Introduction: the scale of sustainability—the limiting universe where everything and nothing is sustainable

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THE GEOGRAPHY OF SUSTAINABILITY: THE ROLE OF SCALE

As geographers, our currency is scale. In the physical realm, our maps are defined by their scale. And in the cultural realm, the importance of a tradition or artefact also depends on its scale. Which is not to say, by any means, that a larger scale lends more value. Just as with monetary currency, the ability to effect good work depends on *knowing* the scale and *appreciating* its importance. A 1-dollar transaction might have just as much impact on quality of life as the multi-trillion-dollar global economy. And, by the same token, a minute drawing of the interior of a room might have equal significance, if we understand its scale, as a map of the world. Or a tiny cultural artefact, with significance to only two people, might hold more meaning than a tradition carried out by half the globe's population. The layperson may find this generalization paradoxical, but those of us, as geographers, in the business of making sense of time (c.f., historicity) and place (c.f., spatiality) underneath the global and local power relations that control our existence, will agree wholeheartedly.

In recent years, we've seen a focus on how sustainable, *at some scale*, our physical and/or cultural realms might be. One of the goals of the current edited volume, then, is to look across disciplines and see what we can understand about this geography of sustainability from a multitude of perspectives that go beyond multidisciplinary or interdisciplinary to crosscutting transdisciplinary approaches. As critical geographers, we must pay close attention to our scale and the possibilities for scaling up or down.

At the extremes of scale, be it spatial or temporal, everything, as well as nothing, is sustainable. We are unable to even fathom the 13 billion plus years of existence that the cosmologists provide for our universe. And even then, the so-called "Big Bang" is best understood as an event horizon beyond which we have not, so far, been able to peer. But upcoming super-instruments, like the James Webb Space Telescope (NASA 2019) and the radio land-based array observatories (NSF/NRAO 2019) include design elements to pierce that event horizon, at which point, as has happened often in the past, our conception of what we mean by "our universe" will change. We will demonstrate that in the vastness of the scales of space and time, everything is sustainable—that is, the universe is infinite—and nothing is sustainable—that is, we cannot conceive of something that has no limits and so it must begin . . . and end. Even the relatively short 4-billion-year scale of life on Earth carries this same "everything and nothing is sustainable" burden.

At the other end of scale, quantum mechanics also reaffirms that everything and nothing is sustainable. We can agonize, at a scale where we can touch and feel a material, whether it will last forever or not. But when we look at what is inside, at the infinitesimal scale, we find something that can only be described using complex statistical mathematics.

According to the quantum mechanics model, the ultimate physical particles that make up matter may only exist, statistically speaking, when we try to measure them. These quantum particles may also be able to surmount the supposed speed-of-light limit and cross distances instantly. Are they anything more than statistical probabilities, and, if that is all they are, then are they at once completely unsustainable, yet also eternal? If calculus, the mathematics that allows rigorous and precise approaches to the binaries of infinities and infinitesimals, can describe these phenomena at the extremes of scale, then, as Richard Feynman said, it is the language that God speaks (Feynman et al. 2011).

Clearly the daily discourse about sustainability is not at the scale of the Big Bang or Quantum Mechanics, although we risk reactionary responses when we ignore that grander context. We must deliberately, and with deliberation, decide on what scale we most effectively analyze geographic sustainability and with what discipline or cluster of disciplines we can attempt such approximations. If, on the extreme scales, nothing and everything is sustainable, then why does it matter how long things last? That must depend on the scale of analysis, and the political climate that controls decisions and policies that affect generational concerns of the present. Before we look at some examples that are within the grasp of our everyday minds (hopefully no calculus required!), let's be sure we erase any potential pre-reactions based on political sentiments or expediency.

