity to act—that can be understood as part of a complex and dynamic force "distributed across multiple, overlapping bodies, disseminated in degrees—rather than the capacity of a unitary subject of consciousness."[227]

> A truly workable new materialist vision . . . would recognize that what we think of as the world about which we care is a collection of intra-active units—or what Latour would call actants. . . . These all have agency and identity as they come together or, more accurately, they have agency and identity in their coming together. However, as Barad reminds us, those units are not just the familiar human or nonhuman actors but the discursive units and material units that make up our understanding of the world—her phenomena are made up of material-discursive practices through which boundaries are constituted.[228]

The familiar "multiple-use, sustained-yield" paradigms embodied in our current public land management policies are examples of the types of material-discursive practices that have constituted our pre-Anthropocene reality. They have literally framed our reality around use and production.[229]

A new materialist ontology does not require the devaluation of human needs. Recognition of bark beetles as agents within the system, for example, does not elevate their importance, nor does it anthropomorphize them. It does, however, challenge management assumptions that go immediately to mitigation and control. Instead, management begins with efforts to conceptualize the system or assemblage, understands the roles played by the various actors, and then determines courses of action that work within the context of the system.[230]

In the case of the Rio Grande watershed, working within the context of the system requires acknowledgment that the trees, soils and other aspects of the forest system will no longer play the role they once did. Once acting as a natural reservoir, the forest system will allow water to move more quickly downstream and flow earlier in the spring. If humans want to continue to use this water, communities will need to rethink options for water storage.[231]

Before making efforts at control, there is first an attempt to understand the system—looking for patterns and processes that enable managers to build models that allow them to understand and respond to change accordingly over time. Wildfire, floods, and other events often cannot be predicted at any given time or place, but their inevitability must be acknowledged.

---

227. *See* Jane Bennett, *Edible Matter*, 45 NEW LEFT REV. 134, 134 (2007).

228. Jones-Putra, *supra* note 16, at 132 (citation omitted).

229. *See* Andrew Martin, *Agents in Inter-Action: Bruno Latour and Agency*, 12 J. ARCHAEOLOGICAL METHOD AND THEORY 283, 284 (2005) ("objects are really the end result of a long process of negotiation between the material world, historical associations and people—who give things names and relationships").

230. *See, e.g.*, TSING, *supra* note 61 (exploring wild mushroom harvest on federal lands in Oregon).

231. Innovations in underground water storage are already underway. The City of Albuquerque's water utility, for example, recently completed the Bear Canyon Storage Project, its first large-scale effort in aquifer storage and recovery. *See* BENSON & CRAIG, *supra* note 19, at 97.

New materialist management involves a recognition of humans as part—but not at the center or top—of an SES. For example, a legal regime that decenters the human would abandon "multiple-use, sustained yield" management goals. This type of management would not require us to ignore the needs of human communities, but it would change the expectation that human needs are central. Instead of management goals with human needs as the focus, a more relational approach would emphasize overall system function.[232] Human engagement within the system would focus on *participation* as opposed to control.

This approach also involves a rejection of natural events as "disasters." The fact that droughts, floods, and wildfires are perceived as "disasters" demonstrates how our current approaches are simply out of touch with environmental processes.[233] Drought law, flood law, wildfire law all reflect attempts "to neutralize the threat by developing and unleashing technological advancements. . . . When that fails or proves counter-productive, governments provide disaster relief payments to offset damage costs and emergency funding to escalate wildfire suppression efforts."[234]

> Unpredictable natural disasters are a convenient scapegoat for the damage caused to people and the U.S. economy, but a more rigorous examination reveals a policy infrastructure that fails to appreciate the inevitability of large-scale natural events. Instead, laws designed to address droughts, floods, and wildfires conceptualize them as unpredictable or unlikely natural disasters, prioritizing insurance schemes and emergency assistance funds instead of integrated disaster planning mechanisms that prepare communities for the inevitable.[235]

Rather than reacting to the next "emergency," a new materialist approach would invest in building the adaptive capacity of the SESs involved. Large scale structural dynamics that render SESs vulnerable are not addressed by fire suppression networks, interstate water transfers, and other infrastructure projects designed to protect human populations from wildfire, floods, and droughts.[236] When those measures fail to address large-scale natural events, reactive measures such as disaster relief funds are employed, but both approaches fail to build adaptive capacity and resilience.[237]

New materialist management approaches would also reject our current, siloed approach that segments the natural world. For example, water and land should not be managed separately. They are inextricably linked, representing many assemblages and processes that change over time. The current, fragmented approach

232. For example, traditional approaches to flood "control" involves built infrastructure in the form of dams and levees, in almost all cases to protect property. Dams and levees. *See*, *e.g.*, Edward Richards, *The Hurricane Katrina Levee Breach Litigation: Getting the First Geoengineering Liability Case Right*, 160 U. PENN. L. REV. 267, 268 (2011). ("Levees create false security and prevent rational adaptations, worsening catastrophes when they fail. Exclusively relying on levees in the future will cause untold fiscal and environmental damage, while providing little long-term safety.").

