A Biblical Perspective on Environmental Stewardship

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In the last three centuries, life expectancy in advanced economies has risen from about thirty years to nearly eighty. Cures have been found to once-fatal diseases, and some diseases have been eliminated entirely. Famine, which once occurred, on average, seven times per century in Western Europe and lasted a cumulative ten years per century, is now unheard of there. While the average Western European family in A.D. 1700 lived in a hovel with little or no furniture, no change of clothing, and barely enough food to sustain a few hours' agricultural labor per day[1] –and, of course, they also lacked electricity, plumbing, water and sewage treatment, and all the appliances we often take for granted– today the average family lives in a well-built home with all those amenities, along with enough food to make obesity, not hunger, the most common nutritional problem even among the "poor."[2] Such advances in the West have been the fruits of freedom, knowledge, and hard work–all resting substantially on the foundation of biblical Christianity's worldview and ethic of service to God and neighbor.[3] These advances have also given rise to a laudable expansion in people's focus on the need for environmental stewardship. For as people come to feel more secure about their basic needs, they begin to allocate more of their scarce time, energy, and resources to attaining formerly less

urgent ends. Consequently, the movement for environmental protection has grown as Western wealth has grown, giving rise to a strong environmental consciousness and to protective environmental legislation.

The world's less developed countries, where material progress began much later, have been catching up in the past century, as shown especially by rapidly rising life expectancy (from about thirty years in 1900 to about sixty-three years today).[4] Nonetheless, in many developing countries, the basics of sufficient and pure water and food, along with clothing, shelter, transportation, health care, communication, and so forth, still remain elusive for many people. For them, continued economic advance is crucial for health and even for life itself: It is small wonder that their attention focuses more on immediate consumption needs than on environmental protection. Tragically, however, people with a strong environmental consciousness who live predominantly in Western countries sometimes seek to impose their own environmental sensibilities on people still struggling to survive. In fact, further advances in human welfare for the poor are now often threatened by a belief in the West that human enterprise and development are fundamentally incompatible with environmental protection, which is seen by some as the quintessential value in evaluating progress. This false choice not only threatens to prolong widespread poverty, disease, and early death in the developing world, but also undermines the very conditions essential to achieving genuine environmental stewardship.

In this essay, we shall present theological and ethical foundations we believe are essential to sound environmental stewardship; briefly review the human progress erected on those foundations; and discuss some of the more important environmental concerns–some quite serious, others less so–that require attention from this Christian perspective. We shall also set forth a vision for environmental stewardship that is wiser and more biblical than that of mainstream environmentalism, one that puts faith and reason to work simultaneously for people and ecology, that attends to the demands of human well-being and the integrity of creation.

Such an approach to environmental stewardship will, we believe, promote human justice and shalom, as well as the well-being of the rest of God's creation, which his image-bearers have been entrusted to steward for his glory.

I. Theological and Ethical Foundations of Stewardship

God, the Creator of all things, rules over all and deserves our worship and adoration (Ps. 103:19—22). The earth, and, with it, all the cosmos, reveals its Creator's wisdom and goodness (Ps. 19:1—6) and is sustained and governed by his power and lovingkindness (Ps. 102:25—27; Ps. 104; Col. 1:17; Heb. 1:3, 10—12). Men and women were created in the image of God, given a privileged place among creatures, and commanded to exercise stewardship over the earth (Gen. 1:26—28; Ps. 8:5). Fundamental to a properly Christian environmental ethic, then, are the Creator/creature distinction and the doctrine of humankind's creation in the image of God. Some environmentalists, especially those in the "Deep Ecology" movement, divinize the earth and insist on "biological egalitarianism," the equal value and rights of all life forms, in the mistaken notion that this will raise human respect for the earth. Instead, this philosophy negates the biblical affirmation of the human person's unique role as steward and eliminates the very rationale for human care for creation. The quest for the humane treatment of beasts by lowering people to the level of animals leads only to the beastly treatment of humans.5

The image of God consists of knowledge and righteousness, and expresses itself in creative human stewardship and dominion over the earth (Gen. 1:26—28; 2:8—20; 9:6; Eph. 4:24; Col. 3:10). Our stewardship under God implies that we are morally accountable to him for treating creation in a manner that best serves the objectives of the kingdom of God; but both moral accountability and dominion over the earth depend on the freedom to choose. The exercise of these virtues and this calling, therefore, require that we act in an arena of considerable freedom–not unrestricted license, but freedom exercised within the boundaries of God's moral law revealed in Scripture and in the human conscience (Exod. 20:1—17; Deut. 5:6—21; Rom. 2:14—15). These facts are not vitiated by the fact that humankind fell into sin (Gen. 3). Rather, our sinfulness has brought God's responses, first in judgment, subjecting humankind to death and separation from God (Gen. 2:17; 3:22—24; Rom. 5:12—14; 6:23) and subjecting creation to the curse of futility and corruption (Gen. 3:17—19; Rom. 8:20—21); and then in restoration, through Christ's atoning, redeeming death for his people, reconciling them to God (Rom. 5:10—11, 15—21; 2 Cor. 5:17—21; Eph. 2:14—17; Col. 1:19—22), and through his wider work of delivering the earthly creation from its bondage to corruption (Rom. 8:19—23). Indeed, Christ even involves fallen humans in this work of restoring creation (Rom. 8:21). As Francis Bacon put it in *Novum Organum Scientiarum* (*New Method of Science*), "Man by the Fall fell at

the same time from his state of innocence and from his dominion over creation. Both of these losses, however, can even in this life be in some parts repaired; the former by religion and faith, the latter by the arts and sciences."[6] Sin, then, makes it difficult for humans to exercise godly stewardship, but the work of Christ in, on, and through his people and the creation makes it possible nonetheless.

When he created the world, God set aside a unique place, the Garden of Eden, and placed in it the first man, Adam (Gen. 2:8—15). God instructed Adam to cultivate and guard the Garden (Gen. 2:15)–to enhance its already great fruitfulness and to protect it against the encroachment of the surrounding wilderness that made up the rest of the earth. Having also created the first woman and having joined her to Adam (Gen. 2:18—25), God commanded them and their descendants to multiply, to spread out beyond the boundaries of the Garden of Eden, and to fill, subdue, and rule the whole earth and everything in it (Gen. 1:26, 28). Both by endowing them with his image and by placing them in authority over the earth, God gave men and women superiority and priority over all other earthly creatures. This implies that proper environmental stewardship, while it seeks to harmonize the fulfillment of the needs of all creatures, nonetheless puts human needs above non-human needs when the two are in conflict.