THE POLITICS OF SUSTAINABILITY: CHANGE TO KEEP THE SAME

At both ends of today's political spectrum, some irony can be discovered in views about sustainability (Avelino et al. 2016). Among political progressives, for decades, environmental conservation has been a central goal. Under the rubric of conservation, a resistance to change drives the discourse, despite a dissatisfaction with the *status quo*, under which current lifestyles, consumption levels and policies are seen as unsustainable. Yet, rather than embrace technological solutions, much of the rhetoric is about conserving and preserving wild areas, returning or rediscovering lower consumption lifestyles and rejecting new technologies. The result can be not only *viewpoints* that are contradictory, but *hypocritical lifestyles* that depend on high levels of consumption of cutting-edge technologies in defense of pristine wildlands and a so-called traditional, or minimalist, way of life.

At the same time, political conservatives believe that environmental conservation should not interfere with capital development and business opportunities. However, despite this drive for an expanded human economy, the rhetoric values maintaining the social *status quo* and supporting only existing industries, especially fossil-fuel-based development. New technologies, particularly in the energy sector, are seen as unacceptable, often solely because they are promoted by political progressives. The result is again *viewpoints* that can be contradictory and, as with progressives, *hypocritical lifestyles* that strive for ever-expanded affluence while rejecting the potential for new sources of energy, which, at some point, must be the basis for economic growth. Debarbieux and Balsiger (Chapter 3) dive into the ramifications of scale and sustainable development highlighting the tendencies of traditional politics.

Wherever an individual's political ideologies lie, we must, as natural and social scientists, look to the realities of what the data tell us and analyze them in the context of a scale that makes sense. Only then do we have a chance of applying the lens of sustainability in a rigorous way (Miller 2005). However, we are still faced with the question of what we mean by, and how we might defend, the idea of sustainability.

THE SPIRIT OF SUSTAINABILITY: WHAT IS QUALITY OF LIFE?

Rationalism and the birth of so-called “Western Thought” required two pillars. The first is an assumption that we share a common reality that can be described, probed, tested and explained. The second is that this understanding of that common reality can be parlayed into improvements in quality of life. The sustainability movement takes its roots from deep within these two foundational pillars. Whether we are trying to understand extinction rates, global climate change, economic inequalities or resource utilization, we assume that a rigorous analysis will bring light on a shared common understanding of the question, and that we will then use that understanding to foment better quality of life.

However, what we mean by quality of life can, and perhaps inevitably must, become a spiritual question. One part of the shared common understanding is that death cannot be eliminated, and most people might also agree that suffering cannot be eliminated. So, if death and suffering are the impediments to much of what we might call quality of life, how do we pursue their diminution? Here, religion and spiritual beliefs may be just as important as a scientific rational approach. Is there anything special about human quality of life, or are other non-human species equally or more important? Do we give primacy to animals, or to plants, or to microbes? Are quick young deaths better than later, prolonged deaths? Or is minimizing suffering at the end of life more important than prolonging it? How can we optimize the distribution of a resource to most improve quality of life? Is it more important to reach more people with a minimal increment, or a few people with a maximal increment improvement? How can we measure suffering, and how can we be sure we are reducing it, or maximizing that reduction?

Interestingly and probably detrimental to the goal of maximizing well-being, the most common measures for quality of life are economic, under an assumption that more is better, especially with regards to production as in gross domestic product (GDP), Global Hunger Index (GHI), etc. (Gullone & Cummins 2012) and income (as in median income for a population or an individual's personal income bracket). More capital is almost always assumed to link with higher quality of life. This leads to monetizing nature and assigning commodity value to ecosystem services. But human capital is rarely considered. And capital goods are most often reduced to their monetary equivalent with little regard to their intrinsic value—in other words an inventory of firearms is considered as equal to an inventory of tulips if they have the same dollar valuation.

