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Lessons of the Past and Present to Sustain the Future

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"Nature, to be commanded, must be obeyed" – *Sir Francis Bacon, 1620*

ABSTRACT

An innovative way to consider the vast 'unused' portion of our natural resources reveals a common and universal ecological pattern. It is characterized by the bulk of the resource being a cushion "in the background," a seemingly endless supply of the resource. Not so. Those 'unused' masses of our resources are buffers essential to life on the planet: they provide back-up protection for life in all its forms. The observed atomic-to-cosmic blueprint demands our attention. This paper connects the dots between the nature of nature, natural resources, population, and sustainability. To achieve sustainability resource management policies and practices must be based on the nature, value, and preservation of the buffers consistent with all the implications – demands and challenges – of a growing human population.

Introduction

This paper explores some past and present lessons and events that will help natural resource managers – and all citizens – face the challenge of sustainability.

Fifty years ago I heard Bacon's quotation from School of Natural Resources Professor Stephen H. Spurr, my academic advisor and instructor in an early forestry course. I wrote it on a three-by-five card and stuck it on my desk lamp as a fundamental guide to forest management. Dr. Spurr passionately believed that one must understand how the tree grows as an individual and in its community – what today we call its environment – in order to responsibly manage it for what was then being called *sustained yield*, continuous generation of all the resources we use on and from forest lands: wood, water, wildlife, and recreation.

The Resource Distribution Pattern

More recently, concerned about how many forested acres – and other resources – we use and need as individuals, I wrote about that issue. Professionally aware of the lop-sided distribution of the planet's water resource, I noted that several resources follow that pattern. Upon inspection, I became aware that in fact *all* our resources are asymmetrically distributed: the Universe's dark matter and dark energy; galactic energy and mass; solar system energy and mass; planetary mass and solar energy reception[2]; oxygen, water, and carbon. The pattern is everywhere, grounded in the very nature of the basic building block of the universe – the atom – wherein almost all of the mass is contained in the nu-

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[2] For example, Earth intercepts approximately one one-billionth ($\sim 9.1 \times 10^{-8}$ percent) of the sun's energy available to the surface of a sphere at a distance of 93 million miles.

cleus but the infinitesimally small electrons provide the means by which the atoms' particles can combine to make all elements and compounds[3].

Consider the water resource, for example: each person needs 5 or 6 pints of water per day to survive; however, we human beings need the vast 97 percent that is in the oceans (362 million cubic miles) just as urgently, relying on that larger portion of the resource to absorb wastes, gases, chemicals eroded from the land, heat energy, and space debris of meteors, comets, and asteroids. And, our civilization likely developed along the seashore, not the water-short savannahs. According to Elaine Morgan in *The Descent of Woman,* the oceans' scanty fringes – the abundantly fertile seashore, tidal flats, and estuaries – were the ideal environments for the development of civilization in the presence of ample and variable foods, safety, and challenges to the human brain, all essential conditions appropriate to the interactions between aquatic and terrestrial environments[4].

From this atomic-to-cosmic blueprint a theory emerges that helps understand how human beings live and thrive as individuals and in their community environments. The **Resource Buffer Theory** (RBT) is that *for every resource where people rely on an infinitesimally small percentage of the total resource for survival as* ***individuals****, the vast remaining percentage serves as a buffer maintaining environmental conditions that promote survival of the* ***species****.*

Links and Barriers

The concept is appropriately applied to Garret Hardin's "global commons": there is no total personal or national ownership of these vital buffers and all are needed in varying degrees in support of life. The buffers are shock absorbers, softening the impacts of disturbances to our environments, as well as being important parts of the carbon cycle, and receiving waste products. Buffers[5] thus embrace vast areas of tundra, rain forest, grass lands, coral reefs, the ice caps, and the oceans themselves. They also include space and energy and, perhaps, even time[6]. As both an intangible idea and measurable entity, biodiversity is appropriately considered as a resource. The National Commission on Science for Sustainable Forestry (2004) asserts:

> Biodiversity supports the functioning of the ecological systems upon which humans depend, provides generic material for new agricultural and silvicultural crops, and provides resilience necessary for ecosystems to withstand climatic changes, disease and pest out-breaks, and other environmental stresses.

The RBT also supports John Lovelock's concept of *Gaia:* conditions eons ago promoted life on Earth and life, in turn, modified the very conditions that enabled it. Life promotes itself in a process called *homeostasis* or positive feedback. Life on Earth is not without potential hazard, however: although global in extent and observable on any local

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3 The mass of a proton, for example, is about 2,000 times that of an electron.