Some environmentalists reject this vision as "anthropocentric" or "speciesist," and instead promote a "biocentric" alternative. But the alternative, however attractively humble it might sound, is really untenable. People, alone among creatures on earth, have both the rationality and the moral capacity to exercise stewardship, to be accountable for their choices, to take responsibility for caring not only for themselves but also for other creatures. To reject human stewardship is to embrace, by default, no stewardship. The only proper alternative to selfish anthropocentrism is not biocentrism but theocentrism: a vision of earth care with God and his perfect moral law at the center and human beings acting as his accountable stewards.7

Two groups of interrelated conditions are necessary for responsible stewardship. In one group are conditions related to the freedom that allows people to use and exchange the fruits of their labor for mutual benefit (Matt. 20:13—15). These conditions–knowledge, righteousness, and dominion–provide an arena for the working out of the image of God in the human person. In another group are conditions related to responsibility, especially to the existence of a legal framework that holds people accountable for harm they may

cause to others (Rom. 13:1—7; Exod. 21:28—36; 22:5—6). These two sets of conditions provide the safeguards necessitated by human sinfulness. Both sets are essential to responsible stewardship; neither may be permitted to crowd out the other, and each must be understood in light of both the image of God and the sinfulness of man.

Freedom, the expression of the image of God, may be abused by sin and, therefore, needs restrictions (1 Pet. 2:16); but governmental power, necessary to subdue sin and reduce its harm, must be exercised by sinful humans, who may also abuse it (Ps. 94:20; 1 Sam. 8). This means that it, too, needs restrictions (Acts 4:19—20; 5:29). Such restrictions are reflected not only in specific limits on governmental powers (Deut. 17:14—20), but also in the division of powers into judicial, legislative, and executive (reflecting God as Judge, Lawgiver, and King [Isa. 33:22]); the separation of powers into local and central (exemplified in the distinct rulers in the tribes of Israel and the prophets or kings over all Israel [Deut. 1:15—16]); the gradation of powers from lesser to greater (Exod. 18; Deut. 16:8—11); and the vesting of power in a people to elect their rulers (Deut. 1:9—15; 17:15). All of these principles are reflected in the Constitution of the United States. Also crucial to the Christian understanding of government is the fact that God has ordained government to do justice by punishing those who do wrong and praising those who do right (Rom. 13:1—4; 1 Pet. 2:13—14).[8]

These principles indicate that a biblically sound environmental stewardship is fully compatible with private-property rights and a free economy, as long as people are held accountable for their actions. Stewardship can best be accomplished, we believe, by a carefully limited government (in which collective action takes place at the most local level possible so as to minimize the breadth of harm done in case of government failure) and through a rigorous commitment to virtuous human action in the marketplace and in government.

These principles, when applied, promote both economic growth and environmental quality. On the one hand, there is a direct and positive correlation between the degree of political and economic freedom and both the level of economic attainment and the rapidity of economic growth in countries around the world. The 20 percent of the world's countries with the greatest economic freedom produce, on average, over ten times as much wealth per capita as the 20 percent with the least economic freedom, and while the freest countries enjoyed an average 2.27 percent annual rate of growth in real gross national

product per capita through the 1990s, the least-free countries experienced a decline of 1.32 percent per year.[9] On the other hand, there is also a direct and positive correlation between economic advance and environmental quality.[10] The freer, wealthier countries have experienced consistent reductions in pollution and improvements in their environments, while the less free, poorer countries have experienced either increasing environmental degradation or much slower environmental improvement. We shall return to this correlation shortly; first, however, it behooves us to know something of the changes in our material condition over the last few centuries.

II. The Marvels of Human Achievement

Until about 250 years ago, everywhere in the world, the death rate was normally so close to the birth rate that population grew at only about 0.17 percent per year,[11] doubling approximately every 425 years, instead of every forty-two years at the world's average growth rate in the 1980s, or every fifty-one years at the average rate for the 1990s.[12] Infant and child mortality rates (around 40 percent overall) were little better for the very rich–royalty and nobility–than they were for farmers and peasants, even into the eighteenth century. Britain's Queen Anne (1665—1714), for instance, was pregnant eighteen times; five of her children survived birth; none survived childhood.

Eighteenth-century French farming–the best in Europe–produced only about 345 pounds of wheat per acre; modern American farmers produce 2,150 pounds per acre, about 6.2 times as much.[13] Early-fifteenth-century French farmers produced about 2.75 to 3.7 pounds of wheat per man-hour, and the rate fell by about half over the next two centuries;[14] modern American farmers produce about 857 pounds per man-hour[15] –about 230 to 310 times as much as their French counterparts around 1400, and 460 to 620 times as much as French farmers around 1600. (This means that modern farmers also manage to farm from 37 to 100 times as many acres, thanks largely to mechanized equipment and advanced farming techniques.) As the great French historian Fernand Braudel pointed out, it became very difficult to sustain life when productivity in wheat fell below 2.2 pounds per man-hour. But for most of the 350 years from 1540 to 1890, productivity in France (which, as was fairly typical of Western Europe, suffered a serious decline in productivity at the start of that period) was well below that.16

Such facts help to explain why earlier generations spent a major part of each day working to earn enough income just to pay for food (excluding its preparation, packaging, transport, and serving), while we spend far less today (under 6 percent of total consumer expenditures in the United States in the 1980s went to food). These developments–along with the advent of glass window panes (to admit light and heat but exclude cold and pests) and screens (to admit fresh air and exclude disease-bearing insects); treatment of drinking water and sewage; mechanical refrigeration (to prevent food spoilage and consequent waste and disease); adoption of safer methods of work, travel, and recreation; and the advent of sanitary medical practices, to say nothing of antibiotics and modern surgical techniques–also help to explain why people live about three times as long now. While "man is destined to die once" (Heb. 9:27), the Bible recognizes death as punishment for sin and, consequently, as man's enemy (1 Cor. 15:26), and it associates long life with the blessing of God (Exod. 20:12; Deut. 11:8—9; Eph. 6:1—3) and with the reign of the Messiah (Isa. 65:20).

Economic development is a good to be sought not as an end in itself but as a means toward genuine human benefit. For instance, consider a few of the things absolutely no one–not even royalty–could enjoy before the last two centuries of economic advance:

- Electricity and all that it powers: lights, telephones, radios, televisions, refrigerators, air conditioners, fans, video cassette recorders, x-rays, mris, computers, the Internet, high-speed printing presses, and all other industrial automation.
- Internal combustion engines and all that they power: cars, trucks, planes, farm and construction equipment, and most trains and ships.
- Hundreds of synthetic materials such as plastic, nylon, orlon, rayon, vinyl, and the thousands of products–from grocery bags and pantyhose to compact discs and artificial body joints and organ parts–made from them.