A call for the inclusion of a non-monetary, and even spiritual, component to the analysis of quality of life has been heard from the fringes of many scientific disciplines, including environmental economics and perhaps notably sustainability studies (Kenter 2016). As geographers interested in sustainability, we must move beyond some of the basic assumptions of economics and bring personal, social, community and spiritual measures to our valuation of quality of life, and thereby the inherent sustainability of a given resource or

practice. A true quality of life framework for sustainability suggests that we should appraise the Nature Values to People (NVP) on the same level as Ecosystem Services (ES) to have a better grasp of well-being assessments (Díaz et al. 2015). Guevara and Frolich (2016) delve more deeply into an analysis of how well-being metrics should be measured and also tabularize many of the known GDP alternatives. Finally, the new effort of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) is a global effort to formalize a more robust and inclusive approach to how well-being and quality of life are measured.

Science fiction and popular culture also provide insights on problematic or unsustainable futures. In the recent set of Marvel Avengers Super-Hero “Infinity Wars” movies, the compellingly sympathetic villain, Thanos, has slaughtered half of the population on his home planet under the belief that this would allow utilization of the remaining resources to end suffering for those who survived. Now, he believes the same principle must be applied universe-wide. Lewis Thomas (1978) argued that life is surely the “toughest membrane in the universe” and we concur that we are naïve to be concerned about its ultimate lasting sustainability. In the end, Thanos is defeated, but to what end if the remaining resources of the universe are so scarce that the incursion of massive suffering is inevitable. And, by the same token, if life is ultimately impermeable to death, where, how and on what scale do we apply our lens of sustainability to strive for ever-increasing quality of life? And how do we dare define this, and its corollary, the diminution of suffering?

Theory can only take us so far, and the scale of sustainability, the often hypocritical politics from both ends of the political spectrum that surround it, and the attempts to define sustainability in the spiritual realm, must frame our debate. But in the end, we are also compelled to take real decisions and real policy about the scalable world around us. The larger-scale questions might best serve to frame a rational analysis of the data, and to take informed decisions within a discipline of moderation. Let’s then look at some examples of how binary issues encountered in this Elgar Companion book, which can present initially as opposites, might help us arrive at moderation with regard to applying scaling of sustainability to geographic analyses.

THE SCALE OF CITIES: WHEN DOES RURAL BECOME URBAN?

By any measure, the appearance of cities and the phenomenon of urbanization is paramount to the geography of sustainability. Even the most outlandish superlatives do not fully capture how impactful our transition to an urban species has been and will be. Furthermore, few other topics are more suitably rooted in the larger discipline of (environmental) geography, and more fruitfully analyzed through the lens of sustainability. Guevara and Frolich (Chapter 2) point to the need to identify binary thinking to assess the impacts of high-energy cities and impending urbanization fronts.

As this young twenty-first century unfolds, humanity’s greatest evolutionary transition—the demographic–ecological shift from the farm to the city—will reach its culmination. More than half the world’s population already lives in an urban environment, and over the next 50 years, most of the other half will be joining us (Gu et al. 2019). *These are times of dramatic evolutionary change for the species in a way that has not been seen before*—more important than the great migrations out of Africa to inhabit all the continents, more

important than the great leap into sedentary agricultural communities after millennia of nomadic hunting and gathering, more important than the initial transition to an industrial economy.

The advantages of the urban environment are numerous. People desire a vibrant central district with cultural, banking and industrial infrastructure. Cities provide economies of scale, ease of provisioning for basic necessities, a concentration of human diversity and the fomentation of innovation through access to new technologies. At the same time, migration to the urban environment presents the risk of a decrease in quality of life, to levels of misery among economically poor segments of the population. *The great challenge for the twenty-first century is to analyze the key elements of urban culture that promote higher quality of life, within the framework of an integral evolutionary ecology that includes the human being.* The geography of sustainability is at the core of this analysis.