4 And humans share some unique chemical and social characteristics with the other mammals that evolved in aquatic environments including the rhinoceros, hippopotamus, elephant, dolphin, pig, and manatee.

5 These buffers are not the same as the now-familiar *buffer zones* managed to protect stream corridors, but both types do provide protection.

6 "Time is nature's way of keeping everything from happening at once" (Woody Allen) contains much wisdom. The RBT is reflected in the observation that humankind developed in the few seconds before midnight of the analogy of 24 hours to the billion-years existence of the universe.

scale, the asymmetrical distribution of small and large resources may be at once complex and sensitive. Thus, a small change in resource form, amount, or distribution at one location may be accompanied by massive and catastrophic environmental changes elsewhere. Best example? A tiny percentage reduction in the amount of inorganic carbon produces an enormous percentage increase in atmospheric carbon dioxide[7], the primary mechanism that threatens ocean levels, numbers and severity of hurricanes, polar ice and mountain glacier melt rates, and global ocean currents driven by the immutable laws of gravity and thermodynamics.

Currently, in broadcast media, books, periodicals, and scientific journals responsible authorities are focusing on the relationships between the human population and the environmental systems that sustain it. They are – in a universal call to knowledge and action – alarmed about the looming environmental challenges, and they are screaming at us all. For example, in *High Tide*, Mark Lynas documents his personal three-year odyssey to alpine, desert, arctic, coastal, and mid-ocean environments and their already-evident and substantial climate changes. James G. Speth observes in *America and the Crisis of Global Environment* that the civilized characteristic of modern society attempts to find legal or market solutions to the broad problem of environmental degradation rather than conceiving of and effectively utilizing otherwise ecologically sound environmental solutions. Loren Eiseley points out in *Man the Firemaker* that man is not just another user of fire but that "he is himself a consuming fire." David W. Orr – along with others – emphasizes the importance of maintenance of biodiversity:

> The very fact of biological diversity suggests humility about what we attempt to control and how we do it. The truth is that diversity of any kind could not have occurred in a thoroughly managed world that some purport to manage thoroughly for whatever good cause. The logic of the modern economy and state runs counter to the flow of evolution, and something will have to give. … The preservation of biodiversity will require a different manner of thinking that runs counter to much of conventional wisdom, including that described as environmental. In other words, the cause of protecting biodiversity must be broadened, deepened, and joined to other causes.

And, says Orr, capitulation to nature as a basis for a global strategy of resource management may abdicate democratic and perhaps even benevolent dictator governments. In short, we are destroying our life-sustaining buffers, and we're doing it in the name of economic interest-spawned investment that mathematically discounts the future, a practice that in the long run – along with harvesting principal rather than income – we are ill-advised to do.

As a fundamental idea, the RBT is not new. Writing in the 1960s, Guy Murchie described in the wonderfully poetic prose of *Music of the Spheres* what he called *order* in the universe. He did not identify or discuss a pattern, but it is there, displaying the universal order about which he wrote. And, alarmingly, the carbon content of human beings violates it: the similarly-patterned natural distribution of the fundamental resource by which life is defined – carbon – is the evidence.

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[7] The ratio of the mass of Earth's inorganic carbon to the carbon contained in atmospheric CO_2 is about 89 thousand to one.

Carbon and Sustainability

Carbon is the stuff of life because its electron number and structure allow it to combine with a tremendous variety of molecules, especially oxygen, hydrogen and nitrogen. Ninety-four percent of all the compounds on Earth contain carbon. Exhibiting a lopsided distribution in the extreme, a measly 0.004 percent of the total planetary carbon is in living (organic) form; the rest (99.996%) is the vast inorganic buffer, including some that is in transition from inorganic to organic form or vice versa[8]. Of the Earth's organic carbon, 99.88% is in plants; 0.12% is in animals. Probably half of that total organic carbon is in viruses and bacteria. Half of the remainder is estimated to be in insects. Consistent with the RBT, the percentage of organic carbon expected for the human species – located atop Earth's food web[9] – should be infinitesimally small. Instead, it approximates a whopping 8 percent of all the terrestrial organic carbon in animals[10].

Ecologically, then, we are misfits. More instructively, that level of carbon in one species so situated ecologically cannot be maintained without destruction of critical buffering life forms. And, that content as human numbers expand by a predicted high doubling of 16 percent over the next few decades may definitely be considered unsustainable. Such an increase would – of course – further upset the planet's delicate and lopsided carbon balance, especially the atmospheric carbon dioxide, which already displays a three-fold increase in magnitude since the end of the Industrial Revolution. That impact – along with excess resource use and mismanagement, pollution, and loss of biodiversity – is what is driving Earth's growing climate change. Simply put, with the acceptance and within the context of the Resource Buffer Theory, our planet is seriously over-populated with human beings. In 1999 David Pimentel and his co-authors support that observation in *Will humans force nature to control their numbers?* They revised a 1994 estimate of the Earth's carrying capacity *down* from 2.5 to 2 billion individuals. Certainly, it is appropriate to question whether the current 6.3 billion is sustainable: my response is "highly unlikely."

