

The Ecology of Heterodoxy

By

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Abstract

Is the continued escalation of environmental problems indicative of an *incompleteness* in rationality or a *failure* of rationality? In their efforts to protect nature, environmentalists ostensibly abide by the findings of ecological science; yet environmental policy largely takes for granted the potential perfectibility of economic tools as rational representations of nature. Are these epistemologies commensurable? Which tools would constitute an appropriate language to articulate and ameliorate environmental problems?

This dissertation is an ethnography of knowledge production at the intersection of ecology and economics. My field site is both a social group – the heterodox community of ecological economists – and an epistemic process – that group’s attempts to illuminate, articulate, and implement a distinction between the *application of economic instruments to nature* (orthodoxy) and their own efforts to *incorporate ecological principles into economics* (heterodoxy). I draw on ten years of participant-observation of environmental public policy, including in-depth interviews with foundational, emerging, and transient participants in heterodox efforts, and analysis of the epistemic content they produce.

I theorize the process by which the social and epistemic practices of a social science – economics – might be rearticulated to comply with the epistemology of a natural science – ecology. This investigation of an interdisciplinary interface takes an interdisciplinary approach to analysis. I draw on the tools of sociological ethnography, science and technology studies (STS), and the science of ecology to examine the context in which economic tools are commensurated with ecological entities. I find that the epistemic project of ecological economics is seeking to operationalize a transition to heterodox environmental policy by valuing the *epistemology of ecological knowledge* at an equal level to the *content of ecological knowledge*. I theorize the possibility of an analytical inversion: a norm of calculation that grants primacy to the embeddedness of societies and economies in a biophysical context, and foregrounds the *purpose and effects of calculation over efficiency in or parsimony of calculation*.

I explore whether a heterodox epistemic mission may *require* pluralist tension, even as its professed goal is the coherence of a concerted alternative. I draw the outlines of a theory of social and epistemic dynamics at an “*unboundary*,” a space of shared discourse containing demonstrably incompatible epistemic commitments in the service of pragmatic ends. This dissertation furthers our understanding of interdisciplinary knowledge creation, and of the practical challenges of developing a policy framework that respects ecological ontology.

Forward: Liminal Spaces

This dissertation is a product of living and working in liminal spaces. It was written in borrowed rooms, sometimes directly under the nose of systems tasked with determining who and what does and does not belong. As an emerging academic with an eclectic formal training across social and natural sciences, I often have trouble understanding what it might mean to approach research as a discrete object. These handicap has fundamentally shaped my outlook on boundaries and the practical challenges of epistemic change.

I would like to thank both the gatekeepers and denizens of the spaces in which I have worked for the insights I have gained as an interloper within their social worlds. I thank the spaces, too. Especially the ones where I most knew that I did not belong – for they inspired curiosity that was not merely intellectually generative, but also life-saving. Idle perusing in the library of Harvard Medical School led me to the work of a surgeon who would later perform an operation on me that three other specialists had deemed impossible.

Each liminal space has come with gifts and challenges. At first, it was necessity that rendered me a keen observer of a space's indigenous behaviors. I had to blend in. I became conscious of my patterns so that, if need be, I could mirror them in sync with the sociality of the work around me. For several weeks in 2009, during a failed attempt to write a book prior to beginning my PhD, I squatted in an unoccupied cubicle in a new biochemistry research building. It was surprisingly easy to pull off. My lunch bag, stack of papers, and pictures of my dogs pinned to the fabric walls of an otherwise dreary

workspace lent my intrusion such an appearance of normalcy that I was soon exchanging casual greetings with the rightful occupants of the building. My ordinary daily work reasonably camouflaged, I was able to write productively without interruption. It must have been assumed that I was a colleague from *another department* who had not yet been introduced. Or, perhaps I had been introduced but - how embarrassing! - everyone had been out on that particular day. I played the part reasonably well. Small talk in the building's transitional spaces provided countless opportunities to respond and mirror the appropriate social cues. Three years later, while taking my first sociology classes, I learned that sociologist Erving Goffman describes the importance of such initial exchanges among strangers as creating a shared *definition of the situation* (Goffman, 1959). The local mundanity of my front-stage performance normalized back-stage work that had nothing to do with biochemistry. Steadily, I observed – and sometimes came to embody with reasonable skill – what was required of an active participant in various different epistemic worlds: linguistic constructions, discursive concerns, habits of movement throughout the building. Each interaction with a native was a new opportunity to affirm the definition of our shared situation. Encounters were not just a test of my belonging, but also a bid for social connection. Indeed, it was not possible to have one without the other. The encounter, the bid, the test of belonging, the connection; they often came all at once. The trick was to learn how to act, and interact with local norms. To behave like I belonged. In the kitchenette of the biochemistry building, as I re-heated my coffee in the microwave, a tall white man in a white lab coat might say: “Hi there! How about that game last night?!” Here I knew the smile and friendly greeting to be an acknowledgement of my existence, a reach for connection. But the question tacked on at

the end, while also friendly, was a test of my belonging. Thankfully, I was never confronted about the appropriated cubicle. Rather, the white man in the white lab coat would discern my alignments in a social world of higher-order importance than the present social environment: the tribalism of sports. In countless interactions, I was expected to be passingly proficient in the language of fandom of that university's hugely popular men's basketball team. Though I had never before followed basketball, I quickly learned some effective conversational deflections. That year, a phenomenally agile freshman was flying across the court and over the net with the effortless agility of a professional dancer. The ability to draw on this knowledge – for me, an appreciation of technical beauty, for him a pride in hometown performance – was enough to pass as part of the tribe. At no time during my stay in that biochemistry building was I ever tested on knowledge of biochemistry. Instead, I shared in transcendent ideals and practical concerns. Both in that building and in every other professional context, there always existed something that mattered *more* than detailed knowledge specific to the ostensible epistemic setting at hand. In the lounge of a law school, where, many years later, I would work on this dissertation for months on end, the highest order of shared knowledge was familiarity with the delivery schedule of leftover seminar food. Regulars, among whom I counted myself, knew who would know about its most recently spotted location. Our legitimate claim to the sociality of the space lay, in part, in the sharing of knowledge completely unrelated to the study of law.

And so it has progressed over the years. I have occupied transient spaces of countless libraries, café's, and marginal spaces in various academic buildings of several major research universities. At times I have stayed only a few hours; often I have held

regular hours for stretches of weeks or months. In the years since that stint in that biochemistry building, I have become much more open about my identity, even in places where I do not belong. Lowly as I am in status, being able to call myself a PhD student, or just “a student” is a category that is as legible as it is disarming. I found that being a student afforded me access to social contexts that, in my previous career, had been obscured by the authoritative routines of “professional” *habitus* (Bourdieu, 1990). *Student* was an invaluable identity I could use as an all-access pass to knowledge making – both its daily customs and, if I were curious, its inner machinery. This orientation to my work setting bled into my research life, where I relished expectations about my beginners mind. “Oh me? I’m a graduate student in social science trying to understand economics, can you tell me about what you’re working on?”

The sum total of all these experiences in borrowed spaces is much larger than the hundreds of hours spent at a series chairs and desks. The perennial problem of finding a place to *get work done* has fed my curiosity about what it means to push, not directly against, but *liminally past* the obviousness of limitation and constraint. Of course, I could have tried to fulfill my need more directly. When I matriculated as a graduate student at the University of Wisconsin in 2012, I finally did ask for official work space. My request landed at the feet of a large bureaucracy, and I was surprised to discover in the *procedurally legitimate* path a thicket of rules and procedures guarding the sanctioned allocation of space. I dutifully assembled and brandished my limited credentials, leveraging various aspects of my identity as it related to membership of a particular group: Was I a student in the department? How many credits had I completed? Who was my advisor? How was I funded? Had I advanced to candidacy? The orderly choreography

of paperwork and procedure came to naught. For a significant time, finding official office space proved impossible even within an institution of which I was a documented member. By this point, I was alternating between nomadic hideouts in a beautiful aqueous geochemistry laboratory in one of the university's original buildings, and the large oak tables of the Wisconsin Historical Society's stately reading room. I spent three years in residence as a PhD student at the University of Wisconsin. Finally, in my third year, I did get to sit behind a door with my name on it. The office had a large picture window that looked directly out onto a courtyard with a bell tower that – by incredible coincidence – housed the carillon bells my partner's grandmother had played as an undergraduate exactly 70 years earlier.



Elsie Taschek at the Keyboard of the University of Wisconsin carillon, 1944.
Image courtesy of the Wisconsin Historical Society (image ID 40942), where its official caption reads:
“Traditionally the carillon was always played by men prior to World War II”

Uncertainty about my disciplinary place lead me to apply a headlong “do it all” philosophy when I tip-toed into accredited intellectual life. Even then, as I began my PhD, eager to be trained and “disciplined,” it was clear that the liminal orientation had become part of me. Familiarity with the feeling of outsidersness – also a central feature of

the queer experience – inclined me to *embrace the uncertainty* about my potential disciplinary belonging. In 2012, I matriculated in PhD programs in both sociology and environmental studies to “hedge my bets” in case my habitus proved incorrigible (and I was secretly certain it would). I couldn’t bear to drop either PhD program, because each was authentic about a peculiar subset of the things that mattered. In sociology, we read hundreds of pages of classical theory and were required to recall it from memory by Friday. In environmental studies, it didn’t matter how much we knew if our thoughts weren’t oriented in the service of environmental problems. That the two programs had in common an allegiance to the higher ideals of mastery and justice was something I would only later come to appreciate. Talking to my interviewees about their orientation to higher-order ideals was a productive entrée into understanding what happens at an *unboundary* – a space of shared discourse containing demonstrably incompatible epistemic commitments.

I advanced to candidacy – the proverbial jumping off point into independent research – just as my partner’s job moved us to Boston. And with that move, the hard-won office behind the solid wood door, the space that had been “mine” for a full year, was lost. In Boston, I quickly revived my old routines of scrambling for interstitial space. Yet the problem felt compounded. I would have to find places to do work simultaneous to finding resources to support the physical and mental labor of independent research. The two problems fed into one another so thoroughly that eventually I was unable to distinguish between them. Rightful, owned, legitimate – *space* – was discipline, order, belonging, boundedness, safety within constraint. How else could I complete a dissertation? Yet the only places available to me were pockets of liminal existence – an

eerily soundless carol in the fluorescent basement of Widener Library in the morning, the comfortable couch, sandwiched between competing conversations, in the corner of Café Gato Rojo in the afternoon. By my second year in Boston, I was stir-crazy with frustration. I had nowhere to lay out my papers, to methodically sort through interview notes without the threat of interruption. I was desperate for a home base, for a touchstone – a community with whom I might mark my daily progress. I accepted an unpaid fellowship in a program for ABDs and post-docs, partially because it provided “office space” – only to discover on arrival a closet-sized windowless room shared by 15 people. A colleague, a well-funded visiting student from Norway, had pursued all the bureaucratic channels and also come up empty. The richest university in the history of higher education had no office space to spare, not even in exchange for payment in the currency the rest of the world ostensibly held most dear.

This is a dissertation both *about* and *born of* paying attention to liminal space in epistemic life. Back in that biochemistry building in 2009, I wanted to know what would happen if I just *appropriated space* without directly confronting the machinery of its control. The experiment went so well that I have been continuing it ever since. I have worked in dozens of buildings and outdoor spaces in the greater Boston area. This approach to getting my dissertation done has led to hundreds of small experiences interacting with existing structures as an interloper and outsider; yet in these interactions, I am also present as an accomplice. In liminal space, outsider status requires the continual renegotiation of one’s positionality in the creation of knowledge – the conditions in which Rich (Chapter 3) is asked to reconsider the epistemic commitments he holds most dear, and Frank (Chapter 4) comes up against the idea that epistemic parsimony may not

be environmentally appropriate. Encounters with insiders rendered me an ally in the thrill of taking a different slice through the “old material” of tacit knowledge. I often tried to just *put my head down*, to treat my environs as a neutral vessel for my labor. Yet the vigilance required of me as an outsider became an embodied knowledge, inevitably pushing me back out into the surrounding landscape of encounters. Frustrated as I often was at “interruptions” of my focus on work, *scene breaking* re-oriented me toward a stance of possibility, to thinking in constellations, and not (much to my continual frustration) in neat efficient lines. Though I was sometimes fearful of being disciplined as a trespasser, I was never confronted. My white skin and neutral clothing helped me pass as an ostensible member of most groups. My continual quasi-embedding in the “back stage” of elite social worlds led me to see *identity* as multiple and malleable – even the identities of insiders in highly privileged or hierarchical contexts (e.g. Jacob, in Chapter 2). The viewpoint of the interlocutor helped me find permeability even in obdurate structures. Indeed, having had previous experience of fieldwork among Honduran peasant coffee growers, this new position of “studying up” (Nader, 1972) – with subjects over whom I did not risk exerting power or privilege – left me feeling both more ethical and scientifically scrupulous.

Gatekeeping functions were usually confined to the perimeters of a space. Certain perimeters were more explicitly policed, requiring keycard access after business hours or on national holidays. Once on the inside, any reason to patrol membership was superseded by the immediacy of a given interaction – with a stranger turned potential associate. Many interactions with the rightful owners of space were enabled by their relaxed relationship to a familiar context. Empowered by my ability to call myself a

student, I had moved on from the evasiveness of my days in the biochemistry building and came to embrace this multiplicity of partially-defined identities. In a city inundated by 152,000 students, no one need know just exactly *where* and *what* I should be studying; moreover, city life is to a great degree characterized by the inconspicuousness of multiplicity. I quickly realized that it was possible to move my small talk beyond the cursory tribalisms. A shared interest in the pressing affairs of the world was more than enough. From service outages on the subway to the latest political outrage, people always wanted to talk about real things of consequence. Indeed, even in rarefied epistemic space, I could engage – if not always with specialized knowledge directly – certainly with the machinery creating the context of its making. My lack of legal credentials never interfered with “shop talk” in the lounge of the law school. Interactions with legal experts didn’t threaten to veer into dry procedural knowledge. Instead, our conversations consisted of a kind of informed but *adisciplinary* sharing about the pressing consequences of current events, through the lens of common knowledge from a variety of epistemic orientations.



The author drafting Chapter 1 in the “write up room” of an organic chemistry laboratory, October 2, 2017.

Use of this cubicle was negotiated with the occupants of the lab for three days a week during the Fall semester of 2017. The drawing and posting of post-it-note doodles was tolerated by other users of the space.

I came to be a keen pursuer of the liminal experience. Indeed— the process of writing this dissertation has closely mirrored the social dynamics I study *in* the dissertation. I observed ecological economists as they attempted to refashion economic practice with ecological ideals – to change the epistemic machinery of an elite space from within. By taking action to render economics responsive to ecology, these liminal elites opened up a forbidden territory – a space where people from a variety of backgrounds are permitted to acknowledge and wrestle with the complexity of various conflicting epistemologies of nature. This space is threatening to the hegemonic paradigm of neoclassical economics, yet the decided marginality of its members also renders them disarming. This space is radical and idealistic, yet requires legibility as “economics” to maintain a source of discursive legitimacy for recruitment to its cause. Institutionally, it has made inroads into exceedingly few centers of power. The emerging field relies instead on many small interactions – face-to-face, student-by-student, project-through-project. The movement gains significant sustenance from the overwhelming success of the polyglottal space of its interdisciplinary journal: *Ecological Economics*. The journal’s top-ranking in three distinct disciplinary spaces: ecology, economics, and environmental studies belies its near-total lack of ownership of a distinct territory to call its own. Only a handful of institutions worldwide offer degrees *in* ecological economics; even fewer seek faculty holding such a credential. This is not just a story of the enormous energy required for systemic change. It’s a story of the process of “doing” ecological economics: a paradoxical dance in liminal space, where practitioners are simultaneously marginalized but also appreciated for the possibility their approach creates. Both the writing and the researching of this dissertation was shepherded into existence by placing myself in

privileged spaces where I did not belong. And *passing* in those spaces – as a student, environmentalist, and potential ‘convert’ – imbued me with a sense of kinship with the experience of making cracks in the seemingly obdurate edifice of neoliberalism’s ownership of the mechanics of speaking on behalf of nature.

Introduction: An Ethnography of Public Policy

In their efforts to “save the planet,” environmentalists ostensibly heed the findings of ecological science. Yet the flow of information in the world of environmental policy is uneven. Nearly every classroom, textbook, policy proposal, political debate and activist screed about the future of nature continues to be very much engaged in applying economic principles to nature, rather than ecological principles to public policy. Environmentalists’ frameworks of action are oriented towards ostensibly ecological ends. Yet “internalizing externalities,” “pursuing resource efficiency,” “carbon market,” and “green consumerism,” are *economically* organized schemes. Does economic epistemology betray environmentalist’s ends? Ecology – concerned with the interactions of matter and energy through assemblages of organisms, communities, webs, biomes, and populations – and economics – concerned with the growth of financial instruments within human societies – share few, if any, ontologically compatible operational principles. This study is an ethnography of a community of heterodox reformers, “ecological economists,” who intend to shift the policy landscape from the *application of economic instruments to nature* to the *incorporation of ecological principles into economics*; it is a sociological analysis of the potential transition between these two approaches to environmental policy. In taking an ethnographic approach to the epistemic mechanics of this intersection, I study how the fundamental precepts of a social science – economics – might be rearticulated along the lines of a natural science – ecology.

Ecological economists, as technical actors in the world of environmental policy, have rebelled against their own technocratic training in the governance of nature via

utilitarian ethics and the *price system of value* (Chapter 2). Their dissent is new and distinct from other environmental social movements in that it presents a direct challenge to the epistemic machinery from which economics constructs its hegemonic discourse of nature. Ecological economists are not luddites, separatists, or isolationists. Nor is this – a project organized by highly educated elites – a dissent of ignorance or a rejection of realist scientific knowledge. Rather, in pushing for reform to economics in the image of the core ideas of ecology, ecological economists’ dissent foregrounds the consequences of elites’ ignorance of science. Like the hegemony of orthodoxy (Chapter 2), the dissent of heterodoxy (Chapters 3 & 4) implicates epistemic content as well as social structure. By studying the process of heterodoxy, I aim to shed light on a perennial goal espoused by many environmental thinkers: making ecological values visible and actionable in non-utilitarian terms. Heterodoxy is a movement to reorient the purpose of economic analysis – towards rendering it “*ecological*” in logic, but also in outlook. But, rather than attempting to adjudicate the epistemic or institutional viability of the new science proposed, I consider the sociological dynamics enabling the push for such a radical transformation. I examine the *pursuit of ecological appropriateness* in the policy language used to speak on behalf of nature.

An ethnographic study of the mechanics of public policy is necessarily a “studying up” (Nader, 1972) within elite space. As such, I also examine the construction of taken-for-grantedness of orthodox economic ontology in environmental discourse, and the potential for its deconstruction within environmental policy. I have therefore refrained from taking economic terms as neutral descriptors of ecological problems. Instead, I place their epistemic merits under scientific – ecological – scrutiny. Economically-trained

professionals seem eager to push these terms (“externality,” “public good,” “rival/non-rival good”) into public discourse as neutral or self evident tools for pursuing environmental ends. But, as I detail in Chapters 2 & 3, these ostensibly descriptive concepts are also containers of implicitly-provided economistic solutions. I examine the rationality of these terms – of the analytic functions economic tools perform in presage to economic analysis – as durable elements of orthodox epistemic power. Their *indigenization* (Burawoy, 1991), in both discourse and practice, is in turn an element of neoliberal power. To focus attention on the context and consequences of orthodox epistemic devices, and to trouble the perceived axiomatic solidity of economic tools and conclusions, throughout this dissertation I have made the deliberate choice not to transpose the details of technical work.

My argument draws on ten years of ethnographic observations of the social and epistemic configurations of the field of ecological economics. My methods include participation, observations, informal interviews conducted at 6 regional and international conferences, and in-depth follow-up interviews with foundational, emerging, and tangential participants in the field. I have also reviewed the epistemic content produced by the field, through extensive study of publications, including textbooks, published articles, unpublished author’s manuscripts, and a training workshop for PhD researchers in ecological economics. Additionally, I draw on analysis of bibliographic relationships using the comprehensive article search tool via the University of Wisconsin Library database, and a content analysis of a database I compiled of all articles published in *Ecological Economics*.

1 **Boundary Object, Boundary Community: An Epistemic Ethnography of “Ecosystem Services”**

I begin this dissertation with an extended chapter on the concept of “payment for ecosystem services” (PES). The PES concept is often taken as the self-evident optimization of ecology with economics. More often than not, when I explain my research as an “ethnography of knowledge production at the intersection of ecology and economics,” I am asked if I study PES. Indeed, it’s arguable that the discursive lens of environmentalism-as-PES has taken off as the dominant metanarrative of global environmental governance.

The PES approach is a means of attempting to preserve nature by apprehending the “value of ecology.” An ecosystem service can be expressed as a concrete material phenomenon (e.g. the carbon cycle), a probabilistic risk (e.g. disruption of weather patterns and prevalence of major storms), a subjective mental state (e.g. the good feelings arising from knowledge of the existence of polar bears in the wild), or an ecological effect on an economically-optimized system (e.g. reduction in commodity crop productivity due to climate change). Rather than setting nature *apart* from neoliberal economic calculation, PES are tasked with providing a countervailing voice for nature *within* those calculations. PES is the result of the belief that the things ecosystems provide for humans can and should be expressed, as are other commodities, in economic terms. Ironically, the concept’s earliest articulation – as “ecosystem services” in a 1983 article highlighting the severity of the consequences of extinction events for ecosystems – leverages the concept as a justification for a transcendent value of nature *outside of what can be apprehended by comparison to manmade sources of value*. Over the past 20 years, discursive use and policy implementation of PES have risen exponentially among a broad

range of academic practitioners, policymakers, and environmental advocates. Gradually along that trajectory, PES became an explicitly economic concept. Environmentalism as a framework of action also came to be explicitly premised on the *potential* for PES to apprehend the totality of “value in nature.”

Both proponents and critics see PES as an “applied” knowledge – that is, as a methodology that serves concrete normative conservation goals. PES’s proponents locate its utility in the discursive power to “reveal new values” by communicating for ecology in economic terms. Its critics point to the cooptation of these values – “pricing the priceless” – as an extension of the forces of neoliberalism. That is, the act of monetizing nature demonstrably enlarges the reach of markets and therefore enhances the potential for ecological destruction. Existing critique of the valuation of nature focuses on three problematics *created by PES*: **1** - The shortcomings of the methods and calculated values of “ecosystem services” themselves; **2** - The effectiveness and on-the-ground implementation of PES schemes; **3** – The limitations, both material and discursive, of an environmentalism increasingly organized around the utilitarian objectification of nature.

This chapter is an exposition of the sociological context of thinking about nature as something paid for as *services* - revealing a theory-methods package (Fujimura, 1996) that is more complex than is supposed by either its proponents or its critics. My “**ethnography of a concept**” locates the development of PES in organizational, epistemological, and discursive space. I show that deployment of PES as a boundary-spanning hybrid – variously interpretable as methodological tool, realist practice, or discursive metaphor – requires distance from the epistemic objectives of disciplinary space. I establish that the concept was hatched by the field of ecological economics, and

that this emerging inter-disciplines' particular epistemic openness was instrumental in building the interpretive flexibility that renders it a broadly useful tool. I examine the social context of its genesis and rise to prominence, illuminating the assemblages of individuals, institutions, and knowledge practices that hold it together. This chapter broadens our understanding of interdisciplinary work products as *boundary objects* (Star and Griesemer, 1989) facilitated by the organizational space of a *boundary community* – a social world at a distance from the confines and objectives of disciplinary space.

This research adds dimensionality and context to the conversation about ecosystem services as a mode of apprehending ecological knowledge and concretizing ecological value. The foundational imaginary of the “ecosystem service” is that of a systematic unification of ecology with economics, with the goal of generating a countervailing voice for nature *within* the economic calculation of GDP. I argue that the controversy around PES is explicitly a battle over (1) representation of the ontology of ecology through the methodology of economics, and (2) whether economic pricing can be deployed discursively without collapsing into the literalization of price.

The ontological elusiveness of environmental values is itself a force pushing conservationists to embrace the *doable problem* (Fujimura, 1996) of PES within the simplicity of the price system. Ecology as it once was – intrinsically valuable, mysterious, and a source of unknown potential – has been eclipsed by an ecology reduced to generator of quantifiable, useful, and compensable inputs to human existence. With this conceptual shift has come a discursive shift: even as almost anything can now be categorized as a “benefit from nature,” ecology is valued in economic – as opposed to ethical – terms. In this chapter, I map the context of this elision. I argue that present

critique also misapprehends the full nexus of PES's power, placing power in the general tendency of markets to exploit commodified entities, rather than also in the terms of the creation of nature as a commodified entity through the epistemic ideal of commensurability between ecological relationships and economic tools. Indeed, many PES advocates explicitly advocate the concept as transcending the dichotomy between economics and ethics (Jax et. al., 2013). Embedded in the thesis of my "*ethnographic approach to a concept*" is a challenge to the terms of prevailing critique. Dissent from PES has focused on problematics *created by it*, to the exclusion of the epistemic and institutional context that creates and continues to sustain the ideals which give the concept both epistemic resonance and political power.

Does the existence of environmental problems represent an incompleteness of rationality or a failure of rationality? In the remaining chapters of the dissertation, I present evidence that the presently-deployed epistemic terms of environmental problems are ecologically "*imperfectable*."

2 A Theory of Orthodoxy: The Ontogeny and Ontology of Epistemic Power

The Anthropocene is an age of accelerating ecological change. Numerous biophysical signs of global ecological collapse unprecedented in human history are all frequently cited not only as signs of crisis in the ecological health of life on Earth, but also the supposed rationality of economic order (e.g. Latour, 1998, York et. al., 2003). This dissertation is about what happens at the intersection of ecology and economics, two discourses positioned as central stakeholders in describing and addressing the crisis of the Anthropocene.

The potential for *perfectibility* in an economic ordering of nature is largely taken for granted. Within the black box of orthodox economic rationality lies a paradox that should give any environmental advocate pause: the box is the originator of the mechanisms that render it profitable to destroy nature. And now – in the age of the crises of the Anthropocene – the box *also* contains the source from which “solutions” to environmental problems are drawn. It has become taken for granted that ecology and economics possess a common language – and that language is, if not identical in its mechanics to neoclassical economics, *commensurable* with it – via utilitarian valuation expressed in the form of marginal price. The foundational project of the heterodox approach is to dive into this paradox: problematizing orthodoxy as the common epistemological source from which problems and solutions are jointly derived. Ecological economics draws authority for its cause by locating imperfectability not in a failure to fully implement a theory, but *within the apparatus of the theory itself*.

In this chapter, I identify three dimensions of the *ontogeny* of orthodox epistemic power – i.e. how orthodox ideas are socially reproduced. The first, a “**Circumscribed silo of expertise**,” is a condition in which the discursive force of an argument hinges on avoiding the significance of the context of its analysis. Through the second dimension, the “**Ethic of mastery and performativity of complexity**,” newcomers, distracted by the difficult process of earning mastery, absorb not only the ability to use the tools – but the unbidden assumptions that make the tools “work” – but only under specific guiding assumptions. The third dimension of orthodox ontogeny is the “**Latency of power within applied tools**,” in which techniques are positioned as superior to ideals.

I subsequently identify three dimensions of the *ontology* of orthodox epistemic power – i.e. the way ideas organize a fundamental understanding of nature. The first, “**Coasian bargaining**,” positions environmental problems as effects that are epistemically equivalent to their economically-generated causes. The second, the “**Operational rationalities of substitutability and efficiency**,” are the tools used to adjudicate equivalence and commensurate between disparate entities. The third, the “**Externality theory of value**,” deploys the first two mechanisms to convert ecological knowledge from the ecological “is” to the economic policy “ought.” Indeed, because the market transaction serves to adjudicate the epistemology of ecology, the frontier of namable externalities is coterminous with the frontier of economics’ ontology of physical reality.

This chapter draws attention to the dynamic of finding “the line” between the *application of economic instruments to nature* and the attempt to *incorporate ecological principles into economics*. The following two chapters – 3 & 4 – are concerned with the epistemic and social space on the other side of that distinction.

3 Heterodoxy: Illuminating the Paradox of Epistemic Mismatch

I begin Chapter 3 by looking through the lens of the economic work practices oriented towards environmental conservation. The identification, measurement, and optimization of (economic) value ascribed to pieces of nature – through PES, “user fees,” and other instruments – are work practices meant to assess dimensions of the *value of a piece of nature*. But they can be more accurately described as assessments of humans’ demand (consumer preferences) for the *use of nature*. Pursuit of ecological *accuracy*

through the calculation of PES is, therefore, actually an effort to achieve economic *effectiveness*. I call this continual process of working towards the ideal of the complete economic valuation of nature “*deep diving*.” The theory of **deep diving** centers the imperfectability of the price system as a representation of the ontology of ecological knowledge. It performs an epistemic imaginary of the economic modeling of nature as *perfectible* given appeals to sufficient data about ecology’s *use*, and that the potential of perfectibility renders a provisional version of such a model a competent tool for the conservation of biophysical entities.

Heterodox critique reveals an epistemological mismatch – that the ontology of ecology – characterized by relationality and embeddedness – can’t be applied in practice with the methodological tools of economics – characterized by price and its one-dimensional valuation through mathematical formalisms. They conclude that economic representations *of* nature – seeing nature through economics – actually result in expansion of the economic system rather than, as all environmentalists who use economic tools intend, containing ecology “away” from the effects of an industrial economy. That is, orthodox economics performs the paradoxical effect that seeing “through” the economic system drives expansion *of* the economic system.

Addressing this paradox – that the valuation of ecology in economic terms leads to devaluation in ecological outcomes – is at the heart of the heterodox push of ecological economics. The paradox is a concatenation of several elements: **externality-driven action, imperfectability, and ontological asymmetry**.

Orthodoxy’s externality-driven mode of advocating for environmental knowledge both creates and circumscribes the area of environmental concern for subsequent analysis

to fix. That is, orthodox ‘*nature*’ does not exist – ‘*out there*’, so much as *through exchange*. The externality is both a *boundary object* translating between ecological and economic value, but is also its own *black box*. As far as the economic system is concerned, the natural world has no value antecedent to an interaction with the economic system. An environmentalism constructed of **externality-driven action** allows ecology no uncertainties, mysteries, secrets or unknowns. Refracted through the orthodox economic system, nature is constructed through the same process by which it is subdued.

The project of heterodoxy is to link externalities, services, and “user fees,” and other instruments of environmental valuation as driving one common epistemological process: the redirection of the complexity of ecology towards the formal logic of economics. The process of parting out that enables a calculation concerning nature to take place within the economic black box is itself an alienation from embeddedness. The escalation of economic sophistication – its *deeper dive* into the depths of the neoclassical toolkit to identify and quantify a greater range of measurable benefits – comes at the expense of adopting an economistically-driven epistemology. The thesis of **imperfectability** implies that *deep diving* will not render externality-driven-action responsive to ecological embeddedness, and that the externality is therefore not fixable at the scale at which it is deployed.

The foundational project of the heterodox approach is not merely to reject the valuationist paradigm. Rather, it is to interrogate the commensurative compromises across the two fields: the inherent conflict between economic analysis, which requires concordance and commensurability, and the ecological imagination, an imbrication of multiple types of incommensurable data. I call the epistemic mismatch heterodoxy

identifies in orthodoxy **ontological asymmetry**. Externality-driven action creates a frontier across which ecology is commensurated with the economy, but this interchange is not a static boundary. As encroachments occur, regardless of whether or not they are formally compensated or ‘internalized’ as ‘externalities,’ the sphere of economic production expands. Ecological economics places the blame for resource depletion, and increased toxic burdens of industry squarely upon the process of *growth* in the ever-widening circle of externality production of the economic sphere. This chapter is the first of two in an ethnographic account of the social conditions and epistemic resources marshaled to cohere an ecologically-based critique of economics as a **competent whole** – a coherent total outcome responsive to ecological dynamics.

Heterodoxy is simultaneously *radical* – it challenges the supposed parallelism between representation and valuation across the interface of ecology with environmental policy – and *reformist* – it’s work goal is to create a legible replacement to orthodox practice.

4 Heterodoxy: The Analytical Inversion

In Chapter 4, I explore how the project of heterodoxy differs from standard policy analysis in that it seeks to value the *epistemology of* ecological knowledge at an equal level to the *content of* ecological knowledge. The generative idea animating the field of ecological economics is that the economy ought to be studied *as* a natural object, and that economic processes should consequently also be conceptualized in terms developed to describe processes in nature. The heterodox response to the structural failures of

ontological asymmetry, is to place context *before* analysis, with an emphasis on the requirement of subsidiarity of economic tools to biophysical laws.

In placing loyalty to the coherence of an ideal – ecology – over the solidity of a methodologically dissociated technique – the externality – the heterodox movement seeks to re-envision environmental problems not as *failures to completely apply* economic reasoning, but *failures of* economic reason. The contention of heterodoxy is that an “economics *of* the environment” and an “ecological economics” are fatefully different paths. The required shift in policy analysis would be to formally concretize what I am calling an **analytical inversion**: a norm of calculation that grants primacy to the embeddedness of societies and economies in a biophysical context, and therefore foregrounds the *purpose and effects of* calculation over *efficiency in or parsimony of* calculation.

The analytical inversion contains three linked commitments: **1** - Taking this ecological knowledge seriously. By considering *ecology as both economic input and economic context*, the ecological imagination enables subsidiarity of analysis. **2** - Placing boundaries on the acceptable use of economic tools, **3** - Operationalizing a synthesis of the first two commitments so that economic activity respects the natural laws of its embeddedness within biophysical limits. An analytically inverted policy process would have an operational logic taking on both the *function* and *form* of an ecosystem. Its methodological choices would accurately convey ecological value by reforming the calculative mechanisms within its black box to supplant economistic marginalism (*function*), and the extent of that black box would be circumscribed within safe operational limits (*form*). That is, value would no longer inhere in the (orthodox)

mechanism of hedonic utility, *or* the “BioPhysical” mechanism of energy (as joules), but in the integrity of ecosystems in a holistic sense.

A product of radical dissent that nevertheless must remain legible in orthodox language, the goal of replacement is reformist in nature; the heterodox model is intended to fit within the same institutional structure of orthodox practice. A necessary compliment to the epistemic project of the analytical inversion is a *social inversion*. Governance of the International Society for Ecological Economics (ISEE) attempts to perform the ‘ecological’ ontogeny – of subsidiarity to both biophysical and political organizing features – as part of its organizational structure.

5 Towards a Theory of “Unboundary Work”

In the concluding chapter, I draw the outlines of a theory of epistemic dynamics at an “**unboundary**,” a space of shared discourse containing demonstrably incompatible epistemic commitments. I explore whether a heterodox epistemic mission may *require* pluralist tension, even as its professed goal is the coherence of a concerted alternative.

Chapter 1

Boundary Object, Boundary Community: An Ethnography of “Payment for Ecosystem Services”

*At this point, the critic of money valuations, who is nevertheless deeply concerned about environmental degradation, is faced with a **dilemma**: eschew the language of daily economic practice and political power and speak in the wilderness, or articulate deeply-held nonmonetizable values in a language (i.e. that of money) believed to be inappropriate and fundamentally alien.*

David Harvey, 1996 (p. 156)

To scientists of the Anthropocene, the epistemic terms of an interdisciplinary reckoning of ecology with economics appear urgent. There is consensus across environmental studies that the rapid material expansion of human enterprise associated with modernity has resulted in biophysical change unprecedented in human history (e.g. Steffen, 2005, Folke 2011, Weathers et. al., 2013). This “great acceleration” has been measured in hundreds of indicators – from atmospheric greenhouse gases, rate of species extinction, and biomass under human cultivation (see **Figure 1**). The post-industrial shift in the way human societies interface with nature is so fundamental that the “Anthropocene” is heralded as a new geological era, marking a qualitative change characterized by an explosion in human-generated effects on nature in tandem with explosive growth in economic activity under neoliberal capitalism (e.g. Krausmann et. al., 2013 Manuel-Navareete and Buzinde, 2011, York et. al., 2003, Young et. al., 2006). As one ecological economist exhorted– quoting MIT Physicist Henry Kendall: “We are on a collision course – society with nature.”

The Great Acceleration

1950 marked the beginning of a massive acceleration in human activity and large-scale changes in the Earth system.

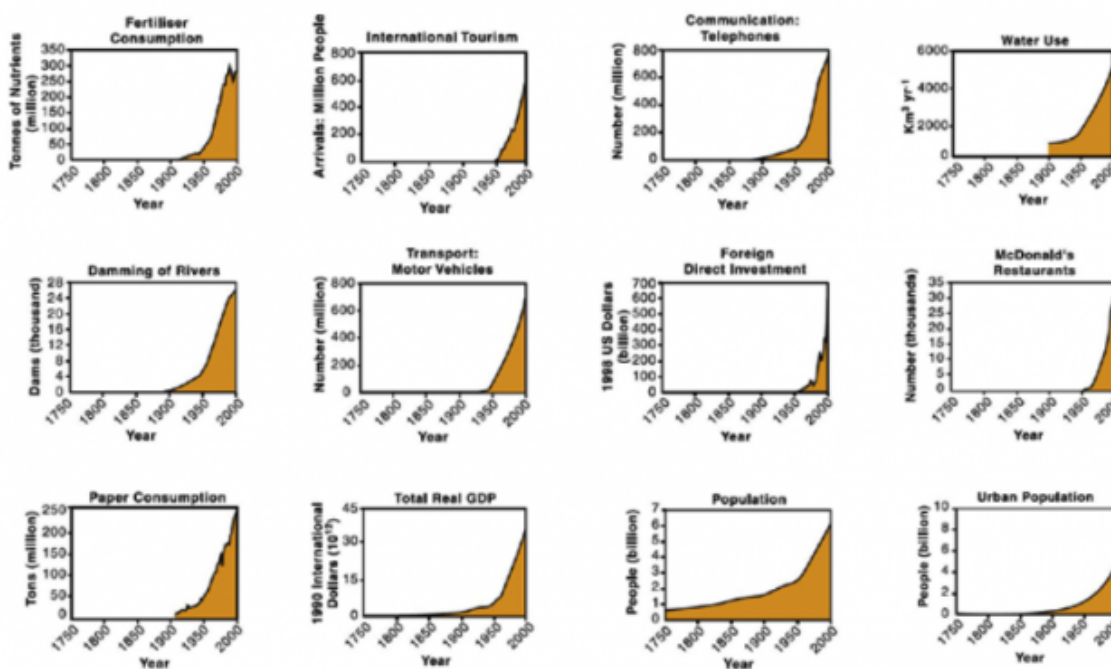


Figure 1: The “Great Acceleration,” reflected in 24 global growth trends from 1750 to 2000, assembled by the International Geosphere-Biosphere Program (Steffen et al.)

Figure 1: “Earth systems trends” (from Steffen et. al., 2005)

In this chapter, I illuminate the institutional and epistemic context of the creation and rise to prominence of the “ecosystem services” concept. Ecosystem services are calculations of the benefits humans derive from nature. Various dimensions of communication across the society-environment interface have been categorized as “services” from nature. They can encompass any dimension of the human experience in nature: clean water and carbon cycle (concrete material phenomena); reduction in commodity crop productivity due to climate change (economically linked material phenomena); the disruption of weather patterns and prevalence of major storms (probabilistic risks); the good feelings arising from knowledge of the existence of polar bears in the wild (subjective mental states) (Alcamo et. al., 2003). Though this

economistic framing of nature as commodity is a recent development, it can appear at once obvious or banal in its reasoning. Biophysical materials and processes – like air, soil, water, and oxygen – “accomplish tasks” and “provide goods” that are essential to life on earth: nutrient cycling, climactic stability, carbon uptake, biodiversity, etc. (Alcamo et. al., 2003, Millennium Ecosystem Assessment, 2005). The “payment for ecosystem services” (PES) approach is a means of attempting to preserve nature by apprehending its value in economic units and articulating that value on economic markets. Rather than aiming to preserve nature by setting it apart from neoliberal economic calculation, as a century of Western environmentalism has attempted through the legal code of property rights, PES are tasked with providing a countervailing voice for nature within those calculations. Values, translated to prices, are meant to convey the importance of conservation as ecology’s highest possible use.

An “ecosystem service” is not an inherent natural relationship, and is therefore not inherently measurable. Rather, it is an attempt to append a reform to an economic paradigm that doesn’t otherwise acknowledge the intrinsic value of ecology. Ecosystem services, and “payments for ecosystem services” are now a pervasive and hegemonic means of communicating the “value of” ecology in environmental governance (Barnaud and Antona, 2014, Fisher and Brown, 2014, Robertson, 2012).

The use of ecosystem services has come to be so ubiquitous in the environmental community that generating, measuring, and pricing appear as practices of self-evident merit. The daily work of conservationists, ecologists, and practitioners of environmental conservation is now pervaded by the discourse of *ecology as service*. Ecology is now not so much intrinsically valuable as it is a generator of useful inputs to human existence.

With this conceptual shift has come a discursive shift: even as almost anything can now be categorized as a “benefit from nature,” ecology is valued in economic – as opposed to ethical – terms. In this chapter, I map the context of this elision. I begin by showing the epistemic and discursive dimensions of the genesis of PES, contextualizing the concepts’ particular interpretive flexibility as having required analogous organizational openness in disciplinary space. I establish that the field of ecological economics was central to the genesis and spread of the ecosystem services concept. I then peer within the black box of PES’s creation and enforcement, at the processes of translation and commensuration (Espeland and Stevens, 1998) that occur at the intersection of the two epistemic worlds – ecology and economics – that have come together to forge and implement PES in conservation schemes. Through examination of the social conditions of the emergence of an idea, I uncover both the *boundary object* of PES and the *boundary community* of “ecological economics.”

The foundational imaginary of the “ecosystem service” is that of a systematic unification of ecology with economics, with the goal of generating a countervailing voice for nature *within* the economic calculation of GDP. The explosive growth in the scale of the economy – as shown in **Figure 1** “Total Real GDP” - has in turn created an explosion of ecologically devastating “externalities” – unintended harm to nature. The task of PES is to fix these externalities, by “internalizing” – pricing nature within the economic sphere. If growth in the neoliberal economy is having devastating and accelerating effects on the integrity of the natural world, the purpose of PES is to render the values in nature economically explicit, so as to put ecology on competitive epistemic footing to counter the catastrophic changes resulting from economic expansion. Advocates of PES assert

that the only way to put a halt to ecologically destructive economic activity is to focus on better communicating nature's value in economic terms (e.g. Chan et. al., 2012, Gómez-Baggethun and Barton, 2013). This chapter examines the organizational, epistemic, and discursive context of the development and rise to prominence of PES.

Ethnography of a concept

Environmental thought has classically embraced a multiplicity of ways of defining the value of nature. Subaltern worldviews have foregrounded *justice* – with the goal of reclamation of political sovereignty, often through traditional ways of relating with ecology (Martinez-Alier, 2002, Orta-Martinez and Finer, 2010, Pellow, 2007). Western movements have found purchase both through the legal mechanism of property rights, and through a professed goal of preservation via an ethic of ‘pricelessness’ (Hanna et. al., 1996, Heinzerling and Ackerman, 2002). Indeed, the history and discursive diaspora of environmentalism can be read as **pursuit of an appropriate language to speak on behalf of nature**. The modern environmental movement initially positioned ‘Nature’ - like human life itself – as a sacred trust contrasted against the profanity and debasement of pricing, markets, and modern economic forces (E.g. Bookchin, 1980, Schumacher, 1975, and Muir (in Williams, 2002)). The epistemology of ecology, the scientific study of the “basic unit of nature,” centers the inescapability of interconnection, a nature of complex consequences (Weathers, 2013). Yet the major victories of the modern United States environmental movement have been remembered as regulatory achievements.¹ It is perhaps counterintuitive that the environmental ethic of intrinsic

¹ The flagship Clean Air Act of 1970 and the Clean Water Act of 1972 remain the predominant modern regulatory frameworks undergirding the pursuit of environmental action in the United States. So apparently

value would find successful practical application in the regulatory apparatus of the state via the political philosophy of property rights. The property rights ontology – in which **nature is set aside** in the form of acres of land, permits to hunt, and restrictions on polluting activity – is both hegemonic and often politically expedient. For decades it dominated the discourse of modern conservation, parsing the ideal of nature into ‘bundles’ of resources subject to legal regulation (Redclift, 2005). This approach – cleaving on discrete physical boundaries and concrete parts which are often implicitly balanced against economic use – performs a particular ontology of nature, an ontology at odds with the foundational insights of ecological science.