In the modern urban areas of the world today, the problem of the confrontation between human beings and the “natural” world is solved with an approach where socio-economic-cultural processes are recognized as part of the natural world, and where economic activities are seen as fundamentally ecological in nature—that in fact economies are nothing more than ecologies where energy can be represented as monetary currency (Vermeij, 1993). A realization of the paradigm of nature pristine is presented by Sarmiento (Chapter 1) analyzing the need of transdisciplinarity approaches to understanding mountains with the new integrative, crosscutting science of montology. He argues, following Nicolescu (2002) for a change of paradigm whereby we will manage the urban/rural dynamics by considering mountainscapes as socio-ecological production landscapes (SEPLS). Sarmiento points, as a leading example, to the International Program of the Satoyama Initiative (IPSI) headquartered at the University of the United Nations’ Institute for Global Sustainability (UNU-IGES) in Japan while Dunbar and Ichikawa (Chapter 10) present this innovative collaborative program in detail. Conurbations, where amalgamated cities become megalopoli, and exurbations, where cities have expanded towards the wooded edges, blur the boundary between urban and rural, resulting in a new class of manufactured landscape: the “rurban,” where SEPLS are highlighted (Kendal & Raymond 2019). However, rurality is still manifest around the world, such as the Satoyama landscapes of Japan: these traditional environments call for a unique understanding of conservation within the framework of a sustainable geography (Subramanian et al. 2018).

The effect of urbanization on the human species is all-encompassing. *At every level—from individual to family to society to population to species—virtually all aspects of human life change in the urban sphere.* A new concept, the *Technosphere*, complements the Biosphere in the Total Human Ecosystem concept (Naveh et al., 2002). Virtually every contribution to this volume on the geography of sustainability addresses, sometimes directly or sometimes peripherally, this greatest of all human transitions.

Christoffel (Chapter 25) brings forth the tight “sister-discipline” relationship between geography and urban planning. He dismisses the term “urbanization” and rather sees cities as fundamental to human culture in today’s world. Cities are “smart” in and of themselves—an emergent intelligence. They illustrate a higher evolved form that is self-perpetuating and self-governing, a high-value and high-maintenance super-organism in the cityscape.

Taylor (Chapter 20) calls for a fourth pillar of sustainability (after ecological, social and economic) which he labels *cultural*. In the social sciences, especially geography and

anthropology, the idea of culture has traditionally come from the study of pre-urban so-called indigenous cultures (Cosgrove & Jackson 1987). Ironically, even the ability to label something as “cultural” is an urban phenomenon, rooted in the notion of the appreciation of “culture and the arts.” Now, the term has come full-circle and includes the cultural contribution of city lifestyles—not only in terms of class-defined “cultural activities” like museums and theatres—but an urban culture that might include street-life, popular music, clothing fashion and more. This newly defined urban human culture affects who we are at every level, from the individual to the species to the new urban super-organism. For the geography of sustainability, urban culture and all that it encompasses must be a part of the analysis and the solutions that are proposed. Taylor defines the Historical Urban Landscape (HUL) as an essential part of sustainability analyses, where the cultural traditions that emerge from urban lifestyles are seen as a driving creative force for “poverty alleviation, gender and youth empowerment, and sustainable use and conservation of natural resources.”

Zimmerman and Zimmerman-Janschitz (Chapter 8) call for the use of GIS (Geographic Information Systems) technology, on a global scale, with an emphasis on urban areas, to guide sustainability decision-making with regards to the geography of inclusion. They focus on equity for the disabled, or differentially abled, population, but their approach is quintessentially urban and applicable across the broad spectrum of our newly defined urban culture. GIS technology itself, inasmuch as it blankets our globe, making a “Google Earth” and mobile interactive mapping possible (Wood et al. 2007), required all the technological advantages and demands of an urban species to come into being. We then see how GIS technology and its derivative mapping allows for a distinctly wildland-based analysis of land cover around Glacier National Park by Resler et al. (Chapter 17) and long-term land use change in Costa Rica by Padgett-Vasquez (Chapter 22). Resler et al., despite their focus on a relatively remote pristine wilderness, still surrounded by rural lands, see significant urban effects, including loss of traditional farmland, “ex-urban” development, loss of impervious land cover and increased forest fragmentation. They conclude that the concept of “mountain protected area” must be challenged, based on the ubiquitous effect of cities.