No matter how rich people might have been a millennium–or even 150 years–ago, if they contracted a bacterial disease, they could not have been treated with antibiotics. This development was prompted by the work of the French Christian and scientist, Louis Pasteur, only in the latter half of the nineteenth century. Also, there were no more effective anesthetics than alcohol and cloves. So when limbs gone gangrenous from infections that today could be cured or, more likely, easily prevented, had to be amputated, patients gritted their teeth and hoped they would pass out from the pain of the crude saw. The

germ theory of disease did not become current until the late eighteenth century, and the use of antiseptics did not begin until half a century later, with the work of the British Christian and chemist, Joseph Lister. Someone with a fever was likely to be bled to death by a doctor trying to cure it.17

Education was the province of the rich. Before the Reformation, few countries had widespread education, and even afterward, schooling was available principally to the rich. Two major exceptions were Germany and Scotland. In Germany, Martin Luther insisted that widespread schooling was important so that people could read the Scripture–which he had translated into the vernacular–for themselves. Similarly, in Scotland, John Knox's followers, convinced that personal knowledge of God and his Word was essential to the maintenance of civil as well as religious liberty (Ps. 119:45; Isa. 61:1; Jer. 34:15; Luke 4:18; 2 Cor. 3:17; Gal. 5:1,13; James 1:25; 1 Pet. 2:16),[18] arranged a parish-by-parish system of church-run grammar schools that ensured that practically every child could at least become literate. Scotland's high literacy rate and its Calvinist ethics of work and saving were important factors in its making contributions to the Industrial Revolution far out of proportion to its small population and earlier economic disadvantages. But even there, few were schooled for more than five or six years, and only a tiny percentage attended college, let alone graduated. Today, by contrast, in the United States, 81 percent of people twenty-five years old and over are high school graduates, and 23 percent are college graduates, and the growth in availability of education is worldwide. That is a particularly crucial factor in predicting the world's material future, because both the creation of wealth and the protection of the environment depend primarily not on brawn but on brain.[19]

The most effective measures of material welfare are mortality rates and life expectancy, because they take into account every conceivable variable that can add to or detract from a long and healthy life. A thousand years ago, human life expectancy everywhere was well under thirty years–perhaps even as low as twenty-four; today, worldwide, it is over sixty-five years, and in high-income economies, it is over seventy-six years. The under-five mortality rate has plummeted from about 40 percent everywhere as late as the nineteenth century to under 7 percent worldwide today and under 1 percent in high-income countries. And improved life expectancy comes not just from declining child mortality but from declining mortality rates at every stage of life.20

Materially, the world is a far, far better place today than it was not only one millennium ago, but even one century ago. Every raw material–mineral, plant, and vegetable–that plays a significant role in the human economy is more affordable (which economists recognize as meaning more abundant), in terms of labor costs, today than at any time in the past. Every manufactured product is more affordable than it has ever been.[21] And in producing all this great abundance, we have also reduced much health-threatening pollution, especially in the developed world.[22] Put simply, the world is both a wealthier and a healthier place today than ever before.

This rosy picture, however, must not generate uncritical applause for economic development, per se. Development can be positive or negative. While the fact that life expectancy keeps rising suggests that the net effect of development on human life has been positive, this does not imply that every instance of development is unmixedly beneficial, either to people or to creation. A biblical worldview and an institutional framework for prudent decision making, which we shall set forth below, are essential to ensuring that positive, rather than negative, development takes place.

We support appropriate development not for its own sake but, for example, because it uplifts the human person through work and the fruits of that labor, empowering us to serve the poor better, to uphold human dignity more, and to promote values (environmental, aesthetic, etc.) that we otherwise could not afford to promote.

The Christian tradition clearly affirms that the accumulation of material wealth should not be the central aim of life; yet people are to use wisely the gifts of creation to yield ample food, clothing, health, and other benefits. It is obvious that the great advance in wealth over the past century has taken place only in a small proportion of countries, namely, the liberal democracies and free economies of the West. Enough is now known about the administration of national economies to conclude safely that free-market systems minimize the waste of resources, and allow humans to be free and to flourish. All other systems that humans have tried lead to endless and unnecessary poverty, hunger, and oppression. For this reason, the religious communities of the Protestant tradition must take very seriously the claim that free markets and liberal democracy are essential to human welfare and therefore have a moral priority on our thinking about how society ought to be ordered.

But an ideological difficulty at present is that Western Protestant churches take too much of the present affluence for granted, misunderstand its origins, and overstate the value of the environmental amenities that have been given up to attain it. Today, this is leading many to embrace policy platforms that are explicitly against economic growth, and that give undue privilege to the preservation of the environmental status quo. This agenda threatens to deny those outside the West the very benefits that we ourselves have attained, and, ironically, it may burden the developing world with even worse environmental problems down the road. This essay challenges the arguments behind the anti-growth environmentalist agenda that is ubiquitous in today's mainstream churches, and argues that a biblical stance is entirely coherent with free-market democracy oriented toward sustainable economic growth.

III. How Economic and Environmental Trends Relate

We noted earlier that there is a direct and positive correlation between freedom and economic development and between economic development and environmental improvement. Necessarily, then, there is also a positive correlation between freedom and environmental quality. Economists find that free economies outperform planned and controlled economies not only in the production and distribution of wealth but also in environmental protection. Freer economies use fewer resources and emit less pollution while producing more goods per man-hour than less free economies. Economic demographer Mikhail Bernstam explains:

> Trends in pollution basically derive from trends in resource use and, more broadly, trends in production practices under different economic systems. In market economies, competition encourages minimization of production costs and thus reduces the use of resources per unit of output. Over time, resource use per capita and the total amounts of resource inputs also decline and this, in turn, reduces pollution….
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> By contrast, regulated state monopolies in socialist economies maximize the use of resources and other production costs. This is because under a regulated monopoly setting, prices are cost-based, and profits are proportional to costs. Accordingly, the higher costs justify higher prices and higher profits. This high and ever-growing use of resources per unit of output explains the high extent of environmental disruption in socialist countries.23

It is not only competition in free economies that encourages better stewardship of natural resources, it is also the incentive people have to protect property in which they have a financial stake. On the one hand, people naturally want their own homes and workplaces, and, by extension, their neighborhoods, to be clean and healthful, so they seek to minimize pollution. On the other hand, in a legal framework in which polluters are made liable for damage done to others' person or property, people also seek to minimize pollution that falls upon others. Moreover, a dynamic economy works to reduce pollution by finding the most efficient means of doing so. This contrasts with a command-and-control approach, in which regulators are likely to mandate particular technologies and methods for pollution control with little regard for overall social efficiency.

What we can infer from all these considerations–and what we find confirmed in empirical studies of the real world–is that free economies improve human health, raise living standards and life expectancy, and positively affect environmental conditions, doing all these things better than less free economies do. Further, the wealthier that economies become, the better they foster environmental protection. "If pollution is the brother of affluence," it has been written, then "concern about pollution is affluence's child."[24] Even if some pollution emissions rise during early economic development, the beneficial effects to human life of increased production far outweigh the harmful effects of the resulting pollution, as demonstrated in declining disease and mortality rates and in rising health and life expectancy, even during that early stage. But soon, increasing wealth enables citizens to invest more resources on environmental protection, and emission rates fall. The result has been termed the "environmental transition," which mirrors the more widely known "demographic transition."