The word *sustainable* may be defined as *being continuously maintained by inherent characteristics and interactions with the environment*. So far, for example, life (as we know and define it on this planet) is definitely sustainable (Heintz 2004): it has managed to exist for about 4 billion years. How? It is posited that storm-generated lightning in the gaseous atmosphere interchanging with the oceanic primordial chemical soup produced amino acids and proteins that are the basic building blocks of life. Some or all of Earth's

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8 Failure to include a sufficient inorganic carbon buffer and suitably-sized forests and oceans as sites for carbon sequestration was a nearly fatal omission in the Biosphere 2 experiment in the Arizona desert in the 1990s.

9 The concept of the food web (or chain), as learned in a first course in biology, is referred to in practical terms as "the biotic pyramid" by Aldo Leopold in *A Sand County Almanac*. He summarizes in a non-technical style the concept in terms of energy-nutrition-sustenance levels, with which the RBT also appropriately fits.

10 The figure is calculated at about 4 percent of the animal organic carbon but, since animal carbon is nearly evenly divided between oceanic and terrestrial environments, and no humans live in the oceans, the fraction is 8 percent of the Earth's terrestrial animal carbon.

early life forms may have arrived from space debris, but whatever the source[11], life appeared on the planet. These molecules could grow and duplicate; cells could generate more cells, then tissues, organs, organisms, populations, communities, cultures. And, again according to the *Gaia* theory, the very early forms of life modified the gaseous content of the atmosphere providing our oxygen-rich atmosphere stabilized by non-reactive but nutrition-rich nitrogen and, of course, carbon dioxide.

Carbon dioxide is a tiny, 0.033 percent of the atmosphere, but a component essential to life. With water it provides the naturally weak carbonic acid rain that erodes rocks and soil over the eons. As a greenhouse gas, it allows incoming short wave solar energy and blocks outgoing long-wave energy. The relatively small amount of this gas, then, was intimately linked to life's development eons ago. It responds to changes in photosynthesis and its opposite processes, respiration or burning. Carbon is in the methane molecule, too, a second important greenhouse gas, and also a product of animals. Bottom line: the continued growth and increasing release of carbon to the atmosphere is not conducive to sustainable populations or to the environments in which they developed and by which they are nurtured[12].

Climate Change

Our excessive and rapidly expanding use of fossil fuels combined with resource abuse, mismanagement, and pollution clearly reduces the buffers of coral reefs, rainforests and other ecosystems. The end result is a shift of carbon from the huge inorganic supply to atmospheric carbon dioxide. The percentage change is dramatically magnified, as described above. This is why the global environment is rapidly responding to the primary impact of civilization, the effect on global carbon distribution.

That has a profound impact on biodiversity, probably our most critical resource. Reduction in that buffer reduces protection and leaves fewer options – natural strategies for survival – in the great variety of life. There are, for example, new and reoccurring diseases that are likely the result of loss of the great variety of terrestrial and oceanic niches and release of DNA from melting ice. Further loss of arctic ice is a death sentence for the polar bear and other species dependent on the icy environment. Accelerated disappearance of animal species is clearly a loss of biodiversity and the overall balance of life forms. Melting tundra removes ecological sustenance and reduces the Earth's ice reserves. That melting is accompanied by reduction in sunlight reflectance that further alters the energy balance and impacts global oxygen production and carbon sequestration. With feedback, the build-up of carbon dioxide speeds the current global climate change, leading in all likelihood to the next ice age: currently, temperatures are increasing, and polar ice caps and mountain glaciers are melting at accelerating rates[13]. Asian desertification is spread-

[11] Even if created at a particular time, as some believe, life exhibits the characteristics described herein and they are still cause for alarm, concern, and action.

[12] As CO_2, it increases atmospheric temperature and, since warm temperatures favor plants over animals, an increase in carbon-sequestering plants defines a carboniferous age and provides another feedback loop in Lovelock's homeostasis.