Finally, Borsdorf and Haller (Chapter 9) look at the particular challenges faced by mountain cities. They elegantly place the city within its natural geographic context, examining how tectonic activity and the orographic terrain impact urban life and its cultural components. They identify how the geography of mountains, which transcend political boundaries, interact with the lifestyle necessities of people living in mountain cities, which are political–social–cultural constructs, thereby merging the physical and cultural aspects of the geography of sustainability. However, Donoso-Correa and Sarmiento (Chapter 16) present an example from southern Ecuador where a case is made for better planning against smart growth and the recovery of elements of village lifestyle in a more harmonious farmscape dynamics.

THE SCALE OF NATURE: WHEN DOES PRISTINE BECOME HUMAN DOMINATED?

The natural–human binary is only subtly distinct from the urban–rural spectrum. Increasingly, humans as a species are defined by the city construct, while the built

environment is frequently conflated with the urban environment, leaving rural/agricultural and natural/pristine as subsets or correlated concepts. At the same time, we *can* identify and utilize a binary that is based on the extent to which the human element is present in the landscape. Pristine wilderness, completely untouched by humans, may exist only on other worlds now. But we can certainly consider the extent to which the human presence, as distinct from non-human natural processes, might influence the geography of sustainability. The role of agricultural and rural geographies is particularly important in this context.

Holdridge et al. (Chapter 15) focus on the importance of small-scale indigenous farming practices. They recognize that locally developed farming regimes, with a rich history, still have much to contribute to an increasingly globalized food distribution system. They point out the value of indigenous farming systems for their flexibility, their diversity and the fact they still feed a large part of the world's population. González and Sarmiento (Chapter 23) add to this view with their analysis of how small farms using indigenous technologies and TEK (Traditional Ecological Knowledge) provide food security for the Andean region and serve as a "Noah's Ark" for food crop diversity worldwide. In a provocative crosscutting fashion, Ibarra et al. (Chapter 24) propose a research agenda for complex foodscapes, making a special plea to protect the biocultural microrefugia as nodes of agrobiodiversity futures.

The "human" end of this binary overlaps significantly with the "urban" end of the previous binary, as human culture becomes predominantly, or at least in its majority, an urban culture. Rozzi (Chapter 11) promotes biocultural landscapes as the appropriate way to integrate human and natural components of the ecosystem. He views humans as one more, if not very important, species that forms the landscape and proposes a philosophical and legal framework, ecosocial governance, ethical foundation and educational basis for this analysis. He proposes a "biocultural ethic" that incorporates his "3Hs": Co-inHabitants, Life Habits and Habitats:

To foster intercultural dialogues that incorporate both the biophysical and the cultural heterogeneity of the planet, we offer the perspective of the biocultural ethic. Its central concept relies on the vital links between (i) the well-being and identity of the *co-inhabitants* (humans and other-than-humans), (ii) their life *habits*, and (iii) the *habitats* where they take place (Rozzi 2012a). This formal proposal of the "3Hs" (co-inhabitants, habits and habitats) offers a conceptual framework to analyze, from a biocultural viewpoint, the worldviews of cultures from different geographic regions, historical periods and/or socio-environmental contexts, and provides a methodological approach to undertake three tasks that contribute to favoring sustainable geographies. (Rozzi, Chapter 11, this volume)

Dudley (Chapter 14) seeks to ultimately define what "natural" means. He promotes moving beyond notions of "natural" as meaning devoid of human influence, to "authentic" ecosystems, which he defines as "a resilient ecosystem with the level of biodiversity and range of ecological interactions that would be predicted as a result of the combination of historic, geographic and climatic conditions in a particular location" (Dudley 2012). He considers to what extent integration with humans is "natural" and values the services that ecosystems provide. Müller (Chapter 13) sees stress from population growth and resource utilization as so extreme that "regenerative development" is called for, where environmental, social, political and cultural systems must be oriented not just towards sustaining, but regenerating from the losses that have already accumulated.