With the recent rise of the epistemic vehicle of PES, the project of conservation is now exiting the realm of sacred duty, sovereignty, or interconnection, and is instead coming to be synonymous with nature as an ontology of parts. But in contrast to a regime property rights, PES draws political legitimacy from the economistic calculation of value itself. The *construction* of an ecosystem service requires the evaluation of a dimension of an ecological process and the translation of that process into units commensurable with a market transaction. Environmentalism predicated on PES foregrounds a technical focus on quantification and monetization in economistically precise schemes. The act of separating and concretizing innumerable and often discontinuous parts into “services” provided by ecology represents a fractionation and dispossession of the imaginary of connection once understood to be central to the scientific insights of ecological thought. By granting an enhanced role for the instrumentality of utilitarian uses, this *turn in approach to conservation* constitutes an extreme functionalism: an alignment of

unremarkable has been the landscape of concerted effort outside of this regulatory infrastructure that in 2004, Michael Schellenberger and Ted Nordhaus famously proclaimed the “Death of Environmentalism” as a movement for cultural and political change.

environmental efforts with the rationality of economic utility, and the derivation of utility through optimization against economic use. Where other varieties of environmentalism attempted to preserve nature by setting it apart from neoliberal economic calculations, PES are tasked with preserving nature *through* those calculations. Yet once the “value of nature” is reduced to an expression of utility in functional equivalents, it seems to follow that an accounting of the “value of nature” is a progressive addition to public policy (e.g. Dominati et. al. 2010a & 2010b, Ekins et. al., 2003). Indeed, such a goal would appear to be both pragmatically expedient and, given the expression of PES in economic terms, politically defensible in an era of heightening neoliberalism.

PES has many proponents among environmentalists and within environmental thought. These advocates argue that that the tool will allow ecology to find a language with which to “speak up for itself” (Interview 3). To those who practice PES, the concept represents not so much an expansion of the sphere of economistic language into nature, but a long-overdue reckoning of ecological value expressed through powerful tools. Discursively, the PES framework has become endemic among academic practitioners, policymakers, and environmental advocates. A wide community of ecologists, economists, and interdisciplinary practitioners are engaged in the measurement of and advocacy for an ever-expanding regime of quantifiable benefits ascribed to nature. It is now largely taken for granted within environmental governance that conserving nature requires it be priced – lest the essential functions of ecosystems risk the brutal abuses neoliberalism inflicts on things that are not valued at all. The identification, measurement, valuation, and marketization of nature’s “services” forms the backbone of environmental policy – from regional and global markets for carbon, to the EPA, the

Millennium Ecosystem Assessment, and numerous state, local, and public-private governance initiatives.

Using economics to speak on behalf of ecology has produced both a new workflow and new epistemic style for environmental advocates. Speaking on behalf of ecology has become transformed into a process of adjudicating and enumerating its quantifiable characteristics. In 1996, at the beginning of the takeoff of ecosystem services, the preeminent geographer David Harvey presented this conundrum – of the forced epistemological intersection of ontologically divergent languages – as the paradox at the heart of environmental conservation in the age of neoliberalism. That is, seemingly in order to participate effectively in environmental policy, ecological knowledge must be communicated in the language of economics. Approached from within the logic of markets, the valuation of nature makes eminent sense. Because humanity owes to nature our very existence, its “products” and “functions” are therefore also essential to - and inextricable from - economic livelihood. Through the enumeration, quantification, and objectification of “ecosystem services,” the contributions of biophysical materials to the process of economic production are thus rendered explicit in the same language employed for other economic inputs (Costanza et al, 1997; Daily et al, 2009; De Groot et al, 2002; Alcamo et. al., 2003; Millennium Ecosystem Assessment, 2005). This forcing represents a fundamental turn in the approach to seeing nature – one that requires that the ontologies of ecology are commensurable with the methodologies of economics.

The explosion of publications on “ecosystem services” over the past 2 decades has been accompanied by no shortage of critique. Yet much of the literature centers PES as a tool of epistemic practice, usually in realist terms. The questions asked are oriented

towards pragmatic outcomes: Did a particular assessment sufficiently quantify enough aspects of a piece of ecology?; Were the calculated prices sufficient to preserve it in present or foreseeable market conditions? PES programs hinge the terms of their success on perfecting the answers to these two questions. Critiques of PES programs also largely assess them on these same terms. In a review of the literature, I have identified three typological dimensions of this critique. First, a large body of literature has arisen debating the methods of ecological measurement and economic accounting that form the backbone of the values of the “ecosystem services” themselves (e.g. Carpenter et. al., 2009; Chan et. al., 2012; Ernston and Sörlin, 2013; Muradian et. al., 2013; Wallace, 2007). A second body of literature focuses on the effectiveness of on-the-ground implementation of PES schemes in policy practice (e.g. Asquith et. al., 2008; Daily et. al., 2009; De Groot et. al., 2002; Naeem et. al., 2015). These first two bodies of critique naturalize PES as a realist practice oriented towards normative conservation goals. A third, overview approach illuminates the limitations of an environmentalism increasingly organized around the objectification of nature (Barnaud and Antona, 2014; Fisher and Brown, 2014; Norgaard, 2010). A subset of this literature – exemplified by Harvey – contextualizes PES as an instrument of neoliberal power (e.g. Robertson, 2004 & 2012, Kosoy and Corbera, 2010). But, I argue, it also misapprehends the full nexus of that power, placing power in the general tendency of markets to exploit rather than also in the terms of the epistemic ideal of commensurability between ecological things and economic tools. Indeed, many PES advocates explicitly advocate the concept as transcending the dichotomy between economics and ethics (Jax et. al., 2013). Embedded in the thesis of my ‘ethnographic approach to a concept’ is a challenge to the terms of

prevailing critique. Dissent from PES has focused on problematics *created by it*, to the exclusion of the epistemic and institutional context that creates and continues to sustain the ideals which give the concept political power. Concretizing PES as a one-dimensional tool of epistemic practice – even when the social effects of that practice are taken seriously – elides large portions of the practices social significance. Practitioners and critics alike have avoided engaging with the black-box of PES and the social processes that construct its machinery. This constrained range of critique has the effect of naturalizing the work done by PES to translate between ecological and economic knowledge – a site of active cross-disciplinary negotiation. The scope of engagement with this problematic *of* PES as one of multiple possible epistemic projects to reconcile ecology with economics has been surprisingly limited. It has become taken for granted that ecology and economics possess a common language, and that that language is, if not identical in its mechanics to neoclassical economics, commensurable with it. This commensurability is perfected through hedonic valuation, and expressed in the form of marginal price.

The perfection of accounting of the harms of economic activities is not merely a methodological tool, a realist practice, or discursive exercise. It is a powerful concatenation of all three. Through this power, PES has become a widespread new form of governance, one propelled by the discursive urgency of imminent ecological collapse. Epistemically, PES are now tasked with ensuring the continued existence and resilience of the natural ecosystems upon which societies rely. This governance of nature manifests as economistic algorithms in the language of utility, undergirded by an ideal of rational control at a nature-society interface. Yet PES also manifests as a new discursive

potential, one that might finally admit nature to compete with the powerful discourse of GDP. The research I present here is an attempt to contextualize a larger family of questions of the genesis and persistence of PES as a methodological tool with both discursive and epistemological characteristics. That is, PES deploys a language – price – to which people will listen, but the literalization of its calculated values occurs through the generator of that language – economics – which has historically not valued ecology at all. PES are the state-of-the-art vehicle through which environmentalism attempts to “price the priceless.”

I position this story as an “*ethnography of a concept*.” By this I mean that rather than objectify my subject, I observe it in its native habitat. What follows is a contextual analysis of PES’s constellation of discursive, epistemic, and organizational relationships. This allows me access to the work the concept does in the world of people, institutions, careers, and political projects. Further – I see the ethnography of a concept approach as performative of the ecosystem concept itself. The ethnographic method allows me to leverage the relational properties of ecosystems as both a hybrid socio-material process and a form of social analysis. I locate the development of PES – as one outcome combining ecology with economics – in discursive, epistemological, and organizational space. Ecological materiality, as well as its discursive expression in the form of “ecosystem services” can be understood both as an *instrument of* and a *response to* the flow of power through terrains of knowledge. It is now all-but taken for granted that environmental efforts require that nature be priced, if only to countervail the acceleration of a neoliberal economic paradigm that doesn’t inherently value ecology at all. This

ethnography of PES is an examination of the social and material construction of that taken-for-grantedness.

My ethnographic field site is the organizational space that generated and nurtured the emergence of PES. This space is not a physical place, but a network of publications, ideas and authors. Identifying its nodes and extent was both a first step in the ethnographic process and an ongoing task throughout my research. This is not a traditional ethnography of a bounded, contiguous space or materially linked commodity chain. Rather, it is an ethnography of material and epistemic connections that generate a highly successful concept – a boundary object used in thousands of diverse social contexts worldwide. The applied knowledge produced by the network – instantiated in countless geographic spaces – has real consequences in real places and for the social worlds of environmental conservation. This unique method expands upon existing critiques that either center PES as realist practice apprehending ecological truth (e.g. Daily et. al., 2009), or as a persuasive tool for communicating transcendent values in economic language (e.g. Fisher and Brown, 2014). *An ethnography of a concept* illuminates the methodological problematics, institutional dynamics, and organizational assemblages that created the conceptual solidity of PES and continue to hold it together. Rather than focusing on whether PES has the potential to “accurately” communicate the ontology of ecology with the tools of economics, I ask what kind of epistemic space facilitated the creation and maintenance of PES as an actor in a trans-disciplinary landscape. To do this, I center the networked relationships between people, ideas, and institutions. My tools include content analysis of databases of all published articles on the

topic, interviews with individuals who create PES and those who are critical of it, and bibliographic and publication data from journals and professional associations.

The aim of this analysis is to establish how a concept can become a political actor. PES is no longer merely an instrument of neoliberal commodification, but inarguably a complex force unto itself. Environmental politics is no longer well-represented by an oppositional field between powerful polluters and aggrieved citizens. Rather, power flows through representations, and “nature” - including “human nature” - has come to be depicted in the image of particular representations of what is good, moral, and just. PES brings with it significant consequences for humans’ understanding of the ontology of ecology itself: our relationship to nature, and the architecture of our moral duties. The rise of PES, particularly in light of its inarguable deployment as an instrument of the neoliberal commodification of nature, is not easily explained. The danger of a too-literal objectification of PES as a one-dimensional object risks re-inscribing existing constructions of both “nature” and “political actor.” The PES concept was shepherded into existence by a few charismatic champions active in 1970’s western environmental thought. By the mid 1990’s, it had incubated and taken shape within the pages of a single interdisciplinary journal. A decade later, it emerged from a number of competing metaphors for human-environment interaction incubating within that journal as a scientific *bandwagon* (Fujimura, 1996). PES was wrought by the emerging interdisciplinary field dedicated to the cause of that intersection. Throughout the three decades since its inception, the concept was developed in a number of publication venues, but by a number of measures was most centrally engaged in the journal of that emerging interdisciplinary field: *Ecological Economics*.

I therefore see PES not as a foregone outcome to be critiqued, nor as a concept that accretes - whether through accumulated observations or paradigm shifts - but as a produced outcome of relationships, in an institutional, organizational, and interpersonal context. This chapter is my attempt to map these relationships, to tell the story of PES, as both an *instrument of* and *response to* the power embedded in organizations, disciplines, and the conceptual apparatus itself. From its earliest mentions in the literature, I find PES intimately bound up in the ecological economics community. And yet, PES's enormous success as a standardized package crafted for application to environmental conservation has lead it to escape the social world in which it was forged. The rationality of measuring, accounting, and pricing ecological dynamics as services is now central to environmentalism. Perhaps paradoxically, it is now not well known that the "ecosystem services" approach is a product of ecological economics.² It is this entanglement and escape, and its consequences both for ecological knowledge and environmental conservation, that this chapter reveals.

My argument draws on ten years of ethnographic observations of the social and epistemic configurations of this emerging academic field. My methods include participation, observations, and interviews conducted at 6 regional and international conferences, and follow-up interviews with foundational, emerging, and tangential participants in that field. I also draw on analysis of bibliographic relationships using the comprehensive article search tool via the University of Wisconsin Library database, and a content analysis of a database I compiled of all articles published in *Ecological*

² I interviewed ten environmental professionals not involved with ecological economics, and none were aware of PES's genesis in the field. Indeed, the concept has become so naturalized within environmentalism at large that it is rarely critiqued by environmental professionals, nor is it spoken about in the language of unfortunate inevitability. Rather, PES are seen as powerful instruments through which nature becomes visible and recognized by the definitive *final vocabulary* of economics (Rorty, 1989, p. 73).

Economics. I focus on the epistemic and institutional relationships that created the PES concept and nurtured it to prominence. I find these dynamics anchored by a network of people, areas of knowledge, and academic journals. This is the first chapter of a broader thesis, in which I study the emerging field of ecological economics: its battles to distinguish itself as a heterodox approach to economics (Chapters 2 & 3), its program for inscribing economic activity as subsidiary to nature's laws (Chapter 4), and a tension of diversity with coherence which I call "unboundary work" (Chapter 5).

Ecological Economics: A Boundary Community

The epistemic imperative for ecological economics arises, according to its practitioners, because many of the most pressing current problems facing nature and society "are not covered adequately by any existing discipline" (Cropper and Oates, 1992). Working collaboratively in the 1980's, early ecological economists intended to develop and formalize an analytical approach at the intersection of nature and society. In bringing these territories together, foundational researchers are explicit about the new fields' normative mission of bridge-building in the service of conservation. In "attempting to reintegrate the natural and social sciences" (Costanza et. al., 1997), ecological economists seek to shift the lens of dominant economic discourse from marketed resources in the economic system to the biophysical basis of interdependent ecological and economic systems (Clark, 1973; Costanza et. al., 1997; Gowdy, 2005; Christensen 1989). To facilitate this change, they emphasize a wholesale reorganization of existing foci of analysis to more perfectly apprehend the fundamental dependence on nature of economic activity. Work in the field is characterized both by a search for a

means to apprehend ecosystems in economic terms, simultaneous to operationalizing an economy that would itself function *as* an ecosystem, and be self-correcting to natural limits within the earth's biosphere (e.g. see Herman Daly, 1991, 1992). I explore these linked commitments of an “analytical inversion” in Chapter 4. The center of consciousness of the discipline - the integration of connections and embeddedness across scientific domains - is itself a space of invention and opportunity that has continued to be re-worked across nearly 4 decades (e.g. Gendron, 2014; Plumecocq, 2014; Spash, 2012, 2013).

Scholarly attention to disciplines as worldviews inhibiting and enabling particular lenses on knowledge dates back at least 5 decades – to C.P. Snow's influential 1959 proposition of a dichotomy of intellectual cultures between scientific and humanistic approaches (Snow, 2013). Rather than interpret this friction as epistemic incompatibility, Clark (1962) proposed it to be the result of limited social interaction, and later developed this work into the “social worlds” hypothesis in the 1980's (Clark, 1987). Disciplinary norms and values profoundly shape attitudes towards knowledge – both what type of knowledge, and what types of questions are legitimate. Scholarship in this tradition has emphasized the extent to which academic journals are also central to epistemic culture, in that they create and reinforce acceptable standards for epistemological focus. Zuckerman and Merton famously linked differences in rejection rates of journals with the levels of knowledge codification in a particular discipline (1971). Subsequent work in Clark's “social worlds” tradition has emphasized the significance of the lived experience of individuals as determined at least in part both by the possibility of their social interactions, and the existence of rewards for engagement across disciplines (e.g. Geertz,

1982; Hermanowicz, 2005). Scholarly work on “interdisciplinary” fields is in its early stages. Foundational contributions emphasize the importance of common tools and epistemologies as a basis for sufficient coherence to transcend the domain specificity of disciplinary problematics (Jacobs and Frickel, 2009; MacLeod, 2018). For example: neuroscience shares the common ontological building blocks of neurons and neural circuits with chemistry, biology, and physiology. Yet ecology – concerned with the circulation of matter and energy through assemblages of organisms – and economics – concerned with the circulation of financial instruments through human societies – share few, if any, ontologically compatible foundational principles. In my ethnographic research on ecological economics, I continually observed a dynamic of *reaching out* – of pursuing intersections that produce knowledge not entirely legible to either ecology or economics (See Chapter 5). Indeed – foundational calls in ecological economics argued for: “retaining the full range of methodologies available in both disciplines rather than merely the approaches they hold in common.” (Norgaard, 1989).

Scholars in STS argue that institutional and disciplinary dynamics determine the knowledge that gets produced. Harry Collins coined the concept of a “core set” – the idea that scientific concepts are advanced by relatively small groups of researchers who are particularly influential. Within the context of a disciplinary problem, core sets funnel the energies of competing scientists, successfully “laundering” the significance of opposing views and neutralizing them as “non-scientific” (Collins, 1981). The knowledge produced by the core set thus becomes paradigmatic, while alternative interpretations are deemed not replicable and fall away as unscientific. Fujimura theorized disciplinary knowledge as transmitted through “standardized theory-methods packages” –analytically useful

methods inevitably bound up with ignored epistemological assumptions (Fujimura, 1996). This epistemological scaffolding cannot be cleaved from its methods of analysis, and indeed often later makes itself known at inconvenient times – an unbidden Trojan horse.

But the relationship between knowledge and its institutional dynamics has only been studied in disciplinary spaces. What are the outlines of the structure of epistemic products, such as PES, produced in spaces dedicated to the ideal of overlap, of transdisciplinary incorporation? I argue that a full accounting of PES requires investigation of the social conditions of the interdisciplinary core set of researchers who generated the concept – ecological economists.

Latour and others have advocated an approach to analysis that centers the networks of relationships between relevant entities rather than naturalizing their identities as category or domain (Latour, 2005). I have organized this chapter by successive focus on *organizational*, *epistemic*, and *discursive* aspects of the network involved in the construction of PES – as refracted through the concrete objects of *publications*, *ideas* and *authors*. **Figure 2** shows this nexus of publication venues, ideas, and authors whose interactions have constructed the concept. I locate this conceptual genesis in parallel to the development of ecological economics as a distinct interdisciplinary project uniting economics with ecology. Each intersection generates several figures illustrating relationships between the actants involved.

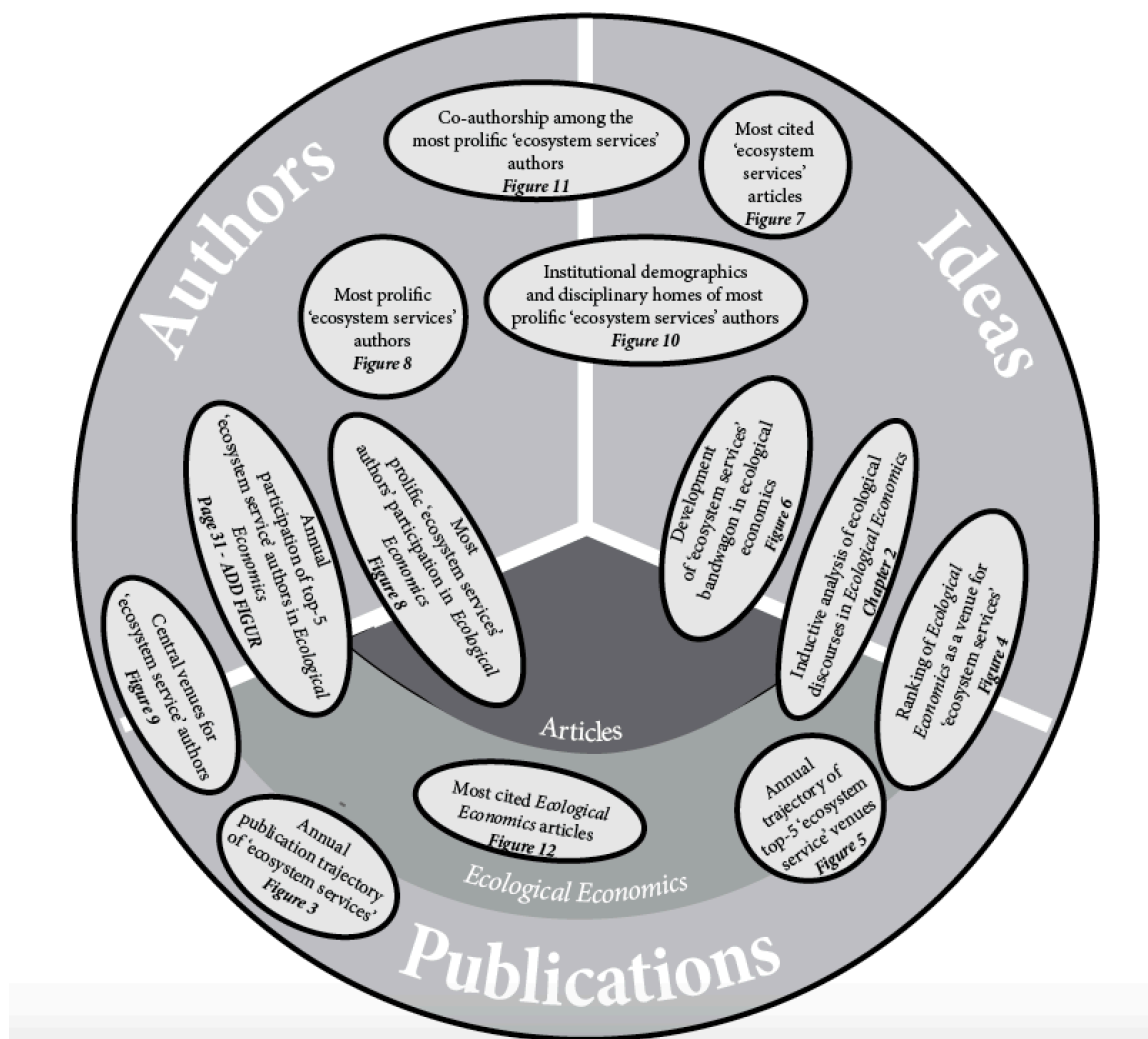


Figure 2: A network of publications, ideas, and authors

Organizational Space: Publications

While environmental politics at large is characterized by divergent claims on environmental knowledge, the valuation of ecosystem services is an increasingly familiar doxa (Bourdieu, 1998) across publications in environmental studies. In this section, I show where ecosystem services arise in a particular network of institutional and organizational relationships. I establish that the field of ecological economics, and its eponymous flagship journal, constitute a central nexus of this network.

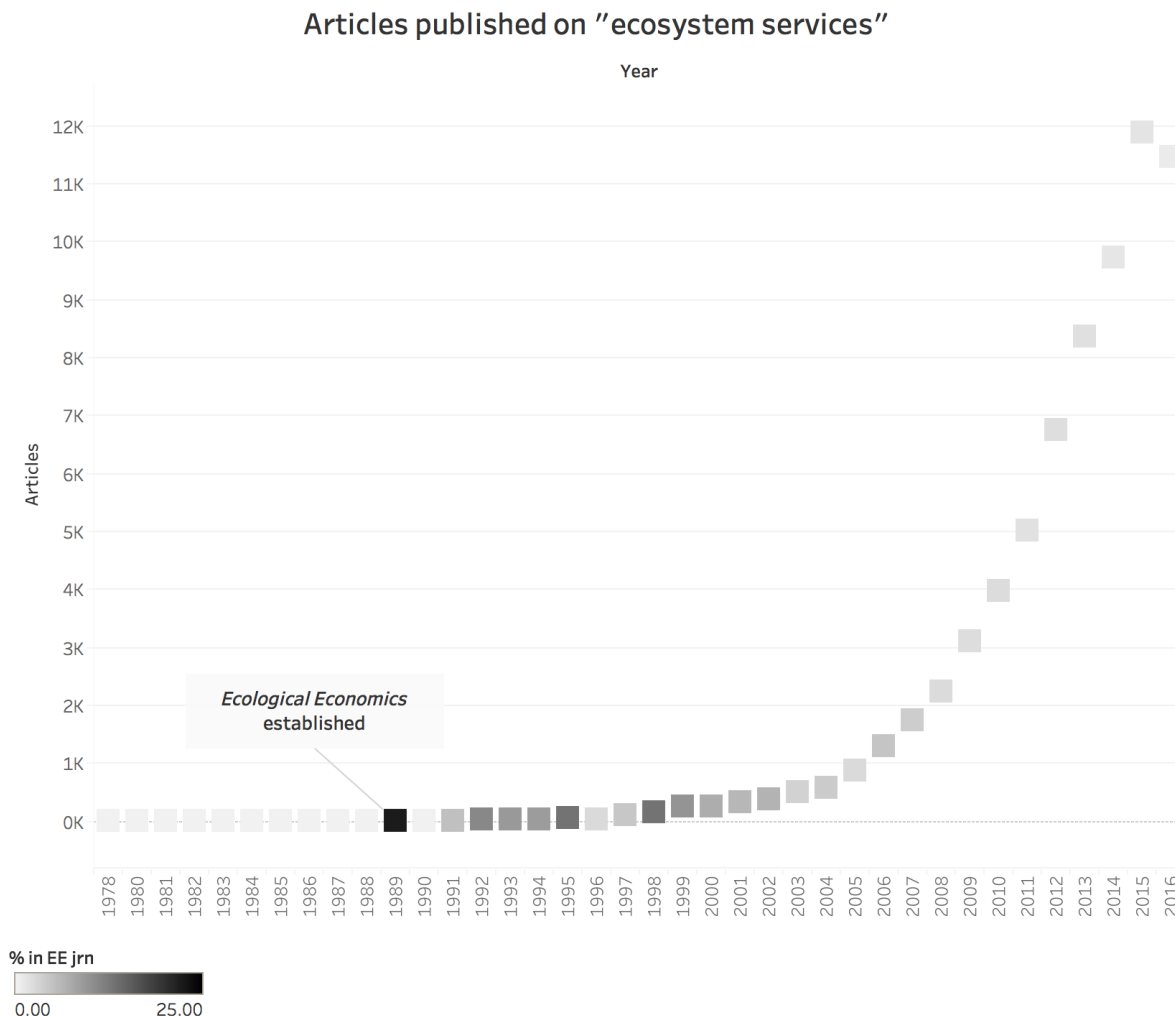


Figure 3: Peer-reviewed articles published on “ecosystem services” in all journals. The exponential growth of the concept of “ecosystem services” occurs after a decade long “incubation period” (~1989-2000) during which a significant portion of work is consistently published in *Ecological Economics*.

I argue that the construction of ecosystems as services is facilitated by the epistemic openness of interdisciplinary space. **Figure 3** shows the exponential rise in usage of the “ecosystem services” concept across all English Language academic publishing. Fully half of the articles published on the topic have been written in the last 7 years. The color of the squares illustrates the percent appearing in *Ecological Economics* (darker squares show values approaching 25%, a high point occurring in 1989, the journal’s inaugural year). This figure points to the long incubation of the PES concept in

Ecological Economics, which took hold in other venues and grew exponentially in the early 2000's.³ As the volume of publications on the topic rose exponentially, PES escaped control by the *Ecological Economics* journal and took hold in other venues across the academic publishing landscape.⁴ Hundreds of journals across dozens of fields have published on the topic – and several new journals dedicated to the concept have been established, most notably *Ecosystem Services*, in 2012.

The first known mention of “ecosystem services” appears as an offhand linguistic construction. In a 1978 review of the ecological impacts of emerging energy technologies, John Harte and Alan Jassby remark on the importance of measuring the stresses these projects have on ecosystems, as these technologies would compromise the ability of an ecosystem to “provide goods and services of benefit to humans.” This statement reflects a characteristic unease within 1970's environmentalism about large infrastructure projects as being anti-ecological despite their ostensive purpose. A more commonly recognized progenitor in the literature (e.g. by Dempsey and Robertson, 2012) is Ehrlich and Mooney's neo-Malthusian screed entitled “*Extinction, substitution, and ecosystem services*,” published 5 years later in *Bioscience*. Ehrlich and Mooney's article slips “ecosystem services” in as a heuristic tool to leverage an argument for the

³ Methods: On September 9, 2017, I performed a comprehensive database search using the University of Wisconsin library “article search” function – which covers all major academic databases including Scopus (Elsevier), Science/Social Science Citation Indices (Web of Science), Science Direct (Elsevier), and 15 other scholarly databases. I used the simple search term “ecosystem service.” The search yielded 188,884 items, of which 70,555 were articles in scholarly journals, 22,086 newspaper articles, 10,617 dissertations, and 6,325 books.

To get a sense of publication trends over time and the venues where the conversation about ecosystem services has taken place, I repeated the search terms for each of the 38 years since the earliest known publication containing the term, in 1978. For each year, I recorded the total number of publications in ecosystem services, as well as the publications per journal for each of the top 5 journals that year.

⁴ See Figures 5A and 5B for a year-by-year graphical representation of the top-5 journals publishing on the topic.

exceptionalism of biophysical and inorganic resources as non-substitutable for human-made capital.⁵ Ironically, in highlighting the severity of the consequences of extinction events for ecosystems, this earliest articulation of “ecosystem services” is used to buttress a justification for a transcendent value of nature *outside of what can be apprehended by comparison to manmade sources of value*. For economics, the apprehension of values *from* nature is both a powerful and heretical idea. The precondition for all of neoclassical theory is the marginal fungibility and adjudication of values through the “invisible hand” of market transaction. As one proponent of ecosystem services lamented to me: “To get at the tradeoff process, you have to transfer everything to one metric” (Interview 17). This tension – speaking in the language of economics on behalf of principles fundamentally mismatched to the behavior of instruments of valuation – has continued to haunt research on ecosystem services in the nearly 4 decades since its earliest appearance in environmental discourse. Attempts to stay loyal to the non-substitutability principle continue today as a key distinguishing tenet of ecological economics’ doctrine (e.g. Ekins et. al., 2003; Jax et. al., 2013; Kallis et al., 2013).

Academic journals are means of curating, consolidating, presenting, and validating knowledge. Traditionally, they contain work advancing a distinct disciplinary viewpoint. Recent changes to the academic publishing landscape have been dramatic, with exponential growth in both the number of journals and number of publications per journal. A rise in interdisciplinary journals, open access and online journals, and the total number of journals is changing the contours of knowledge and troubling the boundaries

⁵ Ehrlich and Mooney’s article is the first to articulate the specific linguistic construction of “ecosystem services.” Though it was published in *Bioscience* 6 years before the founding of the journal *Ecological Economics*, Ehrlich would become a prominent early contributor to both that journal and the new inter-discipline that is its namesake. Ehrlich’s ties to the community have been cemented across the decades. He currently serves as a fellow of the Swedish *Beijer Institute of Ecological Economics*.

of traditional disciplines. As one ecological economist lamented to me, it is impossible for an individual researcher to keep track of everything going on in a journal – so journals have come to function less as hubs (repositories of required knowledge for a field) and more as clearinghouses of thematically related articles (Interview 15). In this section, I illustrate that *Ecological Economics* was not only foundational, but – even in a muddled and overcrowded publishing landscape - has continued to be the central and most influential venue of a wide field of journals publishing ecosystem services work.⁶

The journal *Ecological Economics* has been continuously published since its founding by the International Society for Ecological Economics (ISEE) in 1989. From the beginning, the journal served as a prime venue for articles on the topic of ecosystem services. In that first year of its publication, fully 23% of all articles published whose abstracts contained the word string “ecosystem services” found their home in *Ecological Economics*. As illustrated in **Figure 3**, the first 10 years of the journal saw a relatively large proportion of articles on the topic appearing within its pages. I refer to this period – between 1989 and 2000 – as the “incubation period” – during which the journal was nurturing several economic approaches to nature before the precise construction of “ecosystem services” took off in the early 2000’s.⁷ This incubation period is also significant in that the journal’s hold on the concept precedes the exponential increase in articles on the topic that began in the mid 2000’s.

⁶ The last 5 years have seen *Ecological Economics* overtaken by open-access “megajournal” *PLoS One* as the top venue for publications on ecosystem services. *PLoS* is currently the world’s largest journal by number of papers published – about 30,000 per year, or 85 papers per day.

⁷ Other common discourses on nature and ecology include: “natural capital” “ecology as sacred” “ecology as justice” and “ecology as elusive.” For an analysis, see the discussion in chapter 5 on “Big Tenting”

Figure 4⁸ shows the explosion of academic work on “ecosystem services” in the last two decades, including significant mentions in newspaper articles and books. The exponential increase in publishing on ecosystem service began in the mid 2000’s. The figure also shows the relative ranking of the journal *Ecological Economics* as a venue for academic articles on the topic. In the 28 years since it’s founding in 1989, *Ecological Economics* has published more articles on ecosystem services than any other journal except PloS One. Despite a dramatic decrease in the proportion of ecosystem services articles published in *Ecological Economics* (illustrated in **Figure 3**), the journal has retained its ranking as a top-3 venue in all but one of the years since. Over *Ecological Economics*’ 27-year history, the journal retained the #1 spot for 13 years, and has only fallen below a top-3 ranking 4 times. In addition to being the indisputable central outlet for PES publications, the journal is the second most highly ranked environmental journal overall. It was recently named by Google as the #1 venue in the field of “sustainable development” (according to 5-year impact factor). In a publishing landscape exploding with venues – several hundred have published on the topic – it is clear that *Ecological Economics* is a central actant in the PES network, an “obligatory passage point” (Callon, 1984) - both progenitor and incubator of the “ecosystem services” concept. The journal consistently publishes more articles than other venues, this despite the evident explosion in popularity of ecosystem services over the past 15 years across hundreds of other journals. The conversations about ecosystem services taking place within its pages have raised the profile of both the journal as well as the interdisciplinary field that created it *Ecological Economics* - via its interdisciplinary pragmatically-oriented editorial board

⁸ Methods: I used the same dataset derived from the methods described for Figure 3.

and the epistemic community of ecological economics - is a central actant in the produced outcome of institutional and interpersonal relationships constructing the PES concept.

Publication volume of 'ecosystem services' & ranking of *Ecological Economics* as a venue

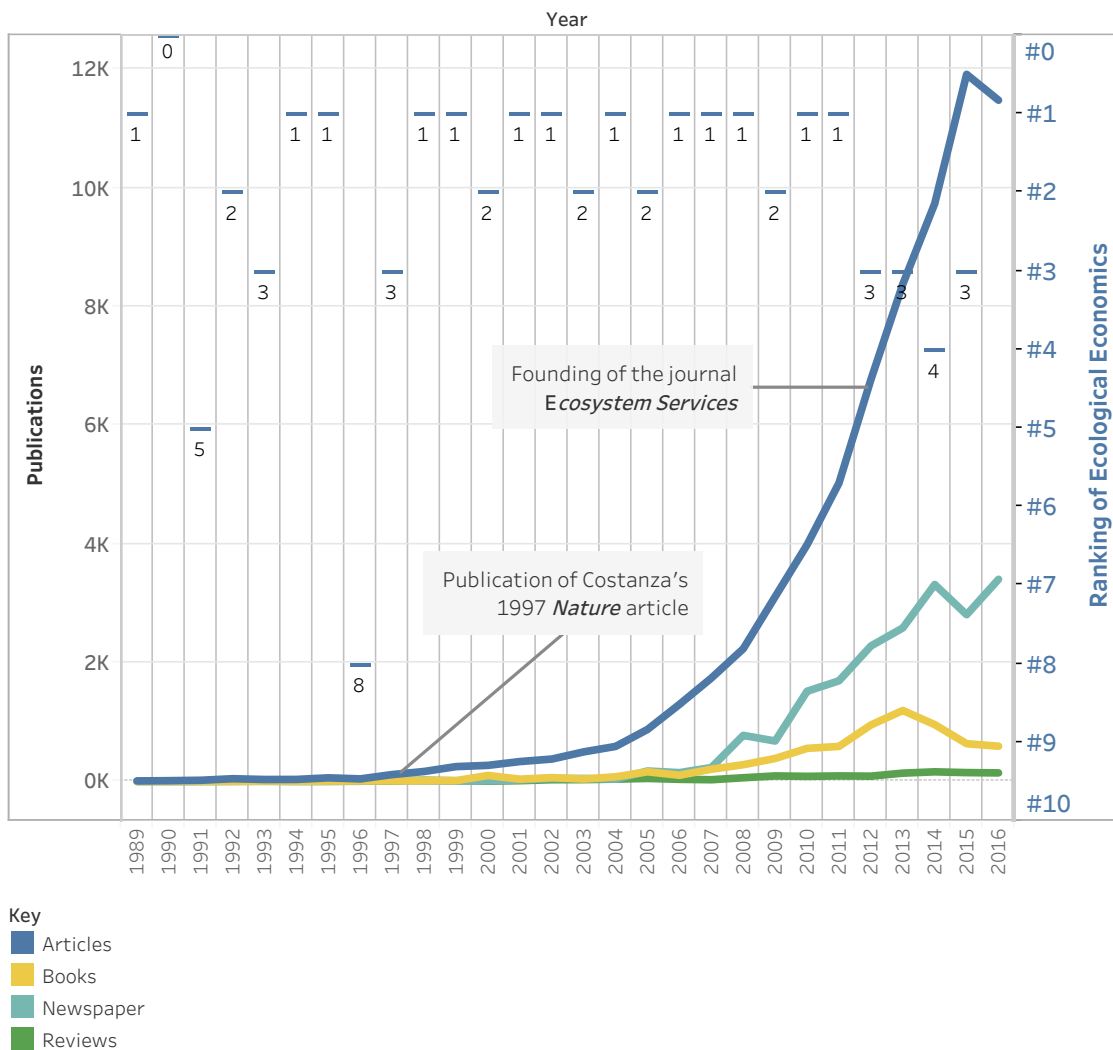


Figure 4: Publication volume of “ecosystem services” and ranking of *Ecological Economics* as a venue.

A broad search of publication records by author reveals that many of the most prolific ecosystem services authors publish their work very broadly, but choose

Ecological Economics to discuss PES. Indeed, in a **content analysis** of environmental narratives within leading journals in environmental economics, ecological economics, and environmental management, Plumecocq (2014) found that the journal *Ecological Economics* “explains most of the variability of the evolution in the ecosystem service discourse” (Plumecocq, 2014). He also found that the journal as a whole, in turn, is pervaded by PES discourse. His analysis of representative journal articles in *Ecological Economics* since 2011 found a preponderance of valuation techniques, most using money (Plumecocq, 2014). That is, PES has become the dominant mode of characterizing economy-environment interaction. The presence of PES methods and debates is increasing in the journal over time. That is, the conversation is happening in *Ecological Economics*, and the conversation is about valuation.

Looking outward across academic venues, the present-day reach of the PES concept is broad – occurring in hundreds of journals across dozens of fields. I wanted to get a sense of the concept’s center of gravity, and whether it has shifted over time. Was the concept ever “owned” by a few specialist journals, or concentrated in specialized venues - either in economics or biology? Did the center of gravity shift appreciably over time? I wanted to get a sense of the disciplinary structure of the concepts uptake across the epistemic landscape.

Over the 39 years of publications on “ecosystem services,” I recorded the top 5 publishing venues each year.⁹ The top-5 publishing venues were both numerous (63 different journals) and diverse – encompassing disciplines across social and natural

⁹ The first few years often had fewer than 5 venues: 1978 (1), 1979 (0), 1980 (2), 1981 (3), 1982 (3), 1983 (2), 1984 (2), 1985 (4), 1986 (3). From 1987 to the present there have been 5 or more venues publishing work in ecosystem services each year. Note that due to the small number of articles published each year in the first decade, a journal ranking is not precise as many journals published only one article, so to break ties of one publication I list the journals in alphabetic order.

sciences as well as newer more interdisciplinary journals – in disciplines such as audiology, public policy, atomic science, forestry, and genetics.

Figures 5A & 5B show the range of journals in the ecosystem services network. Each square represents a top-5 ranking for the year (#1 darkest black to #5 lightest grey). For each year since the term first appeared in an academic journal in 1978, I queried my database to show the top 5 venues publishing articles containing the “ecosystem services” keywords. I recorded the names of these top-5 journals for each year from 1978-2016.

Figure 5 illustrates the results. I have split the figure into two – the top portion, **Figure 5A**, shows those journals that appear in the top-5 more than once. Several times, the reappearance occurred after a significant hiatus (with a gap of 21 years, *Annual Review of Ecology and Systematics*, had the longest hiatus). The bottom portion, **Figure 5B**, shows the trajectory of transient journals that were a top-5 venue for one year only.

Trajectory of the top 5 'ecosystem services' publishing outlets:
Repeat Journals

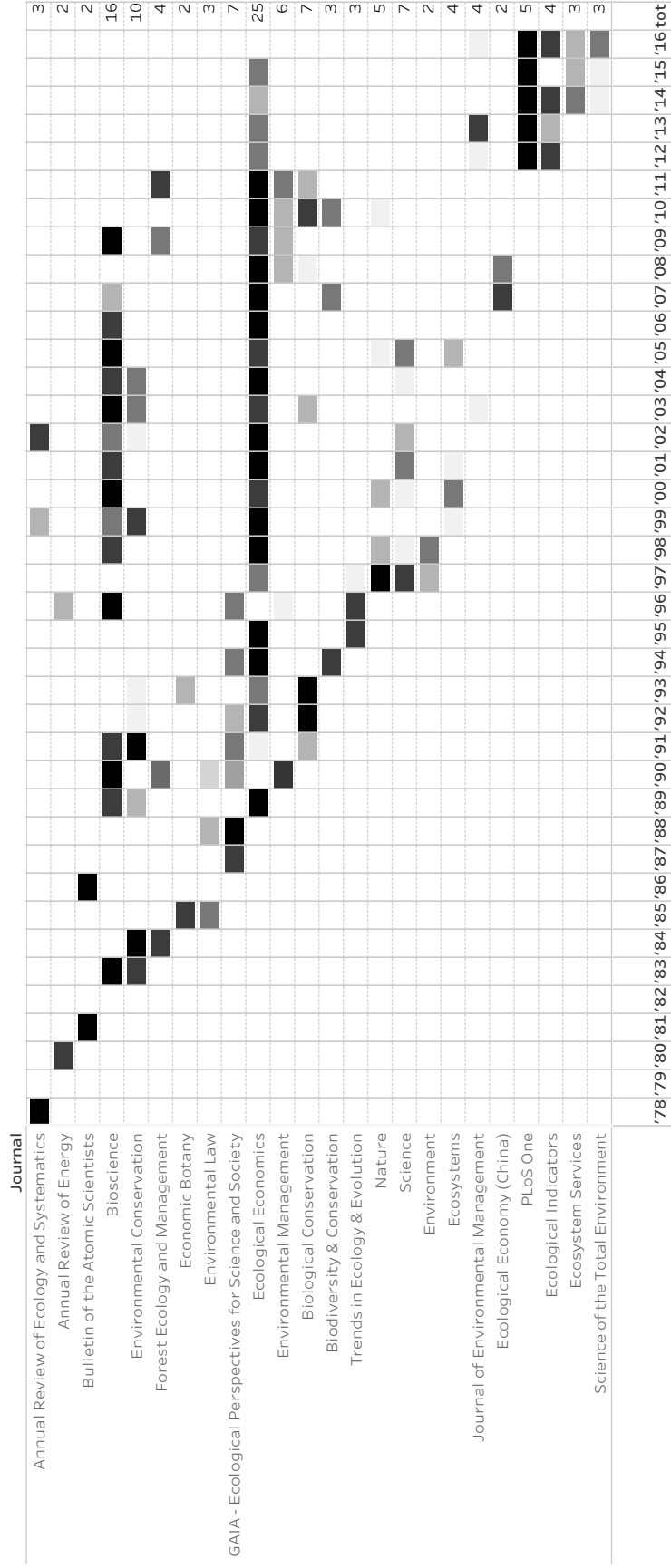


Figure 5A: Trajectory of the top-5 'ecosystem services' publishing outlets: journals appearing in the top-5 for multiple years.