The demographic transition is demographers' way of depicting the tendency for population growth rates to rise dramatically during early stages of economic growth and then decline back to little or no growth later. It occurs because initial increases in wealth rapidly force death rates downward in every age group, especially for infants and children, but fertility habits change only very slowly. Consequently, for a generation or two, couples continue having as many children as their forebears did, both because they expect one or two out of four children to die before maturity and also because in a primitive agricultural economy they rely upon having many young children to boost production. Then, when they become accustomed to the higher survival rates, and when the cost of raising children rises and

the delay before those children become net producers rather than consumers grows, couples begin having fewer children. The result is a short-term high population growth rate preceded and followed by a long-term low (or zero) population growth rate.

Similarly, the environmental transition is a way of depicting the tendency for some pollution emissions to rise in early economic growth and then decline. Environmental economist Indur Goklany notes,

> The level of affluence at which a pollutant level peaks (or environmental transition occurs) varies. A World Bank analysis concluded that urban [particulate matter] and [sulphur dioxide] concentrations peaked at per capita incomes of $3,280 and $3,670, respectively. Fecal coliform in river water increased with affluence until income reached $1,375 per capita.
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> Other environmental quality indicators (e.g., access to safe water and the availability of sanitation services) improve almost immediately as the level of affluence increases above subsistence. For these indicators the environmental transition is at, or close to, zero. In effect, the environmental transition has already occurred in most countries with respect to these environmental amenities because most people and governments are convinced of the public health benefits stemming from investments for safe water and sanitation. In fact, the vast majority of the three million to five million deaths each year due to poor sanitation and unsafe drinking water occur in the developing world.
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> Other indicators apparently continue to increase, regardless of gross domestic product (gdp) per capita. Carbon dioxide and no^x emissions and perhaps dissolved oxygen levels in rivers are in this third category. On the surface, these indicators seem not to improve at higher levels of affluence, but their behavior is quite consistent with the notion of an environmental transition. The transition is delayed in these cases because decision makers have only recently realized the importance of these indicators, or the social and economic consequences of controlling them are inordinately high relative to the known benefits, or both.

> All the evidence indicates that, ultimately, richer is cleaner, and affluence and knowledge are the best antidotes to pollution.25

Understanding the environmental transition, we should not be surprised to find that air, water, and solid waste pollution emissions and concentrations have been falling across the board in advanced economies around the world for the last thirty to forty years. Thus, for example, in the United States, national ambient airborne particulate emissions fell by about 80 percent from 1940 to 1994, and total suspended particulates fell by about 84 percent from 1957 to 1996; sulfur dioxide (so^2) emissions fell by about 34 percent from 1973 to 1994, and so^2 concentrations fell by about 80 percent from 1962 to 1996; carbon monoxide emissions fell by about 24 percent from 1970 to 1994; nitrogen oxide emissions peaked around 1972 and have declined slightly since then, while concentrations have fallen by about a third since 1974; volatile organic compounds emissions peaked in the late 1960s and by 1994 had fallen by about 30 percent; ozone concentrations fell by about 30 percent from the early 1970s to 1996; lead emissions (probably the most hazardous air pollutant) fell over 98 percent from 1970 to 1994, and concentrations also fell by about 98 percent.[26]

It is tempting to object, "This may be the case for advanced economies, but just look at the horrendous pollution in the world's poor countries!" Pollution in many of these countries is indeed horrendous. But there is no reason to think this must continue to be the case. As developing countries become wealthier–which they will do if their economic growth is not stifled by excessive government planning and by unreasonable environmental policies that suppress energy use and agricultural and industrial productivity–they have the opportunity to develop in a similar way. The environmental transition, as a concept, simply generalizes a common-sense insight: People tend to prioritize their spending in terms of their most urgent needs. Generally speaking, the most urgent material needs of the poor are for basic water, food, clothing, and shelter; in a second tier come basic health care, education, transportation, and communication; and in successive tiers come other, less urgent needs. People worried about putting food on the table today understandably consider that to be more urgent than reducing smog next year or minimizing global warming one hundred years from now. But when people are confident that their most urgent needs will be met, they begin allocating more of their resources to needs deemed by them less urgent–including increasingly rigorous environmental protection.

The rapid decline in pollution in advanced economies over the last thirty to fifty years–a decline that is continuing today–is not matched in very poor countries in early stages of economic development. But there is reason to be confident that the environmental transition not only will occur in the latter countries as surely as it has in the former, but also that it can and will occur more rapidly, with lower pollution peaks and more rapid improvements following them. Why? Because today's developing countries can cheaply import ready-made environmental protection technologies and technical know-how developed by others elsewhere at a much higher cost. That is, pollution abatement will become affordable in developing countries at much lower levels of economic development than it did in countries that progressed earlier. This is one reason trade and open dialogue between peoples are so important; they allow for the diffusion of environmentally friendly technologies and methods. The result, as illustrated in Figure 1, is a series of pollution transitions. Just as some countries went through the demographic transition long ago and others more recently, while some are in the midst of it now and others have yet to begin it, so some countries are long past the peak in the pollution transition, while others are at or just approaching it, and still others are just beginning the uptrend in pollution.

While we celebrate the decline in pollution as economies advance, however, we must not be distracted from the need to accelerate that decline in presently developing countries. Some three to five million children under the age of five die each year from diseases contracted from impure drinking water. Perhaps another three to five million die from diseases related to the widespread use of dried dung and wood for cooking and heating in the hovels of the poor, causing toxic indoor air pollution. Urban smog, largely defeated in the advanced countries of the West, remains a serious problem in many poorer cities of the world. We know how to solve these problems, as we have already done so ourselves. What the poor lack is sufficient income to afford the solutions; that is part of why economic growth in developing countries and trade between nations (which can speed the adoption of environmentally friendly technologies, management techniques, and regulatory regimes in developing countries) are so critically important–and why it is so tragic that many environmentalists embrace policies inimical to these ends. Such policies not only delay the achievement of the affluence that makes environmental protection affordable but also condemn millions of people to more years in poverty.

Thinking, for instance, that reducing carbon dioxide (co^2) emissions will prevent destructive global warming, some Western environmentalists are lobbying for severe restrictions on energy use, and are opposing the introduction of modern sources of energy into less developed nations.[27] But because human enterprise is largely dependent upon access to energy, restrictions on energy use are likely to further prolong the time it takes for people to achieve the wealth that makes possible the longer, healthier lives that we in the West sometimes take for granted. Similarly, opposition to "unsustainable" agricultural practices used in the developing world–practices that serve as a take-off point for substantially more productive and environmentally sound agricultural methods down the road–threatens to condemn large numbers in the developing world to perpetual poverty and hunger.

One clear implication of all of this is that an important assumption among many in the environmental movement is simply false. The assumption is that as people grow in numbers, wealth, and technology, the environment is always negatively affected. This idea has been given formulaic expression in Paul Ehrlich's famous equation, i = pat, where *i* is environmental damage, *p* is population, *a* is affluence, and *t* is technology. According to this formula, every increase in population, affluence, or technology must result in increased damage to the environment–and even more so when two or all three of these factors increase together. The damage to the environment affirmed in this vision is twofold: depletion of resources and emission of pollution. The trouble with the assumption–even though it seems intuitively sensible and certainly is a widespread belief–is that it ignores the stewardship role of the human person, and, consequently, is falsified by hard empirical data.