The Galapagos Islands are presented as one of our great examples of where humans and nature have interacted and sometimes collided. Mena et al. (Chapter 21) appreciate how the islands evolved for millennia with no human presence, have been significantly impacted since the arrival of humans and their introduced species, continue to feel strong pressure from that impact, but also remain a great worldwide treasure for viewing pristine processes of evolution, while bringing that biological diversity to the cultural world through a well-developed tourism infrastructure. They conclude with a concern that “lack of understanding about how external pressures like tourism and economic development, population growth and increasing production of waste and pollution will affect key ecosystems now and into the future.”

THE SCALE OF PLACE: WHEN DOES LOCAL BECOME GLOBAL?

For decades we’ve heard the slogan: “Think Globally, Act Locally.” But in an increasingly globalized world, instantaneous communication around the planet, and fast, efficient movement of people and goods can make the entire planet at times feel local, the so-called “glocal.” In fact, people increasingly have closer relationships in other cities and on other continents than with their neighbors. Furthermore, the mass, globalized provisioning of resources into urban cultural landscapes may actually be more resource efficient than a distributed, locally-based production model. Again, the scale is crucial since some resources or products may scale up into mass production and distribution more readily, more healthfully and more efficiently than others. One of the dangers of a capitalist model is when initial scale-up allows for market dominance, making it impossible for smaller-scale producers or distributors to compete, even though they may have a better, healthier and even ultimately more efficient product. Large-scale market players can even afford to lose profits until they eliminate competition. On the other hand, many sustainability advocates make the faulty assumption that small-scale is always better. Dwellings are probably most energy efficient in buildings that are six to 12 stories high (Ali & Moon 2007). Transportation and distribution infrastructure are also probably most efficient in densely populated areas, even when sourcing might be far from local. However, cities, on a global scale, also bring higher economic standards of living and overall increased consumption. The highest levels of energy use come about, anywhere in the world, when, after some number of generations of dense urban living, certain populations return to suburban, ex-urban and rural lifestyles for amenity migration (Gosnell & Abrams 2011). Proponents of these lifestyles might feel as if they are returning to a more locally-based and sustainable way of life, but, on a global scale, they become the highest users of resources. The well-developed urban data infrastructure also makes it much easier to collect massive amounts of quantitative data on the economic efficiency of resource distribution and capital/infrastructure development. However, purely economic analyses, as we’ve mentioned before, do not always arrive at the best solutions to improve quality of life or provide for long-term sustainability.

Harden (Chapter 5) is especially sensitive to the need for multiple-scale analysis, and strongly promotes the role of transdisciplinary geographers:

Geographers are uniquely equipped to study and understand the spatial relationships of actions that increase or decrease sustainability and that link local to global scales.

She draws three lessons from the analysis of scale: (1) that small actions can, in their multiplicity, have larger effects, both positive and negative; (2) that we can clean up our past mistakes and learn from trying to do this on a small scale and then amplifying it; and (3) changes in behavior are possible and can lead to massive-scale improvements in quality of life, as evidenced by the spread of xeriscaping, recycling and the use of LED light bulbs. Finally, Harden insists on the importance of feedback, on measuring the real effects of actions and then adjusting them. She insists on the keystone role that geographers can play in finding the linkages among scale when analyzing system feedback:

To ensure that actions intended to increase sustainability are indeed having the desired outcomes, it is important to approach the quest for sustainability through multiple scales and with well-informed understandings of those scales and how they are connected.

Norberg-Hodge (Chapter 6) makes a strong case for locally sustainable economic practices. Based on decades of experience in Ladakh, India, she believes that the rapid trend towards globalization has led to the loss of locally sustainable farming, ecosystems and cultural practices. She expands this experience into a critique of the dominance of globalized systems, and calls for a reversion to local economies, with detailed analysis of the multiple elements, including trade treaties, capital flows, banking practices, tax systems, indicators of well-being, land use regulations and health and safety regulations, that must be changed to favor local economic development.