A number of observations about **Figure 5A** and **Figure 5B** are relevant to this analysis. In the 38 years of academic work on “ecosystem services,” hundreds of journals have published articles on the topic. The concept of “ecosystem services” is not owned by any single discipline – or even by any single broad disciplinary orientation. Of those journals publishing frequently, 43 distinct journals make an appearance in the top-5 venues. Of those 43, 24 make more than one appearance in the top-5, and 39 journals make a top-5 appearance for a single year only. This indicates a fair amount of both cohesion and turnover – characterizing a fluid publishing landscape.¹⁰ Even during the recent boom in the popularity of the concept over the last 10 years of publishing – during which over 50% of the “ecosystem services” articles have been published – 12 new journals were able to break through and become top-5 venues. Of the journals making multiple appearances among the top-5, 11 are in the disciplines of ecology and bioscience, 3 are in energy and atomic science, 7 are in economics and policy, and 3 are general science journals (including the high-profile venues *Science* and *Nature*). But top venues also include seemingly unlikely journals - like *Annual Review of Genetics*, and *Noise and Health*. Thus, viewed through the lens of journal publication, the concept “ecosystem services” can be understood as not owned by any single journal or discipline. Rather, it’s a means of apprehending something that clearly many disciplines and discursive approaches have use for (Hermelingmeier and Nicholas, 2017). In the classic sense of a boundary object (Star and Griesemer, 1989), PES is a concept that has come to be deployed flexibly across a wide array of disciplinary contexts.

¹⁰ If turnover in the top-5 were perfect diversity, 190 total journals would be represented. In a perfect monopoly, the same 5 journals would continue to dominate.

The clear takeaway from **Figure 3 & Figure 4** is that work in “ecosystem services” is indeed driving readers – and attention - to the *Ecological Economics* journal, and by extension also the field of ecological economics (as many of my interviewees contend). But **Figures 3, 4, and 5** also reveal a somewhat paradoxical dynamic at work throughout the historical trajectory of the concept. The discursive utility of ecosystem services has *escaped the community that created it*, and significant influence is being driven by contributors outside from the core community.

Epistemic Space: Into the Black Box

Is it possible to let nature speak for itself, or to develop an effective mechanism of technical translation that might facilitate speech on its behalf? PES puts forward economics – the most powerful of the social sciences – as possessing a set of tools up to the task. The popularity of PES can certainly be ascribed in no small part to the ease with which its tools can be applied to acres of land, species of fish, and tons of CO₂. And yet, what of the incalculable bits? The unquantifiable, the emergent properties, the unreachable, the might-have-been and the as-yet-unknown? What of the parts of nature, and the totality of its wholes, that presently serve no clear economic purpose? What work is happening inside the black box of PES to apprehend ecological worthiness, and then ascribe to it economic value?

The ecosystem concept is itself an active site engaged in the ongoing work of fact-making that is transforming nature into material for techno-scientific and political intervention (Jasanoff, 2007). Ecosystems are animated through circumscribing and boundary-setting as a way of defining content and producing knowledge about it (e.g.

Latour's Pandora's Box, 1999, Heesen, 2002). PES is a black box, where *inputs* (from raw materials like fresh water or tons of krill) and *sinks* (such as contaminant buffering in soils, or global atmospheric CO₂ absorptive capacity) are quantified and commensurated in the language of price. This black box circumscribes a complex family of commensurations, reflected in three analytic moves. **First**- the anthropocentric conceptions of ecosystems understood in terms of the *services* they provide for human use. **Second** – the fungibility of these services with man-made capital, required by the opening up a space for pricing and markets. **Third** – the attempted preservation of these service streams through the incorporation and actual monetization of nature as market commodity. Through these mechanisms – ecology as utility, utility as fungible, ecology as price - the PES black box establishes a literalization of an economic interpretation of environmental values.

The black box is open to empirical questions of a number of types. First, from a natural science perspective: Are current state-of-the-art assessments of ecosystem health from ecological science, e.g. “biodiversity,” commensurable with input-output understandings of a biological ecosystem as a provider of services? (Fisher & Brown 2014). A volley of publications is developing amongst ecologists attempting to hammer out standards and best practices for producing scientific inputs to be used in the economic models of PES. These ecologists freely admit that the science of ecosystem services is “not comprehensively understood” – even on its own terms (Daily and Matson, 2008; Carpenter et al, 2009) and is “insufficiently developed to facilitate robust predictive modeling” (Norgaard, 2010). A predominant response to this unresolved character of ecosystem service knowledge is an elision of sorts – a focusing on the refinement of

ecological knowledge over a concern for the consequences of its commensuration with economic tools.¹¹ Of the PES practitioners I interviewed – both ecologists and economists – all framed any shortcomings of their projects as a rectifiable problematic of incomplete ecological information. A recent high-profile editorial in *Science*, co-authored by 46 natural scientists and environmental advocates, representing a range of academic departments and conservation organizations, exemplifies this elision. Naeem et. al. champion a “focus on the natural science” as a means of escaping known inadequacies in epistemology and implementation of the concept: “*The problem is the lack of simple, yet rigorous, scientific principles and guidelines to accommodate PES design and guide research* (Naeem et. al., 2015). Nevertheless, a second, simultaneous lamentation focuses on the armature around PES, that ineffectiveness is due to weaknesses in implementation. Ironically, Naeem’s prominent editorial in *Science* ascribes the limited success of ecosystem services to their not being black boxed *enough* – that failures of PES schemes can be blamed on incorrect inputs or incomplete implementation, not on fundamental limitations of the paradigm of nature-as-service. Other lenses on critique have not investigated the armature that sustains and animates the creation and spread of ecosystem services as a black boxed environmental policy.

Ecosystem services are tasked with filling a void of calculation within welfare economics – the optimization of economic activity to provide ‘maximum utility.’ Ecological values don’t directly enter into the calculus of aggregate social wellbeing – usually expressed as a national accounting in the form GDP. So, from the economic perspective, there is a massive *undervaluing* of the social benefits derived from nature. Prior to the advent of “ecosystem services,” problems of environmental harm were

¹¹ For a theory of this dynamic, see “deep diving” in Chapter 3.

adjudicated legally as a matter of property rights and trespass. A century of case law, beginning with *Madison v. Ducktown Sulfur* in 1904 (Plater, 2010), has used property rights to optimize “environmental harms” against the “economic benefits” of industrial activity. The legal system continues to require a regime of strict property rights to adjudicate discrete, identifiable cases of trans-boundary pollution in the computational framework of cost-benefit-analysis. The calculative armature of PES has strong historical roots in a system of pricing nature to generate a value to counterbalance a cost-benefit-analysis. Formalization of “ecosystem services” as an entity in itself, rather than a byproduct of a legal negotiation, has sparked both a discursive shift in environmental politics and a gold-rush in the measurement and valuation of innumerable dimensions of ecological processes. To commensurate the values of nature with the values of the economy, PES are meant to simplify the legal negotiation over “getting the prices right” by measuring and charging for inputs of parts of nature used in economic production, and to adjudicate a perceived conflict between human and ecological needs.¹²

If not yet comprehensive, the “ecosystem services” framework is premised on the *potential* to approach an apprehension of the totality of value in nature. It would do this through a process of refinement and perfection – the continual pursuit and quantification of different types of benefits. These benefits have been identified and enumerated along different dimensions of value – from purely utilitarian framing (e.g. reduction in commodity crop productivity due to climate change), to emotional and psychological states (e.g. the good feeling of knowing that polar bears exist in the wild). The highest ideals of this approach are expressed in Costanza’s central paper: “(ecosystem services)... makes the multiple aspects of ecosystems that are valuable to human life

¹² For a discussion of the rationality of the Coase Theorem, See Chapter 2.

economically explicit and incorporates those values of ecosystems into environmental decision-making” – Costanza et. al., 1997.

Costanza’s now infamous assessment was “for the entire biosphere, the value (most of which is outside the market) is estimated to be in the range of US\$16-54 trillion per year.” Sociologically, the project of total market valuation seems absurd. To whom in particular does this value belong? On what market might earthlings cash in on this value, and who gets to decide? And to what extent is it possible to refuse such a decision? What would we breathe, eat, and walk on if it were all to be sold?

As the pressures of market integration continue to escalate, ecosystem services are supposed to provide a countervailing balance against the material degradation of ecological resources required by economic growth. Ultimately, PES are meant to have the effect of providing local incentives for conservation, a sort of competing force against extractive exploitation at the farthest reaches of the global periphery (e.g. Naidoo et. al., 2008). PES schemes - quantified, parameterized, and justified in the language of ecological science, and then translated into dollars - represent a *turn* in environmental knowledge regimes. The PES framework is a “standardized theory-methods package” (Fujimura, 1996) intended to create a better approach to environmental policy through the process of apprehending ecological knowledge in economic terms. Implementation of PES is meant to adjudicate and optimize perceived tradeoffs between nature conservation and the biophysical and thermodynamic consequences of the economic expansion required by neoliberalism. At the center of this confluence of imperatives are the ecologists, biologists, mathematicians, and economists who have come together to form the new discipline of “ecological economics.” How are “ecosystem services” discursively

produced and maintained in this community, and why? What is distinctive about the epistemic space and institutional structure of the ecological economists rendering ecological resources into do-able economic problems?

Though most contemporary ecosystem service scientists would rather focus on the extensive work of counting and cataloguing that has come to exemplify the natural science contribution to PES, engagement with society-environment interactions inevitably unsettles the boundaries between social and natural science, materiality and social processes (e.g. Barry, 2013). Some STS scholars suggest that a comprehensive engagement with the consequences of ecological materiality necessitates a wholesale analytic reconsideration of social, material, and ecological configurations of relations (Latour, 2004; Chakrabarty, 2012). STS literature on technologies of optimization argues that optimization changes what it means to be a biological organism (e.g. Rose, 2006). What epistemic resources are marshaled in the PES process, to optimize an entire community of organisms in the service of economic value? Such an assemblage of resources facilitating the creation of PES is a rich site of epistemic power. PES scientists construct, measure, and translate “authoritative knowledge” (Gieryn, 1999) about the natural world, and the material-political processes that configure social-natural science transdisciplinary approaches (e.g. Latour, 2005). By probing the organizational, institutional, and biographical context of the rise and dominance of PES, I study the political economic processes of neoliberal *indigenization* (Burawoy, 1991). However, whereas Burawoy and others study the marketization of traditional societies, I study market indigenization in contemporary western societies – specifically in the epistemic space of the social construction of nature. Ironically, the early developers of PES were

explicit dissenters from centers of neoliberal power, and deployed the phrase “ecosystem service” in the course of arguments against the commodification of nature. Yet, the concretizing of PES occurred within the pages of *Ecological Economics*, an avowedly heterodox publication.¹³ The journals’ creators professed as a goal the fomenting of an intractable epistemic task: to re-imagine economic paradigms that would heed ecological principles and ethical ideals of justice. Paradoxically, early pioneers of ecological economics might scarcely imagine that the metaphor coined in an effort to inspire preservation of nature could be leveraged for its exploitation (Martinez-Alier and Røpke, 2008; McCauley, 2006).

Epistemic Space: An Epistemology of Critique

Researchers from a number of disciplines are currently engaged in critique and analysis of the ecosystem services concept. The bulk of this work has largely focused on the ongoing material implications of PES for normative conservation goals. Research frames center either the discursive potential of ecosystem services to facilitate cultural change around conservation, or analysis related to the ultimate consequences of utilitarian framing of conservation goals (e.g. Barnaud and Antona, 2014; Castree, 2008; Jax et. al., 2013; McCauley, 2006; Muradian et. al., 2013; Robertson, 2012). Scholarly engagement with PES from within the environmental sciences has tended to focus on the achievement of ecological conservation as an ideal, with less careful attention paid to the epistemic changes surrounding the emergence and operationalization of new scientific subjects. Recently, natural scientists have shifted critique towards the outcome of PES schemes

¹³ For a discussion the process of heterodox dissent from neoclassical economics’ exploitative relationship with nature, see Chapter 3: Heterodoxy: Illuminating the Paradox of Epistemic Mismatch.

(e.g. Sandbrook et. al., 2010, McCauley, 2006). Critique of these frames has emerged from across the social as well as natural sciences (see e.g.: Barnaud and Antona, 2014; Schröter et. al., 2014).

Critiques from *within* the PES community focus largely on practical approaches to resolving questions of efficacy. Evaluation within this framework paints a bleak picture of PES's prospects for effective implementation. Muradian et. al. (2013) note that some of the most visible and ambitious PES schemes worldwide have not yet been effective at achieving their conservation goals. In the most recent widely influential ecosystem services editorial, Naeem et. al. propose to strengthen the PES concept by finding ways to improve the outcome of PES projects. They see this as a process of more refined and effective calculation – more and better measurement and valuation. Their editorial leverages this argument by appealing to the deeply held values of analytical robustness within the institution of science: “The problem is the lack of simple, yet rigorous, scientific principles and guidelines to accommodate PES design and guide research ... although getting the social science right is critical for PES, we focus on the natural science because of growing concerns over scientific weakness” (Naeem et. al., 2015). An exponential acceleration in PES publications over the past decade is at least in part indicative of this focus on scientific precision. These studies largely ignore growing evidence of the general ineffectiveness of market-based mechanisms, and are instead focused on resolving technical problems of too-limited and/or too-complex data inputs (e.g. Carpenter et. al., 2009; Daily et. al., 2009; de Groot et. al., 2002; Kareiva and Marvier, 2012; Naidoo et. al., 2008; Schröter et. al., 2014; Wallace, 2007).

But PES models are of course not just about conservation goals as framed and pre-packaged by natural scientists. The ecosystem concept is itself an active site of scientific contestation in the project of fact-making. Indeed, a pitfall of the extensive current literature critical of the *concept* of ecosystem services is that it privileges a lens of the material vs. the social, distinguished as analytically by separate, quantifiable, and causally linked domains (e.g. for critiques see Castree, 2008; Muradian et. al., 2013). The creation, implementation, and conditions of their use raise complex ethical questions about the PES project. Political ecologists have long critiqued the monetary valuation process as part of a broader trend of commodification facilitating capitalist expansion and dispossession in social and environmental domains at the global periphery (Harvey, 2011; Polanyi, 2001). Recent writing on ecosystem services specifically has critiqued the ecological knowledge of a “services” frame as a self-fulfilling utilitarian prophecy which impoverishes and oversimplifies the multivalent values in nature (Castree, 2008; Kosoy and Corbera, 2010; McCauley, 2006, Robertson, 2012). A robust literature in political ecology critiques the rise of nature commodification as integral to the neoliberal project. David Harvey has characterized the results of the movement as “alienation of nature from its products in the form of services” (Harvey, 2011). With regard to epistemologies of nature, even proponents of PES schemes have struggled with numerous structural problems in commensurating ecological ontologies with economic values. In modern economic theory, value is generated marginally – transaction by individual transaction. By contrast, ecological thought has a long tradition of taking a more holistic approach to apprehending value – placing agency in the individual, the species, the community group, the abiotic environment, as well as within the dynamic and usually emergent and often

chaotic outcomes of their interactions.¹⁴ If a PES model is to quantify a full range of ecological and social effects, it must square these ecological knowledges with the marginal prices of economics, which is a conceptually, ethically, and empirically fraught task.

An ecological world reduced to fully monetized components has sobering social implications. Asquith et. al. expose the justice implications for landless peasants of tying value streams to property rights (2008); Kosoy and Corbera describe PES as ushering in a new era of commodity fetishism (2010). For a concept that has been so roundly critiqued within the academy, its not clear why PES rose to its current status as the dominant metanarrative of global environmental governance. How did we arrive at this point? Is PES merely another example of simplifying ecological knowledge to fit it into neoclassical models and objectives? The ecosystem services concept is a very interesting epistemic development precisely because it accomplishes a number of discursive moves while seeming to escape reform by critique. It's confounding because not only has no alternative way to advocate for nature been put forward, but the increasing popularity of PES seems to forestall the development of a viable replacement. A political economy approach to this conundrum would highlight that ecosystem services represents the expansion of economics in ways that are difficult to see. I argue that PES's status as a boundary object – legible and useful across a number of disciplines and pragmatic applications to environmental governance – is strengthened by its clear discursive resonance with rhetorical mainstays of social life under contemporary western capitalism.

¹⁴ In Chapters 3 & 4, I focus on the ecological economists attempts to re-fashion neoclassical economic theory in the image of the complexity of ecology. This is a process of dissent that goes beyond attempts to refine the prices ascribed to various pieces of nature – as happens in PES schemes. Rather, many ecological economists are engaging directly with the terms of value production itself.

What is the nature of the rhetorical purchase of the PES concept? Its genesis and development reflect a particular institutional-epistemic context.

Geographer Janet Fisher and Katrina Brown's 2014 study of conservationists working in a large environmental NGO uncovers a practical ends-means split in the worldview of practitioners. Fisher asked conservationists to assess the effects of the PES framework on the organizational culture and ultimate effectiveness of the work of their NGO. She found an ideological cleavage between those who understood PES in either *discursive* or *literal* terms. A first group saw PES as potentiating discursive change useful for the *ultimate* ends of conservation. For this group, ecosystem services are instrumental tools for the communication of important fundamental needs:

“I wouldn't say there has been any change in the central mission... but there has been a lot of change in how we package it, promote it” - (Interview 20 (Fisher and Brown, 2014))

Those who professed greater concern for the long-term consequences of the enterprise of conservation critiqued the utilitarian framing of conservation goals:

“Once you've started using those arguments, it is very hard to go back... if we reduce ourselves to ... utilitarian arguments to justify conservation... we're doomed.” (Interview 23 (Fisher and Brown, 2014))

Fisher and Brown (2014) conclude that “service” concepts constitute an entirely new conservation paradigm, quietly transforming longstanding objectives among environmentalists into a regime of utilitarianism – governance by price. Indeed, the phrase “payment for ecosystem services” has become a kind of analytical short-hand throughout ecological discourse, steadily refracting the ends of conservation through economic means, even as the concept promises to dutifully account for the transcendent value of nature. I argue that this ends-means split amplifies PES's **boundary object** characteristics (Fujimura, 1996, Star and Griesemer, 1989). The concept is robust enough to bind opposing values within a community while remaining

vague and adaptable in its meaning across context. As a boundary concept, the key to PES's strength and widespread adaptation is in the flexibility of its implied meaning. This process is often complex – also entailing boundary work between lineages of social and natural science (Strauss and Orlove, 2003; Redclift, 2011). PES are not only subject to mere interpretive flexibility – the range of interpretations is enhanced by the concepts' simultaneous realist and discursive interpretability, and the strategic positioning by an interpreter on an ends-means spectrum.

My aim is therefore to understand the epistemology that gave rise to PES. To do this, I trace the development of PES within a network of organizational, epistemic, and discursive contexts. I argue that this institutional analysis – of PES as a discursive phenomenon rather than only a material process – is central to a full accounting of the networked consequences of the hegemony of PES in environmental knowledge regimes. Because the concept persists despite rigorous critique, it is important to examine the assemblages – the network of actors, epistemic practices, and material sites of passage – that hold it together. “Payment for ecosystem services” embodies a curious impossibility at the heart of the essential contradictions of neoliberalism and Harvey's dilemma. Implementation of payments for ecosystem services is meant to adjudicate and optimize a regime of mutual coercion between nature conservation and the economic expansion required by neoliberalism. As stand-ins for the complexity of ecology, ecosystem services are purified pieces of nature: quantified, parameterized, and justified in the language of ecological science. They are heuristics reducing the complexity of nature into the language of utility, and expressing utility in the instrumentality of dollars.

As illustrated by the recent editorial in *Science*, the “critical” work of “getting the social science right” has so far only been given a dismissive nod, with little attempt at incorporating the non-economic social sciences in the conceptualization and design of PES schemes (Naeem et. al., 2015). By giving epistemological context to the process of PES implementation as a product of particular epistemic intersections and institutional assemblages, this ethnography of a concept provides a roadmap of how the power of PES came into being. I have done this by following the historical and social configurations of intersecting discourses that facilitated the creation of “payments for ecosystem services” as a political actor in a contested trans-disciplinary landscape, I map its evolution in time and space, paying particular attention to its relationships to understandings of nature and embeddedness.

Epistemic Space: The Bandwagon

For those trained formally as economists, the temptations to see ecosystems through the ontology of economics are powerful. The approach of ecology-as-service is imminently amenable to “plug-and-play” with existing microeconomic models, methodologies that are embedded with certain epistemic assumptions. These theory-methods packages reflect the means by which neoclassical economics apprehends the existence and production of value. The “neoclassical triad” – of land, labor, and capital – is a taxonomy dating to the 19th century (Babe, 2016). It defines material and social entities in terms of markets and commensurates their relationships in terms of exchange as “factors of production.” Land receives rent, labor earns wages, and capital garners interest. All neoclassical economic models are built from this basic theoretical taxonomy.

Reformers internal to the world of economics have made modifications to the system – expanding the idea of labor to include household labor, the definition of capital to include “social” or “cultural” resources, and the relationship among these pillars to account for underground economies in addition to formal exchange. Indeed, the epistemic origins of the reform that would create ecosystem services lie in this movement – where “natures work” encompasses both the long-term substrates of landscapes and biomes, and the annual dividend of “nature’s service” as an interest-bearing return on that “investment.” The economic models that quantify the relationships of PES are the same. Under the thumb of the language of land, labor, and capital, the prospect of respecting plural incommensurable values has in practice become flattened by the totalizing machine of hedonic capitalist calculation. Viewed through ecological economics’ larger project of heterodoxy, ecosystem services have not succeeded in creating an alternative to the system of hedonic valuation embedded in orthodox economics’ models of relationship.

The ontological elusiveness of environmental values is itself a force pushing conservationists to embrace the “doable problem” (Fujimura, 1996) of PES within the simplicity of the price system. The nature of ecology is subject to interpretive flexibility – sometimes manifesting as literal numbers (e.g. acres of rainforest to be set aside), while at other times serving as a discursive point for normative interpretive argument (e.g. minimum acreage required to maintain viable habitat for a targeted species). Often, a kind of pragmatic satisficing happens. While “Frances” is a vocal opponent of ecosystem services as a method of valuation, she demurs in defense of fellow ecological economists who choose to use them: “We use monetary values to arrive at a conclusion I believe in: that the benefit of restoring ecosystems overwhelm the costs” (Frances, 2016). Over our

two hour long interview, Francis lamented that the decision structure of modern environmental policy occurs on a “cost-benefit analysis” framework, in which value is collapsed into a calculation of marginal price to be weighed against other goods. However, given the apparent intractability of the price system of value within a hegemonic economic apparatus, Frances finds fault in the ecosystem service concept only insofar as it might fail at providing ammunition to stand up to the price system. If a PES project generates the right values – a price that shows ecosystem restoration is a better value than ecosystem degradation – then Frances is in favor of that calculation. But Frances acknowledges that many ecological entities are not profitable propositions. As such, PES are structures that set up normative “doable problems” (Fujimura, 1996), sometimes successfully optimizing the doability of valuing nature within the structures of neoliberal capitalism. It is partially this process of pragmatic satisficing on the part of environmental practitioners – and many are fully aware of PES’s epistemological limitations – that has propelled the concept into near universal use. An environmental professional interviewed by Fisher and Brown (2014) illustrates the instrumental reasoning through which the tool is justified: “*Ecosystem services are the way to go in the current international climate where that bridge between conservation and human needs is ... essential ... to raise money for what we do...*” (Interview 23). The concept and its attendant strategies are not merely imperfect scientific theory-methods packages, they also leverage legitimacy on instrumental grounds. In rhetorical space, PES have become boundary-spanning hybrids, their apparent rooting in scientific specificity leveraged in persuasive appeals for conservation projects. The cultural and long-term consequences of the **utilitarian flattening** of arguments for nature conservation are just

starting to play out. For the many proponents of ecosystem services I have interviewed, the economic discourse implicit in the concept – and the resulting epistemic narrowing of debate on policy options towards market-oriented options – is all-but postscript to the pursuit of a pragmatic mission using a powerful discursive tool.

David Harvey's paradox opens up a fascinating, tricky, and surprisingly large terrain between the acknowledged inadequacy of existing economic models to correctly capture ecological dynamics, and the philosophical question of whether problems represent an incompleteness to be rectified or require a fundamental change in the terms of the models themselves. The dilemma illuminates a gap between the intention of discursive means – the “language of daily economic practice”, and normative ends – the prevention of environmental degradation. It asks of the environmental thinker to consider whether an inappropriate but near-universal language might be retrofitted to serve overarching but less tangible ends. To paraphrase Audre Lorde, the case of PES asks us whether the “master's house” – in the form of an economic system that insatiably devours nature - can be demolished with the “masters tools” – in the form of representations of nature's value derived from that same economic system (Lorde, 2018). Many assert that a strategic deployment of economic valuation will further the aims of conservation, seeing utility in the discursive power to reveal new value that can then be translated into economic terms (Liu et. al., 2010). Others see an untenable cost of investing in such compromise: the loss of an opportunity to develop a different, better, approach to environmental policy entirely (Norgaard, 2010). They point to the cooptation of these values – “pricing the priceless” – as an extension of the forces of neoliberal war on nature. They see PES as a backdoor scheme to monetize nature and enlarge the forces of

capitalism (Robertson, 2004). The terms of this debate are an odd muddle – the viability of powerful but ill-suited means directed at seemingly common ends. The case of PES asks us to consider the pursuit of a pragmatically effective program of environmental stewardship – to say nothing of an ontologically correct ecological policy - as a means-ends cat-and-mouse of epistemic practices. The epistemic space of PES is a space where compromises made both undergird and undermine the development of environmental policy. Controversy among the ongoing creators of PES is explicitly a battle over whether the ontology of ecology can be represented by the methodological tools of economics. I now turn toward an institutional characterization of the actors – researchers and authors – in this epistemic space.

Discursive Construction: The Development of Ecology *as* Service

Given the centrality of *Ecological Economics* to the genesis of the “ecology as service” concept, I performed a discourse analysis of all 5,197 articles published over the journals’ 28 year history. I distinguished the relative frequency of the very specific word string that would become the dominant approach - “ecosystem service” – from similar ways of bringing ecological value to an economic audience.¹⁵

¹⁵ In a separate working paper, I examine the broader development of other prominent discourses on ecology, (e.g. “natural capital”) in addition to the family of concepts that concretized ecology into the “goods” and “services” of PES.

The bandwagon assembles, then pulls away

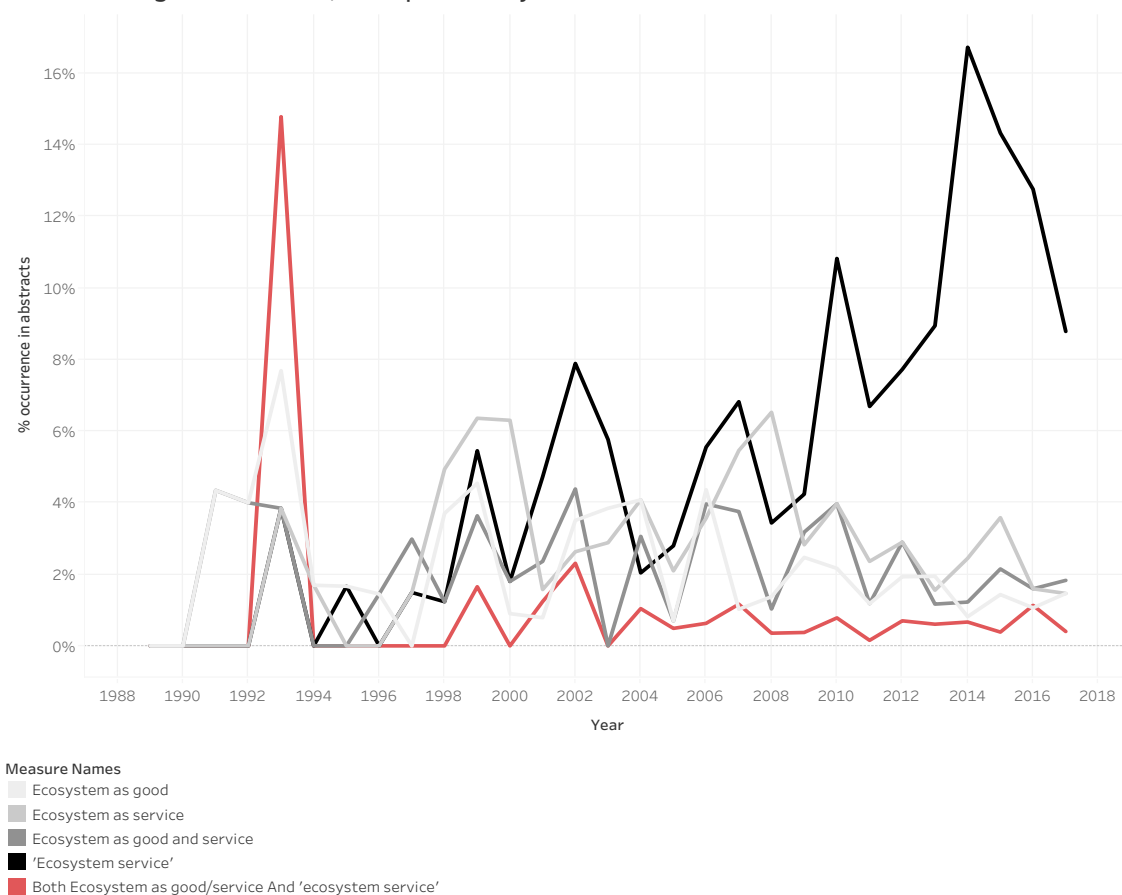


Figure 6: The trajectory of discourses on ecosystems as service in *Ecological Economics*

Figure 6 shows this finer-grained detail of the family of discursive tools lumped together in the *ecosystem as service* category.¹⁶ I conducted a content analysis of word

¹⁶ Methodology: I imported the bibliographic data for all articles published in *Ecological Economics* into a STATA file. I then read a random selection of 10% of the abstracts, and collected word strings relating to discursive approaches to ecology. I then grouped related word strings into categories of discourse (see below, also see (Appendix 1 for the complete set of word strings used in this analysis). I then queried my database by year for all articles containing each discursive approach.

E1 = ecology as good

(“environmental good*”, “ecosystem good”, “ecological good”)

E2 = ecology as service

(“environmental service”, “hydrological service”, “other service”, “ecological function”, “ecological serv*”, “service provided”, “services provided”)

E3 = ecology as good & service

(“environmental goods and services”, “goods and services”)

F = ecosystem service (entire set)

(“ecosystem service”)

Red = articles that use BOTH E & F

strings related to the framing of ecology as good and/or service, with the article abstract as unit of analysis. The three light grey trend lines show the relative proportion of articles discussing *ecosystem as good* (e.g. “ecological good”, “environmental good”) and *ecosystem as service* (e.g. “ecological service”, “hydrological service”, but excluding the specific phrase “ecosystem service”), and “*ecosystem as good and service.*” The black line shows the relative frequency of a the single word string: “*ecosystem service.*” This precise phrase is a notable latecomer to the discursive milieu of ecology as “good” and “service.” Early in the process (in the year 1993) almost 15% of abstracts published in *Ecological Economics* spoke about ecology **both** in terms of ecosystem “goods” and “ecosystem services.” But thereafter, camps differentiated - a published article dealt in ecology as good or service, or what would become the dominant shorthand “ecosystem service”, but not both. The bandwagon (Fujimura, 1996) pulled away in the early 2000’s. By the mid 2000’s, fewer than 1% of abstracts used these discourses interchangeably. The red line is a measure of concept differentiation, showing the proportion of abstracts that use **both** the phrase “*ecosystem service*” and any other of these categories. By the late 2000’s, “ecosystem services” became the clearly hegemonic way of talking about ecology – both within ecological economics and in broader environmental circles. The relatively high differentiation of ways of talking about ecology as good and/or service within a single abstract illustrates the extent to which these are not just different manners of speaking about an identically-imagined concept, but competing discourses – ways of constructing the concept. This establishment of this differentiation was soon followed by a surge in the relative popularity of “ecosystem services” as a distinct conceptual

framework from which to build an analysis linking ecology with society, peaking in 2014 at over 16% of total published articles in *Ecological Economics*.

Discursive Construction: Articles

As “ecosystem services” has taken off as the dominant metanarrative of global environmental governance, journals don’t hold exclusive status as political actors inducing its spread. In addition to journals, both singular articles, and central authors have had influence in shaping the concept. Here I consider measures of article and author influence both in terms of most-cited articles, as well as frequency of publication on the topic. **Figure 7** is a table of the top-cited articles on “ecosystem services.”¹⁷ Only four of the lead authors of a top-10 manuscript on “ecosystem services” have published other research in *Ecological Economics*. While Robert Costanza – who holds the #1 spot - and Carl Folke (at #7) in particular are frequent contributors to the discipline’s journal, most of the other “most influential” papers in ecosystem services have been authored by researchers who participate infrequently or not at all in the *Ecological Economics* journal. The most remarkable finding of this table of the relative popularity of articles published on “ecosystem services” is the singular influence of a single paper – Robert Costanza, et al.’s 1997 bombshell “The Value of the World’s Ecosystem Services and Natural Capital.”

¹⁷ Methodology: I used the subscription-based Scopus (Elsevier) citation tracker tool through the University of Wisconsin Library website to find the most Cited articles containing “ecosystem services” in the title, abstract, or keywords. I recorded complete bibliographic information for the top 10 articles, in addition to all articles in the top-100 that appeared in *Ecological Economics*. As the Scopus Database is a new resource that is still under development, citing information is still incomplete for articles published pre-1997. Nevertheless, information gleaned from this database is quite relevant for my purposes because only about 400 articles (less than 1% of the total) featuring the concept “ecosystem services” were published before 1997.

Top-Cited Articles On 'Ecosystem Services'

Dark bars indicate authors who have ever published any articles in *Ecological Economics*

Author	Journal	Title	Citations	Year of Publication
Costanza, R.	Nature	The value of the world's ecosystem services and natural capital	8K	1997
Foley, J.A.	Science	Global consequences of land use	2K	2005
Mack, R.N.	Ecological Applications	Biotic invasions: Causes, epidemiology, global consequences, and control	2K	2000
Hooper, D.U.	Ecological Monographs	Effects of biodiversity on ecosystem functioning: A consensus of current knowledge	2K	2005
Tilman, D.	Nature	Agricultural sustainability and intensive production practices	2K	2002
Allen, C.D.	Forest Ecology & Management	A global overview of drought and heat-induced tree mortality reveals emerging climate change risks for forests	2K	2010
Folke, C.	Global Environmental Change	Resilience: The emergence of a perspective for social-ecological systems analyses	2K	2006
Worm, B.	Science	Impacts of biodiversity loss on ocean ecosystem services	2K	2006
Chapin III, F.S.	Nature	Consequences of changing biodiversity	2K	2000
Dudgeon, D.	Biological Reviews of the Cam.	Freshwater biodiversity: Importance, threats, status and conservation challenges	2K	2006

0K 2K 4K 6K 8K
Citations & Year of Publication

Figure 7: Top-Cited articles on ecosystem services

The most cited paper on ecosystem services, by a factor of 2, is Robert Costanza's 1997 paper in *Nature*: "The Value of the World's Ecosystem Services and Natural Capital." The paper is an admonishment to take ecology seriously as a contributor to GDP. Costanza et. al. estimate the value of the natural inputs to global economic processes is quite large – between 16 and 54 trillion dollars per year. Costanza, who would later (according to a close colleague) describe the conclusions of this paper as the result of "2 weeks with a computer in a basement at UC Berkeley," (Interview 8) is a foundational figure in the discipline of ecological economics. Actively engaged in international and regional chapters of the society, Costanza has served as the editor of the journal from its founding in 1989 until 2002. He received his PhD training in ecology under foundational mid-20th century ecologist Howard Odum. Costanza has authored over 2 dozen books and 600 scientific papers, and is also the most prolific author publishing on "ecosystem services." For all my interviewees, he is the indisputable champion of PES, and all but singularly responsible for the successful spread of the concept.

Costanza's 1997 bombshell has been cited over 16,000 times, orders of magnitude more than almost any other work not just on ecosystem services, but of any environmental topic. His approach and a methodology, embodied by a singular researchers lab, has had extraordinary influence across environmental science and environmental politics at large. To the extent that there is a "core set" of influence over the ecosystem service concept, all of the people I interviewed for this project agreed that Robert Costanza is at its center. He is by some accounts singularly responsible for the phenomenal spread of the PES approach. The distinction between "most prolific authors" and "most cited works" is stark. Robert Costanza is the only author of a top-10 most cited PES paper who is also among the 12 most prolific authors on the topic. **Figure 8** shows the top 12 authors publishing most frequently on ecosystem services as well as their rate of participation in *Ecological Economics*. Of the top 12, 10 publish with some frequency in *Ecological Economics*, but only Robert Costanza publishes the majority of his work in the journal.

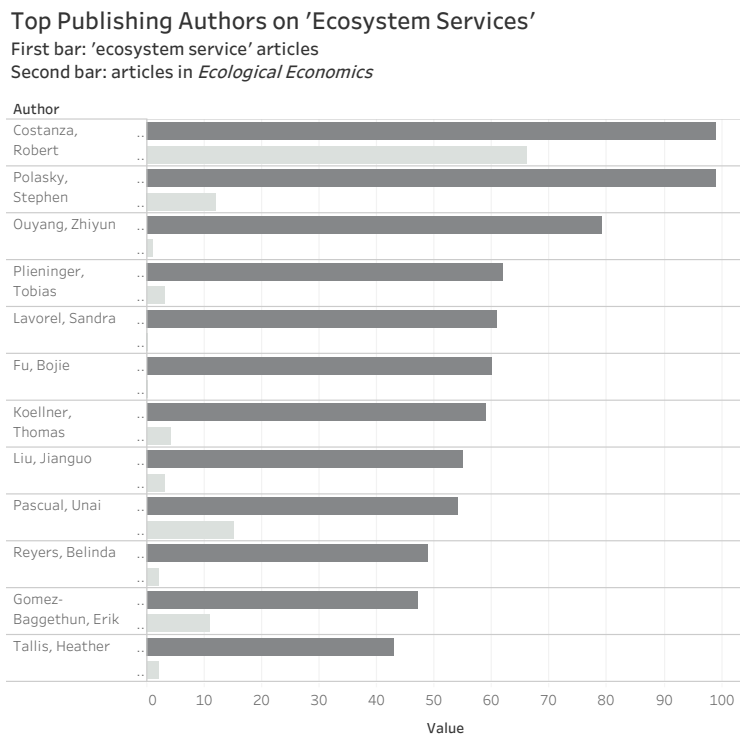


Figure 8: The top 12 most prolific “ecosystem services” authors

Despite the demonstrable centrality of the *Ecological Economics* journal on the topic of “ecosystem services” (**Figures 4 & 5**) none of the overall top-10 most cited papers on “ecosystem services” were published there. Indeed, of the 100 most cited papers on the topic, only 10 were published in the discipline’s journal – the highest ranking of which comes in at #13. Instead, papers that go on to have the most influence are largely published in the high-profile generalist journals – particularly *Science* and *Nature*, in addition to generalist interdisciplinary environmental studies venues, such as *Ecological Applications* and *Global Environmental Change*. The trend of articles that go on to become high profile disproportionately appearing in specialty and generalist science journals is common in many fields, not just ecological economics. Though the journal *Ecological Economics* is a top venue for publications on “ecosystem services,” conceptual traction in terms of the concept’s spread is largely coming from other

journals. On this basis, it is evident that PES has “escaped” the discipline that created it. That is, the journal *Ecological Economics*, though institutionally foundational and epistemically central, doesn’t control its most successful concept.

Discursive Construction: The Core Set

Theorists of epistemic space have identified the significance of a powerful “core set”: researchers at a few prestigious institutions and laboratories, and connected by means of networks with other influential institutions (Collins, 1981). These individuals functionally decide the direction of field progress, the acceptable topics of research, and where the boundary between science and non-science is drawn (Gieryn, 1999; Jasanoff, 2007). High-stakes boundary policing functions to protect the organizational identities of researchers and the status of the institutions within which they work. I.e. – boundary work is both social and institutional (Campbell, 2009). In the world of PES, this feature of epistemic power seems to be present in a different way – with greater geographic distribution and diversity of represented academic fields.

I turn to the community of scholars that nurtured PES, initially as an organizing metaphor, and later into an operational existence. Though the topic of PES spans over 118,000 peer reviewed articles, the field comprises a relatively small number of prolific contributors.¹⁸ The top 30 participants in the field have authored as many as 112 articles on the topic (Robert Costanza) to as few as only 11 (Jerome Dupras). The overwhelming totality of the work is conducted by hundreds of authors with fewer than 5 articles each. The most prolific authors’ participation in environmental studies spans a significant range

¹⁸ Methods: I queried the (same) UW Library database to show the top 30 most prolific authors publishing in ecosystem services, recording total publication counts by journal for each contributor.

of disciplinary venues. The top 30 most prolific authors in “ecosystem services” have published in 131 journals – from *Nature* and *Science* to field journals across social and natural science, public policy – both prominent and obscure. **Figure 8** shows publication rates of the top-12 most prolific ecosystem services authors, and their relative participation in the journal *Ecological Economics*.

I catalogued the publication venues used by the top-30 most prolific PES authors, expecting to find a small group of core journals preferred by the core set of researchers. **Figure 9** shows the results. Within the group of the most prolific PES authors, no single journal serves as a common point of passage for all. In fact, the field appears so diffuse that no single journal has published work by half of the 30 most prolific authors. Even in the central venues, the PES publishing landscape is more democratic than hierarchical. All of the “central venues” listed in **Figure 9** are also central outlets for PES publications by all authors, not just the most prolific (**Figures 5a** and **5b**).

Central Venues for
top-publishing
'ecosystem
services' authors
number of top-30 authors
publishing in each journal

Journal	
Ecological Indicators	14
PLoS One	14
Ecological Economics	13
Ecology and Society	13
Land Use Policy	12
PNAS	12
Ecosystem Services	10

Figure 9: Journals publishing “ecosystem service” work of the top 30 ecosystem service authors

The journal of the International Society for Ecological Economics (*Ecological Economics*) is one of these preferred journals, publishing the work of 13 of the top 30

“ecosystem services” authors, and home to a greater number of top author’s articles than any other journal – in most cases by a factor of 2-4. The overwhelming majority (10/12) of the most prolific authors publishing on “ecosystem services” have published some of their work in *Ecological Economics*. Indeed, a majority of the people I interviewed for this project – foundational, emerging, and tangential participants in the field of ecological economics – spoke of discovering within the field ecological economics the epistemic structures within which environmental problems became “doable.”¹⁹ There was, however, a distinct cleavage among my interviewees. Many pursue these problems through the ecosystem services framework, while others eschewed the approach as having been irredeemably coopted by neoliberal commodification.²⁰

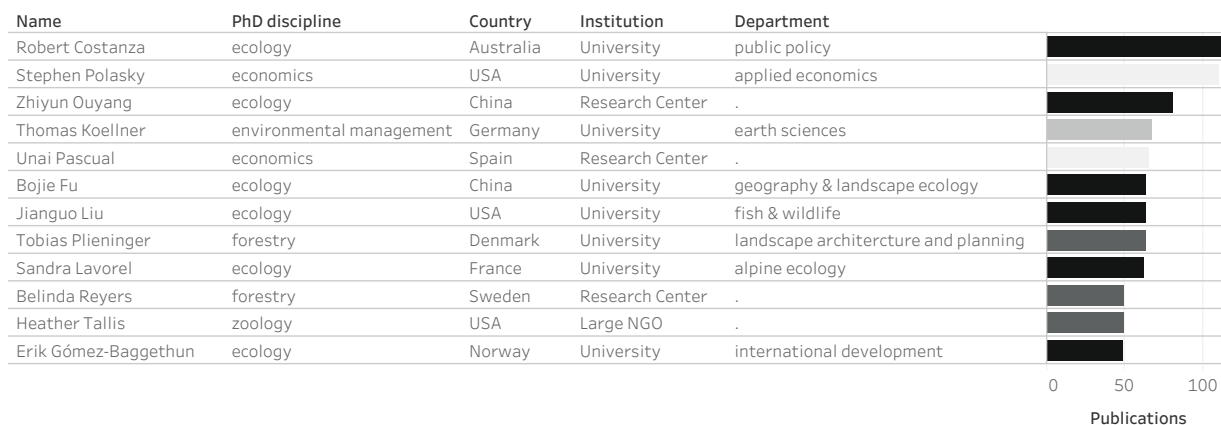
I selected the top 12 ecosystem services authors – representing those who had published most extensively, around 50 or more articles – for further biographical investigation. Using publicly available information, I researched their educational and biographical details to get a sense of any common threads shaping the professional milieu at the top of the field. Any clustering of authors from a single continent or geographic region, disciplinary background, or institutional setting might reveal a discursive home, source of institutional power, or singular influence. The extent of this kind of clustering would provide clues as to any center of gravity among this elite group – and, by extension, the epistemic product of PES. What I found points to a wide-ranging intellectual apparatus recruiting resources from many corners – geographically, epistemically, and institutionally. The results are shown in **Figure 10**.