[13] The current magnitude of the climate changes is (so far) not greater than the historical records indicate, but dramatic changes are occurring in shorter time periods and are in contrast to the affable climate that prevailed during the Industrial Revolution.

ing rapidly, ocean levels are rising, and there are more and greater droughts, floods, and temperature extremes. The gaseous form of water – vapor – is another greenhouse gas that, as clouds increased by evaporation in turn caused by rising temperatures, shields the Earth from the sun's energy, thereby reducing temperatures and bringing back the cold that fosters a new ice age. On a local scale, people around the globe are fully aware that "the weather isn't like it used to be." As a result of small increases of ocean water temperatures there has recently been an increase in the number of hurricanes and typhoons that provide the transfer of equatorial heat energy toward the poles, their normal ecological function. And with those changes, wildfires and floods consume more and more of our time, financial, and humanitarian resources, imposing recurrent and potentially damaging economic, psychological, sociological, and political dimensions to the ever-expanding global population.

The current affable climate of an interglacial period that enabled both the Industrial Revolution and the phenomenal resultant increase in human population numbers (as well as modern technology, wanton resource use and abuse, and sprawl[14]) will be replaced – perhaps very soon – by a glacial period, normally preceded by global warming. Research reported in 1999 by Kendrick Taylor in *Rapid Climate Change*, shows that the ocean current reversals accompanying changing to an ice age can take place in as little as a decade. The North Atlantic Current did, in fact, reverse during the summer of 2003[15], causing high profile news reports on summer temperatures in Europe and Canada's Maritime Provinces. Current global warming is well documented. Awareness, concern, and commitment to fixing the problem is exacerbated because the sciences are so specialized that much of the research reports are not read by workers in other – sometimes even related – disciplines. As a consequence of that disintegrating communication, the public is confused about the occurrence, extent, and danger in pending climate change. Conferences, world summits, a growing number of authors, and the media are picking up on the disparity of professional (and political) opinion and, more importantly, what must be done about it.

The Need for Action

To start, it means – for our western civilization – changing public attitudes about how we use, abuse, and pollute our natural resources. We can, for example, no longer tolerate the gas-guzzling SUV, monster pick-up, or pricey private car wasting gas speeding along a mountain highway, sand dune, or wildland road, or throwing mud and water as it plows through a wetland or stream, or leaves lasting tracks in a pristine mountain meadow in addition to contributing to the greenhouse effect with carbon dioxide. The resources actually damaged in the TV ads (filmed in a studio or with appropriate local safeguards) are miniscule; but the real damage is done to the attitudes of generations of drivers about the indiscriminate, unnecessary, and irresponsible use of energy and power. That, in turn, promotes general disdain for the environment and severely and understandably diminishes the worth of our technology in the minds of other peoples around the world, augmented by our national indifference to and denial of the problem.

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[14] In October, 2003, half of Earth's human population lived in metropolitan areas of one million or more.

[15] At the end of the summer it switched back to its interglacial-period clock-wise circulation.

Overall, we need to heed Bacon's advice: we need to "obey" the nature of nature by recognizing the fundamental distribution of our environmental resources and structure our management policies and practices so as to emulate and preserve the Resource Buffer Theory. That does not mean we need to preserve every acre of forest, grassland, tundra, etc. It does mean, however, that we need to determine how we can simultaneously make productive use of the resources that surround us and upon which we depend for survival and simultaneously preserve that nature of nature, the buffering action of the resource.

In addition, adopting a sound resource management approach must include consideration of the *scale* of the resource being managed and the goals of management. For forests, for example, the NCSSF affirms that "The effectiveness of biodiversity conservation is largely determined by interactions between stand- and landscape-level patterns." From the standpoint of the RBT, the concern demands responses to even broader questions: "To what extent is implementation of this strategy (policy or plan) and tactics (associated on-the-ground practices) going to adversely (or beneficially) affect the ability of this portion of the planet-wide buffer to provide the essential protection from a broad-scale environmental standpoint?" or "Can the loss of buffer function be compensated elsewhere?" For example, it takes a certain number of trees (and other plant life) to provide the oxygen for a person for a year. Suppose, for sake of an illustration, that it takes three full-grown evergreen trees to meet that need. Thus, it requires about 18.9 billion such trees to provide the oxygen for the Earth's 6.3 billion human beings. One would need to add to this the number for all other oxygen-breathing animals and, of course, include consideration of other oxygen-producing plants accordingly. While this is not a particularly practical management process, it realistically illustrates the *scope* of the issue. Further, of course, each local situation requires consideration on a larger scale about how the management decision interacts with similar decisions at other scales and locales. And, there are lots of buffers.