That pollution declines when economies grow wealthier has already been seen. The fact is illustrated well by the situation in the United States. While population grew by 19 percent from 1976 to 1994, the index of air pollution fell by 53 percent. During the same time, affluence tripled, and technology also increased dramatically, with more and more computerization and automation not only in industry and commerce but even in private homes. This is precisely the opposite of what Ehrlich's formula predicts. (See Figure 2.)

That we are not running out of resources is also clear. Since rising prices reflect increasing scarcity and falling prices reflect decreasing scarcity, we can learn long-term resource supply trends from long-term price trends. And the long-term, inflation-adjusted

price trend of every significant resource we extract from the earth–mineral, vegetable, and animal–is downward. Even more significant, the price of resources divided by wages is even more sharply downward, because while resource prices have been falling, wages have been rising. Together, these things mean that all resources are far more affordable, because they are far more abundant today than at any time in the past.[28]

Why have people so often been mistaken about the impact of growing human population and growing economies? Fundamentally, it is because they have not understood the full potential of the human person. They have considered people basically as consumers and polluters. They have not seen them–as they are presented in Scripture–as made in God's image, to be creative and productive, as he is (Gen. 1:26—28; 2:15), and as given a role in the restoration of earth from the effects of God's curse because of human sin (Rom. 8:15—25). But that biblical understanding of human nature leads Christians to expect precisely what we have seen: that, particularly when accompanied by properly formed human institutions and scientific understanding built on a biblical worldview, people can produce more than they consume and can actually improve the natural world around them.

IV. Some Human and Environmental Concerns for Present and Future

Despite the reassuring picture painted by all these general observations, many people continue to fear that we face serious threats to human well-being and to the environment as a whole. How realistic are these fears, and, to the extent that there are real dangers, what can we do about them? Let's look at three important examples: population growth, global warming, and rampant species extinction.

Population Growth

"The population crisis," writes cultural historian and evolutionary theorist Riane Eisler,

> lies at the heart of the seemingly insoluble complex of problems futurists call the world problematique. For behind soil erosion, desertification, air and water pollution, and all the other ecological, social, and political stresses of our time lies the pressure of more and more people on finite land and other resources, of increasing numbers of factories, cars, trucks, and other sources of pollution required to provide all these people with goods, and the worsening tensions that their needs and aspirations fuel.29

Eisler's words represent a common understanding of population growth among environmentalists: It threatens the earth with resource depletion and pollution. As we have seen, however, empirical observation, as well as biblical understanding of the implications of the image of God in the human person, suggests the opposite conclusion.

Nonetheless, many people still fear population growth because they believe it leads to overpopulation. When asked what they mean by *overpopulation,* they usually speak of crowding and poverty. Yet the assumption that high population density begets those things is mistaken. Some of the most desirable places to live in the world are also among the most densely populated. Manhattan, for instance, with its density of over 55,000 people per square mile, also has very high rents–a sure sign that plenty of people really want to live there, despite its high density. Or maybe, instead, they want to live there precisely because of its high density. The teeming population of Manhattan brings together a magnificent mix of human talent that makes life there fascinating, challenging, and rewarding for its millions. Similar things are true of all the world's great cities. With all their problems, they clearly attract more people than they drive away. Why should we question people's judgments about where they choose to live?

Some people think high population density lies at the root of poverty in developing nations such as China and those in sub-Saharan Africa. Yet China's population density is less than one-fifth of Taiwan's, and, aside from their forms of government, the two countries have very similar cultures. Taiwan, however, produces about five times as much wealth per capita as China. And the Netherlands, with population density nearly four times China's, produces more than ten times as much wealth per capita. And sub-Saharan Africa? Despite the common belief that it is overpopulated, it actually suffers instead from such low population density (just over half that of the world as a whole and lower than the average densities of the high-, middle-, and low-income economies of the world) that it cannot afford to build the infrastructure needed to support a strong economy.[30]

In reality, overpopulation is an empty word. As demographer Nicholas Eberstadt puts it, "the concept cannot be described consistently and unambiguously by demographic indicators." Eberstadt asks,

> What are the criteria by which to judge a country "overpopulated"? Population density is one possibility that comes to mind. By this measure, Bangladesh

> would be one of the contemporary world's most "overpopulated" countries–but it would not be as "overpopulated" as Bermuda. By the same token, the United States would be more "overpopulated" than the continent of Africa, West Germany would be every bit as "overpopulated" as India, Italy would be more "overpopulated" than Pakistan, and virtually the most "overpopulated" spot on the globe would be the kingdom of Monaco.
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> Rates of population growth offer scarcely more reliable guidance for the concept of "overpopulation." In the contemporary world, Africa's rates of increase are the very highest, yet rates of population growth were even higher in North America in the second half of the eighteenth century. Would anyone seriously suggest that frontier America suffered from "overpopulation"?
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> What holds for density and rates of growth obtains for other demographic variables as well: birthrates, "dependency ratios" (the proportion of children and elderly in relation to working age groups), and the like. If "overpopulation" is a demographic problem, why can't it be described unambiguously in terms of population characteristics? The reason is that "overpopulation" is a problem that has been misidentified and misdefined.
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> The images evoked by the term overpopulation–hungry families; squalid, overcrowded living conditions; early death–are real enough in the modern world, but these are properly described as problems of poverty.31

Despite all this, some people still fear population growth. Their fears, however, lack both biblical and empirical bases. First, the Bible presents human multiplication as a blessing, not a curse (Gen. 1:28; 8:17; 9:1, 6—7; 12:2; 15:5; 17:1—6; 26:4, 24; Deut. 7:13—14, cf. 30:5; 10:22, cf. 1:10; Ps. 127:3—5; 128:1, 3; Prov. 14:28); in contrast, a decline in population was one form of curse God might bring on a rebellious people (Lev. 26:22; Deut. 28:62—63). Second, although some people continue to believe projections made thirty and forty years ago of the world population topping twenty, thirty, or even forty billion in the next century or so, demographic trends indicate that the reality will be quite otherwise. Those projections were made based on the highest population growth rate the world has ever seen–about 2.2 percent per year in the 1960s, the peak of the global demographic transition. But by the year 2000, the worldwide population growth rate had

dropped to about 1.3 percent per year, and it is expected to drop even further as the demographic transition plays itself out. Eberstadt explains:

> Today, almost one-half of the world's population lives in 79 countries where the total fertility rates [trfs] are below replacement (an average of 2.1 children per woman over her lifetime).... The trfs in countries with above-replacement rates are beginning to fall. For all Asia, trfs have dropped by over one-half from 5.7 children per woman in the 1960s to 2.8 today. Similarly, Latin America's average trfs fell from 5.6 in the 1960s to 2.7 today. If U.N. median-variant projections of world population turn out to be correct, world population will be 7.5 billion in 2025 and 8.9 billion in 2050.