233. *See* Stoa, *supra* note 194, at 72.

234. *Id.* at 427.

235. *See id.* at 395, 396.

236. *Id.*

237. *Id*.

reflects the failures of the anthropocentric view. By focusing almost exclusively on how we use aspects of the system, the laws and policies we create fail to embrace the interconnected nature of SES processes.

In the Anthropocene, climate change, biodiversity loss, and other planetary shifts will bring increased unpredictability to SESs as they unravel and create new assemblages. Whether or not climate change is anthropocentric is not—from a new materialist perspective—a problem. Such questions deepen the groove of the nature/society binary. An enormous amount of time and energy has focused on the "anthropocentric nature" of climate change—time and energy that could have been spent on mitigation strategies and adaptation. The general preoccupation with the extent to which "anthropocentric" contributions are responsible for climate change reinforces a belief that humans are an outside force, separate from nature.

V. CONCLUSION

The Anthropocene is not simply a new geologic epoch. It is a conceptual opportunity. In it, we can reconfigure our orientation to the material world. New materialism offers an ontology that destabilizes many of our currently limiting beliefs about humans and our place in the world. These beliefs include the idea that humans are somehow separate from nature, and somehow exceptional in terms of our capacity to act. These beliefs are the core conditions that created the Anthropocene. Combined, they result in an approach to environmental governance that tends to focus on human needs rather than system function. Only by addressing the ontological assumption of human exceptionalism will governance in the Anthropocene meaningfully address the challenges to come.

New materialism is not a normative attempt placing humans on par with other beings. It is an ontological stance. To the extent to which normative implications (and management recommendations) can be derived from this ontology, scholars emphasize embracing human involvement in this complex, dynamic, and material world while also avoiding human-centered thinking. This is perhaps what Donna Haraway means when she encourages us to "stay with the trouble."[238]

In the case of New Mexico's forest system, a new materialist approach requires recognition of the limits of human control. It also recommends the integration of management of land, water, flood control, and other strategies. Acknowledging the interconnectedness of wildfire events to land management, riparian function, and other human actions allows for more functional and adaptive approaches to the environmental challenges ahead, but will require a paradigmatic shift in our approach to environmental governance.

A new materialist approach to law would reexamine these relationships and create legal forms and processes that more accurately reflect the dynamics and capture the complexity of the future we face. New approaches are needed that reflect our capacity to build conceptual models of SESs, integrate management strategies, and adapt to continual change. Embracing the new materialism is both intuitive and daunting. It is intuitive in the sense that fire, temperature, water, beetles, and other

238. *See* HARAWAY, *supra* note 2, at 35 ("How can we think in times of urgencies without self-indulgent and self-fulfilling myths of the apocalypse, when every fiber of our being is interlaced, even complicit, in the webs of processes that must somehow be engaged and repatterned?").

elements are of course interconnected. Yet proposals for integrating water allocation and land management with flood control policy are considered radical and are not currently even under consideration.[239]

More broadly, scholarship from new materialism has much to offer. It moves beyond Enlightenment-based, Cartesian approaches to materiality. It recognizes that reality is relational and causality is therefore much more complex and reflexive than generally acknowledged. Entities (including humans) do not exist in and of themselves—they define, assemble and relate.

Within the context of natural resource and environmental law, the old materialism still reigns. Virtually all of our approaches view the natural environment as something apart, things to be managed, exploited or even protected. With few exceptions,[240] the focus is on how the environment can be maintained or manipulated for human benefit. Even system-based approaches such as resilience thinking center on how system processes can meet human needs.

As a result, current approaches tend to lack the nuance and complexity we now need in the Anthropocene. While human needs are not to be ignored, anthropocentric approaches unnecessarily narrow our perception and distort our decision making toward short-lived and limited responses. A more inclusive, relational approach to environmental governance in the Anthropocene would acknowledge the powerful role humans play as a species but would also bring a willingness to place human actions within a larger world of which we are one part.

239. Robin Kundis Craig & J.B. Ruhl, *Designing Administrative Law for Adaptive Management*, 67 VAND. L. REV. 1, 1-2 (2014).

240. *See* J. Baird Callicott, *Explicit and Implicit Values*, *in* THE ENDANGERED SPECIES ACT AT THIRTY: VOL. 2: CONSERVING BIODIVERSITY IN HUMAN DOMINATED LANDSCAPES 36 (J. Michael Scott, Dale D. Goble & Frank W. Davis eds., 2006).