¹⁹ For further discussion about the recruitment of diverse researchers and practitioners into ecological economics, see Chapter 4: Heterodoxy: The Analytical Inversion.

²⁰ For an elaboration of the tensions at the boundary between heterodox commitments and pragmatic solutions, see Chapter 5: Unboundary Work.

The top-12 researchers were headquartered in 9 countries on 4 continents (Europe, Australia, and North America, and Asia. The majority (9/12) obtained their PhD in a natural science discipline (6 in ecology, 2 in forestry, and 1 in zoology). Only 2 had studied economics at the PhD level, while one obtained a PhD in the applied field of environmental management. One third of the authors were currently employed in non-university research centers (3), and a large international environmental NGO (1). The other two thirds, though employed in conventional academic departments, were evenly split between natural sciences [fish and wildlife (1), alpine ecology (1), geography (1), earth science (1)] and departments specializing in social science and governance [public policy (1) applied economics (1), landscape architecture and planning (1), international development (1)]. Seventy-five percent of the authors are men.

Institutional demographics of the 12 most prolific 'ecosystem services' authors



Key: Dark bars indicate natural science training, light bars indicate economics training, and intermediate colors indicate interdisciplinary PhD programs. Institutional affiliation current as of 10/2017.

Figure 10: Institutional demographics and disciplinary homes of the 12 most prolific “ecosystem services” authors

Though each author had published around 50 or more articles on ecosystem services, no single journal or group of journals were uniformly preferred. The most popular journals (*Ecological Economics* and *Ecological Indicators*) were used by only 9

of the 12 researchers. As a group, the top 12 authors publish work on ecosystem services in 100 journals across a range of epistemic traditions and recognized academic disciplines.

Discursive Construction: Research Networks

All of the authors publish co-authored work, usually with immediate research colleagues. The structure of the citation networks between those publishing on “ecosystem services” is a measure of the interconnections among this elite group of high-output researchers. I recorded the proportion of articles co-authored with other top 20 publishers in the area of ecosystem services.²¹ The range is quite broad with an even distribution, revealing a real heterogeneity in research networks. The metric reveals the relative isolation and integration of research networks among the most prolific authors in the field. Rates of co-publication ranged from 1.3% to 40.6%, with a median of 15% (See **Figure 11**). The most isolated author in the network – Robert Costanza – co-publishes only 1.29% of his work with other top researchers. Home discipline, department, and geographic location were not significantly correlated with co-citation rate.

²¹ Methods: Using repeated search queries for co-authors within the University of Wisconsin library database, I was able to determine the number of articles each researcher had published with other authors on the top 30 list.

Ecosystem services' top-publishing authors

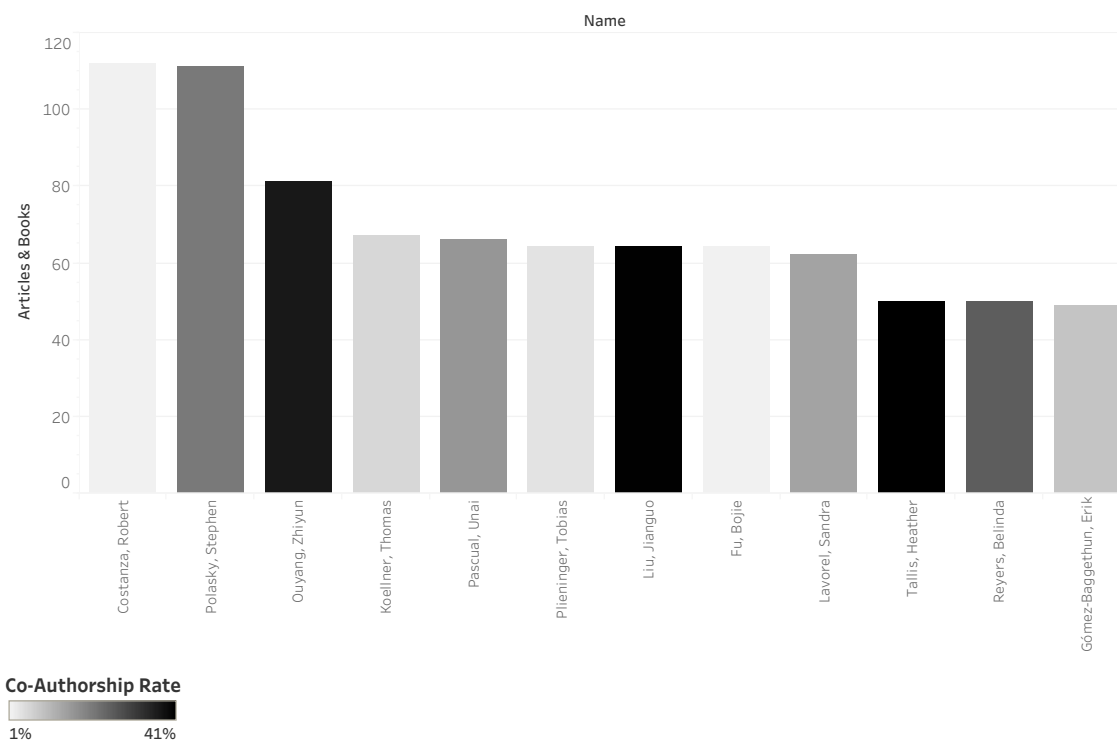


Figure 11: Co-authorship rate among top-publishing ecosystem services authors

I refined a Scopus search to produce the 10 most highly cited works in “ecosystem services” for two different 5-year intervals. The first interval, the years 1997-2001 represents the initial acceleration of work on “ecosystem services.” I compared findings from this year with the most recent 5-year interval: 2012-2016. In the first interval, 3 of the 10 lead authors of the most highly-cited works (Per Bolund, Robert Costanza, and Steve Carpenter) had ever published in *Ecological Economics*. In the second interval, none had. In the initial 5 year interval when “ecosystem services” first hit the publishing scene (1990-1994), the field was both much narrower and more centralized within ecological economics. Two authors have more than one of the of top-10 most-cited papers (John Cairnes and Paul Ehrlich). Of the top 10 distinct authors, half

have also participated in the ecological economics community by publishing in its journal (Bruce Aylward, Cutler Cleveland, Robert Costanza, Thomas Crocker, and Paul Ehrlich).

As I have demonstrated, ecosystem services is a permeable concept that is being taken up by a wide variety of disciplines and orientations to knowledge. As demonstrated by **Figure 5A** and **Figure 5B**, with the passage of time, “ecosystem services” has both spread across dozens of fields and hundreds of journals, yet has also become consolidated by a smaller set of preferred publishing venues.

Top-cited articles in *Ecological Economics*

Dark bars indicate articles focused on ecosystem services



Figure 12: The top-cited articles in *Ecological Economics*. This figure illustrates the dominance of ecosystem services in the field of ecological economics, and hints that ecosystem services are doing something for the field.

Also using the Scopus database, I queried the top-cited articles published in *Ecological Economics*. I wanted to get a sense of the articles and research topics that are the most influential drivers of journal readership and status. There are two major take-aways from **Figure 12**. First, “ecosystem services” are a major driver of readership and engagement with the journal. Out of the 15 most cited articles, 9 are on the topic. Second, of the top 15 most cited authors in *Ecological Economics*, even among those whose

articles on “ecosystem services” are highly cited, none are also among the top “ecosystem services” authors across all journals. This indicates that, despite the escape of PES as boundary concept in wider publishing landscape, a distinct PES niche is being cultivated in the home field.

Conclusion: The construction of taken-for-grantedness

I have positioned this chapter as an “*ethnography of a concept*.” PES’s explicit mission is to put ecology on competitive epistemic footing with economics - an operational countermovement to the catastrophic environmental effects of neoliberal market expansion. In an era of accelerating ecological crisis, the project of PES manifests as urgent and consequential. The concept has become hegemonic, recruiting significant material resources and discursive attention despite limited evidence PES projects can deliver on their stated objectives. Indeed, a substantial body of critique has focused on the problems created by PES and raised significant concerns about the concept’s ultimate effectiveness as a discursive strategy for environmentalists. Yet the use of PES has come to be so ubiquitous in the environmental community that generating, measuring, and pricing are now work practices of self-evident merit. The daily work of conservationists, ecologists, and practitioners of environmental conservation is now pervaded by the discourse and labor of constructing an ecology-as-service.

The ethnography of a concept approach allows me to examine not simply the concept’s material and discursive effects, but also it’s inner machinery: a wide-ranging intellectual apparatus recruiting resources from many corners – geographically, epistemically, and institutionally. Where others have studied the ‘indigenization’ of

markets in traditional societies, the ethnography of PES is a study indigenization in a hegemonic context – the centers of power that construct the epistemic space of the social construction of nature, in tandem with discourses of concern for the environment. Placing PES within a constellation of discursive, epistemic, and organizational relationships allows me access to the work the concept does in the world of people, institutions, careers, and political projects. The aim of this analysis is to establish how a concept can become a political actor. That is, the concept is not merely a tool constructed in an arena of power, but a representation of nature that takes on an additional measure of agency. I see the *ethnography of a concept* approach as performative of the ecosystem concept itself, leveraging the relational properties of ecosystems as both a hybrid socio-material process and a form of social analysis.

With the rise of PES, environmental projects are now thought of not so much as ethical imperatives, but as generators of *useful* inputs to human existence. With this conceptual shift has come a discursive shift: even as almost anything can now be categorized as a benefit from nature, ecology is discussed primarily in economic – as opposed to moral or ethical – terms. The ecosystem services concept is a very interesting development precisely because it accomplishes a number of epistemic and discursive moves while seeming to escape reform through critique. It is now all-but taken for granted that environmental efforts require that nature be priced, if only to countervail the acceleration of a neoliberal economic paradigm that doesn't inherently value ecology at all. This ethnography of PES is an examination of the social and material construction of that taken-for-grantedness.

The epistemic space of PES is a space where compromises both undergird and undermine the development of environmental policy. Controversy among the ongoing creators of PES is explicitly a battle over whether the ontology of ecology can be represented by the methodological tools of economics. Yet, the perfection of accounting of the effects of economic activities is not merely a methodological tool, a realist practice, or discursive exercise. It is a powerful concatenation of all three. Others have asked whether PES has the potential to “accurately” communicate the ontology of ecology via the tools of economics; I ask what kind of epistemic space facilitated the creation and maintenance of a boundary object so successful that – though many environmentalists may be fully aware of its epistemological limitations – it has nevertheless been propelled into near universal use.

Through an ethnographic approach to a concept, I am able to map the flow of neoliberal power in relationships that have thus far escaped critique. Where others have placed power in the general tendency of markets to exploit, I connect that power to the terms of the epistemic ideal of commensurability between nature and economic tools. One compelling explanation for the success of PES is that it is a “plug and play” concept. It works well with hegemonic microeconomic policy models, facilitating rapid uptake by researchers across academic disciplines, in addition to policymakers and activists. Another explanation lies in PES’s flexibility boundary-spanning hybrid - variously interpretable as methodological tool, realist practice, or discursive metaphor. An ecosystem service can be expressed as: a concrete material phenomenon (e.g. the carbon cycle), a probabilistic risk (e.g. disruption of weather patterns and prevalence of major storms), a subjective mental state (e.g. the good feelings arising from knowledge of the

existence of polar bears in the wild), or an economically recursive material phenomenon (e.g. reduction in commodity crop productivity due to climate change). Creation of this highly flexible boundary object required distance from the epistemic objectives of disciplinary space.

PES originated and was nurtured by ecological economics, a boundary community at the intersection of ecology and economics. The widespread success and spread of the concept has become a source of power for the discipline and drawn substantial attention to its journal. Indeed, I argue that “ecosystem services” have become much larger and more powerful than the field that created them. The “escape” of the theory-methods package of PES from the *Ecological Economics* journal and the ecological economics community is evinced by widespread lament among those within the community that they no longer control the direction of its development. Indeed, several of the concepts most vocal critics are ecological economists. If the profusion of the concept into many areas of academia and policy is a hallmark of its success, this extraordinary feat has come at the cost of the explicit ownership by the field of ecological economics over the concept it birthed. This orientation of epistemic openness – to other theories, methods, or in the case of PES, a theory-methods package – is intended to create a better, more actionable, approach to environmental policy. It is a dynamic I explore in detail in the final chapter of this dissertation, “Unboundary Work.”

Chapter 2

A theory of orthodoxy: The ontogeny and ontology of epistemic power

Il meglio è nemico del bene
(The better is the enemy of the good)

Italian Proverb, 1603

The Questions of the Ecological Economist

It is a brisk **Friday morning in early October**, and about 160 academics are drinking morning coffee around circular tables in a large reception hall at the University of British Columbia. It is an eclectic gathering. There are those who, despite extensive training and professional credentials, have broken ranks from the vaunted world of economics. They are joined by academics from natural science disciplines, and professionals from local and international nonprofits. Their common aim is to bring widespread legibility to an optimistic project: the construction of an economic system responsive to the laws of nature. This is the 8th biannual meeting of the US and Canadian Societies for Ecological Economics. Its members are attempting to articulate an integrated science of economics and ecology - a critical break from what they identify as an entrenched and rigid orthodoxy now governing the economics of nature. To the ecological economist, the complexity of ecology is irreducible to the simplified assumptions of prevailing economic models. As such, ecological economics is categorized as a heterodox school of economics.¹ Having placed some distance between themselves and the axioms of economics, these heterodox dissenters have rendered themselves outcasts from departments of economics and business. The International Society for Ecological Economics (ISEE) – which encompasses 10 regional societies – is

¹ There are at least 19 established schools of heterodoxy in economics, all broadly patterned on a rejection of some combination of the bounding assumptions of neoclassical economic theory, the most fundamental being- rationality, individualism, and equilibrium. Ecological economists, to varying degrees, also engage pluralistically with these rejections. Many also identify with other schools of heterodoxy, such as institutionalist, post-Keynesian, or evolutionary economics. But the ecological school adds the distinctive element to the rejection of the structuring tenets of the neoclassical orthodoxy as applied to environmental issues. Ecological economics remains the only school of heterodox economic thought whose primary allegiance is to the material consequences of economic activity on the natural world. Ecological economics is still a relatively small discipline. Its arguable that any sustained success or disciplinary coherence is due to its **enormously successful journal**, ranked #3 in sustainable development overall (https://scholar.google.com/citations?view_op=top_venues&hl=en&vq=soc_sustainabledevelopment).

a social movement founded on the ideal of dissent. The ecological economists are figureheads of an uneasy history of attempts to unite social and natural science, forged of the practical desperation to create an appropriate armature of policy tools to protect the interest of environmentalist efforts.

Until the audience is invited to participate, this conference is an unremarkable event. It's formalities follow a script familiar to all academic conferences. Coffee cups clink on white porcelain saucers as latecomers shuffle in search of available seats. Four luminaries of the discipline make speeches at this opening plenary. They sing the praises of administrative advances made over the past two years, reiterate the foundational commitments of the society, and encourage members to go forth and have a productive conference. Much of the room's attention is apparently divided between the staged program and the thumbing-through of conference schedules. When the final plenary speaker has finished, a moderator invites questions from the audience. Suddenly - a queue of enthusiastic audience members springs into action.

As the first audience member takes the microphone, it's as if he has harnessed an undercurrent of the audience's pent-up unease. His forceful words silence the coffee cups and sideline the conference programs. Unflinchingly, he articulates a barrage of demands:

“How it is possible to save the world and save nature while rejecting the tools of economics -*the strongest social science*? Should we not embrace all methods purporting orientation towards the same ends? Is it not a death wish for environmentalists to refuse to take up the mantle of the awesome power of economics? And [regarding PES] is it not absurd to expect nature be preserved without accounting for the services it provides to humankind? Should we not be promoting the awesome power of these ‘ecosystem services’ to do battle with economics on its own terms?”

With these questions unleashed, the warm chatter in the room slows into uncomfortable silence. There is a focused tension in the audience. For, *these are the questions*. They lurk from the places the ecological economist has left behind. Even today, in the company of friends, *the questions* are there. They are embedded in the subtext of every conversation, they undergird the research that will be presented. These questions polarize an uneasy terrain the ecological economist must negotiate – the battle between the available pragmatic tools and deeper epistemic commitments to heterodox practice. In their opening speeches, the four luminaries of ecological economics had studiously attempted to avoid addressing the questions head-on. Though this was my 6th time observing an ecological economics meeting in 7 years, I could not have predicted what happened next. One of the plenary speakers, a luminary in the field, took the microphone. To a rapt audience, he stated clearly and measuredly: “*‘Ecosystem services’ is not good science. If I had to formulate sentences using that concept, I would be saying something I know to be untrue.*” With this assertion, spontaneous applause erupted from a sizable portion of the audience. A line had been drawn in the sand – and with it a distinction between the hegemonic orthodoxy of the present and the heterodox future many attendees had arrived to help create.

Imperfectability

In chapter 1’s ethnography of the concept ‘payment for ecosystem services,’ I argued that ecological economics’ particular epistemic openness was instrumental in the creation of PES. In constructing the tools and methods to attach the price mechanism to pieces of ecology – the PES concept has been wildly successful. Yet, with respect to the

project of cohering a new intellectual community – much less a heterodox one – the concept has proven *too* powerful. PES has ‘escaped’ the community it created: it is so successful that it is no longer generally identified as a creation of ecological economics. Furthermore, it is being implemented in ways contrary to the explicit mission of the field. Indeed, the bulk of critiques of PES assert that the concept has instrumentalized and hastened neoliberal cooptation of nature. Now, perhaps paradoxically, the heterodox community of ecological economics is dedicated to principles that are at fundamental odds with the goals and work practices of generating ecosystem services. Yet the popularity of the idea continues to serve some interests even as it corrupts others. Those outside of ecological economics – if they are aware of the discipline at all – link it with PES, and the concept is driving attention and readership to the fields’ flagship journal: *Ecological Economics*.

At the 2011 membership meeting of the United States Society for Ecological Economics, then-president Jon Erikson gave an impassioned opening speech. That audience included many members of the journal’s editorial board – though notably absent was its longtime editor-in-chief. President Erikson approached his version of *the questions* with aggressive directness: “The core question members want to know is: “*whether we are truly transdisciplinary, as our discipline requires? Or, are we just economists publishing articles about valuing ecology? The society, and our researchers, have veered too far into ecological microeconomics – payment for ecosystem services – which is what the journal has become.*” The sentiments motivating that speech had some effect – the proportion of articles published in *Ecological Economics* that feature PES has declined steadily since 2011.

In chapter 1, I established that, prior to its explosive growth in popularity over the past decade, the PES concept originated and was incubated in the field of ecological economics. **Figure 1** (Below), which shows the articles published in *Ecological Economics* on PES as a percentage of total articles, adds nuance to that story. From the journal's founding in 1989 until 2002, articles on PES formed a significant portion of its publications (typically 5% or greater). More crucially for the discipline's professed project of heterodoxy, **Figure 1** also shows that the field of ecological economics is engaged in many topics beyond PES. Indeed, since 2007, no more than 3% of PES publications have appeared in the journal. In this chapter, I shift my analytical lens to the emerging field of ecological economics, which is much bigger than PES. Indeed, the center of gravity of the field is not the application of economic instruments to nature, but the attempt to incorporate ecological principles into economics.

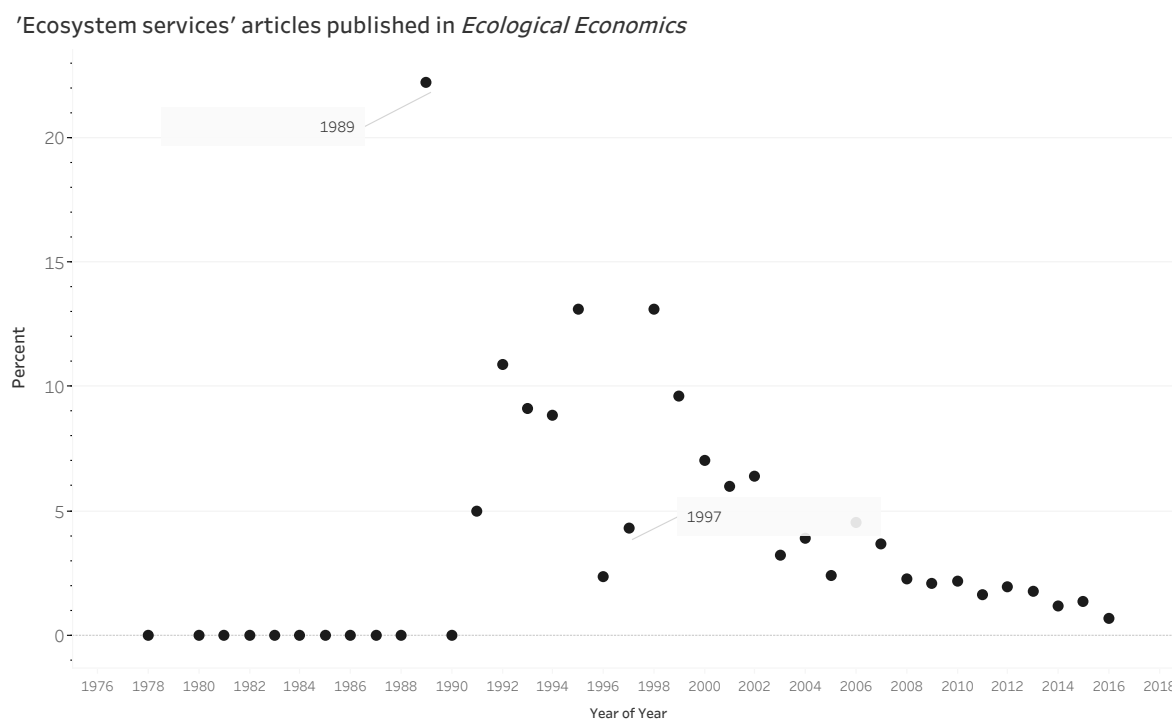


Figure 1: Articles published in *Ecological Economics* on 'ecosystem services,' as a percentage of total articles published on ecosystem services across all journals.

The ‘Bad Underestimate of Infinity’

In the two decades since the opening flurry of publications on what would become the widely popular PES concept, many ecological economists have been busy critiquing PES as playing into orthodox machinery. Foundational figure Herman Daly famously lamented that PES owes its success to the singular fact that economic models require numbers. That is, the pricelessness of nature is obvious to any good ecologist and any card-carrying ecological economist, yet in order for economic models to function at all, *some* number (generally a “proxy value”) must be inserted. But Daly also went farther – pointing to the discursive shift in environmental conservation caused by the rush to focus research around valuation: “It is a crude and inaccurate measure, but I think it is *more than just a bad underestimate of infinity.*” (Daly, 2007). The decades since have produced a robust catalog of research within the discipline, laying the groundwork for systematic critique of the pragmatic defense of monetary valuation (e.g. Gale and M’Gonigle, 2000; Farrell, 2008, 2009). Nevertheless, an increasingly complex landscape of environmental problems is coming to be organized, and disciplined, by a family of dominant logics. These logics – mechanistic ideals of order, discipline, and invariance – are, not-coincidentally, closely aligned with the tenor of modern economics. Not even Robert Costanza, PES’s original and central advocate, defends the practice of monetary valuation on purely theoretical grounds. As one ecological economist told me, it soon became clear that the persistence of this practice must somehow be related to its defense on pragmatic grounds (Interview 7). Epistemically, PES is a legitimation game for the use of economic tools to evaluate nature. That is, the PES concept is bound up with neoclassical tools and inevitably imports this ‘bad theory’ to any attempt to ecologize

public policy towards the environment. The tool “makes it possible to produce what appear to be robust and convincing economic analyses of the costs of environmental degradation” (Interview 12). The products of monetary valuation – though they may be *proxy* units – nonetheless come into social significance as representations of the worth of ecological phenomena. As described in Chapter 1, the use of these proxy monetary values is widespread. The PES method is leveraged in thousands of economics policy papers, the Millennium Ecosystem Assessment, IPCC, etc. PES is the dominant imaginary at the intersection of economic and ecological consciousness, but it is not the only one.

The epistemic problem, if we are to learn from the mountain of critique, is that PES cannot be optimized on its own terms. Parsing nature into economic units is not compatible with ecological theories that emphasize systemic properties such as relatedness and emergence. Heterodox practitioners assert that orthodox economics induces epistemic behaviors and associated work practices that are not perfectible in ecological terms. As explored in Chapter 1, the hegemony of PES is a result of its pragmatic and discursive strength. PES’s boundary object characteristics – epistemic, social, and institutional – have contributed to its massive discursive success and therefore render it difficult to dissent from. The problem for those wishing to challenge this hegemony is that the continued use of monetary proxies serves to further reinforce valuation – and the institutions generating valuation – as a scientifically legitimated assessment practice. This epistemic dominance renders it difficult and risky to pursue alternative approaches to protecting nature. The hope of heterodoxy is to find a framework from which the choice to use monetary proxies is allowed to become a political negotiation and not merely a methodological formality.

A Theory of Orthodoxy

The Anthropocene is an age of accelerating ecological change. Unfettered capitalist accumulation, neoliberal ideology, and numerous biophysical signs of global ecological collapse unprecedented in human history are all frequently cited not only as signs of crisis in the ecological health of life on earth, but also the supposed “rationality” of economic order (e.g. Latour, 1998, York et. al., 2003). Ecological crisis is also an inherently reflexive phenomenon, necessarily characterized both by growth in the extent and complexity of the effects of human activity on the natural world, and growth in the documentation these effects – or “awareness” of that growth. Indeed, one could describe the nature of anthropogenically-generated ecological crisis as persistent *despite* an enhanced understanding and public awareness of a crisis of ever-deepening extent (Speth, 2009). While a large body of academic work points to “neoliberalism” as both a material and ideological driver of environmental crisis (e.g. Büscher et. al, 2014), relatively little attention has been paid to the economic mechanisms that form the machinery of neoliberal rationality. The potential for perfectibility in an economic ordering of nature is largely taken for granted.

One consequence of present dynamics is that environmental “solutions” unwittingly draw from economic rationality. Environmentally-oriented policy tools – “Internalizing externalities,” “resource efficiency,” “carbon market,” among many others – are all constructed in the image of the rationalities of neoclassical economic theory. The orthodox ordering of neoclassical economics is an exceedingly powerful discursive force. Yet a critical look at its underlying epistemic machinery reveals a paradox that should be taken seriously by any serious environmentalist. The black box of orthodox economics is

the originator of the mechanisms that render it profitable to destroy nature. And now – in the age of the crises of the Anthropocene – the box *also* contains the source from which “solutions” to environmental problems are drawn. The foundational project of the heterodox approach is to dive into this paradox: problematizing orthodoxy as the common epistemological source from which problems and solutions are jointly derived.

The Ascent of Dissent

The economistic approach to nature is not a self-evident outgrowth of the knowledge practices of ecological science.² Rather, valuation of nature through the epistemological apparatus of economic tools has refined the texture of ecological knowledge and refashioned its terrain of discursive possibilities in the image of economic utility as expressed by market price. Where several fields of knowledge critique the effects of neoliberalism or attempt to offer wholesale alternative paradigms, one field – “ecological economics” – is working *within* the black box of the economic toolkit. Ecological economists intend to replace the tools of neoclassical microeconomics currently deployed to solve environmental problems. Their work practices center the ideal of creating a better armature for the inner machinery of economics: one that tames the methodological tools of economics to hew to the ontological foundations of ecology while also remaining legible as economic tools. The fields’ explicit goal is to develop a usable alternative to the hedonic price system in areas of environmental concern. In creating an economic system responsive to ecological epistemologies, this alternative would work against the reduction of ecology to the marginalist utilitarian values required

² For further discussion, see Chapter 1.

by neoclassical economics. Heterodoxy in ecological economics is both a conscious rejection of inadequate methods and an articulation of a concerted moral and philosophical orientation to nature.

This second dissertation chapter is the first of three in an ethnography of ecological economics' epistemic and social space. In Chapter 1, I established that the construct of "ecosystem services" – a tool with heterodox potential – was hatched and brought to life within the interdisciplinary space of ecological economics. In this second chapter, I characterize the social conditions of this space as *heterodox* – reflecting organized dissent from a field of epistemic power. Heterodoxy is simultaneously radical and reformist. The epistemic motivation for such a break is a belief in the imperfectability of the neoclassical economic machinery undergirding the hegemonic approach to environmental problems. Ecological economics draws authority for its cause by locating imperfectability not in a failure to fully implement a theory, but *within the epistemic apparatus of the theory itself*. Where orthodox environmental economics proposes ad-hoc refinements to a given methodological apparatus – (e.g.) as exemplified by the workflow of identifying, measuring, and advocating for distinct "ecosystem services" – the imperative of heterodoxy is to dismantle and reconstruct the apparatuses' interior architecture so as to obviate the continued need for that ad-hoc workflow. Heterodoxy's intent is a radical reformulation – not just of the means through which (e.g.) values are placed on parts of nature, but of the process of parting out that presages economistic analysis. Once dismantled, the intent of heterodoxy is to offer a "more correct" armature as a replacement. A product of radical dissent that nevertheless must remain legible in orthodox language, this replacement is intended to fit within the same

institutional structure of orthodox practice. That is, once successful, a fully-implemented program of heterodox ecological economics would supplant orthodoxy entirely.

“Environmental” (neoclassical, orthodox) economics would become “ecological” economics.³ Sociologically, the success of heterodox groups hinges on their ability to create a usable alternative epistemic apparatus while sustaining an alternative social context to nurture the new area of practice into being. Indeed, obviating orthodoxy at its own game is the end-game of heterodox work. This chapter’s analysis of orthodox power forms a parallel with Chapter 3, an analysis of heterodox dissent.

Perhaps paradoxically, the goal of *ecological* economics - as a *heterodox* epistemic movement - is to forestall the perceived inevitability of *economism* – the reduction of ecology to exchange value – in instruments of environmental discourse. Rather than individually defect to academic fields more hospitable to a critique of the price system⁴, heterodox practitioners attempt to draw power from the failures of orthodoxy, organizing dissent around the *imperfectability* of its inner machinery. The practice of heterodoxy among ecological economists is therefore also its own ethnographic process, a reflexive challenge to orthodoxy that – in the course of drafting a usable replacement – nimbly negotiates the task of hewing to a new imperative while remaining legible to orthodox power through intimate observation of how that power is generated.

³ A note on terminology: The descriptor “orthodox economics” describes the contemporary paradigm of neoclassical economics, the prevailing theoretical approach taught in economics departments and practiced in governance throughout the world. Though “orthodox economics” is functionally synonymous with neoclassical economics, its denotation as “orthodoxy” is not a self-imposed identity, but a label ascribed to neoclassical economics by heterodox groups as a way of providing a basis for differentiation and dissent.

⁴ Indeed, the discursive range and epistemological commitments of heterodox ecological economists have more in common with fields in the non-economic social sciences than with orthodox economic theory.

My aim is to theorize the sociology of epistemic dissent. Accordingly, my analysis of heterodoxy begins with a characterization of the power structures of orthodox dominance – the sociological condition from within which heterodoxy intends to find an epistemic apparatus to construct its “way out.” I first characterize these power structures through the stories of those who know it best – students, former students, and graduates of the curriculum of orthodoxy. These individuals are informants to the social conditions of the orthodox epistemic apparatus. I then focus on the epistemic conditions organizing an orthodox analysis of environmental problems – the work done by numbers within the black box of economic calculation. The epistemic conditions of orthodoxy are mutually constitutive of its social conditions – not functionally distinct.

Jacob, Tim, and Josh: The Ontogeny⁵ of Epistemic Power

Every ecological economist I interviewed located the origins of their coming to heterodoxy within interactions with mainstream economics’ epistemic approach – or conspicuous lack thereof – to environmental issues. Heterodoxy was not a first choice, but a reasoned reaction to incongruities discovered within orthodox work that had been presented to them as their *only* choice. There are over 150 PhD-granting departments of economics in the United States, 11 of which offer heterodox curriculum of any kind.⁶ The sole PhD-granting program in “ecological economics,” was established in 1992 and has no affiliation with a traditional economics department.⁷ Its graduates obtain employment

⁵*Ontogeny* refers to how conceptual devices develop and are reproduced in social space.

⁶ https://cobe.boisestate.edu/lreynol/WEB/PDF_HET/GRADUATE%20PROGRAMS.pdf

⁷ The Gund Institute for Ecological Economics is located within the Rubenstein School of Environment and Natural Resources at the University of Vermont.

not in traditional academic departments, but primarily in interdisciplinary environmental studies programs and the public policy sector.

Josh Farley, now a senior figure in the world of ecological economics, is a founding faculty member of this PhD program. He is also a co-author of the United States' most popular ecological economics textbook. Josh is explicitly embarrassed by every aspect of the dissertation work that earned him a PhD in economics. The document, entitled "Optimal deforestation in the Brazilian Amazon: theory and policy" is an economic optimization study balancing the 'costs' of cutting down trees against the 'benefits' of GDP. With it, Josh earned a PhD in (orthodox) economics from Cornell University, a top graduate program. Completed in 1999, the dissertation's approach to valuing nature – grounded in the efficiency criteria of (hedonic) valuation – continues to be the standard armature for efficiently "balancing" the value of nature against its economic uses. This is the orthodox logic of environmental protection: the "costs" of destroying ecology and its "benefits" to the world both expressed in the same language – dollars payable on a market for nature's "products." In the two decades since he completed his degree, Josh has been approached by several publishers and policy groups eager to apply his study to public policy. Yet Josh is the first to tell *anyone* that though this work is mathematically sophisticated, he is not proud of it. He has refused these offers on the firm conviction that the study is "not ecological economics." When he did use this document – in its capacity as "proof of degree" – to obtain his first academic job, he qualified its existence with: "*I have a PhD in economics, but please don't hold it against me.*" Like Josh, a significant portion of ecological economics' adherents are converts primed for 'self radicalization' by experiences of unease in orthodox spaces.

“This school is the example of the old way of thinking, the very technocratic way of thinking: where you can leave the public aside, and you just need the experts to provide the answers of *how* is the type of society in which you want to live.... What we need is a different way of understanding how we deal with policy problems. Or public problems. So in that sense I have struggled with this school.”

– “Jacob,” 2017

I embedded myself with Jacob during his final year at a prestigious public policy master’s program where he was receiving extensive training in orthodox economics.

Jacob was a rare informant: an insider with demonstrable fluency in the orthodoxy who nevertheless believed its epistemic apparatus inadequate and was consciously searching for alternatives. Jacob had come to this experience with his eyes wide open. A lifelong Catholic from the global south, he located the origin of his ability to have a critical orientation to orthodoxy in his interpretation of the church’s teachings on social justice. In Catholicism, he found permission to question the axioms he nonetheless absorbed through years of economics classes: *“you have a different notion, from religion, about who people are. To think of people just as rational people who only think of their own self-interest, that was clashing already with my understanding of people”* (Jacob, 2017).

Jacob’s constant moral unease rendered him vigilant to what nobody else around him could see: that institutional power was being used to inscribe and reproduce epistemic power. A career technocrat, Jacob was well-familiar with institutional power, having served for several years in the Ministry of the Economy in his home country. He’d come to one of the world’s most prestigious policy schools with the goal of propelling himself into a political career when he returned home. Jacob spoke openly and explicitly about his choice to come to a global center of power to receive the imprimatur of a prestigious institution. Yet he was equally frank in expressing that its pedagogy was one

with which he profoundly disagreed. Jacob was forthcoming in speaking with me about his experience in these terms. A temporary insider within the halls of power, Jacob articulated that he believed a main function of the school was to teach students how to embody the habitus of power: *“Everyone is portrayed as being ‘successful’ and that is reinforced. You are here to earn some skills to be ‘much more successful.’ If you were already changing your society back home, now you’re going to ‘change the world.’”* (Jacob, 2017). He had come to see this training as a vehicle for real abuses to people and nature, and was consequently reflexive not only about the material, but of the socialization into power he received in tandem with formal instruction. To Jacob, the tools and ideologies of orthodox economic power went hand-in-hand.

Like Jacob, many of my interviewees had come to heterodox beliefs in explicit reaction to dissatisfaction with experiences in orthodox spaces. Tim, an adjunct senior lecturer at a Canadian university, holds a PhD in orthodox economics but has since openly renounced that training. He described his decision not to pursue employment in the field of his degree in explicitly moral terms. As a result of his choice to abstain from opportunities that would otherwise be available to him, Tim’s professional life is tenuous. At the time we spoke, he was occupied by climate activism and adjunct teaching gigs. Tim placed the social power of economics in the *performed* demands of its training process. *“Economics departments ... serve irrelevant theory, puzzle solving, getting credentials, a lot of busy work instead of actually doing useful stuff for humanity”* (Tim, 2015).

My interviewees frequently pointed to something apparently invisible to those who remained orthodox insiders – an extensive armature of social mechanisms,

particularly the enforcement of conformity to discipline, keeping orthodoxy afloat. Several marveled at the extent of an epistemic “*herd mentality*” in mainstream economics. Indeed, in the wake of Foucault’s Discipline and Punish, scholars of academic work organization have described academic behavior of all kinds as shaped by the enforcement of commonality in disciplinary outlook. Becher and Trowler’s 1989 foundational text on the subject theorized the existence of disciplines as a direct outcome of the rigor with which social and intellectual boundaries are policed. Knorr-Cetina’s 1999 ethnography of a high-energy physics laboratory introduced the concept of “epistemic cultures” to describe the intertwined nature of knowledge signification with disciplinary work practices. Subsequent work has further explored the simultaneous social construction of both the machinery of knowledge construction with its outcome in the form of knowledge produced (Knorr-Cetina, 2007, p. 363). Lamont’s 2009 comparative study of doctoral admissions committees linked discipline-specific ways of knowing with evaluations of scholarly legitimacy. Her typology of “epistemological styles” (comprehensive, constructivist, positivist, or utilitarian) illuminates the ways in which epistemic communities differentially legitimize distinct outlooks on knowledge, research, and methods. This growing body of research consistently points to the need to examine epistemic context in tandem with social context. My interviews and observations through time spent with Jacob, Tim, and Josh⁸, affirm that reproduction of disciplinary power is not just an epistemic matter, but a social process. That process plays out in the context of educational socialization – the invitation to embody epistemic power ontogenically – through the process of walking within the lines of its bounded

⁸ As outlined in Chapter 1, the field of ecological economics is male dominated.

techniques. The positivist epistemological style of economics further disciplines the territory of acceptable material for students to master and reiterate. This process reinforces the enhanced strength and prestige of economics as an orthodox field. In the following pages, through the lens of my heterodox informants, I theorize the socially and epistemically intertwined sources of power in orthodoxy.

The Ontogeny of Epistemic power: A Circumscribed Silo of Expertise

Academic gatekeeping is characterized by the deep structure of shared norms and values (Abbott, 2001; Campbell, 2009). But professors often take for granted the disciplinary basis of epistemic structures reinforced and reproduced by the “normal science” of day-to-day scholarship. Orthodox economic practice derives much of its power from these in-group standards of disciplinary work. In the case of economics, ideals of “mathematical rigor” circumscribe a tight boundary of acceptable methodologies and objects of study. In Kuhnian terms – this *paradigm strength* of shared commitment to methods and theories within a discipline is a foundational necessity for the genesis and continuation of a particular research tradition (Kuhn 1970, p.11). A senior Canadian ecological economist pointed to the intellectual isolation of orthodox practice as a source of its power: *“They’re insular, they keep reinforcing each others ideas, they don’t look outside.. ecological economics is anathema, so they pay no attention to it.”* (“Bill,” 2015). Heterodox dissenters link this social isolation to their observations of the epistemic limitations of siloed knowledge production. They characterize the orthodox center as having become far too narrow: “more a brackish puddle of techniques than a sparkling torrent of ideas” (George, 2007). Organizationally, this tightly defined

mainstream economic orthodoxy stands in direct contrast to a diffuse, fragmented social structure across multiple heterodox groups (Dow, 2007).

The first dimension of orthodox power is a *circumscribed silo of expertise*. Heterodox dissenters recognize that the power of orthodoxy is being drawn from the focus on mastery of specific areas of practice using the methodological techniques of applied economics.⁹ These limitations place hard limits on admissible knowledge practices and shore up orthodox economics as a strong field with corresponding social distance from alternative disciplinary logics, even those that hold potential to address the problematics of potential concern to the economics discipline.

Over the course of our time together, Jacob expressed repeated moments of frustration at only being allowed to see social problems through a technocratic lens. The formalism of his applied training admitted only a narrow range of acceptable types of data as permissible inputs – and similarly constrained the field of permissible outputs in the form of defining what was an acceptable problem to solve. At one point, Jacob went to battle with one of the most powerful macroeconomists working today, Harvard’s Greg Mankiw. Jacob describes his interaction with this economist as frustrated by Mankiw’s inability to see the epistemic significance of the *context* of the numbers leveraged in an analysis, but the overriding surprise to Jacob was that Mankiw was taken aback at being

⁹ The assumption of internal coherence within distinct “disciplinary” spaces can be a stumbling block for scholarship in this area. One of the earliest mechanisms of distinction defining disciplinary space is that of paradigm strength. For Kuhn, paradigm strength is ‘shared commitment to methods and theories’, and is a prerequisite to ‘the genesis and continuation of a particular research tradition’ (p.11). Progress *within* disciplines is classically imagined in the linear, cumulative fashion that Kuhn (1962) and Lodahl and Gordon (1972) proposed. Yet this dynamic contrasts with a history of research envisioning knowledge-making as a long evolutionary process of internal division along both methodological and theoretical dimensions. Ideas about how knowledge progresses are also, to a certain degree, performative of how epistemic communities organize themselves. That is, to practitioners within a strong field such as economics, the imaginary of progress through Kuhnian puzzle-solving reinscribes the *ideal* of a circumscribed silo of expertise as an epistemic “good.”

challenged at all. Mankiw's disciplinary confidence allowed him to elide geographic and cultural differences as relevant factors for consideration. After a public talk to the community of the public policy school, Jacob tried his hand at breaking down the walls of the macroeconomic silo. This is how he described the experience:

“At the Q&A moment, all these students were asking questions ... and I said; “I have a question for you too. To me, the problem is not X¹⁰, as you have posed. In terms of numbers, X is completely meaningless as we have been discussing all morning. Because X is derived from the US. So if I take X here and put in Chile, it's peanuts, if I take X from Chile and put it here, its peanuts. So it's not X that produced the problem. something [else] has changed in society that [has caused] a problem. Its not X. It's not about the numbers. So my question is: what changed in society that now Y is a problem?” [He was] shocked. And Mankiw, and I was really surprised in a bad way with him, he said: “*Well I don't know about the world, because my focus is on the US, and a traditional technocratic expert approach,*” That was his answer! Those types of things have been my way to try to challenge the economic understanding of things. But as you see in this answer, they [orthodoxy] completely close the possibility of discussing in a different way.”
 - “Jacob” (2017)

Indeed, rather than being weakened by its apparent lack of precision, the discursive force of Mankiw's argument hinged on avoiding the significance of the context of the analysis. This elision – the assumption that the general solution holds for all contexts – is a defining feature of orthodoxy. I draw its origins as arising within the rationality of economic calculation. Contemporary economics is characterized by a particular approach to theory based on the *mathematical model*. Empirical work is typically based on a limited range of econometric techniques within existing models, with little attention paid to the connections between the parameters of a model and what they

¹⁰ To focus attention on sociological and epistemic problematics and not the specific analysis in question, I have replaced the dependent variable of this particular economic analysis with “X” and the independent variable with “Y”.

might imply for the underlying condition being modeled.¹¹ The potential for mismatch between methods, tools, and theory is heightened by the tendency of economists to only acknowledge a limited range of theoretical approaches. A consequence is that advances in economics are largely technique-driven rather than “issue” driven. As one interviewee put it – the orthodoxy performs a strange paradox: *“Orthodox economists often extol the benefits of economic competition, but at home they much prefer unregulated monopoly in the market for ideas!”* (interview 15).