At the same time, Christoffel (Chapter 25) believes that planning for the built environment must cross the local to global spectrum, under the rubric of the geography of sustainability, arguing that the:

framework for geography's contributions from its broad base and role as a scientific integrator of knowledge in support of planning processes whose implementation by public and private governing bodies affects the built and natural environments. This challenge will soon be recognized as being so great that boundaries between disciplines, trades and skills, nations and peoples, will have to be crossed to solve the sustainability challenges. Planning, informed by greater science and real-world experience, will have to network even more broadly, becoming more comprehensive, so implementation will be more effective at all levels and in all circumstances. The deepest, most basic community motive can be brought forth at a greater level for action, as individuals and groups understand the need of human civilization for sustainability long term. This is the level of understanding this volume supports. The future of geography is sustainability.

THE SCALING OF TEMPERATURE: WHEN DOES WEATHER BECOME CLIMATE?

This binary, from local weather conditions that change from minute to minute to long-term modeling of the global climate, has, obviously, been the focus of an immense research and analysis effort (Pachauri et al., 2014), far beyond the scope of this volume. However, it is worthwhile pointing out that the discipline of geography incorporates virtually all of the kinds of sub-analyses that should be, but are perhaps not always, included in climate models. Not only are physical processes important, but cultural, social, demographic, and economic processes may well affect the ultimate outcome of a climate model. Young (Chapter 7) makes a case for how the climate framework is biased by a Global North

perspective and calls for the inclusion of Global South views. An important contribution of this volume is that the meteorological climate changing is but one of the climates that have affected farmscapes and cityscapes alike. Mostly in the developing world, there are other climates that have had and continue to have deleterious environmental effects, such as religious climates, political climates, investment climates, armament racing climates. Again, whereas this volume does not even begin to pierce into this topic, we believe it is worthwhile to call for a comprehensive, physical-cultural geographic approach to the multiple temporal and spatial scales of climate change.

THE SCALING OF DEATH: HOW MANY MUST DIE TO CALL IT EXTINCTION?

This binary has also been the subject of decades-long interdisciplinary research programs that include not only a comparison with the historical fossil record, but the short- and long-term monitoring of populations and theoretical modeling of everything from what a species is, to how phylogenetic trees should be constructed, to the rate of genetic change, clade dynamics, and more (Edie et al., 2018). The impact of human landscape alteration and a globalized transport system that now routinely carries species across and between continents adds to the complexity of this topic. Cheddadi and the *Vulpes* project (Chapter 4) discuss the paleoecology of extinction and how it might inform our understanding of the geography of sustainability. With the idea of preventing mass extinctions, the nuanced articulation of Harmon (Chapter 12) calls for underlining the importance of protected areas, such as national parks and equivalent reserves, and their role in preserving elements of the ecosystem that have been placed under stress through the pressures of urban development. He posits that there are geographies of commitment that need to be incorporated in the decision-making towards sustainable futures.

THE SCALING OF THE SACRED: WHEN DOES SPIRITUALITY BECOME RELIGION?

In the discussion of spirituality as manifested from the cryptosystem of cultural values, the incorporation of indigenous points of view are highlighted by Stadel (Chapter 18), who argues in favor of listening to the murmur of the tropical mountains and the claims of Andean people in order to better define sustainability scenarios. He presents specific adaptations to climate change and highlights the resilience of the ecosystem to withstand the impact of changing precipitation patterns and changing temperatures. TEK is seen as a way to incorporate non-traditional actors in the debate around sustainability scenarios.

The role of spirituality and religion in the geography of sustainability must be framed from a local perspective. Boillat (Chapter 19) introduces the ontology of place in the context of indigenous wisdom. He formulates conditions for assessing how perceptions of change in the environmental space and place are affected by the spiritual milieu. Indigenous ecological knowledge (IEK) applied to the consideration of animistic mythology can be mixed with Catholic (Western) dogma and the indigenous approach to managing conflict, leading to the development of syncretic landscapes. He concludes that

considering the “plurality of place concepts and place making processes in sustainability research can play a crucial role in understanding and bridging systems of knowledge and values.”