But even that might be overstating likely future population. "If present global demographic trends continue, the U.N. low-variant projections are likely. That would mean that world population would top out at 7.5 billion in 2040 and begin to decline."[32]

There is no good reason to believe that overpopulation will become a serious problem for the world. On the contrary, the more likely problem is that an aging world population will put greater stress on younger workers to provide for older, disabled persons.[33] Such a prospect, coupled with the sanctity of human life, makes all the more tragic the support in many quarters for morally illicit means of population control. Only genuine barriers to human flourishing create the problems associated with "overpopulation"; attacking problems such as poverty head-on is a far better way of improving human welfare and upholding human dignity than simply deeming certain lives unworthy of living and so, in the name of fighting "overpopulation," embracing abortion, euthanasia, and other actions that undermine the sanctity and dignity of human life.

Global Warming

Global warming is the biggest of all environmental dangers at present, maintain many environmentalists. Ironically, the great fear thirty years ago was of global cooling, for scientists recognized then that the earth is nearing a downward turn in its millennia-long cycle of rising and falling temperatures, correlated with cycles in solar energy output. But no more. Now people fear that rising atmospheric carbon dioxide, called a "greenhouse gas" because it traps solar heat in the atmosphere rather than allowing it to radiate back into space, will cause global average temperatures to rise. The rising temperatures, they

fear, will melt polar ice caps, raise sea levels, cause deserts to expand, and generate more and stronger hurricanes and other storms. Are there good reasons for these fears?

While atmospheric carbon dioxide (co^2) is certainly on the rise, and global average temperature has almost certainly risen slightly in the last 120 years or so, it is by no means certain that the rising temperature stems from the rising co^2. The most important contrary indicator is that the sequence is the reverse of what the theory would predict. Almost all of the approximately 0.45°C increase in global average temperature from 1880 to 1990 occurred before 1940, but about 70 percent of the increase in co^2 occurred after 1940. If the rising co^2 was responsible for the rising average temperature, the reverse should have been the case. In addition, roughly two-thirds of the overall increase is attributable to natural, not manmade, causes (primarily changes in solar energy output).[34]

Highly speculative computer climate models drove the great fears of global warming that arose in the 1980s and endured through the 1990s. Early versions of those models predicted that a doubling of atmospheric co^2 would cause global average temperature to increase by 5°C or more (nearly 10°F). As the models have been refined through the years, however, their warming predictions have moderated considerably. In 1990, the Intergovernmental Panel on Climate Change (ipcc) predicted, on the basis of the computer models, global average temperature increase of 3.3°C by a.d. 2100; by 1992, it had lowered its prediction to 2.6°C, and, by 1995, to 2.2°C (less than half the amount of warming predicted by the early computer models). Even that latest prediction is likely to turn out much too high, for it still is based on models that, had they been applied to the past century, would have predicted twice as much warming as actually occurred. As Roy W. Spencer, senior scientist at nasa's Marshall Space Flight Center, points out:

> All measurement systems agree that 1998 was the warmest year on record. The most recent satellite measurements, through 1998, give an average warming trend of +0.06°C/decade for the 20-year period 1979 through 1998. Even though this period ends with a very warm El Niño event [which would exaggerate its high-temperature end], the resulting trend is still only one-fourth of model-predicted average global warming for the next 100 years for the layer measured by the satellite.35

Additional uncertainties arise from significant discrepancies between temperature measurements obtained from instruments at the earth's surface and those obtained from instruments on satellites (which are substantially confirmed by instruments on weather balloons), which measure atmospheric temperature not at the surface but in the lower troposphere. These discrepancies were reported in a study prepared by the National Research Council of the National Academy of Sciences and published in January 2000.[36] For the period 1979 through 1998, the surface data appear to indicate an average warming trend per decade of about 0.196°C (or about 1.96 °C per century), while the satellite data[37] indicate a trend of only 0.057 °C per decade (or about 0.57 °C per century). After correcting the surface data for a variety of contaminating factors, a team of researchers produced new estimates of surface temperatures that yielded apparent decadal trends that were 0.097 °C to 0.106 °C larger than the satellite data trends for the lower troposphere. The differences, however, are still highly significant, since the corrected surface data trends are still 170 percent to 185 percent higher than the satellite-recorded lower troposphere trends.[38] The trouble does not end there, however. By making 1998 the final year of the study, the researchers chose a year in which global average temperatures were pushed markedly higher by an unusually strong El Niño; had the series ended with 1997 instead, the satellite data would have shown no statistically significant decadal trend, and the differential between them and the surface data would have been larger. Also, while the researchers corrected the surface data in part by accounting for the cooling effect of the eruption of Mount Pinatubo in 1991, they chose to ignore the cooling effect (about half that of Mount Pinatubo's eruption) of the eruption of Mount Chichon in 1982, further exaggerating the apparent uptrend in the satellite data.[39] The most significant problem for global warming theorists is that the computer models predicted that greenhouse warming would be faster in the lower troposphere than at the surface. But the data–to the extent that both sets are to be trusted–now show the opposite to be true. The significance of this is that the computer models clearly remain far from accurate enough in their depiction of atmospheric temperatures, which suggests that policy makers should be very slow to base their decisions on model predictions.

Not only is the actual global warming that is to be expected far from what the ipcc and other climate modelers originally predicted, but it is also questionable whether global warming is likely to bring many harmful effects. There are several reasons for this. Most

important, increasingly refined models now indicate–and empirical observation has confirmed–that the majority of the warming will occur in the winter, at night, and in polar latitudes.[40] This warming is far from sufficient to cause the polar ice caps to melt, which means it is also unlikely to result in significant rises in sea level–one of the most feared results of global warming because it was thought likely to inundate many coastal cities in which millions of the world's poorest people live. Instead, nighttime warming during the winter, to the extent that it affects populated areas at all, should result in a slight decrease in energy consumption for heating (and, therefore, some reduction in future emissions) and a slight lengthening of the growing season in spring and autumn.