Systemic disinterest in the context of analysis is further reinforced by a basic premise of neoclassical theory, upon which all other theory in modern economics is premised. The doctrine of consumer sovereignty *“De Gustibus Non Est Disputandum”* (“there is no accounting for taste”) inscribes the purpose of economic analysis as concerned only with individual choices at the moment they are expressed. From this axiom flows the logic of the price system as a means of adjudicating alternatives: prices as operational guide to individual, maximizing economic agents into activities presumed optimal for the overall economy and society. (Stigler and Becker, 1977). By focusing analysis on choices expressed through markets in the language of price, “Economists tend to overlook (or dismiss) the contextual (social) framing of individual preferences.” (Vatn & Bromley, 1994) The basis for avoiding the social contexts shaping choice – not to mention the socially-significant outcomes of millions of individually-optimized choices– is a pragmatic one. Such complexity is beyond the reach of the mathematical model:

¹¹ The range of mathematical techniques used in the work of orthodox economists (and some heterodox ones) is fairly circumscribed and largely dates back to formal traditions established in the eighteenth and nineteenth centuries. A relatively small areas of mathematics is used: calculus, linear algebra, and game theory. So, for example, research involving topological techniques such as catastrophe theory or chaos theory is often rejected by the mainstream.

“Once tastes and preferences are treated as contingent, the (economic) model becomes quite indeterminate” (Vatn & Bromley, 1994).

The siloization of disciplinary knowledge practices also contributes to the reinforcement of orthodoxy through institutional mechanisms. The mainstream economics profession is characterized by a tightly-defined professional structure with a narrow range of primary publication outlets and a constrained career development context. This professional structure constitutes an ‘invisible college’ which controls publication, appointments and promotions. No other discipline maintains such a sharp discontinuity between its ‘core’ journals and all other forms of publication (George, 2007). Indeed, heterodox critique has named the cornerstone of this power orthodoxy’s “Core Journal Doctrine.” A small group of journals (around 10) gatekeep knowledge in the discipline. The prestige hierarchy of journals becomes a proxy for perceptions of the quality and importance of research. Anything published in a core journal is of “high quality,” and all other publications are of “low quality.” (George, 2007). The assessment of research quality via the proxy of prestige and selectivity of core journals rewards the epistemic practice of pursuing increasing levels of mathematical rigor – the perfection of the *mathematical model*.

Perhaps nowhere is the epistemic structure of disciplines generating and enforcing a common sense of acceptable approaches as comprehensively visible as within modern neoclassical economics. Prevailing theory, epistemology, methodology, and practical priorities shape the evaluation criteria and decision-making processes used in orthodox practice. These siloized disciplinary logics “define and even determine” (Geertz, 1982) the evaluation of academics, organizing the social worlds and work practices of orthodox

economists. Shared disciplinary assumptions become the basis for in-group models of rationality by which faculty legitimize standards of quality and reproduce work practices through boundary-policing (Posselt, 2015).

The Ontogeny of Epistemic Power: The Ethic of Mastery, the Performativity of Complexity

The boundary policing of siloed acceptable methodologies leads to techniques pursued as an end in themselves, not a means to an end exogenous to economic analysis. Indeed, the homogeneity of economics is often advanced as a *positive* feature of the discipline. Ioannides and Nielsen (2007) argued that economics is “now widely seen as the most advanced of the social sciences with its mathematical formalization, public prestige, and Nobel Prize awards.” In both “theoretical” (i.e. mathematical modeling) and “empirical” (i.e. statistical analysis) approaches to research, orthodox economists privilege the precision offered by numerical evidence and algorithmic epistemology. Piketty’s landmark Capital in the Twenty-First Century linked the social failure of global economic systems with an epistemic “obsession with mathematics... an easy way of acquiring the appearance of scientificity” (Piketty, 2014, p.32). Disciplines not only train preferences and behavior, they can be coercive of behavior. In economics, “those who question the basic axioms of the subject are liable to find themselves cast into a wilderness of their own” (Becher & Trowler, 2002). Close policing of disciplinary boundaries at home seems to also enable an imperialist attitude towards other disciplines. The spread of economic thinking as an epistemic style – critiqued as “disciplinary imperialism” – is often implicitly premised on an ostensive potential to generate a “unified framework” for understanding all human behavior (Ruttan, 2001). Indeed, many

orthodoxy economists extol the sophistication of their discipline by analogizing its “total theory” potential to physics (for an in-depth intellectual history, see Mirowski, 1989). From “there is no accounting for taste” flows a neat set of mathematically concordant frameworks: the theory of rational choice, the formal modeling of social life as an aggregation of atomistic actors, the pursuit of “welfare” through a particular means of rationalizing interactions, and – in the rare cases where orthodoxy directly concerns itself with environmental problems – the parsing of nature into pieces knowable in economic terms.

Economics is a strong field. Indeed, heterodox economists often remark that mainstream economists are usually untroubled by their academic critics: after all, controlling publication, appointments, promotions and research grants provides a crucial measure of the power necessary to keep interlopers out. “The mainstream maintains its homogeneity, not by appeal to evidence but by appeal to authority” (George, 2007). Rarefication of disciplinary knowledge is accomplished through the social distance afforded by such appeals to authority. This social distance is a process of differentiation accompanied by the development of a specialized vocabulary – including mathematical models – largely incomprehensible to those outside its disciplines and sub disciplines. Yet the discursive authority of the word ‘economics’ pervades the development, dynamics, decisions, and discursive moves of those operating in its valence. Discursive power is a center of gravity for orthodoxy, and the idea that economic paradigms rule all of political discourse – indeed that the hold of orthodox economics on the political process is un-seeable by those who haven’t spent time outside its black box – is common among my interviewees. Many expressed the view that the ideology of neoliberalism is

so embedded throughout society that, e.g. “*Every ‘independent, free-minded thinker is in the thrall of a defunct economist’*” (Josh, 2011).

As evinced by its failure to respond to movements of heterodox dissent, orthodox economics does not learn from other social sciences, so much as it attempts to colonize them with the grand theory of formal modeling (Dow, 2007). When presented with challenges to the economistic accounting of human nature, responses from within orthodoxy are either to ignore social science disciplines altogether, or to seek ways to incorporate them safely into economics (George, 2007). Incorporation is typically pursued through epistemic imperialism - flooding the rival discipline with mathematical formalism. As a heterodox movement, the ecological economists are both being pushed out from – but also pushing away from the orthodox idiom. Taking a critical orientation towards the abuses of market environmentalism, and in particular the theoretical assumptions and mathematical fetishes that underpin orthodoxy, is the source of a profound social sense of unity. In my multi-year study, I have come to see the admonition against neoclassical economics as the primary defining feature of the community’s stated epistemic commitments.

The ethic of mastery is a central driver of the epistemic machinery of orthodox power. Jacob describes the pedagogy of the educational curriculum as bestowing the social power of economics onto those who agree to master its technical intricacies:

“The type of people that come here are looking for *solutions*. They want to go out there and bring whatever solution they have learned – in this crystal tower in [city] where you see the whole world from there – [e.g.] “*as an ambassador of that tower to Africa, and I bring solutions to all of these problems...*”. I also come from that tradition and it’s very difficult to move away from that. You’re always being told – with a stronger technical background you will be able to provide **better** solutions and so forth. The kind of people that get here

come from government, or from consultancy, or from big NGO's.
 And all of them reinforce this idea, this frame. ... Any class they take
 is about having a new answer, a new technique."
 – “Jacob” (2017)

Despite his openly critical stance, Jacob was well-liked by his classmates. Whenever we spent time together in the school's common areas, students went out of their way to come over and say hello. Jacob moved easily and affably through the halls of power. In keeping with his political aspirations, he seemed to have adopted a respectful orientation to all – even those with whom he profoundly disagreed or (worse) whose aspirations he considered fundamentally misguided. At one point, a recent alumna interrupted a conversation Jacob and I were having about the ethos of the school, chiming in with her enthusiasm for its professional programs. Once she was safely out of earshot, Jacob turned to me and sighed. He lamented: *“That’s the type of student who comes here, all about diversity, leadership, women in power; but then they learn the economics, and it undercuts all that.”*

In a pedagogical environment with a curriculum ostensibly focused on “leadership” and “service,” deviations in practice from that idealized mission are surprisingly invisible to those participating in it. The epistemic power of orthodoxy is both a consequence of the way it is taught, and also the result of the accreted pedagogical performativity of tools learned in the name of serving a greater good.

“The curriculum ... is performed in a way that students are disoriented!, deer in the headlights!, amazed! - when they learn this new technique. This is presented to you as solving all these many issues. And you're just at that point – where this is “so great!” that maybe you could go into a second thought, of, well this might cause problems, but just as you are getting to that point, then you learn part two, you go into the second phase of it and you learn this “*much more impressive*” technique. After the first 2-3 semesters, you have the

sense that people feel that “*now that I have the power to get into my computer and have some data... of whatever issue I want to tackle, I have the sense to face it...*” But **they don’t think they’re doing economics**, [because] they’re **talking about inequality**, why the world is unequal, and so on and so forth.”
 - “Jacob” (2017)

Here I am suggesting that, through the performativity of complexity of techniques learned ontogenically, the student accretes her own allegiance to orthodoxy. Distracted by the difficult process of earning mastery, the student absorbs not only the ability to use the tools – but the unbidden assumptions that make the tools “work”: a world composed of basic fundamental things that can be modeled. The perfection of modeling becomes a recapitulation of the work done to become a practitioner of economics, and applying the model becomes a source of pride in mastery. If there’s a problem discovered in that model, a component can be tacked on to that model to “*internalize the externality*” – to modify it, make it more abstract, and therefore, incrementally, more impressive. In talking to Jacob, I came to see the curriculum of applied economic problem solving as performing the ontogeny of orthodoxy’s disciplined approach to epistemology. Indeed, scholars of heterodoxy have described orthodoxy’s focus on the perfection of economic models as providing a useful barrier to entry to the market for ideas (George, 2007).

The Ontogeny of Epistemic Power: Latency of Power Within Applied Tools

Orthodox power is in large part derived from the belief that economics “has the right tools,” and power is maintained through a monopoly over their use. Theorists of heterodoxy corroborate that young people studying economics for the first time often believe that it will supply, if not the answers, then at least the intellectual tools to tackle

issues of social importance. In the words of one critic: “Rarely has so much human capital been so seriously misallocated” (George, 2007). A senior American ecological economist related the power those tools wield in the imagination of young students at his working-class college: “mainstream economics is a story of hope - you do what I do and you can get rich!” (“Ken,” 2015).

With an applied curriculum performed as a source of power, the epistemic sources of economic power are hidden within those tools. Therefore, it is important for a theory of heterodoxy to encompass not merely epistemic content or social dynamics, but the coproduction of epistemic tools with social spaces. Though students may be unaware they are learning the language of orthodoxy, the transmission of fundamental economics axioms through an applied curriculum actively feeds power back into the machinery of that orthodoxy.

“... maybe you never really get to distinguish what the basis for what you’re doing is. You’re not thinking to ask about ‘homo economicus’ because you weren’t taught about that, even though you’re thinking in that way. It’s not easy to see the basis. ... This is why people don’t challenge the technocratic approach! Because you’re answering questions – and all these classes, they’re providing the answers to all these questions. So you are doing ‘infrastructure,’ ‘public budget,’ etc. classes. You’re not *doing* ‘**economics**.’”

– “Jacob,” 2017

This latency of power within applied tools has the effect of cutting off potential sources of critique that might otherwise center the epistemic machinery inside orthodoxy’s black box. Instead, newcomers of all stripes are wowed by the seemingly value-neutral applied potential of economic tools. Epistemically, the latency of this power reveals itself when, e.g. in the case of Jacob’s challenge to Mankiw, the same

analysis doesn't work in different contexts. Similarly, to the ecological economists, the epistemic apparatus of economics is fundamentally incompatible with ecological science. The power of orthodoxy is a special case of disciplinary power – it functions to “restrict criticism, reduce the number of comprehensive theories to one, and to create a normal science with this one theory as its paradigm.” (Feyerabend, 2004). Indeed the process of circumscribed knowledge creation is seen by orthodox economists as a source of disciplinary rigor that has the potential to position economics on equal footing with the strong paradigm natural sciences, to operate with the “rigor” of a single unified theory.

When asked about whether they engaged with orthodox economics, or orthodox economists, my interviewees often scoffed at my naiveté. The hold of orthodox power is so thorough that ecological economists view a program of heterodoxy – organized differentiation over internal reform – as the only way to deal with orthodoxy's epistemological abuses. Orthodoxy's power is maintained through classic boundary policing (circumscribing a silo of acceptable methodologies and answerable questions), but also through ontogenic practices of socialization into the discipline that perform power as they impart it. By circumscribing an area of acceptable questions and providing the methods to answer them, the power of orthodoxy is maintained through work practices that position *techniques* as superior to *ideals*. Josh's dissertation in orthodox economics asked: “what is the ‘optimal’ rate to destroy the Brazilian Amazon?” He wished he'd been given the tools to ask: “How to prevent deforestation in the Brazilian Amazon?” But the search for tools to answer that question would have taken him outside of orthodoxy's area of practice.

The Ontology¹² of Epistemic Power

Now I shift to the epistemic conditions organizing an orthodox understanding of environmental problems: the work done by theories and numbers within the black box of economic calculation. A main thesis of this chapter is that orthodoxy isn't visible as hegemonic until its dominant logics are named by heterodoxy and critiqued as problems. As such, the heterodox challenge to orthodoxy begins with an analysis of the way environmental problems are conceptualized. The second half of this chapter is dedicated to examining the orthodox framing of environmental problems – the ontology of orthodoxy's epistemology. Though my informants – the heterodox ecological economists – necessarily formulate their own critiques of orthodoxy in the course of constructing a heterodox response, the following analysis is my own. Indeed, as I argue in Chapters 5, the epistemic distinctions made by heterodox practice do not fully account for the epistemic conditions organizing orthodox power. Here I draw both on my training in environmental economics, and my observations of the challenges faced by heterodox economists, to present my own theory the machinery of orthodox epistemology. Environmental problems are understood by orthodoxy through a particular theory of action - Coasian bargaining - made operationally possible by the operational rationalities of economic thought - substitutability and efficiency - and concretized through a particular framework for determining worth, the "externality."

¹² *Ontology* refers to the way ideas organize an understanding of the fundamental nature of a concept.

The Ontology of Epistemic Power: Coasian Bargaining

Economically, environmental problems are actions with unintended consequence. A tree is felled so a person can make lumber, generally not with the primary intent to destroy habitat for wildlife or absorptive capacity of CO₂. Most environmental consequences are diffuse in space and time. Particulate emissions - the byproduct of the combustion of fossil fuels - cause acid rain, which in turn contributes to the leaching of nutrients from soil. These complexities play out not through the ledgers and accountings of markets, but in the physical world of relationships between atoms, flora, fauna, nutrient cycles, populations, landscapes, and chaotic and predictable events. How can wrongs be identified, adjudicated, and rectified, and who controls the process? The search for a way of accounting for actions that have a harmful effect on “others” is an old and knotty problem in economics. Coase’s eponymous theorem¹³ – published in the 1950’s – provided what would prove to be the foundational epistemic framework for a solution to the indeterminacy of trans-boundary problems. Though not initially put forward in his writings, the prevailing interpretation of the “Coase Theorem” has come to mean that as long as property rights are clearly defined and transaction costs are low, third-party interventions to “solve” environmental problems are not necessary because *the individuals involved can always efficiently negotiate a solution*. That is, pollution – preconceived as an unfortunate but unavoidable byproduct of activities that generate positive (economic) benefits – entitles those who can causally demonstrate harm to

¹³ Coase’s contribution was actually popularized by George Stigler, of the Chicago School of economics, who coined the term “Coase theorem” in his 1966 textbook. The analyses that are facilitated by Coase’s writings – which seem to assert that politics can be obviated by economic calculations - have rendered him an icon of the political right. In practice, Coase is said to have rejected the possibility that his theory was perfectible, asserting that efforts to rectify unintended consequences were an inevitable cost that should be acknowledged as intrinsic to the adjudication of unintended effects.

access a reasonable share of those benefits. Environmental problems are now widely imagined as extending from the general case of this problematic: as wrongs that can be fixed through rational negotiation. That is – Coasian rationality allows pollution to be not so much a wrong *inhering in* an economic process, but a *rectifiable byproduct of* human progress. Harms become “externalities” to be “internalized” – typically using money as a medium of exchange.¹⁴

The epistemic power of the Coasian imaginary is that it supersedes considerations of time, money, and effort required to adjudicate the nature and quantity of environmental harm; indeed, The Theorem requires that these factors have negligible influence on the analysis. This theory of action is premised on another fundamental theoretical assumption undergirding the orthodox approach to environmental problems: The Pareto principle – that is, that the outcome of a negotiation will be optimal for all parties involved in the transaction. Yet, the physical realities of ecological complexity – incomplete information, diffuse and unpredictable interdependence of systems across space and time – renders economic transactions a special case of harmful effects to “others.” The knotty nature of environmental problems often means that relevant information about the nature and extent of environmental harms is simply not possible to obtain. Worse, change may be irreversible, as in the cascading and emergent effects of the Fukushima nuclear disaster. Coasian bargaining is hardly sufficient to the rectification of environmental problems. The Coasian approach fundamentally elides political

¹⁴ There are some notable exceptions, including the in-kind practice of “mitigation banking” under Section 404 of the Clean Water Act, whereby the destruction of one piece of nature in one location can be legally compensated through the restoration of a different piece of nature in another location, so long as the “exact function and value” is maintained.

considerations, as any opponent to economically-efficient (profitable) interests is characteristically fragmented and weak.

Yet the option of reforming environmental politics through a critique of Coasian analysis is a train that has long left the station. Environmental economics takes Coasian negotiation for granted; ecological economics does not waste time with critique. Environmental policy – which has come to mean the naming and righting of wrongs by making polluters pay – is premised on a Coasian understanding of the origin of environmental problems. Indeed, the ubiquity of the Coase theorem within orthodox logic has rendered its *explicit* use unnecessary. Environmental problems are now conceptualized implicitly within the imaginary of a Coasian solution – as in-kind negotiations with “rights” mirroring “wrongs”; an optimization problem that can be solved given significant time, information, and analytical sophistication. The fixes put forward perform a negotiation between polluters and those harmed by pollution, between costs and benefits, using financial instruments as a common medium of exchange between economics and nature.

The ontology of Epistemic Power: The Operational Rationalities

In Chapter 1, I presented an analysis of the deployment of economic transactions (“PES”) ostensibly made on behalf of nature. Here I examine in greater detail the rationalities that allow the those numbers to become concrete. Heterodox thinking is inspired by a critical orientation to the uses and abuses of economic abstraction as a source of epistemic power. In contradistinction to the clear and efficient argumentation privileged by the mathematical model, heterodox critique centers the messy problematics

inevitably created by the application of such models to real-life conditions. Here I characterize the orthodox approach as emphasizing the efficiency of mechanism – “the invisible hand” – over efficiency in the backstage process of applying the mechanism. In the case of environmental politics, the identification and enumeration of countless dimensions of “ecosystem services” is far from an efficient Coasian bargain. Rather, it represents an enormous undertaking of time, effort, scientific expertise, and ultimately political power.

There are two core operational rationalities enabling the economic calculation of ecological value: the ideal of *substitutability*, by which things are made equivalent and subject to a common medium of exchange, and *efficiency*, the neoclassical ideal through which the calculative mechanism of orthodox economics is justified.

The core imaginary at the heart of any economic accounting of nature is the substitutability of manmade capital for natural capital. In the perhaps ironically titled “Sustainability, an Economists perspective,” Nobel prizewinning orthodox economist Robert Solow articulates the neoclassical view as agnostic about both ecological destruction and species extinction as intrinsic problems. He states: “there will always be another species of fish.” (Solow, 1991). That is, the doctrine of substitutability renders the following three objects of equivalent value: money paid to harvest the last individual of a species, that last individual, and an individual from another species. This methodological black box is embedded in all of environmental policy, and much of environmental politics. Rather than bother with a complex world of ecological relationships, the orthodox ideal requires nature be dissemblable into fungible parts which obtain value via whatever a market will bear. Via the common medium of market

exchange, the significance of ecology becomes an epistemology of economic parts: what *has been, would, or **could be*** paid for tangible bits of *useful* nature. So long as each garners an equivalent price, no part of nature is more important than any other. The ontology of ecology as fungible units performs a powerful task for orthodox economics. In rendering pieces of nature usable by the price system - an analytical tool intended to adjudicate decision-making *about* nature - it provides a rational armature for strategic avoidance of emergent effects.

The second operational rationality at the core of orthodox epistemic power is the ideal of efficiency itself. My thesis is that the implicit argument for ‘efficiency-based’ conservation rests on such a syllogistic sleight of hand, which logicians call the ‘fallacy of equivocation.’¹⁵ For modern conservation, energy-saving, cost-effectiveness, and other efficiency-based metrics are unimpeachable as environmentally beneficial actions. In fact, “efficiency” here does double discursive duty. Orthodox economic theory is also premised on “efficiency,” via the transactional efficiency of the Coase Theorem, and the supposed allocative efficiency of a market-determined Pareto-optimal distribution of goods in society. This twin “environmental” *and* orthodox economic acceptability of the efficiency concept rests tenuously on a central syllogistic elision within the epistemic black box. “Efficiency,” in fact, has two meanings. The steps of the elision are as follows:

1 – **efficiency** ₍₁₎ = Efficiency, defined as an effective approach to conserving and protecting natural resources (saving energy as equivalent to saving resources)

2 – **efficiency** = Efficiency, by its longstanding neoclassical definition, as the efficiency of price to factor inputs, not of underlying material resources.

¹⁵ This insight owes much to James Ferguson’s 1994 *Anti-Politics Machine*, which makes a similar case regarding the false linkage between contemporary ‘development’ discourse and colonial marketization via the common ideal of ‘progress’.

3 – **efficiency** (2) = Therefore, because the price system is fully implicated in neoclassical approach to efficiency, ‘efficiency’ of price comes to mean an ‘effective approach to conserving natural resources.’

The elision-in-practice of these two meanings of a seemingly simple concept is a source of orthodox epistemic power. It has obfuscated both the project of modern environmental economic approaches as well as hamstrung the universe of possible alternatives. One should ask: efficiency of *what*? Efficiency has become shorthand of its economic meaning. This uncritical short handing is a source power for the rationality it supports.

The Ontology of Epistemic Power: The “Externality Theory of Value”

Deploying the framework of the Coase Theorem as its theory of action, and the operational rationalities of substitutability and efficiency, how does environmental policy go about determining ecological worth? The legal proceedings following the 1989 Exxon Valdez oil spill in Alaska were instrumental in establishing a process for the redress of ecological harm through economic compensation. In addition to addressing the direct losses to fishermen’s profits and the livelihoods of others who had been directly affected, damages were calculated by surveying a sample of all United States households about their hypothetical “willingness to pay” to know that the Prince William Sound had been restored. Literally – a representative sample of households were asked what they *might* contribute towards the imaginary of a restored ecosystem. Those values, elicited but not paid, averaged \$31 per US household. That hypothetical price was then aggregated over 91 million households to create a mathematical damage function totaling \$2.8 billion.

That is, through a survey of individuals who had never set foot in Alaska, a *market* for the loss of “ecological services” was created where no market had existed before (Fourcade, 2011). By way of restitution for the ecological catastrophe it caused, Exxon corporation was charged with funding that market. The 2.8 billion dollars was then apportioned to those who successfully made a legal claim – in the Coasian tradition – of a direct loss of economic livelihood.

This approach to adjudicating the worth of nature may seem bizarre, but it represents the only mechanism through which neoclassical economics can apprehend ecological value. In the contemporary neoclassical approach to economics, nature is granted no intrinsic worth. Rather, certain consumable pieces of nature acquire a kind of implicit value as physical raw material for market goods via economic transactions. This ‘hedonic’ approach to assigning value renders nature into tangible pieces, pitting it against other goods via individual marginal transactions on existing or hypothetical markets¹⁶. The Exxon Valdez case typifies the philosophy of neoclassical economics as applied to nature. It dutifully deploys the major components of neoclassical economic theory – methodological individualism, equilibrium, efficiency, the price system – at the core of orthodoxy as applied to environmental problems. It’s logics are consistent with the practice of *environmental* economics, which seeks to re-optimize the neoclassical production function to try to account for environmental problems.¹⁷ The Exxon Valdez

¹⁶ Hedonic price theory is a way to estimate the “embodied value” of something by subjecting it to market conditions. Through hedonic pricing tools, pieces of nature become “environmental goods” or “amenities” created through mathematical models of what would or could be paid for them.

¹⁷ A distinct body of work also operates ostensibly at the intersection of ecology and economics. Unlike *ecological* economics, *environmental* economics does **not** claim a heterodox mantle. Instead, it exists comfortably yet marginally as a sub-discipline within orthodox neoclassical economics. Environmental economics applies neoclassical economic methods to modern environmental problems – optimizing the ecological “costs” of economic activity – through an assigned value of monetary damage caused to nature –

case is illustrative of the normalization of environmental problems seen as parsable, adjudicable units, akin to PES's "services" from nature. Indeed, the purpose of valuation is to come up with *any* value – "a bad underestimate of infinity" – as economic models cannot function without value inputs. With the question of value settled through hedonic pricing, a market is established to adjudicate costs and benefits (Fourcade, 2011, Porter, 1996). Hedonic valuation has no way of apprehending intrinsic, relational, or emergent values. In the Exxon case, the claims of native peoples – who presented evidence of wholesale and perhaps irretrievable damage to their indigenous way of life in its *entirety* – were rejected by the court. Orthodox analysis was only interested in "values" rendered legible in market terms.

This is the epistemic machinery of the orthodox approach against which heterodoxy positions its dissent. Both explicitly and implicitly, the orthodox approach invokes and rearticulates the logics of the price system. Here I argue that it is the mundanity of this very *ubiquity* of market-generated price – as opposed to consideration for scientific, indigenous, or other claims on ecological knowledge – that is a source of orthodoxy's inertial power. Environmental politics writ large has accepted a discourse of value-in-exchange precisely because a sufficiently parallel language of countervailing value does not exist. Those engaged in improving and perfecting schemes to attempt to remediate this problem – e.g. the project of PES – do so by adding ever-expanding dimensions of value to existing hedonic frameworks (such as "cultural values,"

against its monetary "benefits," also in the form of a hedonic utility function. These ontologies and methodologies of environmental economics are embedded in environmental law, policy, and a good portion of environmental politics. Environmental economists don't intend to change the fundamental mechanics of orthodox economics, they want to solve environmental problems by working within them. The mundanity of environmental economics' pervasiveness in environmental life often serves as a foil against which ecological economics counterposes its attempts at heterodox discipline-building.

“existence values”, “non use values” etc.). They are kept busy with local optimizations while the epistemic sources of orthodox power go unchallenged. Though instruments like PES attempt to “account for nature” – ultimately “ecological” values are transmuted into economic terms. Orthodoxy’s hegemony is maintained by preventing any other type of value from nature from being relevant to the *inner machinery* of economic analyses. This value-in-exchange ignores nature – until and unless nature is exchanged. I call this totalizing discourse the “externality theory of value.” I now examine the epistemic machinery constructing nature as an outcome of value-in-exchange.

The externality is an apologetics for the hegemony of neoclassical hedonic pricing of nature. Where Coasian bargaining is orthodoxy’s theory of action, the externality is the concrete framework from which it builds its rationality of adjudicating worth. The ‘externality’ is the label given to an unintended byproduct of the machinery of neoclassical economics within that black box of the market. It was coined by A.C. Pigou in 1920 to describe the ‘spillover’ of costs or benefits of activities onto third parties (Pigou, 2013). Central to the theory of externality is that actors demonstrate what they value through action – or, such as in the Exxon case, are held accountable after a widely unpopular accidental action.¹⁸ The externality is a concept created to concretize and rationalize the emergent socially and environmentally-significant outcomes of private choices, a back-rationalization of the effects at stake that weren’t taken into account during the pursuit of economic gains. With attention diverted towards ‘internalizing’ negative externalities through policy mechanisms like taxation, the pursuit of economic gains can be left sacrosanct. The logic of the externality provides a one-stop-shop for a

¹⁸ However, Lionel Robbins challenged the universalism of the externality in the 1930’s by demonstrating the indeterminacy of a comparison of utility between different people – as required by Pigou’s theorem. Now, “measuring” utility requires either guesswork or external exchange.

crucial epistemic transition: from the ontological “is” to the practical “ought” – from problem to solution. Where an “unintentional” consequence has not been rectified in Coasian terms, the “fix” becomes the externality – and helping along of the failed Coasian bargain through its *internalization*. The end-game of externality-hunting is a comprehensive dragnet of data: “The value of all externalities would need to be worked out by economists, ecologists, and others and incorporated into the prices of the goods that generate the externalities.” (Daly and Farley, 2010) Indeed, the great power of the externality is in its epistemic machinery- in both the daily work practices it requires of people, as well as the work of rationalizing its machinery performs. In cleaving negative consequences from their source and deeming them ‘unintended’ and ‘external’ to the rationality of the economic black box – the externality contains within itself an implicitly provided solution. Through its avoidances and separations, the externality sanctifies two powerful elisions: the externality separates “the pursuit of economic gains” from the creation of environmental problems, and merges the problematic phenomenon with a mathematically matched solution. The typical environmental project thus becomes a technical task, to ‘internalize the externalities’ – through the enumeration of discrete, identifiable, measurable, redressible quantities of harm, and the proposal of projects that might correct it – from *local* wetland restoration to a *global* climate accord.

The externality is, therefore, both a **boundary object** as well as its own **black box**. It both creates and circumscribes the area of environmental concern. That is, ‘*nature*’ does not exist – ‘*out there*’. As far as the economic system is concerned, the natural world has no value antecedent to an interaction with the economic system; it does not ‘exist’ in orthodox terms until and unless it becomes implicated in economic

exchange. Nature is constructed by the economic system through the same process by which it is subdued. Untapped natural resources and undeveloped landscapes have merely not yet been spoken for, or, they have no agency to speak until and unless they can provide value-in-exchange for the economic system.

In compensating the ‘losers’ of industrial progress, the externality brings their claims of damage over the boundary and into the economic sphere. The ‘invisible hands’ inside the box then rationalize the terms of this exchange. Neoclassical environmental economics centers its disciplinary problematic on the framework for valuation that the externality creates. In separating some consequences from their antecedent cause, orthodoxy creates a market for its own solutions. If an unwanted byproduct is to be redressed, the readymade mechanism to do so is to “*internalize*” it through economic mechanisms. The epistemology of the externality is that of classical physics – commensurable quantities, cause and effect, equal(ized) and opposite reactions. That is – through a process of parsing, accounting, and commensuration, a “just” exchange across this boundary is rationalized and adjudicated to the standards of the discipline. Facilitating this exchange is the very same market process of commensuration between social and physical values that produced the externality. Indeed - because the market transaction serves to adjudicate the epistemology of ecology - the frontier of the externality is coterminous with the frontier of economics’ ontology of physical reality.

In constructing this “externality theory of value,” the boundary work done by the externality is the foundational ontology of neoclassical environmental economics. Because the externality-based approach has no way of apprehending ecological value antecedent to a functional interaction with the economic system, ecological economics

seeks to find a way around it, rather than “through” it (e.g. either via PES or hedonic pricing). The goal of ecological economics is to dismantle the externality and reconstitute an ontological epicenter of human-environment interaction.

Conclusion: Formalized Unconcern

Earlier in this chapter I claimed that environmental problems are “actions with unintended consequence.” Dear reader, the crux of the problem with orthodoxy is that this popular conception is fundamentally incorrect. Environmental problems are *modeled by* orthodox economics *as if* their genesis was unintended. But in an era where the evidence linking neoliberal rationality to widespread ecological harm is unimpeachable, how much longer will economists allow the inner machinery of that rationality – orthodox economics – to keep on ticking? The black box of orthodoxy contains the epistemological mechanisms that render it profitable and rational to destroy nature. A more ecologically accurate account of the origin of environmental problems might place their genesis not in unintention, but in *unconcern* for consequence. Indeed, the project of heterodoxy is to interrogate the supposed parallelism between action and consequence – grounded as it is in a theory of nature as existing only as value-in-market-exchange. Ecological economics locates *imperfectability* not in a failure to fully implement orthodox theory (“internalizing the externalities”), but within the epistemic apparatus of the theory that defines “unintentionality” as the source of environmental problems. This approach seeks to invert the Coasian rationality – from “environmental problems” as a supposedly rectifiable byproduct of human progress, to a wrong inhering in an economic

process. The heterodox analysis then places “the pursuit of economic gains” firmly at the center of critique.

In this chapter, I have rendered visible the dominant logics of orthodoxy, the ontogeny of their social replication, and the ontology of their epistemic rituals. A main finding is that orthodoxy isn't visible as hegemonic until its dominant logics are named by heterodoxy and critiqued as problems. In my next chapter, I develop a theory of heterodoxy, the social and epistemic apparatus through which dissenters from orthodox power intend to construct a “way out.” My aim is to build a sociology of epistemic dissent.

Chapter 3

Heterodoxy: Illuminating the Paradox of Epistemic Mismatch

*“The greatest enemy of knowledge
is not ignorance
it is the illusion of knowledge”*

Stephen Hawking
(apocryphal)

“You get what you measure”

Robert Costanza
(2018 editorial in *Nature*)

After the End of Steam

It's the last day of the 2015 joint meeting of the *Canadian and United States Societies for Ecological Economics* (CANUSSEE). "Rich," a young PhD candidate in economics from a major Canadian university, is presenting his dissertation research. This is Rich's first ecological economics conference, and his articulate confidence belies a perhaps inevitable fate: in about 12 minutes, he will receive a strenuous critique from the audience. Rich is enthusiastic and articulate. His talk is rife with sophisticated economic equations presented in the florid empiricism of mathematical detail. His slides brim with equations; his equations are awash with variables; his variables are drawn from a sea of long-ago-abstracted numbers – numbers which in turn are meant to represent soils, trees, animals, plants, and molecules of carbon dioxide. This extensive apparatus serves the ostensible purpose of Rich's analysis: to preserve a particular watershed. It is clear that Rich has invested countless hours grappling with the analysis of this data. So it must come as a surprise to him when the assembled audience displays complete disinterest in the accuracy of his numbers, the mechanics of his variables, or the assemblage of his chosen equations. He will receive no query about the usage of a variable, the relevance of a statistical assumption, or even the precision of his analysis. No-one will question the solidity of his mathematics.

Rich doesn't know it yet, but the seed of his downfall instead begins in the very mundanity of a statement of what he considers to be glaringly obvious. By way of clarity, he gives a succinct summary of the imaginary that is behind all of neoclassical environmental economic thought: "Properly designed environmental programs pay for

themselves.” To facilitate this design, Rich continues, the task of the economist is to “get the prices right” – to uncover the *value of nature* so that it may be accounted for in economic terms. It is decidedly unremarkable that Rich would frame his research in this way; it is unsurprising that he would task his analysis with filling in the local specifics of a truly massive project of optimization. “Getting the prices right” is the ostensible task of *all* environmentally-oriented economic projects. Or so Rich Believes. In the world of economics – the field that will in two months award Rich its highest educational credential – it is a tenet so obvious that only a beginner would bother to assert it.

And yet, as a not-quite-certified-expert, Rich just *might be* within the window of being open to conversation about what the premise of “getting the prices right” leaves unaddressed. At least, this is what his present audience is clearly hoping. They are hoping to convince Rich that when he refers to the conceptually alluring ideal of “getting the prices right” – he is not talking about an intrinsic quality of nature itself, he is talking about making nature into something legible to the abstractions of economics. If they can get this far, they will work to convince him that environmental policy premised on the values of abstracted nature is not sufficient to preserve nature itself. These heterodox economists are hoping to show the young economist that the ground upon which he has built his analysis – his equations, variables, and the logic that holds them together – is the wrong approach to thinking about nature.

This third dissertation chapter is the first of three in an ethnography of the epistemic and social space of ecological economics as a *boundary community*. In this chapter, I shift to the social world of heterodoxy – and its attempts to organize around an alternative framework that would forestall the epistemic abuses of economic orthodoxy as applied to the ecological world. Members of the *Canadian and United States Societies for*

Ecological Economics interrogate the analytic appropriateness of economic tools applied to ecological knowledge. They are uneasy with the premise of the economic problematic – the transformation of nature into utilitarian pieces, parsed into uses, rendered into variables, balanced with equations against a devalued future. In the following pages, I characterize the epistemic project of heterodox resistance– reflecting organized dissent from a field of epistemic power. Heterodoxy is simultaneously *radical* – it challenges the supposed parallelism between representation and valuation across the interface of ecology with environmental policy¹ – and *reformist* – it’s work goal is to create a legible replacement to orthodox practice.²

This ethnography of environmental policy examines a paradox at the intersection of two fields in an ostensibly urgent and necessary conversation. The discursive backdrop of “the Anthropocene” has well established a sociotechnical marriage of ecological problems with economic solutions. The tenor of *environmentalism*, in turn, is increasingly oriented towards the commensuration of ecological *values* with economic *tools*. In the name of environmentalism, we are pushed to pursue certain goals – e.g. efficiency, the commensuration of carbon dioxide with dollars through taxation – that are animated by the logic of economic ideals. Driven by the anthropogenic engines of industrial growth – the processes of ecosystem decline are ideologically underpinned by the rationality of neoclassical economics. This includes efficiency and marketization, as well as the axioms of “individual as rational agent” and a society governed by consumer choice. In our efforts to “save the planet,” we ostensibly heed the findings of ecological science. Yet the flow of information in the world of environmental policy is uneven.

¹ See Chapter 2 for an introduction to this discussion.

² See Chapter 4 for a discussion of what would be required in terms of a replacement.

Nearly every classroom, textbook, policy proposal, political debate and activist screed about the future of nature continues to be very much engaged in applying economic principles to ecology, rather than ecological principles to economics (See chapters 1 & 2). In the two decades following “Harvey’s Lament” (Chapter 1), a kind of disciplinary-scale cost-benefit-analysis has accompanied the spread of financial cost-benefit-analysis into ecology. Ecology is expressed – and understood – in the language of economics. The terms of that commensuration will have profound consequences – both for the future of environmentalism and the future of nature. To be successful, the interdisciplinary project of ecological heterodoxy requires not merely dismantling the edifice of neoclassical economics – both enormously powerful and mundanely ubiquitous (Chapter 2) – but also formulating a coherent analogue – or set of analogues – to put in its place. Through this ethnography of an heterodox critique, I hope to contribute to problematizing the assumed mundanity of workaday commensurations of ecology with economics.

The case of ecological economics presents a unique opportunity to ethnographically “study-up” (Nader, 1972). It reveals that some of the centers of dissent against managerial economics of nature are actually coming from *within* the field. The ecological economists, as technical actors in the world of environmental policy, have rebelled against their own technical thing: environmental governance via the price system of value. Their dissent is new and distinct from other environmental social movements in that it presents a direct challenge to the epistemic machinery that renders economics a hegemonic discourse of nature. Ecological economists are not luddites, separatists, or isolationists. Nor is this – a project organized by highly educated elites – a dissent of ignorance or a rejection of realist knowledge. Rather, in asking that economics incorporate core ideas of ecology, heterodoxy is a dissent that foregrounds the

consequences of elite's ignorance of science. Like the hegemony of orthodoxy (Chapter 2), the dissent of heterodoxy implicates epistemic content as well as social structure. By studying the process of heterodoxy, I aim to shed light on a perennial goal espoused by many environmental thinkers: making ecological values visible, rational, and actionable in non-economic terms. The ecological economists are attempting to formalize the non-economic work done in this direction by an inspirational legacy of vaunted environmental thinkers, including Aldo Leopold, Rachel Carson, and Wangari Maathai, among many others.

Both my mode of analysis and object of analysis take me beyond “plain critique” – the kind that Bruno Latour famously pronounced as having “run out of steam” due to its agnosticism about informing action (Latour, 2004). Indeed, this dissertation does not take up the task of dismantling neoclassical environmental economics – either its ideologies or its effects– a task which hundreds of authors have handily accomplished in path breaking and persuasive literature (e.g. Castree, 2008, Kosoy & Corbera, 2010, McCauley, 2006, Robertson, 2012, Spash & Vatn, 2006). Rather, my project is an ethnographic account of the social conditions and epistemic resources marshaled to cohere a critique as a *competent whole*.³ By this, I mean dissent that assembles a wholesale alternative approach, incommensurable with a summation of marginal reforms. It is a critical study of the production of alternatives *through* pushing a more or less institutionally cohesive critique into a socially organized “next step.” The ecological economists have put forward a family of questions about the appropriateness of economic tools of analysis to apprehend ecological dynamics. Their fundamental finding is that neoclassical economic

³ I am defining the term “competent whole” to describe an outcome of piecewise analysis that yields a coherent total apprehension of the analytic object. Analytical methods have collectively failed if their additionality of their use does not obtain a coherent collective outcome. See also Chapter 4.

tenets of marginal valuation and commensuration are the wrong tools – they misapprehend ecological dynamics – for the wrong job – their implementation has proven to have anti-ecological effects.

The ecological economists are analysts of their own situation – of what is required to push against and transform orthodoxy – so I let their actions drive the context of my analysis. Heterodoxy’s monumental task is to locate epistemic failure within the machinery of the economic approach to nature. At home within the black box of economic calculation, they have tinkered with its parameters and arrived at a paradoxical conclusion. As masters of the economic calculations required to construct an economics of the environment, they have come to believe that partitioning nature into pieces of economic value actually results in its devaluation. They conclude that economic representations *of* nature – seeing nature through economics – actually results in expansion of the economic system rather than, as all environmentalists who use economic tools intend, containing ecology “away” from the effects of an industrial economy. That is, orthodox economics performs the paradoxical effect that seeing “through” the economic system drives expansion *of* the economic system. The ubiquity of orthodox belief as a contemporary discursive logic animating neoliberalism requires that heterodoxy go a step further. Its radical assertion is not merely a critique of the inappropriateness of economic tools. If heterodoxy is successful in painting environmental problems as not a result of incomplete accounting, but a wrong *inhering in* an economic process - then the action animating the economic process (“*the pursuit of economic gains*”) is up for critique. That is, the inner logics within the economic black box produce material realities antithetical to ecological science. And the *application of economic instruments to nature* – the present approach of environmental economics – is

untenable in the face of an alternative that would, as the ecological economists intend, *incorporate ecological principles into economics*. Rectifying this epistemic mismatch through an “analytical inversion” (Chapter 4) as a would-be replacement is heterodoxy’s reformist goal. In taking heterodoxy seriously as a social and epistemic process, I theorize what might be required to map a *way out* of this conundrum. This so-called ‘ecological economics’ is an unfinished project, requiring the marshaling of significant epistemic and institutional resources. The challenge of heterodoxy is to overcome a series of commensurative paradoxes in the heart of the black box, and develop a catalog of ecological constructs that could form the armature of a new approach to environmental policy.

This chapter follows the ecological economists as they make the case for the imperfectability of that machinery – assembling a radical challenge to the armature of the contemporary imaginary of not just an economics *of* the environment, but environmental policy and the structures and strategies of environmentalism itself. It is also, necessarily, an ethnography of the social processes associated with assembling a heterodox moment. My analysis draws on ethnographic observations, primary research with participants in the field, and interviews with both newcomers and longstanding participants, including foundational figures. The biography of these people is emblematic of the epistemic path they are taking, and is instructive of how scholars and citizens might come to recognize, challenge, and provide alternatives to the objectification of nature at the hands of economic logic. Though ecological economists have proffered theories about how their project is structured, the content of this analysis is my own.