Syncretism of religions has helped to mold unique identity markers that fuse the binary terminus into a continuum of shared values, generally based on respect for Mother Earth (*Pachamama*), accentuation of the reciprocity of community members (*Ayni*) and the possibilities to envision the “good living” or *Buen Vivir* (*Sumak kawsay*) that have made the Andean lifescape (Guevara and Frolich, 2016).

CONCLUSION

We are glad that the reader has entertained the concepts presented in this introduction, so as to avoid a fatalistic outlook on sustainability. We wish to emphasize that the randomized occurrences of natural processes can provide a frame of understanding for the actual cultural responses of society resulting in an ever-changing mindscape. Navigating this topography necessitates a clear sense of scale and an appreciation for the potential of scaling up or down in reference to sustainability issues in geography (Sarmiento & Frolich, 2012).

As geographers interested in questions of sustainability, we must employ our daily currency of analysis: the temporal and spatial scale. In so doing we wield a powerful tool for arriving at rational useful and applicable approaches to what can seem to be intractable problems of space/time pulses. Choosing the appropriate scale of reference, however, carries its own set of potential pitfalls.

First, we must be aware that at the extremes of scale, sustainability has no meaning. If we delve out to the supra-telescopic infinities of the universe, or inwards to the sub-microscopic infinitesimals, we can only arrive at the conclusion that everything, or if you like nothing, is sustainable. At these extreme scales, time and space lose their tangible meaning and we are left with larger questions in the scientific domain of cosmology and quantum mechanics or in the spiritual domain of where, how and why all this that surrounds us is possible. But we mustn't neglect this larger framework for the value it holds in providing perspective on the realizable and understandable scales within which we contemplate what is sustainable, how it can be sustained and why it should be sustained.

The other major pitfall we encounter is a tendency towards political polarization around sustainability questions. Here, allegiance to a particular brand of politics can lead even academic practitioners to hypocritical and contradictory policies and conclusions. Whereas those on the left-leaning progressive side of politics tend to promote change and adoption of new technologies to help solve problems while incorporating diverse cultural approaches, they also believe that conservation of so-called (and probably non-existent) “wildland” areas is central to sustainability. Meanwhile those on the right-leaning conservative side of politics tend to promote economic growth even at the cost of sensitive ecological environments but negate the value of many new and alternative technologies, especially in the energy sector, which at some level is the basis for all economic growth.

Our hope is that this Companion book to geography, transdisciplinarity and sustainability can provide some helpful perspectives on the scale of sustainability problems as they relate to particular aspects of the physical and cultural world. We know that our

selection of topics may be iconoclastic and we by no means intend to be comprehensive. However, we believe this small effort will provide some insight to a few fascinating scale-related problems in the geography of sustainability. Questions such as how we are going to adapt, as a species, to the massive scale of worldwide urbanization, how we are going to find a balance between local and global economics, at what scale we address tenacious problems such as weather and climate change, the extinction of species and changes in cultural practice all require the kind of appropriate scale-based solutions and policies that we as geographers provide.

Finally, we believe the transdisciplinary nature of the scale-based geographical approach has much to offer to the analysis of sustainability issues. Geography, with its emphasis on spaces and “-scapes,” stands at the threshold of every discipline—neither science nor humanity, neither art nor engineering, geography embraces all (Sarmiento & Frolich, 2012). This volume includes engineers and architects, environmental scientists, social justice proponents and many cross-disciplinary workers of all kinds, not to mention the geographers themselves. The trope of the different geographies, to incorporate hybrid approaches of the physical and the cultural under one comfortable canopy where people in their dendritic spaces perform the rhizomic function of planetary well-being, brings a powerful set of comprehensive tools to the study of sustainability issues. Sustainability, transdisciplinary approaches, and geography at large, will be tallied against the measure of a satisfying, fulfilling lifestyle and the diminution of suffering. Our greatest hope is that this small contribution might, for our readers, their future efforts and the people they might touch, be a small step in this direction.

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