Further, whatever rise in global average temperature occurs will likely result not in expanding but in contracting deserts, and not in contracting but in expanding polar ice caps. Why? More water evaporates in warmer temperatures. While one might think this is bad news for deserts, the opposite is true, for deserts make up only a tiny fraction of the earth's surface; over three-fourths of it is water, and most of the remainder is moist land. But air circulates over all of it. This means that enhanced evaporation everywhere will result in enhanced rainfall, even on desert areas, which, because those areas are so dwarfed by the rest of the earth's surface, will likely receive more water by enhanced precipitation than they lose by enhanced evaporation. But the enhanced precipitation at the poles is likely to enlarge polar ice caps, offsetting a long-term natural rise in sea level. As environmental scientist S. Fred Singer points out in reviewing a variety of studies of sea level trends,

> Global sea level (sl) has undergone a rising trend for at least a century; its cause is believed to be unrelated to climate change [1]. We observe, however, that fluctuations (anomalies) from a linear sl rise show a pronounced anti-correlation with global average temperature–and even more so with tropical average sea surface temperature. We also find a suggestive correlation between negative sea-level rise anomalies and the occurrence of El Niño events. These findings suggest that–under current conditions–evaporation from the ocean with subsequent deposition on the ice caps, principally in the Antarctic, is more important in determining sea-level changes than the melting of glaciers and thermal expansion of ocean water. It also suggests that any future moderate warming, from whatever cause, will slow down the ongoing

> sea-level rise, rather than speed it up. Support for this conclusion comes from theoretical studies of precipitation increases [2] and from results of General Circulation Models (gcms) [3,4]. Further support comes from the (albeit limited) record of annual ice accumulation in polar ice sheets [5].41

While only mild harm is to be anticipated from the small temperature increases that are most likely to come, some benefit is to be expected–indeed, has already occurred–because of enhanced atmospheric co^2. Carbon dioxide is crucial to plant growth, and recent studies show that a doubling of atmospheric co^2 results in an average 35 percent increase in plant growth efficiency.[42] Plants of all kinds grown in doubled-co^2 settings become more efficient in water use, more efficient in taking up minerals from the soil, and more resistant to disease, pests, excessive heat and cold, and both floods and droughts.[43] Consequently, a portion of the great gains in agricultural productivity in the past century has been due not to intentional improvements in farming techniques but to enhanced atmospheric co^2 caused by the burning of fossil fuels for energy to drive modern human economic activity.[44] This means that rising co^2 has made it easier to feed the world's growing population. In addition, greater plant growth efficiency should mean–and empirical observations confirm–that plants' growth ranges will increase to higher and lower altitudes, into warmer and colder climates, and into drier and wetter climates.[45]

Some people have asserted that global warming poses a serious threat to human health through increased incidence of tropical diseases and heat-related ailments. However, the Program on Health Effects of Global Environmental Change at Johns Hopkins University, in a congressionally mandated study, "found no conclusive evidence to justify such fears"[46] but instead concluded that "the levels of uncertainty preclude any definitive statement on the direction of potential future change for each of [five categories of] health outcomes," adding, "Although we mainly addressed adverse health outcomes, we identified some positive health outcomes, notably reduced cold-weather mortality…."[47] As the report exemplifies, it is easy for researchers to focus only on anticipated negative health effects from changes in global atmospheric chemistry and climate. However, not only must such anticipated effects be carefully justified and quantified in themselves, but they must also be studied in balance with anticipated benefits. For example, the reduction in hunger and malnutrition attributable to rising agricultural yields from increased

atmospheric carbon dioxide, however difficult to quantify, must certainly be considered. Thomas Gale Moore concluded his careful evaluation of various studies of anticipated health effects of global warming by writing, "… a warmer climate should improve health and extend life, at least for Americans and probably for Europeans, the Japanese, and people living in high latitudes. High death rates in the tropics appear to be more a function of poverty than of climate. Thus global warming is likely to prove positive for human health."[48] What is clear is the need for added study before long-term, difficult-to-change policies are adopted.

Despite all this, some people still want to greatly curtail fossil fuel use to reduce co^2 emissions. They are promoting a number of measures to do so, such as the Kyoto Protocol, an international treaty to force reductions in energy consumption. But since every form of economic production requires energy, reducing energy use entails reducing economic production. Some will reply that the losses in production can be offset by improved energy efficiency. To some extent they might be, but it is very unlikely that the reductions in emissions could be achieved through government-mandated efficiency measures alone; almost certainly, some actual loss of production would result. Because individuals seek to reduce their cost of living and businesses seek to maximize their profits in a free and competitive economy, they have a natural incentive to minimize waste, that is, to eliminate inefficient behavior and adopt the most economically efficient technologies they can (though these are not always the most technically efficient). The apparent need for government to mandate further emission reductions therefore suggests that these reductions must cause a net loss in production and, ultimately, diminish human welfare.

The independent economic forecasting firm wefa, even after accounting for likely improvements in energy efficiency, estimates that meeting the United States targets under the Kyoto accords would cut annual economic output by about $300 billion (or about 3.5 percent of the roughly $8.4 trillion in 1998 gross domestic product [gdp]) and, by 2010, destroy more than 2.4 million jobs and reduce average annual family income by about $2,700. Another economic forecasting firm, Charles River Associates, projects lower costs–about 2.3 percent (or, currently, about $193 billion) of gdp per year. Whether higher or lower, these economic costs translate into very human costs. Specialists in risk assessment estimate that in the United States, every $5 to $10 million drop in economic output results in one additional statistical death per year.[49] At that rate, the loss of $193 to

$300 billion in annual economic output entails at least 19,300 to 30,000 additional premature deaths per year in the United States alone.

But the United States is a rich country, far better able to cope with the costs of Kyoto than the vast majority of the world. The lost economic growth in any developing countries that are forced to comply with Kyoto emission restrictions spells added decades of suffering and premature deaths for their people, for whom the affordability of basic water and sewage sanitation, health care, and safe transportation will be long postponed.

Thus, says Frederic Seitz, past president of the National Academy of Sciences, in a letter accompanying a petition against the treaty signed by over seventeen thousand scientists,50

> This treaty is, in our opinion, based upon flawed ideas. Research data on climate change do not show that human use of hydrocarbons is harmful. To the contrary, there is good evidence that increased atmospheric carbon dioxide is environmentally helpful. The proposed agreement would have very negative effects upon the technology of nations throughout the world, especially those that are currently attempting to lift from poverty and provide opportunities to the over 4 billion people in technologically underdeveloped countries.51

Even assuming that the popular global warming scenario were true, what benefit would come from all the costs–not just in the United States but all over the world–of complying with the Kyoto accords? Proponents of the accords estimate that without the Kyoto limits, hydrocarbon emissions will increase at about 0.7 percent per year and that this will raise effective atmospheric carbon dioxide concentration from the present level of about 470 parts per million (ppm) to about 655 ppm in the year 2047. The Kyoto Protocol calls for reduction of emissions to 7 percent below 1990 levels during the years 2008 to 2012 and no increase thereafter, with effective carbon dioxide concentration in 2047 of 602 ppm. How much warming would be prevented by then? About 0.19^{o}C out of a potential 0.5^{o}C.[52] At a cost to the United States alone of about $200 billion per year (slightly above the Charles River Associates estimate but only two-thirds of the wefa estimate), this would mean a total cost of roughly ten trillion dollars and one million premature deaths. Such a price is too much to pay for so small and doubtful a benefit.

Not only the highly uncertain nature of both the theory and the evidence of global warming but also the unresolved question of whether global warming's net effects will be negative or positive point to one sure policy for the present: to delay action–especially highly costly action such as mandatory reductions in energy consumption–until the matter is much better understood.