As a means of systematizing knowledge, even knowledge about nature, the *field* of economics is operationalized quite differently than that of ecology. Ecologists might

approach Rich's assignment to preserve a particular watershed quite differently. The ecological imagination might begin by measuring stream flow and describing it through the biophysically-grounded gallons-per-minute. But ecologists wouldn't only look at the stream. They would characterize the stream's data contextually alongside other dimensions of the local environment: pH, soil type, slope gradient, canopy cover, evapotranspiration rate, prevailing winds, etc. They would then go into great detail to correctly identify each component and set of relationships that together typify the dynamics of the local hydrological system. Perhaps the system's common metric would be expressed in units of water – but even an ecologist specializing in hydrology would remain keenly aware that it should also be described in terms of energy flow, nutrient cycling, and food webs. Indeed, the ecological imagination requires the juggling of multiple incommensurable dimensions simultaneously. The field's discursive norm is the concatenation of multiple types of data to describe a particular ecological place. Environmental economics, by contrast, is not so much concerned with the questions of “correctness” in an initial assigning of descriptive values. Nor does it trouble itself with seeking the commensurations that would be required to reduce ecological complexity to a single metric. Rather, economics centers its project of optimization on the outcome of a financial market. This is epistemic mismatch. When dealing with an ecological problem in economic terms, environmental economists like Rich must negotiate a tricky concordance. They must assign monetary values to pieces of nature at a level low enough that nature may be *useful*⁴, and high enough that it not be used “too much.” If Rich can

⁴ Utilitarianism is the basic ethical principle preceding economic analysis. For pieces of nature to be sequestered entirely from economic activity, neoclassical economists sometimes speak of “non-use” values, but these values can only be generated and assigned by setting up “hypothetical” or “shadow” markets, constructs which are nonetheless modeled to behave in utilitarian terms.

show that a watershed produces so many gallons of freshwater, and the health of its surrounding ecosystem requires access to so many gallons, he'll know how much he'd need to charge for the privilege of extracting the gallons in-between. If Rich has data on human demand for those gallons, he can construct a function that apportions demand to its "highest" – that is, its most economically efficient – use. The economic price of a gallon, therefore, is neither an identity of the gallon, nor is it a property of the material of water. Rather, it is a reflection of an assumed relationship between how much money might be exchanged for a gallon, and an ecologically determined acceptable number of extractable gallons.⁵ As water grows more scarce, its continued extraction will, by definition, be driven by those with the highest ability to pay.⁶ This logic is dictated by application of basic economic theory: the axioms of consumer choice, individual as rational agent, and the allocative efficiency of markets. Applied to the ecology of "resource problems," this rationality leads to projects of searching for and then allocating payment to charge "user fees"⁷ and "internalize externalities."

⁵ Absent the environmentally-aware economist setting an "ecologically determined acceptable number of extractable gallons," the price of a gallon will be a function – not of ecological signals at all – but only of available supply and competing demand, escalating theoretically to an infinite absolute value as the last gallon of an essential resource is consumed entirely. Orthodox economics is agnostic about the doomsday scenario of total consumption of any particular resource, because the doctrine of substitutability holds that lower-priced substitutes – including in the form of the "man made capital" created through the consumption of "natural capital" – will be available as a more economical "replacement."

⁶ Indeed, because markets maximize the marginal utility of those with the highest available resources to spend, the ecological economists' definition of the fundamental orthodox tenet of "economic efficiency" is, in the words of Josh: "starving the poor to meet the needs of the rich."

⁷ This process, of "providing the chance for a *beneficiary* to pay a *user fee* for nature" has become quite popular within environmentally-oriented economics. Even as it is not a heterodox approach, it nonetheless pervaded the 2015 meeting of the CANUSSEE. I explore this dynamic of retrenchment and other "unboundary work" in Chapter 5.

The Question of Value

As I established in Chapter 2, the contemporary algorithms of environmentalism are drawn in the language of neoclassical economic theory. In this microeconomic approach to nature, value is negotiated through the action of exchange – by the ‘invisible hand’ within the very black box of the market transaction itself. From an orthodox perspective, the environment serves three purposes: resources for production (since World War II, evaluated through “natural resource economics”), assimilative capacity to absorb pollution (since the 1960’s evaluated as “environmental economics”), and, more recently, direct utility related to the individual’s enjoyment as a “user” of nature (amenity value) (Sandmo, 2015).

This orthodox approach to environmentalism operates within the imaginary that environmental problems (as economic problems) are epistemologically issues of scarcity that can be self-correcting through optimization using the technical tool of marketization.⁸ That is, assigned value based on aggregation of individuals’ ability to pay. Insofar as they cannot be communicated as hedonic ‘functions’ or ‘benefits,’ other reasons to preserve nature – e.g. cultural, spiritual, social, non-utilitarian, indigenous, rights-based or justice-oriented frameworks – are not counted as it is not possible to communicate their extra-economic value in orthodox models. Orthodoxy sees nature as a set of products, or benefits, to be integrated into economic production functions. The scientific relevance and social severity of environmental problems are put on trial in a court with a singular evaluative ideal: efficient allocation of highest-order economic use. The operational mediation between ecologically-grounded value and an economically-

⁸ Even the climate problem – scientifically understood as an overabundance of CO₂ and other greenhouse gases – is analytically framed in its black-boxed economic rationalization as an issue of scarcity of atmospheric absorptive capacity for pollutants.

modeled ecology is efficient balancing through price. The project of heterodoxy is to scrutinize the faith in the black box of marginal valuation, the logic of a one-dimensional scarcity-derived value (price), and the ideal of efficiency itself.

Though there are clear limits to what can be valued hedonically, economic models operate and hold political status *as if* they are able to account for all relevant pieces and connections that typify social and ecological life. Conventional neoclassical environmental economics prescriptions of pragmatically-oriented action rely on leveraging hedonically-rationalized price. Price-as-value, in turn, has a profound effect on broader discursive possibilities for environmentalism. Frequently critiqued within ecological economics as a “strange conglomerate,” price has the simultaneous character of both means and ends; it is an instrument of valuation, and the goal of valuation. Rather than re-orient the idea of what can be valuable, ecological economics’ critique centers on the inadequacy of the orthodox price system and the use of externality-driven action to evaluate, communicate, and justify ecological information.

The commensurative tool at the heart of economic rationality used to arrive at that “highest-order use” is cost-benefit-analysis (CBA) (Porter, 1996). Rationalizing an environmental problem as a CBA involves assessing and measuring all costs and benefits, including “externalities,” in terms of price and bringing that price to a “present value” by a given rate of discount. Many ecological economists argue that the practice of CBA raises a number of serious concerns. In a classic paper, Vatn & Bromley argue that “fundamental environmental choices are better made without prices” (1994). To make evaluative matters more difficult, the outcome of CBA is highly sensitive to long-term discounting – that is, the standard practice in economic models of assigning lower value to the future use of a commodified resource. The problem, argue the ecological

economists, is that – in a world of fundamentally finite resources – there is no “environmental” discount rate, and use of this instrument poses a landscape of fatally-circumscribed options for solving environmental problems. For example: At a 3% discount rate, ecological catastrophe on the order of the material damage wrought by hurricane Katrina (\$300,000,000,000) 500 years from now would be worth only \$110,000 today. At a 5% discount rate, the present value of preventing Katrina-scale damage in 500 years is only \$8. Indeed, the act of discounting the future in a finite world implies that “natural capital” and man-made capital are acceptable substitutes. That is, the doctrine of substitutability renders orthodox economics agnostic about preventing future Katrina-scale disasters because present-day dollars are worth so much more than long-off suffering. Carried to its logical conclusion, the imaginary of fundamental substitutability holds that the incrementally efficient expansion of economically driven encroachment will lead to *the singularity* – where human capital and natural capital are one and the same.

How did neoclassical economics arrive at the hedonic theory of value? Is *any* economic accounting of nature doomed to be ecologically incorrect? Is it possible – or desirable – to base an economic value system on an ecological unit – such as “intrinsic” or fundamental units of biophysical nature? Would such a revised accounting of nature be capable of protecting ecological resources by sequestering them from economic processes long-term? These questions drive at the heart of the epistemic task of heterodoxy’s twin project of critique and reform.

Western economic theory was not always organized around the supremacy of individual preferences – the foundational dictum of *De Gustibus Non Est Disputandum*

(“there is no accounting for taste,” (Stigler and Becker, 1977) – which renders the forces structuring individual action safely sequestered from scrutiny within the black box.

The first formalization of economics as a scientific study were made by the European **physiocratic** school in the late 19th century – during the height of an agriculturally extractive economy governed by a landed aristocracy. The physiocratic theory of value, in which value comes from land, is the only historical precedent for an economic epistemology that formalizes value as originating in a biophysical substrate. With the rise of industrialism, it became clear that economic value was increasingly produced by industrial processes. In Wealth of Nations (1776), Adam Smith famously provided an economic theory for the emerging capitalist class. Like Malthus, Marx, Ricardo, & Bentham, the labor theory of value was at the heart of Smith’s treatise – shifting the laws of economic power from material substrate to the means by which land is transformed via industrial processes. With the change from physiocratic to classical economics, value no longer inhered in an intrinsic source, but was only expressed through the capacity to act to transform that substrate (“labor power”). Smith described his disciplinary undertaking as ‘political economy,’ a “branch of science that aids the government in setting conditions that will stimulate economic growth” (Smith, 2003). With the stated mandate of the classical economy placed firmly within the context of statecraft and industrial growth, classical economics shifted the purposive orientation of economic thought away from Aristotelian concern for social justice. Though Marx’s Capital (p. 416) contains several lines referencing the importance of soil as a crucial – and exhaustible – substrate for the production of economic value, his theoretical contributions are overwhelmingly toward the development of a labor theory of value over a physiocratic or biophysically-grounded theory (**Figure 1**).

The rise of economic neoclassicism began in 1890 – and the change in orientation of the purpose of economic analysis exemplified by what Lionel Robbins would describe as “the science which studies human behavior as a relationship between ends and scarce means which have alternative uses” (Robbins, 2007). Neoclassical economics maintains classical economics’ analytical focus of methodological individualism – but makes a major break by embracing the governance of efficiency as adjudicating an “equilibrium” in economic processes. In the neoclassical world, value is imagined not as coming from physical land, nor potentiated labor, but from ‘subjective considerations of utility.’ The adjudication of value takes place as a tradeoff between competing “scarcities” (Robbins’ “wants”). This theoretical orientation ostensibly avoids allocative questions altogether, replacing the labor theory of value with hedonic utility, the “science” of the allocation of means. Critically, imagining the aggregation of economic value as a collection of subjective shifting preferences *absolves any individual or distinct group from responsibility for the quality of collective outcomes* – socially or environmentally. Since everyone is “free” to express their utility preferences (or, really, marginal preferences) on the market, in principle nothing bad can happen. With the late-20th century rise of neoliberal ideologies normalizing efficiency and the pursuit of profit, public reason has absolved the system itself of responsibility for bad outcomes.⁹

⁹ For an in-depth discussion of neoclassical theory, see The Evolution of Economic Thought (Oser, 1988)

	Time period	Source of value	Social context	Machinery
Physiocrat	1756 - 1776	Land	Aristocracy	Dynamic
Classical	1776 - 1890	Capital, Labor power	Statecraft and industrial power, The rise of capitalism	
Neoclassical	1890 - present	Subjective 'hedonic' utility	Global capitalism, Unlimited wants	Static ("equilibrium")
Ecological	TBD	Ecology, Energy	Equality, Justice, Material satisficing within limits	Interdependent

Figure 1: Value systems in Western economics: Classical political economy posits an 'objective' theory of value, but a dynamic model of the economic exchange. In neoclassical economics, there is subjective value (marginal utility), but a static model of economic machinery (the "equilibrium" created by the invisible hand). Neoclassicisms' focus on the individual elides social class, and also any provision for the context to apprehend ecological dynamics.

The job of orthodox analysis within neoclassical economics is to make nature "worth" valuing as a comparative option among many economically framed choices. It works towards this not as a result of apprehending intrinsic biophysical qualities, but – as Rich demonstrates – by collecting sources of aggregated marginal individual utility. The neoclassical imaginary of ecology is a regime of governance in which it is economically rational to pay for nature. This orthodox economic regime of *hedonic valuation* – has critical implications for the construction of ideas *of* nature. Does nature have value only at the moment of interaction with the economic system (market orthodoxy)? Does nature acquire value through the potential of such an interaction (hedonic valuation)? Or is nature *extrinsically* worthwhile in ways that are incommunicable in the language of economic utility – through some other means of acquiring value (ecological economics)? It is these questions that heterodoxy seeks to operationalize and, eventually, better formalize into a revised economic black box.

In the orthodox neoclassical language of user fees, the remedy for an environmental harm has less in common with the ecologists' work of teasing out the complex dynamics leading to environmental disaster – e.g. cumulative causation, tipping points, and complex interrelationships – than it does with the economists' famous quip about whether a \$100 bill on the ground is worth the effort of the transaction of being picked up. The banknote is not valuable as an intrinsic good – rather, it is only valuable if the individual in question values her effort to pick it up at less than \$100. That is, “value,” in modern economics, is never an intrinsic property or physically-grounded relationship, but *only arises as the result of a cost-benefit comparison*. If the passing pedestrian is sufficiently wealthy, nothing distinguishes the banknote from a piece of rubbish.

As described in Chapters 1 & 2, the regime of adjudicating user fees to fix environmental harm will require the work practices of assigning economic value to partitioned pieces of nature and then simultaneously refining the parameters of knowability and payability to emulate the contours of ecological processes. This sociotechnical regime has one use for ecological science: the construction of models of ecological systems to provide roadmaps to enough \$100 bills. Once all the “user fees” are identified and implemented, the ideal of this approach is that ecology will be preserved by simple virtue of its being too expensive for all but the richest people to consume.

The Allure of Deep Diving

The ongoing spread of the neoliberal imaginary of nature has insidious consequences that further the push towards an idealized goal of total valuation. This is

because, once begun, an incomplete implementation of this valuationist regime is potentially disastrous. If a dimension of the value from nature isn't articulated, it can't be priced. Pieces of nature that aren't priced are not valued. Nature that isn't valued greater than as an input to an economic process is destroyed. Already degraded nature, which by this definition possesses less value, can be destroyed more handily. Large gaps in ecological knowledge pose a looming existential problem for a regime premised on the need for total valuation. As one interviewee, an ecologist, put it: "We simply do not have either enough data, or the right data. It's estimated that only 86% of the planet's species have not yet been discovered, and we cannot appropriately value these unknowns" (Interview 8).

As an actor within this existing landscape of "price or die," Rich must be confident that implementation of his price model will charge sufficient user fees to preserve the watershed. Armed with a horde of data fed through complex calculations, Rich does seem confident. His first audience challenge is a softball question, with only one possible scientifically-correct answer: "What would you do to enhance the accuracy of your model?" Rich responds in a mode well-familiar to discourse at the interface of science with the public policy process. He laments the areas where his model lacks data. He would construct a more detailed environmental damage function. For this, more data inputs on the value to human health, agricultural productivity, and recreational resources would be required. These dimensions of the value of the ecosystem are meant to assess humans' demand – but can be more accurately described as assessing consumer preferences to enjoy the watershed. In speaking about his model's ecological *accuracy*, Rich is actually aiming towards its economic *effectiveness*. The richness of Rich's model doesn't necessarily require assessments of biophysical properties like ecosystem

function; indeed these properties are useless to a valuation model unless Rich can link them to a direct utilitarian benefit. Ecosystems, species, rivers, gallons of water, or even molecules of carbon dioxide have no intrinsic economic value.¹⁰ The model – having rendered an ecosystem into a technical problem of optimizing utilitarian benefits – appears perfectible. Rich easily identifies the next piece of work in this area: the further refinement of its various elements as an economic optimization.

The refrain is a familiar mainstay of technical work undertaken to inform environmental policy. With more data will come better answers about what is valuable; with better answers will come more certainty about “correct” prices; prices will induce behavior that values ecology. It is as if the policy process is a race between the engines of economic destruction and the drive towards economic valuation. A closer look at environmental policy premised on analyses like Rich’s reveals what it circumvents: the problem of scientific uncertainty about the workings of ecology is replaced with economics’ indifference to the ideal of intrinsic value itself. The best possible solution to capturing a better image of nature is to hope for more data – but *not* data about the inner *workings of nature*. Orthodox economics can only consider data about the *utility of nature* to humans (or, more precisely, to the economically measurable aspects of individuals’ ability to pay for wants and requirements). If ecology contains value not reflected in or translatable to this hedonically-generated price, then further refinements of economic models may never arrive at “correct” values.¹¹ The consequences of such a

¹⁰ My own experience in the world of environmental policy is illustrative of this epistemic elision. I spent several years working in environmental policy, including obtaining master’s level training in natural science research methods and conservation tools without realizing that natural science data is never directly admissible into (economic) public policy models.

¹¹ What is “correct”? In the ecological economists imaginary, a correct value for nature would be the result of a biophysically-grounded property. It would take into account interrelationships between species,

misappropriation for an ever-shrinking ecological sphere could be catastrophic. This focus on perfectibility through acquiring more data – rather than an overhaul of how that data is modeled ecologically – is an epistemic dynamic I call “**deep diving.**” The practices of identifying, measuring, and optimizing (economic) value to pieces of nature – through PES, “user fees” and other instruments – is the work of deep diving. It represents an epistemic imaginary that the economic modeling of nature is *perfectible* given appeals to more data about its use, and that perfectibility renders a provisional version of such a model a competent tool for the conservation of biophysical entities. Deep diving – ostensibly an attempt to enhance the accuracy of scientific inputs – is actually a continual process of working towards the ideal of complete economic valuation of nature. This process, and its reliance on perfectibility, is the elision that renders it provisionally acceptable to render ecological relationships and biophysical entities in economic terms.

My focus here is not on the particularity of various devices of valuation within a neoclassical economic paradigm.¹² Instead, I present my findings from dozens of observations of heterodox critique. The project of heterodoxy is to link externalities, services, and “user fees,” and other instruments of environmental valuation as driving one common epistemological process: the redirection of the complexity of ecology towards the formal logic of economics.¹³ Such reductivity has a paradoxical common effect on the

biomes, and biogeochemical processes, and the embeddedness of economic activity in ecological relationships. Such a value might therefore not be utilitarian, parsable to individual entities, useful, or even entirely knowable (See Chapter 4).

¹² To focus attention on the context and consequences of epistemic devices, and to trouble the perceived axiomatic solidity of various economic tools, throughout this dissertation I have made the deliberate choice not to transpose the details of technical work.

¹³ Indeed, arguably a main driver of PES’s rise to prominence is its *apparent* way to try to escape the problems of hedonic valuation due to some ostensible measure of analytical distance between identifying

sociotechnical apparatus of environmental policy: there will always be another population to survey, value to count, and dimension of resilience to consider. Yet, for those dimensions to *count*, they must be collapsed into the language of hedonic utility. I call this escalating nature of hunting for the “externality” and “services” the *paradox of deep diving*. Where Robert Solow famously dismissed the extinction of individual species by invoking an economic doctrine (substitutability: “there will always be another species of fish” (Solow, 1991), deep diving avoids acknowledgement of the totality of ecosystem worth through an analogous epistemic sleight of hand. Even as known parts aren’t valued enough to warrant their preservation, there will always be another dimension of ecosystem utility to measure, to appeal to, to keep calculating. Indeed, with externality as theory of environmental action, dimensions of economic utility derived from nature become visible as a consequence of their destruction. This paradox is particularly visible through observation of epistemic conflicts in a boundary community, like the field of ecological economics, where practitioners are actively negotiating the appropriateness of commensurating different types of data and questioning the terms of analysis that give it context, and – therefore – analytic meaning. The theory of deep diving centers the imperfectability of the price system as a complement to the epistemology of ecological knowledge. It evaluates the degree to which the analytical tools of economics work for evaluating ecology.

Rich’s second audience challenge comes gently enough: “Now that you’ve spent three days at this conference, is there anything you’ve learned here that would cause you

an ecosystem service and pricing it. The values of PES are nevertheless adjudicated hedonically, and its boundary object characteristics (Chapter 1) drive flattening into one dimensional metrics. This is part of what makes heterodoxy difficult – the deep diving that drives the “reaching” towards plural values appears to offer the promise of multidimensionality – the apprehension of ecological relationships.

to rethink or reorganize your approach? Can you approach this problem in any other way than “getting the prices right?” Rich is silent. He at first appears quizzical, then confused. After a few moments, he clicks through his presentation, and then begins to reiterate his analysis - ironing down the connections between his variables, the sequence of his equations, the ineffability of his conclusion. For this particular newcomer, at this conference, the proposition of considering these questions is a non-starter. Rich will continue to search for the correct prices, through the seemingly unassailable logic of correctness through price.

The ecological economists are a friendly bunch. Their meetings attract a wide range of academics from disciplines across the social and natural sciences, as well as students, activists, and laypeople interested in environmental issues. Over a period of 10 years, I attended 6 national and international meetings on 4 continents: first as a natural science student, then as a policy professional, then as a social science student. Rich’s experience is analogous to a scenario that I have observed play out dozens of times at every ecological economics meeting. A newcomer to the group, assuming methodological common ground given the name of the organization and the stature of its namesake journal, enters unprepared to find a landscape polarized over the question of what economics *is*. Eager to build their numbers, heterodox advocates continue to welcome newcomers, and push them towards engaging with that question. Like Rich, many newcomers are deploying neoclassical economics to solve environmental problems. Indeed, many claiming identity as ecological economists are doing the same – and enter the space initially confident that projects that deploy microeconomic valuation to “get the prices right” are acceptable to the community. The journal *Ecological Economics* has maintained a “big tent” policy: publishing a wide array of work, from orthodox valuation

studies to excoriating critiques of the field as not being heterodox enough.¹⁴ As discussed in Chapter 1, the journal *Ecological Economics* is an active site of contention in the battle to differentiate a heterodox school from the prevailing orthodox approach. But the controversy goes deeper than conflict over the appropriateness of deploying economic instruments in an environmental context.

Here I start peeling the onion – of the epistemic elisions entailed by “seeing” ecology through the economic system. What follows is a tour through the scale of paradoxes implicit in the neoclassical approach to ecology. I typify the scales and levels of critique required of heterodoxy to apprehend the problems with orthodox analysis. Heterodox critique reveals an epistemological mismatch – that the ontology of ecology – characterized by relationality and embeddedness – can’t be applied in practice with the methodological tools of economics – characterized by price and its mathematical foundation of one-dimensional valuation. In taking heterodox critique seriously, I find that pursuing conservation within the black box of the existing economic **system** **requires** a series of imbricated epistemic moves to commensurate the gaps between economic tools and ecological science.

The Paradoxes of Commensuration

At that same meeting in 2015, the graduate student of a prominent ecological economics scholar presented research on “collaborative valuation” in a community-based conservation project. “Patty’s” research has a noble goal: She is seeking render “indigenous values” visible in orthodox economic models. Her ecosystem valuation project is somewhat unusual in that it includes a survey of values elicited from a native

¹⁴ For a discussion of “Big Tenting,” see chapter 5

community on dimensions such as “*sense of place*” and “*spiritual wellbeing*.” With the added dimensionality of these values informing her models, she is diving deeper than Rich. Yet her final analysis – in which she comes to the “ecologically correct” conclusion by arguing for wholesale preservation in economic terms – illustrates that communicating ecological values in the formal language of economic value is a Faustian bargain. Patty’s hopeful question from the audience is voiced by Pearle, one of the few established senior women in the discipline: “Do you see any problem in the concept of valuation? Is there any way, in your model, to place spiritual wellbeing as a *non-negotiable essential resource*?” What follows is an uncomfortable back-and-forth. Like ships passing in the night, it is as if Patty and Pearle are on course to fulfill entirely different empirical trajectories. The senior economist tries to elicit an acknowledgement of the flattening that happens when all values are expressed in terms of economic price. Patty is incredulous. She is clearly frustrated that her model – which arrives at the correct solution – could be critiqued for the way it gets there. Her reply, dutiful to textbook teaching, is that the values incorporated in the model can be “non monetary” as well.¹⁵ Yet the project’s implicitly required commensurative process is a fundamental analytical conceit of economic analysis. Valuation relies on an epistemic elision, an incorporation of different dimensions in terms of common – and therefore fungible – units. Patty’s model came to the correct conclusion – that “spiritual wellbeing” was worth preserving, but it did so at the expense of reducing that need to an economic price. A price that may one day – in a

¹⁵ Perhaps as a quasi-acknowledgement of the importance of non-marketed value in of much of social life, “non-monetary valuation” (technically: the valuation of something for which there is no established market) is a mainstay of the toolkit in neoclassical environmental economics and informs a significant portion of the material of textbooks on the subject. Yet nothing in economics, whether deemed monetary or “non-monetary,” can escape maw of evaluation. See also the “reaching towards plural values” – e.g. “spiritual values” described in Chapter 2.

more dire economic landscape, in next year's revision to Patty's model, in a 500-year projection, at a 5% discount rate – be surmounted by something else.

In the present discursive environment, environmental policy bears a significant measure of obligation to appeal to economic modes of reasoning. Environmental outcomes are judged not primarily on ecological grounds, but also undergo a test of economistic rationality via ideals (e.g. efficiency) and mechanisms with assumed neutrality (e.g. cost-benefit analysis). The inevitable resulting friction between values, tools, methods and epistemologies renders the valuation of nature an active site of epistemic negotiation. The heterodox core of ecological economics is the assertion that the values of hedonic exchange are not representative of ecological reality. This is because, as Pearle gently suggests to Patty: “To get at the tradeoff process, you have to transfer everything to one metric.” In a certain sense, as asserted by heterodox practitioners, the problems of environmental exploitation are “a direct result of aggregate effects of process of economic commensuration” (Polimeni et. al., 2009). Given these realities of commensuration, ecological economics must therefore problematize the black-box logic that allows for accretion of individually efficient transactions – the aggregate effects of which, the field claims, will inevitably swallow the ecology. As one frustrated ecological economist put it: “economists haven't taken irreversibility seriously,” and, referencing the urgency of finding a countervailing force to battle the escalation of hedonic commensuration of ecology with price: “there are at least 8,200 contingent valuation studies out there.”¹⁶ Heterodoxy is a project of problematizing the ideal of commensurability itself.

¹⁶ *Contingent valuation* is an orthodox economic method of estimating value by asking individuals to place a price on something – e.g. In the case of the Exxon Valdez oil spill, Alaska's Prince William Sound.

The assumption that values can be made commensurate, and that commensuration is therefore a prerequisite to **rationality** itself, are powerful ideas worth exploring. The logic of commensurability centers another powerful assumption: that all value is relative and that the value of something can be expressed only in terms of its relation to something else. As Espeland and Stevens assert, “commensuration, the comparison of different entities according to a common metric has a long history in social thought, a mode of power.” This form of valuation **denies** the possibility of intrinsic value, pricelessness, or any absolute category of value (Espeland & Stevens 1998). Commensuration also creates unintended consequences. As I detailed in Chapter 1, PES markets create broader conditions beyond their borders in the locations in which they are embedded that might interfere with the larger aspirations of their environmentalist intention. Granting analytic attention to institutions is one mode of providing context to the embeddedness of market mechanisms. As I detail in Chapter 4, heterodoxy has put forward concepts new to economics: complementarity, non-reducibility, and lexicographic preferences to reflect perspectives that cannot be reduced to any common denominator (Røpke, 1999).

For most established ecological economists, the struggle with the uses and abuses of abstraction marks a turning point towards adopting a heterodox orientation. “Ellen” linked her transformation to an insight gleaned from reading eco-feminist Carolyn Merchant’s Death of Nature (1981). In this pioneering work, Merchant develops a concept of “dead nature” intimately related to the glorification of atomization and technical fixes – ideals embedded in neoclassical economic analysis. Romanian heterodox economist Nicolas Georgescu-Roegen (1906-1994), claimed by ecological economists as a progenitor, famously referred to the practice of abstracting as “economy

of thought” (1971: 28-35). Even as he went on to develop brilliant economic models, Georgescu-Roegen struggled with the knowledge that economic language, through enabling the logic of clear and efficient argument, also necessarily entailed formalized ignorance of huge amounts of relevant information about reality. Most who claim the mantle of heterodoxy assert that the problem is ‘*economism*’ – the reduction of everything to exchange value. “Wholesale arithmetization,” Ellen asserted unequivocally, “is impossible.” Further, Ellen implored, to truly enable ecologically sound economic thought, unquantifiable knowledge must not be removed from ecological relevance (Ellen, 2015).

With the disciplinary shift to move beyond numerical abstraction as a unifying standard of empirical argument come questions about the appropriateness of mathematical abstractions that form the building blocks of economic models. Ecological economists argue that neoclassical environmental economists are not only constructing hedonic price models that interface with nature using ecologically incomplete parameters, but that the very parameterizations of those models inappropriately characterize ecological dynamics (Gowdy, 2005, Paavola, 2007). For Ellen, the danger of flawed calculations is through their concretization through operationalization. In the eyes of the most heterodox practitioners, abstraction itself drives abuse. In a Foucaultian analysis of abstraction as a disciplining force, Ariel Salleh says: “numbers are still fetishized and used aggressively to construct plausibility for the design of those with power to control the direction of societies.” (Farrell et. al., 2013).

The Externality: From Value to Action

The price theory of value – through which all values are reduced to price – doesn't inherently explain environmental action. In Chapter 2, I laid out a theory of externality-driven action as a more complete accounting of how environmental problems are defined and adjudicated within the black box of orthodox economic theory. Just as neoclassical economics assigns economic value within the interaction between supply and demand, it can only determine value in nature marginally as it is consumed. That is, externality's theory of action is the price assigned to destruction, a price that in practice is only approachable after-the-facts of destruction have been determined (see Chapter 2). Though "*externality hunting*" doesn't require that the harm has *yet* taken place – it does require that a price for such loss is presumed knowable. Yet, the valuation of nature through the economic system is a process premised on incremental destruction through the marginalism of the price theory of value. This paradox – that the valuation of ecology in economic terms leads to devaluation in ecological outcomes – is at the heart of the heterodox push of ecological economics. At the hands of a market-oriented system that is focused only on exchange, entities and relationships which cannot be communicated in terms of price are doomed to exploitation. This theory of externality driven action explains the epistemological mechanisms behind contemporary environmental policy's claims-making on behalf of nature, and is central to the contemporary imaginary of environmentalism.

The neoclassical approach to fixing problems resulting from this system also relies on a formalized project of individual counting, and marginalist adjudication of supposedly commensurable entities. This is the neoclassical approach of '*internalizing*

externalities,’ the dominant tool of neoclassical environmental economists.¹⁷ It is this approach that many ecological economists reject when they stress that their idiom should make no room for the valuation *of* ecology. As one senior ecological economist pointed out: “I think it’s ridiculous to call them externalities, because, you know, they are absolutely unavoidable elements of the economic system.” (Josh, 2016) And another: “Externalities is a misnomer, since there is (EE solidifies) an unbreakable link (throughput) between resource depletion, production, and waste emissions, so these “externalities” are actually 100% *internal* to the economic process” (Interview 11). Many ecological economists, therefore, reject the externality theory of environmental action, as part of a rejection of price theory of value (Röpke, 1999). Ecological economics looks at externalities not as market failures but, as Kapp suggested, a “cost-shifting” successes (Kapp, 1950; 1971). The term more appropriately characterize the biophysical consequences of an abstracted black-box process, and also troubles the discursive norm of externalities as analytically acceptable – and therefore highlights them as inherent to the economic process.¹⁸

¹⁷ The “externality” is an orthodox concept introduced in 1890 by Alfred Marshall in his “Principles of Economics.” Marshall’s original phrase – “external economies” – used the entity to explain the *increasing* returns to scale redounding to a firm as a result of structural efficiencies resulting from industry-wide increase in production. Though Marshall only considered economically ‘positive’ effects, not costs or social harms, he was the first economist to theorize a divergences between private and social interests. The externality is the epistemic device deployed to rationalize observed phenomena unexplainable through marginalist theory. As such it is an extra-neoclassical precursor to the insights about emergent properties and institutions that would come out of heterodox schools a century later. Marshall’s proposed marginalist solution to the problem of externalities was intervention by governments in the form of tax and price subsidies – to theoretically narrow the gap between “marginal social net product” and “marginal private net product.” So the externality – a social failure of the price system – was born at the same time that it’s ostensible fix – working within the price system. This epistemic dynamic symbolically marks the birth of neoclassical environmental economics, which sees corrected prices as sufficient to solve both environmental and social problems. Indeed, many of the heterodox practitioners I interviewed confided a belief that ‘economies of scale’ are more precisely be defined in environmental terms as the ‘accumulation of negative externalities.’

¹⁸ The discursive move within the ecological economics’ community from the use of “externality” to “cost-shifting” is a deliberate one that has required a campaign of its own. As a participant-observer of this

Externality-driven action creates a kind of epistemic mismatch. The benefits of any given economic activity redound to a relatively small number of people, while the costs – ‘externalities’ - are famously diffuse, both across space and throughout time. Internalizing externalities creates a locally ‘better’ situation, but doesn’t solve fundamental or emergent problems. Many ecological economists find it unacceptable that – despite ever-increasing analytical sophistication – future generations aren’t reflected in economic models. “Future generations cannot possibly participate in today’s markets, and therefore today’s market prices will not reflect their preferences. The market can therefore ‘efficiently’ allocate resources only if we assume that future generations have no rights whatsoever to the resources being allocated” (Daly and Farley, 2010). Ecological economics hopes to fix this problem by imposing **sustainability criteria** to markets, delineating stocks of resources in the present as an endowment to sustain the existence of future generations (so-called “option value”).¹⁹

The heterodox movement is a critique of an environmentalism premised on accumulated work practices of *deep diving*: Hunting for all the harms done to nature and putting a price on them so they can be “internalized” within the economic system. Here, “price” is a marginal value determined through interaction between nature and the economic system. The end game of this practice is an environmental politics *requiring* price, as its theory of value, in order to act. As a theory of value, price is in turn reified through action. This is a problem for nature, because, as Daly and Farley state: “the

community, I was invited to write a book chapter on PES for a comprehensive edited volume on the field. The editor of the volume strenuously objected to my use of the word “externality” – even in the course of a critique.

¹⁹ The irony of externality-driven-action in matters of ecology is that effectively internalizing externalities requires leveraging the sworn enemy of a market-driven economic system - centralized planning by those with expert knowledge about ecology as a whole.

marginal value of an ecosystem service changes along with the quantity of the ecosystem service supplied” (Daly and Farley, 2010). Or, as ecological economist Richard Norgaard states: “there is a mistaken presumption that we can analyze a global problem within a partial equilibrium framework and reach a new economy project-by-project without major institutional change.” (Norgaard, 2010) As a mode of environmentalism, deep diving *is premised on* the destruction of nature through economic activity. Heterodoxy offers a critique that goes beyond a catalog of economics’ “failures” of calculation.²⁰ Ecological economists differentiate between “allocation” (the machinery of economic transactions) and “scale” (the emergent effects of those transactions) and point to the circularity of attempting adjudicate scale questions via allocative calculations.²¹ Indeed, heterodoxy’s contention is that a systematic fix of these failures through marginalist adjudication of value does not produce a competent ecological whole.

Given the toxicity of its theoretical assumptions, “Arnold,” a senior European scholar, lamented the use of the externality by many ecological economists. “Economics is a normative field. It claims to solve political problems, but it is always cost-shifting. Neoclassical economics is founded on the wrong theoretical assumptions – assumptions that make subsequent analysis simple” (Arnold, 2016). For Arnold, the larger point of the heterodox project is to illuminate that economics itself is a cost shifting discipline, and the simplifying moves of cost shifting render it easier to both analyze, as well as act in

²⁰ Indeed, a common deflection among orthodox practitioners is the attempt to sideline a systemic critique of these failures by formalizing them into categorizes of widely-acknowledged “market failures,” for which orthodoxy has technical solutions, in an often-successful deflection of systemic critique as a straw-man argument. For more on this, see the discussion of “Unboundary work” in Chapter 5.

²¹ As Daly and Farley describe in their field textbook “As resources become increasingly scarce, their marginal values rise exponentially which is why economists attempt to calculate those values. To internalize these ecosystem values, we would need to continuously recalculate them, centralize the information, then feed it back into the market mechanism via taxes or subsidies. Yet calculating the value of such resources is very expensive, and centralizing the knowledge and feeding it back into the pricing mechanism would require an enormous and expensive bureaucracy.” (Daly and Farley, 2010, p. 459)

the name of economics. The paradox of externality-driven-action is that the tool which is the ostensible fix – the externality – may not be fixable to achieve its intended purpose.

The Heterodox Challenge, The Challenge of Heterodoxy

“If we don’t value these resources” – one interviewee, an ecologist, earnestly beseeched in flabbergasted counterpoint to my probing skepticism about PES – “they will certainly disappear” (Interview 3). The project of heterodoxy is not to refute the conclusion of the pro-valuationist assertion. Indeed, heterodox practitioners build the foundations of their epistemic project on identical realist ecological findings about the urgency of protecting ecology. **The project of heterodoxy differs in that it seeks to value the *epistemology of ecological knowledge* at an equal level to the *content of ecological knowledge*.** Heterodoxy seeks to render streams and watersheds valuable for what they are, not merely for how they are comprised or how they can be of use. Nature, while useful, is valuable above all for its intrinsic properties not accessible through hedonic pricing. In taking ecological knowledge seriously, heterodox ecological economists are attempting to reframe the imaginary which renders the economic approach to solution-making the hegemonic epistemic approach. This is a complex task – its problematic hinges on the work done by an ideal – *value* – and its elision and commensuration across economic and ecological contexts.

In a general sense, the central aim of all claiming the mantle of ecological economics is to reform the algorithms of the current economic system to render them responsive to ecological dynamics (e.g. Røpke, 1999, Spash 2014). This motivation is so

uncontroversial as to be “obvious and banal” (Røpke) to all in ecological economics.²²

The project of heterodoxy is complicated by the fact of being distinct from this central, malleable ideal that is more discursive than it is concrete. The distinction rests on rendering the imperfectability of orthodox analysis visible.

The challenge of heterodoxy is to link harmful environmental effects to the core tenets of the paradigmatic approach of orthodoxy. Ecological economics draws authority for its cause by locating imperfectability not only in orthodoxy’s social context and performative ubiquity (Chapter 2), but also by constructing an ideal of ontological inappropriateness – that it is *incorrect* to tackle environmental problems in economic terms. Epistemically, it must present these effects as inevitable intractable outcomes of the orthodox approach – as opposed to models that are expected to attain scientific accuracy given sufficient data. A heterodox break requires an epistemic commitment to *imperfectability*. That is, conviction that the neoclassical economic machinery undergirding the hegemonic approach to environmental problems is a set of tools inappropriate to the job of environmentalism. Implicit in this radical critique is not just a failure of knowledge, but also a failure of imagination. The epistemology of price-as-value is so totalizing in its power that it has prevented a would-be countervailing discourse of value from coming into practice. Its dominance has eclipsed a diverse terrain of potential alternative pluralist possibilities, more correct economic alternatives that heterodoxy seeks to create.

To the *heterodox* ecological economist, the contemporary armature of neoclassical theory is a politically strong – *yet ecologically imperfectable* – paradigm

²² Indeed the imaginary of reforming the economic system to respect nature has escaped its genesis within heterodox spaces and now frames the language of many environmental economics textbooks. I explore this dynamic as part of my theory of “unboundary work” in Chapter 5.

upon which to build an environmental policy apparatus. Seen through the framework of Kuhnian paradigms, the epistemic process of heterodoxy is a recognition of accumulating anomalies in the neoclassical approach to ecology (Kuhn, 2012). The emergence of an ‘ecological’ economics is an explicit attempt to create a ‘new economics’ as a usable alternative paradigm. Its social task is to push away to such an extent that a new paradigm – a new armature of policy tools and imaginaries of ecological practice – is given space to develop.²³

Ontological Asymmetry

In an age of ecological crisis, the environmental policy process requires a commensuration between the identification of environmental problems – using ecological science – and the application of tools to address that crisis. Interaction of epistemologies at this science-policy interface currently consists of an uneven commensuration between ecological science and modern neoclassical economics. This incomplete contemporary language for nature leaves practitioners of environmental policy with little choice but to be cunning chasers of economically communicable value, playing cat and mouse throughout a landscape of individual problems, endlessly refining utilitarian instantiations that might make connections between them. With more data can come better, more refined, models. Yet the price of this sophistication is an escalation – a *deeper dive* into the depths of the neoclassical toolkit to identify and quantify a greater range of measurable actionable effects. It is unclear what great leap, at what scale of analysis,

²³ Kuhn didn’t have a direct explanation for institutional change in epistemic space (the creation of new disciplines), but in that interstitial period of anomaly and controversy - where the significance of ecological findings and approaches begins to be admitted to relevance in economic problems - one could imagine how a group could split – or be pushed – away, particularly as an orthodox field retains its links to centers of political power antagonistic to ecological knowledge.

would enable economic analysis to grasp a competent ecological whole. The foundational project of the heterodox approach is not merely to reject the valuationist paradigm.

Rather, it is to dive into the commensurative compromises across the two fields. Within the black box of externality-driven-action, heterodox inquiry finds in economic orthodoxy an imperialist imaginary that positions itself as a common epistemological source from which problems and solutions are jointly defined and adjudicated.

The epistemic requirement of concordance and commensurability in economic analysis contrasts with imaginaries at the heart of the ecological worldview. In ecology, relationships between individuals, groups, biophysical processes, habitats, patterns and consequences are not necessarily symmetrical or one-to-one. In a biomagnification processes, toxics accumulate as they are passed up the food chain; many species migrate over large non-contiguous territories; a single catastrophic weather event may alter a food web irredeemably; a slow-building qualitative change may appear as if from nowhere. Though some effort has been made to retrofit economic rationality, this understanding of relationships – chaotic, dynamic, interrelated – has no ready parallel in mainstream economic thought. Because ecological and social dynamics are not often marginal, ecological economists argue that it does not make much sense to use marginal assessments in ecological decision-making. Nor are marginalist theories of value compatible with ecological understandings of relationships in nature. The interdisciplinary project of ecological economics is to refashion the tools of economics to reflect dynamics of embeddedness of economic activity in ecological place – and within ecological relationships themselves.

The central animating ideal of heterodoxy is that there can be no uniform standard of value. The new interdiscipline seeks to include cumulative causation, tipping points,

and multiple causation as operational tools (Spash and Vatn, 2006; Vatn, 2010). To accomplish an analysis that respects embeddedness, many ecological economists begin to build their epistemic framework with institutionalist theories of markets and price, theorizing prices as embedded in the social and physical structures of society as accumulated and compounding effects (Røpke, 1999; Vatn and Bromley, 1994). Institutionalism's distinction between allocation and scale allows ecological economists to circumvent orthodoxy's attempt to use efficiency to solve problems of distribution (as Josh pointed out, a practice that "leads to poor people being forced to do all the changes to protect the environment").

The ecological understanding of environmental dynamics is not symmetrical with proposed economic solutions. That is, seeing nature *through* the economic system is not equivalent to seeing economic rationality as subsidiary to nature's laws. I call the epistemic mismatch heterodoxy identifies in orthodoxy *ontological asymmetry*. The consequences of such asymmetry are several. First, 'incorrect' accounting of ecological problems reliant on the externality theory of value. As a result, ecological resources are not valued until and unless they interact with the economic system. The energy well-intending environmental actors focus on parsing microeconomic functions diverts emphasis from the totality of environmental problems. More insidiously, the performative dominance of inappropriate logics within economics creates its own unintended phenomena. The imaginaries of environmental policy have been constrained to only contain mechanisms of commensurations required to make the economics work.

If environmental problems can be shown to be the result of an epistemic wrong inhering in an economic process, the project of heterodoxy is to demonstrate the ontologically inappropriateness of an imaginary that approaches those same problems in

economic terms. Ontological asymmetry gives a name to the paradoxical dynamic driven by the worldview of externality-driven action: seeing nature through the economic system drives the expansion of the economic system, and therefore ecological destruction. Over 20 years have passed since Robert Costanza's 1997 bombshell ushered PES into nearly ubiquitous use. In an April 2018 editorial revisiting the idea of valuing nature, Costanza judiciously – without directly critiquing PES or mentioning heterodox approaches at all – advocates for retooling the concept of value. Acknowledging that the perceived solidity of assigning value can distort motives and decision-making, he says: “You get what you measure” (Costanza, 2018).