There are other related issues, such as the continuous and insipient removal of natural landscapes for agricultural production, concurrently decreasing biodiversity. In addition, increasing urban sprawl causes severe adverse impacts to water quality, increased surface runoff causing greater downstream flooding, and simultaneous reduced ground water recharge and consequent subsidence, especially in the sun belts where even short-term sustainability is highly questionable. There are also issues that are rooted in undesirable aspects of human behavior. Thus, according to a recent report by Lester Graham reassessing research from the 1970s' Kerner Commission, many educational, economic, and environmental problems of older inner city communities and modern suburbia stem from a continuing combination of greed and prejudice. One could conclude that our most serious resource use problem – sprawl – is simply the result of human thought.

The relationship between Earth's ecology and human numbers are, of course, the focus of the problem. In the "30-Year Update" of *Limits to Growth*, the authors assert:

> The generations that live around the turn of the twenty-first century are called upon not only to bring their ecological footprint below the earth's limits, but to do it while restructuring their inner and outer worlds.

That means determining the carrying capacity of the planet and the assimilative capacity of our essential resource buffers. But, before starting on that demanding project, we need to understand what the RBT means for us.

The Bottom Line

The details of the relationship between human numbers and resource use and the RBT explain the changes that are occurring. Comprehending the fundamental and essential nature of the RBT is the key to understanding how the asymmetric distribution of carbon is the critical link underlying how the conversion of a tiny percentage of inorganic carbon to the atmospheric carbon dioxide can have such a tremendous impact on the global environment, even far from the country or region of resource extraction and/or use. Any widespread burning of fossil fuel endangers life on the planet.

The natural distinguishing characteristic of the Resource Buffer Theory, then, provides the basis for understanding the true nature of human impacts that endanger the ability of the Earth to sustain us.

A great irony of the RBT is that it models the distribution of strategists within the human population, too. Thus, it falls on the shoulders of the relatively few of those that understand the nature of nature to convince the rest of the planet's population of the necessity for major changes in human behavior. Those changes, in addition to the need to control human numbers, include major tax- and subsidy-shifts that could productively affect natural resource use, reduction of resource abuse, and constructively educating masses of the world's population as to why.

Finally, another very pertinent and ironic example of the RBT is evident in the tremendous numbers of cells in the human brain compared to the rather small percentage we actually use. It is more evidence confirming the theory.

Summary

In sum, a universal pattern characterizes the distribution of the energy, water, air, soil, biological, and chemical resources in all our environments. The current distribution of the resource that defines life – carbon – violates that pattern. The human population exceeds what some experts consider to be the sustainable carrying capacity of the Earth by a factor of about three. In addition, the fossil fuels we burn, though a miniscule fraction of the Earth's huge inorganic carbon buffer for home, industrial, and transportation purposes has a disproportionate impact on the atmospheric carbon dioxide content. Thus, the atmosphere is warming up, apparently preparatory to the next ice age. Human behavior, both directly and indirectly related to resources management generally, must be modified to achieve sustainability. Discouraging, to say the least; daunting because consideration of all the signals – connecting the dots – is really quite depressing.

Now, fifty years later, I have used that three-by-five inch card to find my way out of that depression. If the RBT accurately describes our environment, and I obviously believe that it does, then it is imperative that we find ways – strategies – to "obey nature." In short, we must embrace the concept of the RBT in resource management policies and practices; learn to live meaningfully with the support of natural systems based on our understanding of nature. And, of course, that must be accomplished along with finding humane ways (if that is possible) to reduce the Earth's human numbers from the current 6.3 billion to between 2 and 2.5 billion. Resource managers – and their publics – must assume a global perspective of buffering by the resource in addition to the familiar existing management scales such as commercial, institutional, or governmental stewardship; biomes, regional ecological-biological types, and habitat; private and public-use parcels, and watersheds, open space, landscape, and recreation units. Most natural resource managers have a special characteristic – a long-range view – that is essential in communicating these thoughts and the need for action to the public: we need to get busy.

Conclusion

We are sustained because the exigencies of life on Earth are buffered, backed by reserves of resources, and protected by massive buffers of biodiversity. The mushrooming human population and globalization of Earth's economy are propelling us towards climate change and perhaps uncontrollable environmental disaster. Along the way, we must ask: What is the scale and portion of the natural resource we are trying to manage in a sustainable manner? The Resource Buffer Theory demands that we consider local to global scales of resource distribution, with special attention to biodiversity.

Our challenge is to learn *how* to manage the resource buffers under our influence and control so that we effectively emulate the Resource Buffer Theory. We must "obey nature" in a broad-scale-buffer perspective that underlies management policies along with conforming practices that effect this objective at the local level. Sustainability requires that we start by asking: What is it we are trying to sustain? We owe it to our children and all succeeding generations to respond to the challenge.

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