Conclusion: Emergent Properties

The elision fallacy is linked to one of the fundamental material arguments at the core of ecological economics: the material effects of economic processes. To the ecological economist, the great unraveling in the ecological credibility of orthodox economics begins with the economic expansion – growth – required by neoliberalism. An early and foundational truth is that the frontier across which ecology is commensurated with the economy is not a static boundary. As encroachments occur, regardless of whether or not they are formally compensated or ‘internalized’ as ‘externalities,’ the sphere of economic production expands. A long tradition of research in the field renders the engine of economic growth as an insatiable driver of natural resource consumption and pollution. Ecological economics places the blame for resource depletion, and increased toxic burdens of industry squarely upon the process of *growth* in the ever-widening circle of externality production of the economic sphere (Alcott, 2005, Van den

Bergh and Kallis, 2012). Crucially, this research implicates the machinery within the black box of economic calculations. This is actually not a new theory – but a revival of the foundational insight of early classical economist William Stanley Jevons, who, in 1865, heretically and correctly hypothesized that advances in the efficiency of the coal-fired steam engine would not, as initially expected, reduce demand for raw energy inputs. Instead, under capitalism, efficiency and thrift are themselves driving forces in the expansion and proliferation of available avenues for the use of resources (Jevons, 1865). That is, the operational economic ideal of efficiency is the driver of emergent properties that cause expansion of the sphere of economic production – of the consumption of resources and production of pollution. This insight stands in opposition to the present ‘green’ environmental discourse and its extraordinarily pervasive focus on energy efficiency as an organizing means of achieving environmental sustainability.

This growth in the economy entails the consumption of more resources and the generation of inevitably larger quantities of polluting byproducts. Ecological economics’ ontology of economic growth is a materialist analysis that the consequences of over-encroachment into the natural world have no commensurable substitutes, and are therefore *irreversible*. That is, the destruction of nature to produce consumer goods – though it may be economically efficient – is not ecologically redeemable. All encroachments represent expansion of the sphere of the economy into the sphere of ecology. Further, capitalism itself requires ever-escalating rates of ecological encroachment (Schnaiberg, 1980). This is further evidence of ontological asymmetry between ecological and economic understandings evaluations of the worth of nature.

Ecological economics sees its disciplinary purview as the management of relationships of embeddedness between plural and seemingly incommensurable values -

natural, human, and market. It is concerned both with the ecological consequences of economic activity, and the re-inscribing of human activity as subsidiary to nature's laws. As an interdisciplinary attempt to operationalize a public policy process to protect ecology – it seeks to find a way to place the evaluation of bits of ecological knowledge as subsidiary to an operationalization of ecological epistemology. In Chapter 4, I consider how an analysis premised on embeddedness might be formalized into an academic discipline.

Chapter 4

Heterodoxy: The Analytical Inversion

*The victim who is able to articulate the situation of the victim
has ceased to be a victim.
He, or she, has become a threat.*

James Baldwin

From “Failure to” to “Failure of”

For the United States Society for Ecological Economics (USSEE), 2011 marked a crisis point. The organization’s longtime administrator had just been tried and convicted of embezzlement; by the time of her sentencing, it was revealed that she had robbed the organization of most of its savings. But ruinous financial circumstances were only one aspect of the organization’s apparent looming catastrophe. In what seemed an ominous indicator of dwindling enthusiasm for the group’s mission, the biannual meeting at Michigan State University drew less than 200 participants, down from twice that number two years before. Given the meteoric rise of *Ecological Economics* as a high-profile journal, many in attendance expressed frustration at the low levels of participation in the necessary participatory work of advancing the discipline itself. At the membership meeting, one longtime devotee asked: “Do they want to join us? Or just publish in our highly-cited journal?” But, despite its few active members and dwindling material resources, the society’s firebrand new president focused his presidential address on what appeared to him a greater, more insidious, threat.

Jon Erickson did not mince words in his address to the assembled membership. The field to which he had devoted his entire career was embroiled in an existential battle for its very soul. In an intimate meeting room to an audience of largely familiar faces, the USSEE president gave a speech that would presage the end of a 14-year reign of *Ecological Economics* as the top¹ venue for articles on ecosystem services. For Erickson, the clarity of ecological economics’ mission required a heavy line in the sand. He lamented that focus on ecosystem services had exerted a menacing effect on the mission

¹ in the #1 or #2 position, see Chapter 1: Figure 4.

of the society. In rejecting PES as a methodology, he pronounced that it had not merely distorted, but actually coopted both the image and energies of the discipline: “In practice and in perception, ecological economics has largely become the application *of* economics to the conservation agenda of ecologists and environmentalists.”

Erickson implored the society to refocus its energies away from the economic valuation of nature. He asked his fellow ecological economists to join him in regrouping around the vanguard of thinking in the field, which he described as a focus on the classic foundational metaphor: placing boundaries on the acceptable use of economic tools. Erickson lamented the long-arm of neoliberal cooptation: “In the tradition of ‘The Armchair Economist’, ‘Freakanomics,’ and many other popularizations of ‘thinking like an economist,’ ecological economics of late has fallen into that alluring trap of a *theory of everything*... everything has a price, and thus *economics has no bounds*.” The speech received vigorous applause from the assembled faithful, many of whom already considered themselves part of the vanguard of heterodoxy.

The belief that the fundamental responsibility of ecological economics is to place limits on the reach of the price system of valuation is indeed common among those involved with ecological economics. It is a natural consequence of a commitment to the existence of a supra-economic reality, that ecology is fundamentally inaccessible to economic language. Where neoclassical economists seek to speak on behalf of the environment by communicating for it with economic tools, ecological economists seek to build a policy apparatus that respects the reality that ecological values are not adequately representable by economic tools, that such tools are imperfectable to the complexity of ecology (Chapter 3). In a rhetorical move that would reverberate through the community

for many years to come, Erickson distinguished between a discipline focused on the classic economic instrument of *market failure* (the “externality” which is the focus of environmental economics) and the larger overarching significance of the failure of *markets* to deliver ecologically appropriate outcomes. He implored his colleagues not to see the abuses of markets as “*failures*” in need of correction through economic instruments, but to have the imagination to recognize the “*failure of*” those instruments in a collective sense. The task of the reawakened society would be to flip the focus at the heart of their epistemic commitments, to build a field committed to *fixing* “*the fix*” – reforming the context in which all manner of market fixes, including PES, take place.

Towards a “Living Economy”

Despite placing the blame for ecological catastrophe on the *failure of economic tools*, ecological economists wish to retain a professional identity as economists. Many teach in economics departments, and publish in economics journals. The majority wish to retain the word “economics” in the title of their flagship journal.² While the primary goal of their work is not exactly the *accounting of* ecological dynamics in a mechanistic or technocratic sense, it is to *account for* ecology by developing an approach through which to speak up to neoliberal exploitation on nature’s behalf. If this sounds like an overly subtle distinction, indeed it may be too subtle to provide a strong basis for practical differentiation from the existing formalized language used by environmental economists and those engaged in the practice of PES. For the ecological economists, success in marking the distinction appears to hinge on developing a usable alternative to the hedonic

² A description of one heated public discussion about the name of both the society and the journal appears later in this chapter. The contentious debate was won by those advocating for the benefits of the discursive and political power of the word “economics” as an attractant to new converts.

price system as a means of accounting for nature (Chapter 3). The primary goal of heterodoxy, therefore, is to dismantle and reconstruct the policy apparatuses' interior architecture so as to obviate the continued need for the ad-hoc workflow of naming and valuing nature as a collection of "services" and "benefits." But such a reform is not a straightforward task. Indeed, it is a goal that has remained as elusive as it feels imperative. Ecological economists are well aware that their desired disciplinary change hinges on a transformation of the epistemic context of economics, not merely its methodological content. Does the eventual alternative look more like a replacement system of price, or will it be a means of systematically limiting the use of *any* type price system as a means of preserving ecology? The nature of the potential structure of the landscape of heterodox solutions is a source of continual debate.

Heterodoxy's momentum is towards radical reformulation – not just of the means through which (e.g.) values are placed on parts of nature, but of the process of parting-out that presages economic analysis. The goal of an economic system responsive to ecological epistemologies is to surmount the ecologically imperfectable commensurative problems of externality-driven action (Chapter 3). Once dismantled, the intent of heterodoxy is to offer a "more correct" armature as a replacement. Its work practices center the ideal of creating a better logic for the inner machinery of economics: one that would tame the methodological tools of economics to hew to the ontological foundations of ecology. An ecologically-responsive economic system would perform an economy-ecology relationship that is ontologically symmetrical across that interface. A product of radical dissent that nevertheless must remain legible in orthodox language, the goal of replacement is reformist in nature; the heterodox model is intended to fit within the same

institutional structure currently occupied by orthodox practice. It would become the basis for a new standard economics curriculum and a new public policy process. Retaining a discursive role for economics, though part of heterodoxy's power, also constrains its universe of possibility. Identification of a field as "economics" signifies that heterodox tools must also remain legible as economic tools. That is, the "steam" animating critique also animates assembly of the scaffolding for a plinth of action in response to critique. Josh Farley professes significant awareness of the entrenched economic logics forming the hegemonic norms of contemporary neoliberal power (Chapter 2). Nevertheless, he believes there to be no better way forward than reform to the economic system *as* an economic system: "Changing the paradigm and goals of the economy is much less a challenge than changing the ecological and biophysical laws of the planet" (Josh, 2016).

In rejecting formulations that represent the ontology of nature with the financial instruments of economics, ecological economists are attempting to perform an end-run around the need to pursue conservation through the mechanisms of externality production. The center of gravity of the field is not the application of economic instruments to nature, but the attempt to incorporate ecological principles into economics. The epistemic task of heterodoxy is to assemble mechanisms of epistemic practice that reflect the embeddedness of economic activity within ecological contexts. Their search is for a means of protecting ecology that would supplant the work practices of orthodoxy and the marginalist utilitarian values required by neoclassical economics. Ecological economists are attempting to operationalize a challenge to the contemporary economic order – the pro forma hedonic valuation taking place within economics' black box. Ecological economists may wish to retain the scaffolding of "economics," but the

ultimate mark of taking biophysical laws seriously is the modeling their discipline on an ecological conception of relationships. Given ontological asymmetry across the assumed parallelism between nature and orthodox economic tools (Chapter 3), the ecological worldview is a metaphor generative of a new imaginary. The ecological concept of nature is a heuristic in which analytical primacy is given to the “whole” system, to appreciating the whole before parsing the parts. But ecology’s often nuanced understanding of the importance of relationships renders it recalcitrant to economics’ formalism of individuals. The heterodox challenge of ecological economics is to transform the failure of economics to apprehend ecology (imperfectability) at a scale of analysis which incorporates and contextualizes the tools of orthodoxy as a failure *of* its broader epistemology. It’s success hinges on the development of an evaluative framework that responds to biophysically-based understandings of nature.

Jon Erickson traces the history of his heterodox conviction of the need for such a paradigm shift to his serendipitous discovery of Herman Daly’s 1994 book For the Common Good while in graduate school studying environmental economics. In the book, Erickson discovered a field with: “a vision of economic development that embraced ethics, affirmed life, and argued for well-defined limits to economic reasoning.... I discovered a way to reconcile my economics training with my natural science education.” Most of the more active and influential participants in ecological economics have formal training in orthodox economics, and describe a similar “conversion experience” as punctuating their intellectual turn towards heterodoxy.³ While listening to Erickson’s

³ Daly’s work has had a profound impact on the foundation and development of the discipline. His 1968 “On Economics as a Life Science” in the *Journal of Political Economy* laid much of the conceptual the groundwork for the eventual formation of Ecological Economics as a separate field of study. The article has been cited over 600 times.

presidential address at that 2011 conference, “James,” a graduate student, found himself inspired by the blustery call-to-arms. In describing to me the task of ecological economics’ campaign of heterodox reform as the need for a “living economy” beyond being “an irritant at the margins of conventional economics,” James drew explicitly on Herman Daly’s foundational vision. I found the ecological economists often characterized their push towards an ecologically responsive living economy as drawing authority from the imaginary of Kuhnian paradigm shifts as a model of progress in science. Like many of my interviewees, James explicitly likened the shift towards an ecological economy to other leaps marking genuine progress of science: “This transition is much like the transition from Newtonian to Quantum physics,” he excitedly proclaimed.

In the half-century since Daly’s pronouncement that economics could be rendered ecologically responsive, the details about what might constitute a “biophysically correct” center of economic calculation continue to be very much up for debate. To be successful in the goal of crafting a coherent replacement for neoclassical environmental economics, the interdisciplinary project of ecological economics requires not merely dismantling the enormously powerful edifice of neoclassical economics, as countless radical takedowns have done over the years (e.g. Barry, 2012; Gowdy, 2005; Spash and Ryan, 2012). The ultimate success of heterodox movements hinges upon formulating a coherent analogue – or set of analogs – to put in its place. This as-yet unrealized goal of an ‘ecological’ economics requires the marshaling of significant epistemic and institutional resources.

Figure 1 shows various dimensions characterizing the distance between orthodox neoclassical approach to protecting nature and the intended mechanisms of its would-be

‘ecological’ replacement. The imaginary of a desired alternative is created both as a *reaction* – in explicit response to the failures of orthodox pedagogy – but also as a creative exercise, a concerted attempt to use ecological principles to create better economic tools housed in more appropriate methodologies. The process of heterodoxy lays claim to a new area of praxis with a reformist intention: generating a heterodox replacement that fits within the same institutional structure as the orthodox practice.

Figure 1’s illustrated categories and content both represent a distillations of my findings from interviews and a review of published articles on ecological economics.

Ecology as Generative Metaphor

Ecological economics draws from the historical tradition of “holistic ecosystem” concepts built by Odum (1953), Naess (1973), Leopold, Carson, Ehrlich, and Wilson (Babe, 2016; Golley, 1993), and Lovelock (2016) and Margulis (1998) in their efforts to expand biological understandings of nature through the ideas of networks and emergence. The field’s analytical apparatus draws on the Post-War “general systems theory” approach, developed in ecology by Bertalanffy (1981), Wiener (1961; 2013), and Boulding (1981). Systems theory apprehends sets of components that together generate emergent outcomes, often at distinct scales of analysis. The properties of a system depend not only on the attributes of the components, but on the relationships among the components, and their embeddedness in larger wholes.

The significance of the epistemology of an *ecosystem* is that the properties of a whole cannot be foreseen from knowledge about either individuals or individual interactions among parts. In making use of “ecology” as generative metaphor from which

to construct a biophysically-responsive economics, the systems imaginary allows ecological economists to see economies as human constructions that are “special cases of the economies of nature” (Charlie, 2016). It is through this “ecological epistemology,” ecological economists argue, that a key departure from hedonic theories of value in economics can take place.

An Ecological Approach to Empiricism

Historians of modern ecological science draw its roots in 1866, when German zoologist Ernst Haeckel coined “oekologie” to define a supra-species ‘home’ comprising all of nature.⁴ Oekologie for Haeckel was the study of animals, of the household, and also of the “material economy” – with salience drawn from both organic and inorganic components. Today the definition of ecology retains this epistemology of situatedness; Its analytic concerns include study of the interaction between organisms, species, communities, and their conditions for survival.

Ecology’s modern disciplinary orientation developed in the 1950s, when it was first identified as a specific branch of biology (Kaarhus, 2000). The term ‘ecosystem,’ coined by Arthur Tansley in 1953, drew from Physics. Then-nascent ecosystem science imagined a ‘whole system’ as a collection of forces and properties affecting the behavior and interaction of entities embedded in and interacting with a biophysical context. In

⁴ Discursive roots for the European idea of ecology can be drawn even earlier – to two books first published in 1789. Gilbert White’s *The Natural History of Selborne* (1789: 2013) was the first account of natural processes as holistically-oriented relationships. White, a British pastor, observed interactions in nature and attributed them to divine planning. This lens on the close observation of nature led him to see a harmonious coexistence of species in a holistic sense. By contrast, in *Economy of Nature*, Carlus Linnaeus, the father of the binomial nomenclature of modern taxonomy, developed a philosophy of ecology he called “the economy of nature.” Linnaeus’ proto-ecology was an atomism of competitive parts. These two books reflect radically different approaches to ecology – holistic vs. reductive – that have continued to mutually define the discipline of ecology.

contrast to the approach of biology, analysis of ecosystems was grounded not by a standard unit of analysis, but by a common situatedness within a given scale of analysis. As ecology cohered into its own discipline in the second half of the 20th century, its purview and methods came to embrace a kind of methodological diversity (Worster, 1977; Mayr, 1982). Indeed, the 1989 inaugural issue of *Ecological Economics* is clearly inspired by the openness of ecology to explicitly embracing multiple modes of analysis. Richard Norgaard's "The Case for Methodological Pluralism" in the first issue of the flagship journal remains generative for the field, and continues to be cited today. Norgaard emphasized that, in its search for operational principles, *Ecological Economics* should "retain the full range of methodologies available in both disciplines" – explicitly as a way to move away from the logical positivism and marginal theory of interaction undergirding economic approaches to analysis (Norgaard, 1989). In the decades since, the embrace of methodological diversity has continued to both enrich and complicate the society's search for common operational principles.

Most early ecological studies began with organisms as their point of departure, and then considered organisms' relationships to other plants and animals. Though Tansley's initial scientific goal was reductive – to mathematically describe energy flows, and reduce the subject matter of ecology to the laws of physics and chemistry – subsequent ecological analysis has instinctually resisted hewing to reductive ends. Some contributions to the field - e.g. Smuts 1986 - pointed in new "holistic" directions.⁵ The takeoff of contemporary ecological science is largely the result of work by ecologist brothers Eugene Odum and Howard T. Odum (Babe, 2016). Their epistemic innovation

⁵ Smutz coined the concept, as "*The tendency in nature to form wholes that are greater than the sum of the parts through creative evolution*" (1986).

was to promote the integration of the scientific perspective of ecology alongside the consciousness of the nascent environmentalist movement. The “whole before parts” sensibility was synthesized by Eugene Odum in his classic textbook Fundamentals of Ecology. First published in 1953 (and continually published until a 5th edition in 2005), the text became a landmark for the promotion of ecology with a systems perspective. In contrast to other textbooks, the book entries *perform* the epistemology of whole before the parts, beginning broadly at the ecosystem level and proceeding to the communities and organisms that compose the larger whole. Odums’ description of ecosystems included both their biotic and abiotic components, and used energy as the common denominator for cross-scale comparisons. In an ontogenic move that would presage the development of “BioPhysical economics” as a reformist offshoot of ecological economics, beginning with the second edition in 1959, all subsequent editions of Fundamentals of Ecology featured a chapter formalizing “ecological energetics” as a means of cross-scale intra-species and intra-context commensuration.

Ecological Imaginaries of Economy

The primary discursive commitment of ecological economists is to create a field of study that embodies a shift from the disciplinary imaginary of economics to that of ecological science. As discussed in Chapter 3, the present terms of the commensuration between the fields of ecology and economics as they currently exist are ontologically asymmetrical. The task of a heterodox replacement is to resolve epistemic friction resultant from uneven imbrication of units of analysis, standards of commensuration, and operational laws (**Figure 1**). This heterodox transition would countervail the subsuming

of nature into the rationality of orthodox economics. If an economy can be imagined, as Haeckel envisioned, “ecologically,” then perhaps its resulting ecological mode of analysis could reform some of that economy’s most abusive tendencies towards nature. Indeed, a large part of the Odums’ lasting influence on knowledge production across ecology and economics has been their training of generations of students, several of whom have gone on to become active creators of the field of ecological economics.

Common Goal: Sustaining the Environment	
Neoclassical Environmental Economics	Ecological Economics
Laws Market mechanisms, Efficiency	Laws Ecology, Thermodynamics
Mechanism ‘Internalize’ (bring into the center of calculation)	Mechanism Draw boundaries between the complexity of the natural world and the reductionism of economic calculation
Tools Price, Utility	Tools Circumscribing ‘limits,’ formalizing embeddedness, and emphasizing the failures of orthodox analysis
Power Political-economic embeddedness Discursive coherence Cultural ubiquity	Power Cross-disciplinary legibility Promise of reform Name: “Economics”
Value Hedonic Utility Efficiency-Generated Price	Value Biophysically-grounded: Joules, Land, Species Pluralism & Incommensurability
Methodology Methodological Individualism Reduction to common denominator	Methodology Methodological Diversity Pluralism & Holism
Economic Imaginary Utilitarianism, Unlimited Growth	Economic Imaginary Subsidiarity to biophysical limits No-growth / “De-Growth”
Social Imaginary Unlimited Wants, Competition	Social Imaginary Cooperation, Interdependence
Biophysical Imaginary Extractive industry Fossil energy	Biophysical Imaginary Circular economy Renewable energy

Figure 1: The organized differentiation of ecological economics

Initial epistemic moves to create an ecological imaginary of economic processes sought to unite the two systems through a common medium of exchange or an analogous process of exchange. This search for commensuration through a common medium has been a major through line in both the push for heterodox reform, and in work towards establishing disciplinary legitimacy.⁶ A first analysis of the task led to a search for common descriptive analogs between economics and ecology to unite them under a common biophysical imaginary. In the second edition of Fundamentals of Ecology, Odum addressed the temptation to analogize an ecological currency with the currency of economics: “While energy can be thought of as the “currency” of ecology, energy and money [the latter being the currency of economics] are not the same because they flow in opposite directions” (Odum, 1959). That is, the circulation of money follows the movement of economic activity towards its ends of growth. But the circulation of energy in nature is constrained by the “iron biophysical laws” of thermodynamics, in which energy becomes increasingly unavailable as it moves through a system. Unlike growth-generating economic currency, energy follows an inexorable path of entropic degradation: from extraction as a high-grade resource, to ever-lower forms across the economic production process. The dream of easily commensurable units between ecology and economics is undone by this methodological wrinkle. As “John,” a leading European ecological economist, pronounced flatly to drive home the point: “Money circulates while

⁶ Indeed, as I discuss in Chapters 2 & 3, the invocation of the process of commensuration and imposition of the norm of commensurability are themselves sources of power within the discipline of economics. A history of economic epistemology, Mirowski’s More Heat Than Light (1999) illustrates this dynamic in detail. Mirowski shows how neoclassical economics carried epistemic legitimacy through the transposition of the mathematics of potential energy prior to physics’ description of the second law of thermodynamics. Neoclassical economics came to formalize its concept of “utility” by directly copying now-obsolete equations describing potential energy observed in nature.

energy does not.” An industrial economy based on fossil fuels, as many ecological economists assured me, “is not circular, it’s entropic.” (John, 2014).

Though a direct transposition of money – or other forms of human-made capital – with joules proved methodologically indefensible, attention to the second law of thermodynamics introduced fertile ground upon which to imagine an “ecologically correct” economic model. In the ecological approach to the economic processes, heterodox reformers found in the law of entropy a conceptually unassailable tool with which to tame ecologically-destructive economic growth through the application of “natural laws.” One foundational text – The Entropy Law and the Economic Process by Georgescu-Roegen (1971; 2013) – continues to be remarkably influential in the field today. Together with the works of Herman Daly (1977; 1991), Georgescu-Roegen problematized a continued course of exponential growth via a fossil-fuel based economy as being in violation of the second law of thermodynamics. In turn, looking at the economic process from a thermodynamic point of view piqued speculation about what kind of economy would *not* violate nature’s laws. Though the neoclassical economy – with its orthodox epistemic machinery – is not circular, ecological economists pronounced that its heterodox replacement *should be*.

The environmentalist consciousness of the 1960’s and 1970’s provided significant material to the genesis of a heterodox economic moment – both through its attention to environmental disaster and the emerging focus on the political limits of fossil fuel energy as a result of the 1973 Arab oil embargo. In his introduction to a 1997 textbook, Robert Costanza drew the roots of the field directly in the imaginary of this American environmentalism. In particular, Kenneth Boulding’s 1966 classic “The economics of the

coming spaceship earth” famously crystalizes the imaginary of ecological limits with its characterization of the need for a transition from “frontier economics” – where growth in human welfare implied growth in material consumption – to the “spaceship economics” of the future – where ecological limits would be respected, and growth in human welfare would be constrained to non-material qualitative improvements. The discourses of entropy and limits became foundational to the work of ecological economics. Perhaps the most well-known – and oft-repeated – metaphor of the field is Herman Daly’s: “The economic subsystem must not grow beyond the scale at which it can be permanently sustained or supported by the containing ecosystem” (Daly, 1977; 1991)⁷ Imagery of the globe from space helped crystallize the imaginary of earth as a **closed energetic system (Figure 2)**, a point of view instrumental in constructing the rhetorical flip ecological economists use to operationalize their area of practice.⁸ The central analytical move in this tradition is to see the implementation of an ecological economy as a problem of mass-balancing. As unimpeachable natural law, mass-balancing within the closed energy system is used throughout ecological economics to advocate for controlling “throughput,” the conversion of low entropy resources into high-entropy waste. The reformed economy would cause “no growth” in its material extent.⁹ In contrast, orthodox economics is ostensibly agnostic about growth in throughput because, assuming conditions of

⁷ Ecological concepts based on biophysical limits to growth of human encroachment on natural processes – such as ‘carrying capacity’ & ‘ecological footprint’ – are a legacy of this interaction between ecological science and environmental concerns. For example: the ‘ecological footprint’ concept was developed in a PhD dissertation by Mathis Wackernagel under the direction of Bill Rees at the University of British Columbia in 1992. Bill Rees holds a PhD in population ecology, but now identifies as a human ecologist and ecological economist.

⁸ Technically, owing to an average daily input of solar irradiation of 1000 Watts per square meter, the earth is not a closed energetic system but an isolated one. Ecological economists’ biophysical imaginary of a circular economy with limited inputs of this *renewable* energy remains central to its analytic consciousness.

⁹ Or, as ecological evidence increasingly points to the overshoot and collapse of many natural systems upon which human society depends, a political economy of *degrowth* (Latouche, 2009).

substitutability, the engine of economic activity is presumed sufficiently dynamic to solve problems of scarcity (Sagoff, 1995).



Figure 2: “The Blue Marble,” 1972, taken by astronauts aboard the Apollo 17 spacecraft [photo courtesy of Wikimedia Commons]

Thermodynamic holism, therefore, doesn’t just implicate a medium of circulation (energy) – but also the epistemology of boundaries, of economics’ reliance on biophysical resources and ecological systems. To the ecological economist, this embeddedness of economy in nature implies a need to impose limits to the scale of economic production before the point at which encroachment upon nature’s limits results in ecological catastrophe (Rockström et. al., 2009). The heterodox approach to studying economy *as natural object* uses **subsidiarity** to flip the process of externality-production from one of marginal (hedonic) rationalizations of ecological effects, to one in which *the economy is itself internalized within ecological limits*. In contrast to the ‘*imperfectability*’ of economic tools *applied to* nature – internalizing the economy within nature is pursued by appealing to the common higher order discourses of ecological holism, shored up by the physical laws of thermodynamics. I now turn to the operationalization of this subsidiarity.

The Flip

The generative idea animating the field of ecological economics is that the economy ought to be studied *as* a natural object, and that economic processes should consequently also be conceptualized in terms usually used to describe processes in nature. (Røpke, 2004). Ecological economists seek to construct their new discipline as if it is embedded in – and responsive to – natural processes. Economic processes would then also become natural processes in the sense that *they can be seen as implicating biological, physical, and chemical processes and transformations*. Once formally embedded as subsidiary to nature's laws, in principle, economic processes would not be allowed to overshoot them. It's telling that Røpke goes on to describe this foundational imaginary of ecological economics – that the human economy is embedded in nature – as “banal and difficult to disagree with.” The ideal of an economy that in some way responds to the need to protect nature is bound up in Western environmentalism, and has become relatively familiar to a wide audience. Yet the contention of heterodoxy is that an “economics *of* the environment” and an “ecological economics” are fatefully different paths.

According to their heterodox dissenters, orthodox environmental economists are practicing a methodology that does not respect the worldview of embeddedness of society, and of economy in nature. To the *ecological* economist, the thesis of imperfectability (Chapter 3) implies that the externality – though its imaginary is hugely resonant in public reason – is not fixable at the scale at which it is deployed. Imperfectability leads to not just a shift in mismatched epistemic tools (Chapter 3), but also in the imaginary of how those tools operate so as to be *inherently* responsive to

ecological embeddedness. That is, the process of parting out that enables a calculation concerning nature to take place within the orthodox economic black box is itself an alienation from embeddedness, and therefore an ecologically inadmissible analytical conceit.¹⁰ On the question of the distinction of heterodox practice: Josh flips both the perspective and scale of the externality as a rhetorical device: “I’m trying to internalize the economy into the global ecosystem, rather than trying to internalize the global ecosystem into the economy” (Josh, 2017). “Sarah,” an ecological economist at an urban HBCU, agrees, saying: “*internalizing the economy* can be achieved more easily than trying to internalize the biophysical world into the economic system. If that economic system isn’t assigning value terribly well, then why do we think that we want to internalize everything back into that?” (Sarah, 2015).

The aim of an ecologically-grounded economic practice is to use data about the flow of materials and energy to express economic embeddedness in nature, and then work towards a system in which biophysical data – and not hedonic price – adjudicates the “correctness” of these economic models. For Sarah, the technical adjudication of ecological embeddedness implicates both ecological and social knowledge. Like many ecological economists I spoke with, Sarah emphasized the view that moral and ecological motivations for pursuing a heterodox path forward were aligned with fundamental physical laws: “The economy is a subsystem of biological physical systems, and we would do well to be informed about how those systems work so that we don’t bump up against them all the time. So that means that value has to be expressed in something other than money, also because real people relate to things other than money” (Sarah, 2015).

¹⁰ In a critique of this procedural purification of environmental problems into a summation of freestanding discrete parts, sociologist Michael Redclift described environmental policymakers as truly believing they are “carving nature at the joints” (Redclift, 2005).

Having trained for several years in an orthodox economics PhD program, Tim crystallized his frustration with the collapse of environmental values into hedonic value. He thought it inane that his environmental economics professor believed: “If people want to deplete the environment, that is an acceptable choice, and it is the economists job to help them do it efficiently.” This approach, imagining environmental action as a set of consumer choices subject to hedonic valuation, pervades contemporary environmental analysis.

Through over ten years of observing the push for heterodoxy within ecological economics, I have often asked – and been asked – what differentiates ecological economics’ project as being incompatible with reform-at-the-margins, and with environmental economics. Is there a line of distinction, a boundary between the two? I have come to the following analysis, which begins with a rhetorical flip deployed by many of my informants, including Josh and Sarah. The flip’s emphasis is on the subsidiarity of economic tools to biophysical laws. It is formally concretized through what I am calling an **analytical inversion**: a norm of calculation that grants primacy to the embeddedness of societies and economies in a biophysical context, and therefore foregrounds *purpose and effects of calculation over efficiency or parsimony of calculation*. My analysis is distinct from the ways in which heterodoxy is discussed among members of the ecological economics’ community.

The process of differentiation from the failures of markets brings analytical urgency to the *context of analysis* at the intersection of ecology and economy. Rather than being weakened by its apparent lack of precision at achieving environmentalists’ goals (Chapter 1), the discursive force of orthodox argument hinges on avoidance

through abstraction of the significance of the context of calculations (Chapter 2). This elision is a defining feature of orthodoxy. I draw its origins as arising within the rationality of economic calculation, and its power as a result of discursive coherence and cultural resonance with both efficiency and market-generated price. Indeed, not only – as Tim complained – does orthodoxy exclusively value nature as a contributor to economic exchange, nature does not ‘exist’ in orthodox terms until and unless it becomes implicated in economic exchange (Chapter 3). Orthodoxy’s externality-driven mode of advocating for environmental knowledge is both a **boundary object** of translation between ecological and economic value, but is also its own **black box**. It both creates and circumscribes the area of environmental concern for subsequent analysis to fix. That is, orthodox ‘*nature*’ does not exist – ‘*out there*’, so much as *through exchange*. Ecology is allowed no uncertainties, mysteries, secrets or unknowns. As far as the economic system is concerned, the natural world has no value antecedent to an interaction with the economic system. Refracted through the orthodox economic system, nature is constructed through the same process by which it is subdued. The heterodox response to this structural failure is to place context *before* analysis (George, 2007). Recognizing the complexity and fragility of ecology as context, ecological economists intend to place limits on the material expansion of the economy, which is itself created through the process of analysis (see “externality theory of value,” Chapter 3). Though orthodox environmentalists do see “the externality” (once defined as such) as a problematic device, they draw its problems as resulting from difficulty in identification, calculation, and communication of environmental harms *as* externalities. Boundary policing of the rationality of the externality as an acceptable analytical conceit leads to the technique

pursued as an end in itself, not a means to an end exogenous to economic analysis. The pursuit of ends for their own sake is a hallmark of orthodox power (George, 2007). In order to grant analytical primacy to that most fundamental of contexts: the ecological systems which support all life on earth, to respect subsidiarity to the primacy of ecological context, economic analysis must be *inverted*.

Analytical Inversion: The Three Commitments

Heterodoxy is a movement oriented towards reconsidering the purpose of economic analysis. The starting point of orthodoxy's internal movements to reform neoclassical theory is to tinker at the margins of what is possible in a neoliberal political economy: to 'nudge' *consumers* into individual decisions, to advocate for regulatory adjustments commensurate with the salience of available data about environmental harms. The starting point of heterodox movements, by contrast, is not the pursuit of 'solutions' through environmentally-oriented action. Rather, having determined economic epistemology inappropriate to ecological ends, heterodoxy must carefully assemble its rejoinder conscious of this ontological asymmetry. This consideration for the context of economics leads to wrestling with the contemporary political economic ordering of nature and what this means at the level of its *epistemic imaginary*. Rather than economic processes as a substrate *for* seeing nature, ecological economists are trying to develop machinery that would reflect an inversion of analytic primacy - the truism that economic activity is not possible absent its embeddedness *in* nature: a place with spatial extent governed by physical laws. I frequently observed participants try to grapple with how to express and operationalize their abstract conviction that economic

tools were not universally useful or appropriate. The acknowledgement that valuationist means drive anti-ecological ends, and a need for control over economic means to foreground ecological ends, was often expressed as implying a limit to the reach of economic tools – to *invert* economics’ analytical primacy as subsidiary to biophysically-derived laws. The search for a new approach begins with an attempt to recast the problem of collective action across the society-nature interface, to replace the ostensible purpose of the externality as mechanism guiding environmentalist action with something more appropriate to the structure of ecology. This agenda seeks to both change the edifice and limit the extent of economic rationality entirely. The heterodox movement seeks to re-envision environmental problems not as *failures to completely apply* economic reasoning, but *failures of economic reason*.

The subversive ideal is a central driver of heterodox energy. When speaking about their movement in ideal terms, ecological economists almost never slip into the discourse of “deep diving” (Chapter 3). Their ideals are instead expressed as an inversive flip, e.g. “ecologizing the economy instead of economizing the ecology” (Colby, 1991). This imaginary is of a contextualization of economic processes that is, in both form and internal logic, circumscribed within ecological limits. Indeed, when speaking about the goal of their emerging discipline, many of my interviewees expressed imaginaries similar to Josh’s – who sees his work as “internalizing” the economy into the ecology, rather than the other way around.

But can a new discipline be operationalized through a rhetorical flip? Is linguistic framing sufficient to distinguish an ordinary economic analysis from one that is respectful of limits? Indeed, hundreds of deep divers consider themselves ecological

economists, and many empirical studies grounded in PES and hedonic valuation continue to appear in the field's flagship journal. Within minutes of pronouncing his commitment to internalizing the economy into the ecology, Josh lamented to me— with open contrition — that he had recently consented to co-authoring several recent papers on PES. When it comes to the numerous contingencies and pragmatic realities of individual careers, projects, and publications — the ontogeny that builds the academic economist — orthodox epistemic practices exert a magnetic pull. It often appears that there is no clear line, no useful distinction between overhaul and reform.

Where presently all values from nature must be conceived in the language of hedonic utility to be admissible to economics' black box, the heterodox project seeks to render biophysical data *directly* admissible to economic analysis. But taking nature, and ecological data, seriously requires that ecology be a substrate for — not merely an input to — the process of economic analysis. My informants often assert that *human economies are special cases of economies of nature*. The recognition that analysis requires a context from which to derive categories of meaning does have a strong precedent in the history of orthodox economics. Acclaimed economic historian Josh Schumpeter's concept of "pre-analytic vision" is often cited by ecological economists for this contribution (Schumpeter, 1994). The importance of this recognition of context for the project of ecological economics "cannot be overemphasized" (Costanza, et. al., 1999). Reviving Schumpeter's pre-analytic plea has granted the community intra-disciplinary permission to consider *ecology as economic context*. Taking this ecological knowledge seriously is **the first commitment** enabling an inversion of analytical primacy.

Truly taking ecological knowledge seriously requires the acknowledgement of ‘imperfectability’ – that everything in nature *not* have a price (Chapter 3). Recognizing that ecology must serve as a substrate that is itself not an input implies a limit to the parts of nature that can be converted into inputs to economic processes. **The second commitment** of analytical inversion is the placing of boundaries on the acceptable use of economic tools. Economic activity is embedded within biophysical limits and should respect natural laws. By self-imposing a series of limits meant to be reflective of the embeddedness of economic practice in nature, ecological economists challenge a regime of governance by the technocracy of economism in ecological space. Under the second commitment, limits to the use of economic analysis create room for other types of value. Referencing the scope of orthodox analysis that deals with ecological relationships on the narrow level of the externality, “Howard,” a longtime journal editor said: “When you have a narrow perspective, things seem like technical problems” (Howard, 2016).

The overarching goal of the field is to place markets – and all economic activity – in a context of ecological appropriateness within boundaries to control the conversion of natural resources into waste. But how might a boundary be drawn between markets and pricelessness? This question is the central perennial object of debate within the group. Ecological economists are in agreement that biophysical guidelines should be used to adjudicate the correctness of models and the location of boundaries on the use of economics. And, for the most part, they reject the idea that these biophysical limits can be generated through the logic of price (Røpke, 1999, others). But the means through which biophysical data might be assembled into a technical logic of appropriateness to adjudicate a policy process remains unresolved.

The third commitment towards the analytical inversion is to operationalize a synthesis of the first two commitments. Granting ecological knowledge primacy by circumscribing the acceptable use of economic tools draws into focus both the process and outcome of an ‘ecological’ economy: it would have an operational logic taking on both the *function* and *form* of an ecosystem. This new economic system would mirror the biophysical properties of an ecosystem, accounting for the interdependence and subsidiarity of economic systems within ecological context (Clark, 1973; Cleveland, 1987; Martinez-Alier, 1998; Christensen 1989). Its analytical choices would accurately convey ecological value by reforming the calculative mechanisms within its black box to supplant economistic marginalism (*function*), and the extent of that black box would be circumscribed within safe operational limits (*form*). Such an endeavor would shift the operations within economics’ black box from hedonically-adjudicated allocation into a new (and as-yet-unrealized) formal logic. The key task of the ecological economist, according to Howard, is an integrative one. Only in taking a perspective that is ecologically ‘correct’ can the strength of the tools of economics be appropriately applied. Howard defines such appropriateness in a pragmatic sense.

The “analytical inversion” is constituted by these three linked and interdependent commitments to reinscribing economic processes within ecological limits (**Figure 3**). Hewing to the three commitments inverts the focus of analysis: seeing economy *as an ecosystem*. This approach would recast economics as a “life science” Daly (1968).¹¹ That is, the new economic system requires the onus be placed on economic activity to

¹¹ Instead of as a social science retrofitted from mathematical formalisms lifted from pre-thermodynamic physical science.

demonstrate that it respects a *logic of appropriateness* (March and Olsen, 2013) between economic tools and ecological dynamics that is consistent with the findings of ecological science. This logic respects the sovereignty of ecology above economy, and the sanctity of natural laws as master operational criteria. The analytical inversion is in contrast to an orthodox – asymmetrical – status-quo in which economic tools take precedence, and the “fix” for ecological damage is to internalize that damage with economic language. For this, ecological economics draws both on the science of ecology as a generative metaphor, and on the blue marble imaginary of the ‘first wave’ of environmentalism. The imaginary leverages a cosmology of limits, of smallness, of vulnerability and interconnection. In placing definite limits on the material growth of the economy, ecological economists hope to find a means of performing an end-run around the need to pursue conservation through the marginally-adjudicated mechanisms of externality production. To generate this epistemic programmatic, they place environmental policy in subsidiarity the rationality of ecology, the ecological worldview.

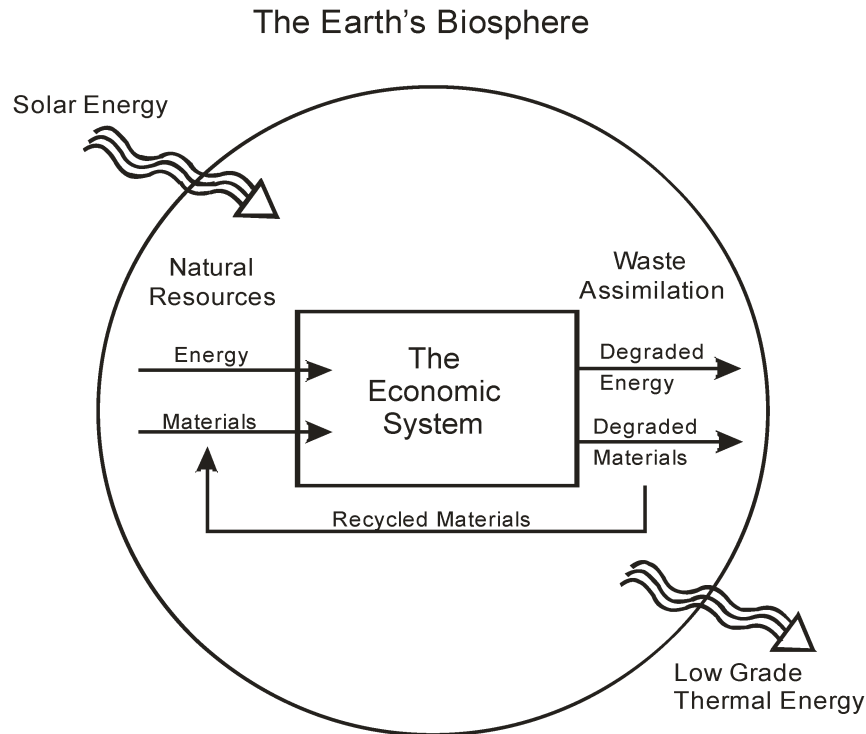


Figure 3: The ecological economics imaginary of concentric rings
[Adapted from Cleveland and Ruth, 1997]

Converting Bad Theory, Transforming Bad Practice

I met “Frank” on the first day of the 2016 meeting of the International Society for Ecological Economics (ISEE) as he hopped enthusiastically between sessions. An environmental research fellow at a liberal American think tank just a few blocks away from that year’s Washington DC venue, Frank was having a first experience with ecological economics. On that first day, Frank’s enthusiasm appeared boundless. He had only learned of the conference a few weeks prior, but the promotional materials had piqued his interest in the field as a source for fixes to environmental problems. As an applied policy professional, Frank had grown dissatisfied with the status-quo available to him. He felt resonances with the conference’s messaging that located the problem within the tools of economics. Frank told me he agreed that a new economic paradigm would be

necessary in order to foster a more appropriate path towards environmental solutions. He felt very urgent about the scale of global environmental decline, and even during our first brief chat, explicitly expressed that he had come to look for *heterodox answers* to ecological problems. Though he was already a seasoned policy professional, Frank reminded me a lot of myself experiencing the moment of my own first ecological economics conference. Eight years earlier, having just finished my master's degree in environmental science, I had won a grant to fly to Nairobi to present research at that year's ISEE meeting. It was the hopeful bid of a young idealist who had grown suspicious of the policy apparatus I had nonetheless trained for and graduated into. I desperately wanted to find a coherent alternative to an imagination of environmental policy reduced to the econometrics of externality-aggregating damage functions, to a politics predicated on price as ultimate arbiter of, if not correctness, certainly doability. But, does an ISEE meeting present a viable alternative programmatic for professional practice?

To the ecological economist, the reason the rise of ecological discourse as value-in-exchange has colonized environmental politics is precisely because a sufficiently parallel language of countervailing value does not yet exist (Chapter 2). The default status of nature without an assigned price is valuelessness; indeed, even pricing comes with paradoxical peril. A growing body of empirical evidence is finding that placing prices on nature results in its *devaluation* (Barnaud and Antona, 2014; Brookes, 2000; McCauley, 2006; see also Chapter 1). Indeed, the great power of the externality lies in the simultaneous simplicity and opacity of its epistemic machinery. It creates elisions – both by excusing the process of harm, and giving the illusion that harm is appropriately

redressible in economic terms, to say nothing of whether it is actually effective in applied practice. In both the daily work practices it requires of people, as well as the work of rationalizing its machinery performs, the beauty of the externality as a mechanism of value-in-exchange is that it provides environmentalists an apparent way forward – a logical, economically-defensible armature upon which to build the daily routines of doing environmental good. This is the institutionalized machinery of the orthodox approach, the commonly accepted reality against which heterodoxy counterposes its dissent. Though instruments like PES attempt to “account for nature,” ultimately the resulting “ecological values” are transmuted into economic terms. That is, insofar as environmental policy respects the rationality of “environmental economic” analysis, it is inherently reductive to the terms and values of economic analysis. Both explicitly and implicitly, the orthodox approach invokes and rearticulates the logics of the price system. Orthodoxy’s hegemony is maintained by preventing any other type of value from nature from being relevant to the *inner machinery* of economic analyses. In Chapter 2, I argue that it is the **mundanity of this very ubiquity** of market-generated price – as opposed to consideration for scientific, indigenous, or other claims on ecological knowledge – that is a source of orthodoxy’s inertial power. A main thesis of Chapter 2 is that orthodoxy isn’t visible as hegemonic until its dominant logics are named by heterodoxy and critiqued as problems. So, given a steady influx of innervated footsoldiers like Frank and myself, who are eager to learn and promulgate an alternative, why is there still no new way of communicating ecologically appropriate value to the world of policy analysis?

The heterodox project aims to “bring appropriateness” to analysis via reform to the terms through which environmental problems are acknowledged, named, and defined

– their economic and biophysical, imaginaries (**Figure 1**). The heterodox challenge to orthodoxy begins with an analysis of the way environmental problems are conceptualized. Heterodox analysis begins with the *competent whole*.¹² The blue marble imaginary of indivisibility, interconnection, and limits is a generative metaphor: not only of a holistic perspective on the totality of ecological effects, but of pluralist consilience among a diversity of approaches to the whole. The heterodox approach is to place loyalty to the coherence of a larger ideal – ecology – over the solidity of a particular technique – the externality.

By the third day of the conference, I found Frank, so recently a buoyantly enthusiastic newcomer, unexpectedly downcast. At the conclusion of one panel, he publicly voiced his frustration with the complexity of the programmatic proposals he'd encountered at the meeting. His problem didn't exactly stem from a misunderstanding of the material presented, so much as a frustration that he hadn't received usefulness from it. The ideas seemed good, but their packaging didn't lend to straightforward use in policy analysis. For all its sophisticated critique, heterodoxy's apparent inability to provide a legible path forward seemed to him a maddening oversight. After the panel, I approached Frank to discuss his changed outlook. He quickly recognized me from our first meeting, and was eager to get my take on the situation: Why, given ecological economists' longstanding shared agreement about the evils of neoliberal environmentalism, was there no concerted ideal of an appropriate replacement? Especially galling to Frank was that the ecological economists posed no common metric upon which to ground their

¹² See also Chapter 3. I am defining the term “competent whole” to describe an outcome of piecemeal analysis that yields a coherent total apprehension of the analytic object. Analytical methods have collectively failed if their additionality of their use does not obtain a coherent collective outcome. In this case, ecological economists are in search of a methodology that accounts for the earth's biosphere and all it contains.

calculations. This failure to present a coherent package seemed fatal to the organization's bid for relevance. Even worse, it seemed to preclude the ability to advocate for sound policy: "Is there a quantifiable metric for sustainability?," Frank implored me. "Price? Joules?" Though Frank wasn't satisfied with orthodoxy's tools – of valuation and PES – and mechanisms – of externality hunting – he found heterodoxy's lack of consensus about alternatives to be an unforgivable shortcoming. It seemed that many of the talks he attended implied an end to the rationality of economic analysis entirely, the question of units be damned! Frank found himself unexpectedly flummoxed. He hadn't asked to have his definition of the purpose of environmental policy so frustrated by the controversy about the implications of an ecologically-embedded economic science. Speaking with Frank, I was struck by the analytic consequences of the 'inversion' – its apparent substantive complications and perhaps inevitable confusions about its relevance to the policy process.

The mundanity of ubiquity of orthodox machinery is rendered more powerful through its focus on the content of the reformist goal, cutting out context and alternative incommensurable paradigms (Chapter 2). In the mire of critiques and new proposals, it wouldn't do to *merely* abandon the simplicity and discursive force of orthodoxy. For policy leaders like Frank, relevance was predicated on the actual existence of a competitive – legible – replacement. It would have to stand a basic test of coherence. The state of the incipient field as Frank encountered it was far too inchoate to be useful. Heterodoxy, as a discipline intent on respecting the emergent integrity of the ecological biosphere, had not presented its own program as a *competent whole*.

Indeed, many ecological economists have anticipated the needs and expectations of newcomers like Frank. In the search for a countervailing operational construct to hedonic utility, heterodoxy initially focused a great deal of its work within the economic black box. The first step for an answer to the need to convert bad theory – and ground economics with a biophysical metric – is the joule, the elemental unit of energy as described by the physical sciences. As a ‘fundamental,’ measurable, and thermodynamically grounded operational unit, the joule now forms the basic unit of value in the work of a large faction of participants in ecological economics.

Thermodynamic Authority

Physical sciences, in particular those that theorize the concepts of energy and thermodynamics, are a central component of ecological economics’ claims to epistemic authority, and have grounded its methodological apparatus since the field’s inception. Over the course of 24 interviews with participants in the field, I came to see epistemic power in ecological economics as flowing directly from the axiomatic solidity of physical laws. ‘Foundational premises’ for the field were most commonly invoked as either a direct reference to an early luminary (e.g. Herman Daly, Georgescu-Roegen), or a biophysical law (most commonly a thermodynamic law), or both! After all, as “Rob,” a longtime activist for Herman Daly’s vision, explained, the economic process also directly implicates biophysical processes. “Herman Daly looked at the conventional variables in neoclassical economic theory and saw that ‘*production*’ is actually the transformation of matter into energy, and ‘*consumption*’ is actually the disarrangement of the same” (Rob, 2011). Using energy as a common denominator to draw the programmatic approach of

the field along thermodynamic lines is not merely an instrument for reforming the functions of economics. It is also a legitimation move to theorize the second commitment of the analytic inversion, that economic activity should be formally constrained within an optimal scale.

Though ecological economics did not begin to cohere as a field until the mid-1980's, its boosters invariably cast anchors towards earlier roots. In 1925, physical chemist Alfred J. Lotka deployed energy as a measure to cut across biotic and abiotic processes and provide a common perspective (a common denominator!) on processes in both nature and society. His contributions at the intersection of physics and biology are often pointed out as foundational to ecological economics (Bobulescu, 2015). Many of the field's animating contributions have come from chemists, such as the early 20th century Europeans Wilhelm Ostwald and Frederick Soddy (Hall et. al., 2009). Indeed, insofar as the field is a biophysical approach to understanding the activity of human society, Joan Martinez-Alier – himself a founding contributor – argues that the school of ecological economics has existed since the 1880s! (Martinez-Alier, 1990).

The dream of thermodynamic authority is one of disciplinary transcendence. Eugene Odum's 1959 2nd edition of Fundamentals of Ecology presented ecosystems through the analysis of energy flows, and in converting biomass units into energy units, rendered thermodynamics a central throughline of the ecological worldview. As all ecological relationships implicate processes of energy transfer, the articulation of ecological systems in terms of energy relationships could, in principle, provide a definitive means of apprehending knotty emergences that characterize the complexity of multiple interacting biological entities. The second law of thermodynamics – that natural

processes run inevitably towards disorder and entropy – implies that the biosphere contains finite energy. Ecological economists not only theorized the methodological apparatus of biophysically-grounded economic analysis (Craige, 2001), they also transposed this “entropy law” as a central justification for their animating advocacy for “limits to growth” in the economic sphere of production (Ayres, 2007; Daly, 1973; Meadows et. al., 1972). Drawing on the Odum’s insights, this new “BioPhysical” approach to ecological economics considered energetic flow as central to the ecological costs of the extraction and disposal of material resources. Drawing on Herman Daly’s model of a steady-state economy operating within an optimal scale, BioPhysical economists envisioned “minimal energy returns for a sustainable society” as a new operational beginning to an analytic process. Through the totality of thermodynamics, heterodoxy found a way to yoke the discourse of economics with an ideal of its own limits (**Figure 3**).

The solidity of energetics quickly gained epistemic purchase as a means for measuring ecological effects. Whereas neoclassical production functions *create economies* by using hedonic value to adjudicate an equilibrium of things within an ever-expanding black box – a system of relations that ecological economists critiques as in violation of the laws of thermodynamics – “BioPhysical economics” came to provide a means for the materiality of ecology to enter into economic relevance by providing a language through which the acceptable extent of the spread of that black box might be circumscribed (**Figure 3**). Thermodynamic methods provided a means for adhering to the first commitment of the analytical inversion: to supplant hedonic marginalism within the *function* of the economic method.

Both *BioPhysical* economists and *ecological* economics seek to build an epistemic space that leverages settled biophysical laws to render economics ecologically correct. Even as BioPhysical economists moved to differentiate themselves to form a new epistemic space, the flow of people and ideas has continued between the two areas of work. Indeed, in his fiery 2011 call-to-action, USSEE president Jon Erickson framed his ideal of reform as a need for “An economics built on biophysical truths.” Only by rendering their epistemic project directly responsive to the solidity of physical dynamics, Erickson seemed to be asserting, would the society regain its dignity from the jaws of PES. The assembled membership seemed to agree wholeheartedly. As their applause died down, the first audience member to answer Erickson’s call was Charlie Hall, a senior professor of environmental studies and long-ago advisee of Howard Odum. Hall concurred with Erickson’s assessment of the society’s dire existential crisis. Turning to the assembled audience, he took the opportunity to promote a different path forward, his own: “I’ve gotten so frustrated with the coopting of this field by the neoliberal agenda that I’ve gone on to start a new field “BioPhysical Economics.” This new field – born from ecological economics – would formalize energy as a “master resource” driving the economic process. By dealing with economies in the ways they *actually are* in a materialist sense, rather the idealized model of hedonically-driven interpersonal comparisons of utility – “a world that never really exists” – the field would form an solid counterpoint to the corruptibility of PES. BioPhysical economics would stand for ecological correctness *and* policy relevance. But would it be able to fulfill the third commitment of the analytical inversion – circumscribing economic activity within ecologically safe operational limits?

Several other longtime ecological economists joined Charlie Hall in this crusade. Over the intervening 7 years, they would go on to formally launch this new movement – an internally-generated reform to heterodoxy. The *International Society for BioPhysical Economics* currently holds its own separate annual conferences in addition to co-sponsoring joint meetings with the ISEE. A year after the fateful USSEE conference of 2011, Charlie Hall and Kent Klitgaard published their own textbook: Energy and the Wealth of Nations, billed as a “unified approach to economics in an energy constrained world.” In the laws of thermodynamics, BioPhysical economists find both *sanctity from* and *robustness against* the perversions of economic orthodoxy. They claim the field is not vulnerable to the half-measures of the practice of PES. “David,” an assistant professor of environmental studies assured me: “There isn’t really an analogue in BioPhysical economics of ecosystem service valuation” (David, 2015). I don’t know whether Frank ever connected with the BioPhysical economists, but if he was looking for a singular metric for sustainability, they are the ecological economists with the most coherent methodological program.

In proposing an economics that by definition obeys the laws of thermodynamics, the goal of BioPhysical economics is reform by anchoring economics to laws that are deeper and more solid than hedonic utility. As an energy-based methodology, the “BioPhysical economy” is an extension of Lotka's prototypical unification across the biological and physical. That is, its mathematical *functions*, anchored as representations of biophysical properties, carried the potential to accurately represent ecological value. As one interviewee explained: “One cannot understand the dynamics of the economy by looking solely at the process of *exchange*, where neoclassical economics focuses.

Production should be studied as an actual process of *work!*” Such work – extraction, processing, and consumption – is the material machinery of the economic process (Interview 2). By quantifying its effects in “objective” physical terms, the use of energy as a common denominator for analysis provided a new means to attempt to tame the neoliberally-driven destruction of nature.

BioPhysical economics has harnessed energy – the Odums’ prototypical “currency of ecology” – into a functional calculative project. But what of the *form* of the economy – its containment within “ecologically safe” operational limits (Rockström et al., 2009)? Having determined that there is finite energy available to sustain both ecosystems and societies in subsidiarity to nature’s laws, do thermodynamic laws also provide a roadmap to operationalizing those limits? Can BioPhysical economics synthesize the first two commitments of the analytical inversion, completing a whole synthesis of all three?

Though BioPhysical economists largely retain their ties to ecological economics, they have also met with resistance from within the heterodox space that forged their movement. Going back to Odum’s 1959 cautionary warning, many see a too-neat transposition of the currency of ecology with the currency of economics. But something else is amiss. The ecological economists’ commitment to heterodoxy is not just a rejection of the hedonic theory of value, it is an embrace of incommensurability of nature to any single standard of value (Chapter 3). If the orthodox approach can be characterized as emphasizing the efficiency of mechanism – “the invisible hand” – over efficiency in the backstage process of applying the mechanism – the parting-out that presages economic analysis – the source of its power may not lie in the hedonic theory of value, but in the

ideal of value monism in general. Indeed, a fundamental commitment of most ecological economists is to a plurality of ecological values not reducible to a single substance or metric. The problematics arising from a fundamentalism of joules has led some to see *value monism* as the defining characteristic of orthodox abuse (Spash, 2011). In this view, the very ideal of reducing multiple dimensions of value to a single common metric – the fundamental analytical conceit of the mathematical machinery of economic calculation – is suspect. The acceptability of the efficiency concept – adjudicating a singular dimension of commensurable entities – rests tenuously within the epistemic black box as a center of syllogistic elision. Within the black box, the invisible hand of efficiency balances incommensurables to a single central standard. In the reformist drive to generate *heterodoxy as a replacement* – a new economic model that fits within the same institutional structure as the orthodox practice – that same hand balances price or joules. In contradistinction to the clear and efficient argumentation privileged by the mathematical model, heterodox critique centers the messy problematics inevitably created by the application of such models to real-life conditions. But this complexity comes at the cost of providing a coherent, competent whole of sufficient appeal to the policy process.

Those bearing the torch of incommensurability in ecological economics have maintained their commitment to the full operationalization of the analytical inversion. They seek to shift the **definition of value** away from a quality inhering in particular physical objects. A heterodoxy of incommensurables wouldn't assign value as a *function of the economic process* – *either* the provision of salable products (hedonic price) or the flow of materials (joules) – but on the survival of species, or the varieties of communities

– incommensurable aspects of ecology’s integrity as *form*. That is – value would no longer inhere in the (orthodox) mechanism of hedonic utility, *or* the BioPhysical mechanism of the energy joule, but in the integrity of ecosystems in a holistic sense. The three commitments of the analytical inversion would be realized. But how could this commitment to incommensurability be accomplished in a formalized discipline? It is difficult to imagine an economic system not dependent on a single dimension of value. Heterodox thinkers have proposed several potential paths forward in the direction of this goal. Many advocate an internal reform to the system of economic utility that would account for *lexicographic preferences* in formal analysis – the requirement for multiple dimensions of value not representable on a single hierarchical scale of interchangeable units (Mayumi, 2001; Spash and Hanley, 1995). In the growing “Post Normal Science” tradition, Funtowicz & Ravetz (1993) and Funtowicz (1994) proposed an overhaul of economics to account for necessary complexity. But cohering a critical mass of ecological *economists* on this bandwagon has proven a difficult task.

Social Inversion

My interviews and observations through time spent with Jacob, Tim, and Josh (Chapter 2), lead me to conclude that the reproduction of disciplinary power is not just an epistemic matter, but a social process. To Jacob, the student learning orthodox economics at an elite policy school (Chapter 2), the tools, ideologies, and social structures of orthodox economic power went hand-in-hand. Indeed, a growing body of research consistently points to the need to examine the epistemic context of the production of

science in tandem with social context.¹³ Ecological economists seem to understand the organizational significance of establishing social spaces for the development of their ideas. I therefore also study the “solution” – the project of heterodoxy – jointly; it is a project of knowledge differentiation inextricable from social context. However, my analysis of the heterodox project reveals it to be a significantly different undertaking from that of orthodoxy. Orthodoxy’s easily characterized epistemic standards and its tightly defined mainstream stands in direct contrast to a diffuse, fragmented social structure across multiple – often mutually incommensurate – heterodox groups (Dow, 2007). Yet, the success of heterodox groups hinges on their ability to sustain an alternative social context to nurture into being a coherent new area of practice. A distinct peer group, with its own standards and values of knowledge production, is key to building a common heterodox identity. Yet heterodox identity may *require* pluralist tension. No sooner had a group of members formalized (in the form of BioPhysical economics) a methodological basis for unifying the discipline, than that group itself received pushback as being too fundamentalist to accept pluralism.

Ecological Economists are reflexive about the process of belief construction. When asked for his assessment about why neoclassical economists are so reluctant to change their approach, even in the face of environmental calamity, “Bill” pointed to the importance of social context in the enforcement of belief: “People searching for keys in a pool of light are people trapped in a paradigm. ... People get stuck believing things, all

¹³ Beginning in 1986 with Shapin and Schaffer (1986; 2017), Bruno Latour (1986), and Donna Haraway (1988), the literature in science and technology studies (STS) has continually demonstrated the significance of social and institutional context in the creation of scientific knowledge. In the sociology of knowledge tradition, Lemaine et. al. (1976; 2012) emphasize the emergence of new research areas as most appropriately studied as a combination of cognitive and social processes, not merely through a process disembodied ideas developing from each other.

evidence to the contrary! They will go to the wall defending their beliefs!” (Bill, 2015) Indeed, Espeland and Stevens (1998) describe a paradoxical dynamic at the heart of the epistemic commensurative process. Though commensurative ties overcome analytical distance between disparate objects, abstract languages (and the specifics of the abstract cognitive styles those languages encourage) also imposes distance from the meaning and context of the analytical object. In asking economics to take ecology seriously, the analytical inversion requires a widening of the lens of analysis to focus on the indivisibility of ecology as a competent whole. The analytically-inconvenient commitment to incommensurability is a resistance to abstraction as an imposition of inappropriate distance from the complexity of ecology.

Opening up the Silo

Ecological economists are also reflexive about the power of signaling difference. Labeling, as a process of differentiation, is also a source of power; the field carries both scientific and social legitimacy from its claims to being “ecological” as well as “economic.” “Orthodoxy” – a label ascribed to neoclassical economics by heterodox groups – is never a self-imposed identity, but a means of both calling out an unreconstructed traditionalism and making room for their own moves of differentiation and dissent.¹⁴

As Bill illustrates, the practice of heterodoxy among ecological economists is therefore also its own ethnographic process. It is a reflexive challenge to orthodoxy that – in the course of drafting a usable replacement – nimbly negotiates the task of hewing to a

¹⁴ Indeed, in Ch. 5, in another freaking dissertation, I explore the label as a source of conflict with colleagues who don’t wish to be perceived as regressive.

new imperative while remaining legible to orthodox power – as a source of converts and resources – through intimate observation of how that power is generated.

Like Bill and, famously, Herman Daly (in Goldman, 2005), Tim took the ‘critique from within’ path: “I wanted to see if I could help undermine mainstream economics departments by showing some embarrassing stuff...I tied it to the university’s sustainability commitments – pointing out that we’re supposed to be teaching students to be ecological, and showing that departments are doing the opposite, (I wanted to) create that pressure for change.” Daly is known among young environmentalists for advocating a formal training in neoclassical economics, so future practitioners of heterodoxy will nonetheless “understand the issues and know how to speak the language” (interview 8).

But the overwhelming majority of longstanding members I spoke with cautioned against the very idea of orthodox training, which they viewed as a source of corruption to the scientific imagination. Unlike Tim & Herman Daly, noted ecological economist “Colin” vehemently asserts that there is “little hope of transforming the system from within” (Colin, 2014). He believes that students should receive a rigorous training outside of economics if there is to be any hope of fundamentally changing it’s inner structure. That is, internal consistency of the structuring logics of orthodoxy is a huge source of its strength (Chapter 2), so any alternative must be cohesive enough to stand on its own. But cohesion – as a commensurative process – is itself a conservative force, one that might not withstand the inherent tensions and conflicts within a value-plural interdisciplinary science.

When asked about whether they engaged with either orthodox economics, or orthodox economists, my interviewees often scoffed at my naiveté. Several pointed out

that training in orthodoxy legitimates and drives anti-ecological outlook and behavior. Assumptions of “economic man,” I was told, legitimate selfish behavior, encouraging greed and rationalities linked to ecological degradation¹⁵ (Hodgson, 1997). Indeed, heterodoxy is pushing back on the Hobbesian state of nature at the roots of Western concepts of ecology as “red in tooth and claw” (Tennyson, 1849; 2003). The hold of orthodox power is so thorough on those operating within its valence that ecological economists view a separate organizational program – one in which they consciously critique and then dismantle taken-for-granted operational tenets – as the only way to deal with orthodoxy’s epistemological abuses.

Conclusion: An Organizational Simulacrum of “Sociodiversity”?

As much as the success of heterodoxy hinges on boundaries drawn against orthodox practice, the community is also reflexive about the use of boundaries within its borders. The imperative of environmentalism implicates more than biophysical context.

¹⁵ The project of ecologizing the economy is not the first time these two fields have encountered one another. Natural science theories of nature bear the imprint of their historical development within a social context. Early ecologists Linnaeus and White proposed theories that focused on cycles in nature as divine perfection. Discarding the idea of a divine creator, Darwin’s 1859 *Origin of Species*, proposed instead that natural processes flowed primarily from “the struggle for existence.” This “struggle” – an accretion of individual trait transfers optimized towards the singular goal of survival – bears much in common with the discourse of individuals acting “rationally” in a classical economic sense, for personal gain.

Whereas Malthus saw life as a struggle that was regrettable and tragic, Darwin’s principle of natural selection came to be seen a laudable metaphor for social life. The highest forms of life arise through the struggle! The influence of classical political economy on Darwin in turn had a recursive influence on social science – most crisply as the “social Darwinism” of Herbert Spencer and William Graham Sumner in the United States. It was Spencer who coined “survival of the fittest,” and proposed that natural selection could be applied to all areas of social and political life (Hofstadter, 1992). Early ecological thought was thus the science of the morally ordained value hierarchy – of nature and people organized through invisible forces of judgment. In the areas of politics and economics, the struggle for existence precluded interfering with the machinations of economic competition. By excusing the production of poverty via capitalism and the despoiling of natural environments (via the extinction of “unfit” species), the Darwinian ideal has subsequently come to be understood as having contributed to scientifically – and therefore morally – sanctioned ideas of the divine justice of the invisible hand.

A belief in the importance of both organizational structure and social content is articulated through the political structure of the society. The ISEE's governance performs the 'ecological' ontogeny – of subsidiarity to both biophysical and political organizing features. Through this, the society attempts to subvert traditional institutional structures that default to hierarchical deference to wealthy, academically powerful, English-speaking nations, and privileged social groups. Ten regional societies – representing every part of the globe – hold biannual meetings. At the 2016 ISEE membership meeting of all the regional societies, a discussion among leaders of the regional societies focused on the technicalities of creating a new regional chapter in Latin America. The conversation centered as much on the commonalities of ecological zones and colonial history as it did on nationality. In advocating for the new “Andean Society for Ecological Economics” – which would comprise Ecuador, Columbia, and Chile – a member of the Meso-American society (Mexico) argued: “This division makes a lot of sense because of both geographic barriers and colonial barriers.” To accommodate different perspectives and political concerns, the Brazilian society self-subdivided into biome-specific chapters. The geographic diversity of contributors to *Ecological Economics* is well-representative of the society's active membership (**Figure 4**, also see Chapter 1 for an in-depth discussion). Though the overwhelming majority of contributors to the journal come from Western Europe and the United States, active members have been moderately successful in their efforts to sponsor the travel of low-income participants to biannual international meetings. More significantly, three out of six recent international biannual meetings have taken place in the global south (2008, Nairobi, Kenya; 2012, Rio de Janeiro, Brazil; 2018, Mexico City, Mexico). Ecological economists are also conscious that the success of their

project requires reaching toward other knowledge communities and forms of expertise. Despite origins in the field of ecology, and early ties to Odum and his disciples, there's a perpetual push to maintain connection with ecologists and natural scientists. "We need to think about ways to reach out to ecologists and other natural scientists, to encourage them to be involved" (Laura, 2015).

Whereas a feature of orthodox power is the explicit elision of geographic and cultural differences – indeed, of as the significance of the context of the analysis – as relevant factors for consideration (see the vignette about Mankiw in Chapter 2), heterodox reform focuses on inclusivity as a higher-order ideal. Sarah, the professor at an HBCU, pointed out that, as a subsystem of society and culture, the economy can either undermine or support this analytical context. Sarah is one of several advocates for *sociodiversity* (Dansereau, 1992a,b,c; O'Hara, 1995) within the society, which she is as concerned about – or more – as she is with the loss of biodiversity. "We're homogenizing our organizational systems and so forth, our institutions. This means we need to make a movement towards participation again. And those *sustaining capacities are not just biophysical*, they are social" (Sarah, 2015). The move to incorporate racial diversity and the teachings environmental justice into the society has been steady, if slow. Sarah stressed "It is often underserved communities that bear the brunt of these social cultural emissions that impact peoples lives" (Sarah, 2015).

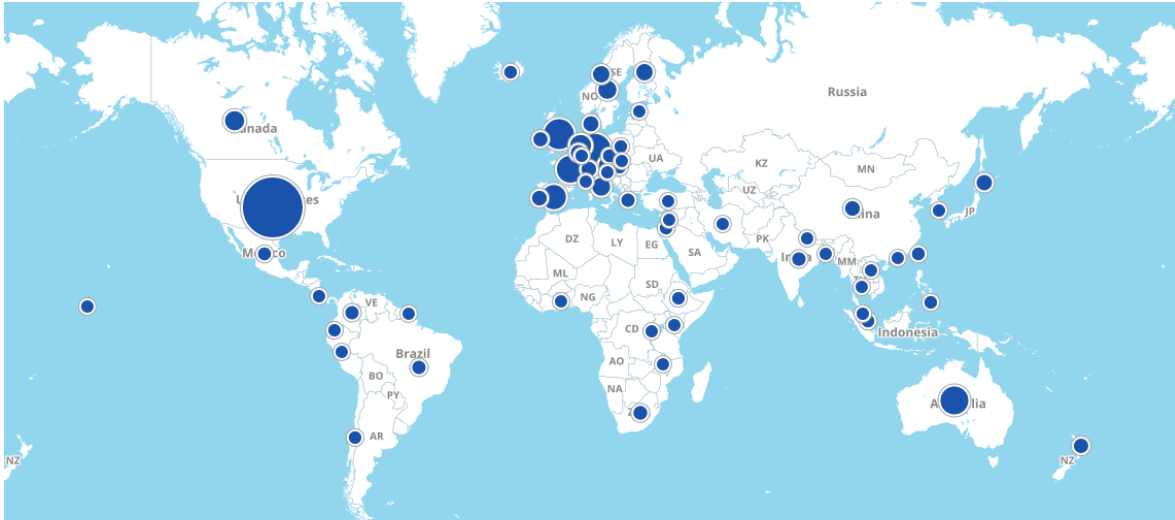


Figure 4: Countries of origin of *Ecological Economics*' authors, 2016
 [Size of dot indicates relative frequency. Image courtesy of Elsevier Publishing]

There is perennial sentiment that the very name of the society – to say nothing of its exceptionally desirable journal – is not reflective of the heterodox project its members intend. Many feel the society might be rendered more relevant – and unmistakably interdisciplinary – by changing its name, along with the name of its journal, to something that does not include the word “economics.” Advocates for this change argued strenuously at the 2014 ISEE meeting that the perception of the field as a “type of economics” was not a fair representation of the interdisciplinary and methodologically-pluralist work of the society. Many felt that the terms of heterodox interaction were being foreordained by the fields’ seeming openness only to those willing to work in the valence of economics. But, at that 2014 meeting, the inertia of history held the day. Proponents explicitly stated that, though the work of the society is to move “beyond” economics, the power and prestige of the moniker were powerful tools for legitimation and recruitment into the cause. Heterodoxy is staked on drawing from the discursive power of the hegemonic high status field of economics, and leverages it to attract attention and

followers. This high-profile space keeps the 'new' field still ostensibly within economics. But, in doing so, it also circumscribes the epistemic landscape of possible replacements.

Chapter 5

Towards a Theory of Unboundary work

The border is an equation in search of an equals sign. The border is the location of the factory where lightning and thunder are made.

Alberto Rios,
Arizona Poet Laureate

*“When you draw the lines,
you make the rules.”*

Karl Rove,
political mastermind

The choice of field site says a lot about how the sociologist sees the world. On first analysis, my field site might be described as an epistemic community: the ecological economists. But this community is a place of ragged edges and uneven depths. I have instead come to think of my field site as characterized by the problem of *context*. The preceding pages are an attempt to characterize an overlooked but consequential boundary – the line between the application of economic instruments to nature and the attempt to incorporate ecological principles into economics. Does the existence of environmental problems represent an incompleteness of economic rationality, or a failure of economic rationality? The location and character of this line has ontological stakes that represent a real crisis for the outcomes of environmentalism. This ethnography of public policy is an attempt to understand the way elite professionals and powerful discourses organize the worldviews of how to advocate for nature.

Early in my research, a friend and colleague – a fellow environmentalist with formal training in economics – confided in me that he was befuddled by my choice of project. “There is no difference between ecological economics and environmental economics,” he insisted. In this judgment, my friend is far from alone. This view of the landscape of is also held by many who identify *as* ecological economists. Indeed, in separate content analyses of articles published in *Ecological Economics*, both Luzadis et. al. (2010) and Plumecocq (2014) describe more convergence than any bright lines of distinction. **Figure 1** illustrates the relative frequency of each approach in English-language book publication. The economic approach to nature is first established in the late 1960’s as “environmental economics,” a subfield of orthodox neoclassical economics. By the mid 1980’s, during a period of relative stagnation in environmental

economics, “ecological economics” emerges as a separate field. Both fields grow in prominence throughout the 1990’s, but by the end of the millennium, environmental economics falls steadily from use. By 2008 (the most recent available data point), the two approaches reach an apparent convergence in published usage.

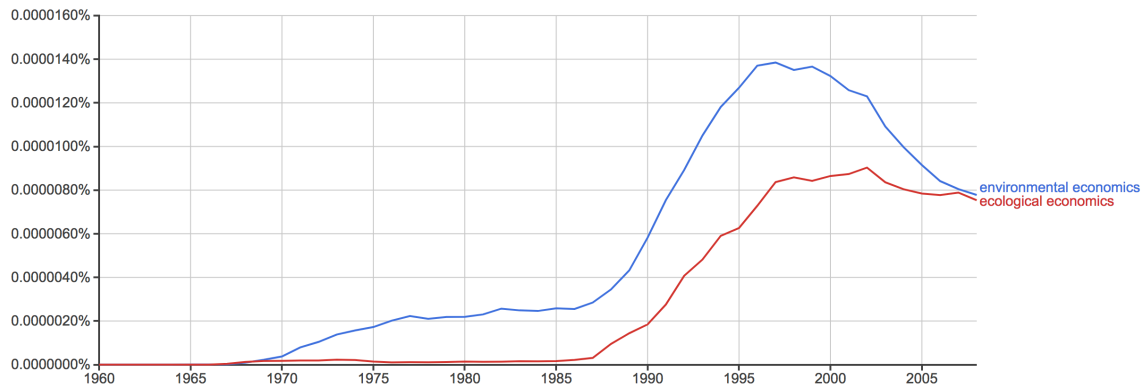


Figure 1: A Google Ngram showing relative frequency of “environmental economics” and “ecological economics” in Google’s representative sample of English-language books.

The studied opinions of many, including my colleague, Luzadis (2010), Plumecocq (2014), and Google, appear to triangulate in support of one conclusion: increasingly little appreciable distinction between two approaches to environmental problems. These experts are joined in this opinion by none other than ISEE president Jon Erickson who, in his 2011 call-to-arms, complained of being unable to distinguish the field he helped build from its sworn enemy, the “machinery of neoliberalism.” Ecological economics was meant to be a project of re-contextualization, of placing economic tools as subsidiary to ecological reality (Chapter 4). Yet, Erickson found himself presiding over a field that had capitulated to rule by market forces: “ecological economics has simply become a prescription for green growth, but growth nonetheless” (Erickson, 2011).

Nor do orthodox economists see heterodoxy as appreciably different from their own area of practice. When presented with the critiques of heterodoxy, orthodox

economists respond that heterodoxy is attacking a straw man. *Homo economicus* is not always a very useful way of understanding individual behavior or the dynamics of interaction; *methodological individualism* is not always appropriate as an analytical orientation to modeling complex systems. Surely, the heterodox view of economic thought is a shorthanding so facile as to be universally recognized as a caricature of itself? Yet the foundational assumptions of the orthodox framework of action remain durable, improved upon through interior refinement, through internalizing, through the acquisition of more data. Where orthodox power hinges on the perfectibility of those commensurations, heterodox dissenters build their critique from the demonstrable failures in orthodoxy's translation between the commensuration of individual elements and the apprehension of a *competent whole*.

If ecological economics ostensibly presents a radically different approach to environmental policy, what has caused the message of the field to become so consilient, so apparently devoid of distinction from the ideology it pushes against? Even as others, including a sizable and vocal core group that contains Erickson himself, maintain a vision of the field as a diametrically opposed upset to the rationality of economics itself?

In a classic work about the production of knowledge, Steve Woolgar and Dorothy Pawluch describe *boundary work* as the use of distinctions to create legitimacy (Woolgar and Pawluch, 1985). The assertion of a knowledge claim requires *work* because defending any knowledge claim is a process of backgrounding the assumptions required to give that claim resonance. Academic fields are traditionally circumscribed by boundary-setting; official or tacit, boundary-setting delimits an appropriateness of acceptable tools, methods, and research questions. An extensive concatenation of

boundary work is required to construct the facts of environmental economics: that environmental harms are unintended byproducts of human progress, which can be measured, priced, and “internalized” into an otherwise-rational system. The orthodox epistemic project is powered by theoretical consistency, methodological parsimony, and the coherence of an ideal of commensurability between economic tools and ecological things. As I discuss in Chapter 2, *boundary work* within this strong field is both epistemic and social in nature.

But what organizes the process of dissent? The drive to neutralize economics, to name and object to bad tools and ecologically inappropriate practices, is not itself a method that can be operationalized. Heterodox dissent provides none of Latour’s “steam” – a concerted vision for a way forward into action. Instead, it is characterized by the goal of subduing orthodoxy’s monological orientation through an orientation of pluralism: tolerance for multiple – sometimes incompatible – epistemic commitments. Longtime *Ecological Economics* editor Richard Howarth emphasizes this openness of the field as being unified by a set of concrete problems, rather than a particular epistemology or methodology. He emphasizes the pragmatic solution of “loyalty to problems” as the most effective means of creating a “bridge between seeming disparate points of view.” Howarth is openly and explicitly dismissive of attempts to build ecological economics through enforcement of theoretical distinction: “If we’re hung up on epistemology and theory, then we’re not being responsive to what’s right in front of us” (2016). A significant portion of those publishing in the journal and active in the society are also advocates for this approach. David, a professional ecosystems services consultant, expressed frustration at Erickson’s call to hammer down a line between orthodoxy and

heterodoxy. Indeed, I frequently observed that the urgency of environmental issues as problematized entities drives the field's energy and enthusiasm toward pragmatic solutions: "I feel less urgent about ideological consistency, or breadth, or whatever...we desperately need more ecological economics applied, more students, more academics, right? To actually *get problems solved*" (David, 2015). Howarth is famous for delimiting a "*big tent*" strategy to managing the content of the journal – to encourage the greatest possible collection of potential solutions (Howarth, 2008). This approach is a longstanding one, going back to Norgaard's highly-influential cast of the gauntlet in the disciplines' inaugural issue for the field to embrace a "methodological pluralism," of equanimity towards epistemologies and tools available in *both* ecology and economics (Norgaard, 1989).

Where disciplines enforce adherence to common methods and subjects of research, **big tenting** coheres multiple approaches to knowledge work. Often conflicting, these approaches are united by a pragmatic orientation towards the *solving of problems* – ostensibly through omnivory of tools, methods, and epistemologies. Big tenting is a call for unification, a break from the boundary work of disciplinary space through allegiance to an ideal of transcendent unification. Big tenting sees any "overriding problem" within the community as resulting from a lack of epistemic diversity among practitioners. It presents itself as an explicit appeal to work with difference: "to be a group of people who think across those disciplinary boundaries" (Laura, 2015). The work of big tenting is to see the boundaries of environmental problems as not so much "policed" but expanded, or – in the interest of casting a wide net of potential stakeholders and solutions from every corner – "*unbounded*."

Big tenting is an articulation of a pluralist inclusive vision. But the ideal of pluralism can also be a form of retrenchment; the singular vision called for is one of accepting *anything* in the name of pragmatic problem solving. Indeed, in the early pages of his field textbook, veteran ecological economist Peter Söderbaum muses that: “the open-minded attitude implies that even a neoclassical environmental economist can refer to her or himself as an ecological economist.” Big tenting leads to counterintuitive behaviors in epistemic space – where I discovered during my interviews with senior ecological economists that asking them to articulate a “foundational premise” unifying their field never resulted in a simple answer. Throughout this text, I have illuminated a few obvious candidates for what might unify the field: no growth, metabolism, appropriate scale, embeddedness, incommensurability, justice, and – perhaps most obviously – a simple opposition to orthodoxy itself. This hesitant reluctance to commit to a singular foundational premise is an articulation of a broader allegiance – to the ideal of big tenting. But what does big tenting accomplish for the field as incipient institution? I observed that inconsistency about a foundational discourse within the field was strategically deployed to attract not merely a plurality of approaches, but a multiplicity of ends. Indeed, “fundamental laws” animating the field can shift dramatically during the course of even a single conversation, sometimes used to subtly urge the incorporation of new concepts, or new converts, into the mission. Big tenting is not just a bid for inclusion or plurality – but a strategy to attract potential new participants from every corner. In an address to the assembled membership at the 2016 ISEE meeting, longtime *Ecological Economics* editor Howarth remarked: “Ok so we did *intend* to imply that the journal was mainly an economics journal.”

At that same meeting, the ISEE hosted a big-ticket visitor, the former deputy secretary of a large US government agency. In her talk to the assembled membership, she was effusive in her praise for TEEB¹ as a tool for environmental governance. Clearly presuming agreement from an auditorium she saw as brimming with economists, she pronounced: “You can’t manage what you can’t measure!” Often, a very politically powerful or high profile outsider is invited to visit the heterodox fold. This appears to be a bid to both attract attention and prestige to the cause, but also apparently to try to shift the guest’s own thinking via pushback from the assembled heterodox audience. At a different conference, one member complained that the choice of a prominent and explicitly orthodox speaker amounted to granting a platform to an unethical point of view. It’s organizer demurred: “I need to stage performances, I have to do something I do not believe in in order to make something happen at [prestigious institution].” The organizer hoped the staged performance would provide the opportunity for reasoned critiques from the assembled heterodox audience to percolate cracks in the edifice of orthodox thought.

Indeed, making the heterodox approach legible to orthodoxy - “mainstreaming” - is a conscious strategy for many ecological economists. Yet, these “staged performances” of openness to orthodoxy happen at a cost. I met “Veeda,” at a session of the 2016 ISEE meeting focused on the work of Karl Polanyi, the broadly influential early 20th century political economist whose work brought the concept of embeddedness into scholarly discourse. Veeda, a scholar from the Global South, was returning to the ecological economics community after a 12-year hiatus. She had been encouraged by the content of

¹ Initially a project of the European Commission, TEEB, “The Economics of Ecosystems and Biodiversity,” is a World Bank funded international initiative to monetize ecosystem services.

the session, which she described to me as focused on the context of economics rather than the facts of valuation. Nevertheless, Veeda expressed that the tone and focus of that year's meeting represented a dramatic shift from how she had remembered the society in the past: "I don't feel a sense of community in this current conference" (Veeda, 2016). Veeda returned home unsure as to whether she wished to remain involved in ecological economics.

Indeed, over the course of this research I came to see the pursuit of coherence, or more precisely, the elisions *required* by coherence, as themselves a driver of the growth of orthodoxy. The strategy of big tenting – in which anyone who shares *a* critical perspective about the economy-ecology interface is invited into membership – has led to lack of clarity about a common mission. Ironically, but perhaps unsurprisingly, big tenting fosters methodological convergence, a renewed connection with familiar and readily available neoclassical tools. The imaginaries of embeddedness, limits, and the exigencies of ecological boundaries may be too fundamentally abstract and complex in combination to yield the stated ideal of the society, the coherence of a heterodox countermovement.

Ecological economics' push to "get problems solved," (if not a foundational premise, certainly an overarching aspiration) is a source of retrenchment towards orthodoxy. Indeed, orthodox epistemology may spread to environmental applications through means never conceived of as appropriate even in their original context. Prolific critic Clive Spash argues that instrumentally-oriented pragmatism between economists and ecologists has led to ecologists "employing cost-benefit tools in ways that practicing environmental economists would never have dared to. Valuing ecosystems at highly

aggregated levels, implicitly advocating the spread of pricing and markets to all aspects of environmental management” (Spash, 2013). “Paul,” a newcomer at the 2016 ISEE meeting, performed the ontogenesis of this process: “Coming here, it struck me, the amount of tribalism you have going on in this field, as people argue about how to bring the environment back into the equation.” Paul’s first statements were typical of a newcomer working through the possibility of heterodox alternatives to neoclassical economic theory. But, in expressing these frustrations out loud over the course of our interview, Paul recapitulated the dynamic of retrenchment to existing economic structures that is embedded in the magnetic coherence of orthodox ontology. Within a few sentences, Paul’s allegiance to resolving the complexities inherent in the problem of environmentalism, which he viewed pre-analytically as trying to “*account* for the environment,” had him retrenching to the tool of PES as a coherent solution. “The idea of ecosystem services is a useful tool for this organization... to come up with a way of accounting for the flows from the environment so that they can be treated as parts of the equation, rather than externalities” (Paul, 2016).

Boundary objects - like heterodoxy - are important to the process of maintaining coherence among different perspectives. Yet, the price of coherence and recruitment to the heterodox cause – treating heterodoxy as a boundary object subject to interpretive flexibility – is slippage into the familiar routines of orthodoxy. I believe orthodoxy is empowered by, and grows, through the accretion of elision. As a boundary object, heterodoxy is approached differently by each participant. Indeed, the mental state of heterodox commitment can be a boundary object within a single individual placed in different contexts. I observed Ken – a prominent BioPhysical economist – make two

seemingly incommensurable interjections at the same ISEE conference. In the first – a moment of heated debate among presenters and audience members over the potential for physical determinism in an energetically-grounded economy – Ken seemingly played the role of a sociologically-oriented constructivist: “I’m different from everyone else here... you can’t possibly reduce human behavior to physics.” Yet, later, by way of defending BioPhysical economics to a different audience at the same conference, Ken’s intervention was seemingly incommensurable with his first: “I’m no longer a Marxist economist. Once you understand energy, there’s no other way” (Ken, 2016).

Heterodoxy in ecological economics is a movement towards embeddedness: the re-contextualization of economic tools as subsidiary to nature’s laws. By taking action to render economics responsive to ecology, ecological economists become liminal actors in epistemic space. Their newly opened territory is a space where people from a variety of backgrounds are permitted to acknowledge and wrestle with the complexity of various conflicting epistemologies of nature. Yet the task of formally articulating economic tools as subsidiary to nature’s laws remains incomplete – itself an unsettled knowledge claim, or *boundary ideal*. If boundary work is the focus on distinction to create legitimacy, then unboundary work is the breaking down of distinction to acknowledge context.

Unboundary work is the result of heterodoxy as boundary object.

Unboundary work broadens and opens to ontological uncertainty – doing the epistemic work of the analytical inversion by breaking down distinction to make room for context. In moving beyond a terrain of knowledge as oppositional dichotomy, unboundary work liberates possibilities for movement. Yet, even as its professed goal is the coherence of a concerted alternative, heterodox space may *require* the pluralist

tension of the unboundary. The work of breaking down distinctions is also a result of reflexivity about social exclusion in the face of still-developing standards of practice. As John, a foundational figure whose authority in the field is as respected as anyone's put it: "I wouldn't want to say 'you are not part of ecological economics,' I mean, *who* is going to say this?" (John, 2014).

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