It is tempting to say that we must not politicize this (or any other) environmental issue, and we do not intend to do so; our focus is on sound science rooted in a value structure that emphasizes honesty and openness to debate and evidence. But the issue has already been heavily politicized. Starting in the early 1990s, advocates of the Kyoto Protocol frequently spoke of a "scientific consensus" about global warming and derided the motives of scientists and others who questioned that conclusion. More recently, Rev. Dr. Joan Brown Campbell, general secretary of the National Council of Churches, went so far as to say that belief in global warming and support for the Kyoto Protocol should be "a litmus test for the faith community."[53] Clearly, as a result of such thinking, the quality of public knowledge and, hence, the ability to make wise public policy decisions, have been badly compromised with regard to global warming. Massachusetts Institute of Technology meteorology professor Richard Lindzen, one of the leading researchers in greenhouse effect and climate change science, pointed out in the early 1990s that "the existence of large cadres of professional planners looking for work, the existence of advocacy groups looking for profitable causes, the existence of agendas in search of saleable rationales, and the ability of many industries to profit from regulation, coupled with an effective neutralization of opposition" have undermined the quality of debate over both science and public policy, and that

> the dangers and costs of those economic and social consequences may be far greater than the original environmental danger. That becomes especially true when the benefits of additional knowledge are rejected and when it is forgotten that improved technology and increased societal wealth are what allow society to deal with environmental threats most effectively. The control of societal instability [brought on by the politicization of science in the global warming debate] may very well be the real challenge facing us.54

Contrary to earlier claims, it turned out that there was no consensus in favor of the popular global warming scenario. Even in the early 1990s, when the National Research Council

appointed a panel dominated by environmental advocates–a panel that included Stephen Schneider, who is an ardent proponent of the catastrophic hypothesis–the panel concluded that there was no scientific basis for any costly action.[55] If any scientific consensus has grown since then, it has been critical of the catastrophic vision and the policies based on it. First, like a warning shot across the bow, came the Statement by Atmospheric Scientists on Greenhouse Warming, released February 27, 1992. Signed by forty-seven atmospheric scientists, many of whom specialized in global climate studies, it warned that plans to promote a carbon emissions reduction treaty to fight global warming at the upcoming Earth Summit in Rio de Janeiro in June 1992 were "based on the unsupported assumption that catastrophic global warming follows from the burning of fossil fuels and requires immediate action," adding, "We do not agree." It cited a 1992 survey of United States atmospheric scientists, conducted by the Gallup organization, demonstrating that "there is no consensus about the cause of the slight warming observed during the past century." Further, the statement cited "a recently published paper [that] suggests that sunspot variability, rather than a rise in greenhouse gases, is responsible for the global temperature increases and decreases recorded since about 1880." It continued, "Furthermore, the majority of scientific participants in the [Gallup] survey agreed that the theoretical climate models used to predict a future warming cannot be relied upon and are not validated by the existing climate record," and it pointed out that "agriculturalists generally agree that any increase in carbon dioxide levels from fossil fuel burning has beneficial effects on most crops and on world food supply."[56] This was followed by the Heidelberg Appeal, released at the Earth Summit. Although it did not specifically name global warming, the Heidelberg Appeal warned against "the emergence of an irrational ideology which is opposed to scientific and industrial progress and impedes economic and social development." Over three thousand scientists, including seventy-two Nobel Prize winners, signed it.[57]

Three years later came the Leipzig Declaration on Global Climate Change, developed at the International Symposium on the Greenhouse Controversy held in Leipzig, Germany, in November 1995, and revised and updated after a second symposium there in November 1997. Signed by eighty leading scientists in the field of global climate research and twenty-five meteorologists, the document declared "the scientific basis of the 1992 Global Climate Treaty to be flawed and its goal to be unrealistic," saying it was "based solely on

unproven scientific theories, imperfect climate models–and the unsupported assumption that catastrophic global warming follows from an increase in greenhouse gases." It added, "As the debate unfolds, it has become increasingly clear that–contrary to conventional wisdom–there does not exist today a general scientific consensus about the importance of greenhouse warming from rising levels of carbon dioxide. In fact, most climate specialists now agree that actual observations from both satellite and balloon-borne radiosondes show no current warming whatsoever–in direct contradiction to computer model results." And it concluded, "based on all the evidence available to us, we cannot subscribe to the politically inspired world view that envisages climate catastrophes and calls for hasty actions. For this reason, we consider the drastic emission control policies deriving from the Kyoto conference–lacking credible support from the underlying science–to be ill-advised and premature."[58]

But those early signs of consensus against the popular vision were dwarfed by the release in 1997 of a Global Warming Petition developed by the Oregon Institute of Science and Medicine and accompanied by a thoroughly documented review monograph on global warming science. The petition urged the rejection of the Kyoto Protocol "and any other similar proposals," saying boldly, "The proposed limits on greenhouse gases would harm the environment, hinder the advance of science and technology, and damage the health and welfare of mankind." It added,

> There is no convincing evidence that human release of carbon dioxide, methane, or other greenhouse gases is causing or will, in the foreseeable future, cause catastrophic heating of the Earth's atmosphere and disruption of the Earth's climate. Moreover, there is substantial scientific evidence that increases in atmospheric carbon dioxide produce many beneficial effects upon the natural plant and animal environments of the Earth.59

The Global Warming Petition was signed by more than 17,000 basic and applied American scientists, including over 2,500 physicists, geophysicists, climatologists, meteorologists, oceanographers, and environmental scientists well qualified to evaluate the effects of carbon dioxide on the earth's atmosphere and climate, and over 5,000 chemists, biochemists, biologists, and other life scientists well qualified to evaluate the effects of carbon dioxide on plant and animal life. The consensus of scientists on global warming has turned out to be quite the opposite of what the apocalyptic vision proponents claimed.

Species Extinction

The Bible clearly indicates that God takes delight in his many creatures (Job 38:39—39:30; 40:15—41:34; Ps. 104:14—23). This entails the importance of stewardship of life itself. Confronted with claims that anywhere from 1,000 to 100,000 species are going extinct per year and that many or most of the extinction is caused by human action,[60] Christians must wonder whether they have failed in their stewardship obligation. However, in the spirit of 1 Thessalonians 5:21 ("Test all things; hold fast to what is good"), we can insist that claims of species extinction rates be tested empirically and that the significance of these numbers be carefully evaluated in the proper context.

When the claims are tested, they are found to be highly dubious. When two eminent statisticians challenged the claims, asserting that no empirical field data existed to support them,[61] the International Union for the Conservation of Nature (iucn) responded by commissioning a major worldwide field study. The result was a book[62] in which author after author admits that, despite expectations to the contrary based on theoretical models, field research yields little or no evidence of species extinction, even in locales–such as heavily depleted rain forests–in which the highest rates were anticipated. In that volume, V. H. Heywood, former director of the scientific team that produced the Flora Europea, the definitive taxonomic compilation of European plants, and S. N. Stuart, executive officer of the Species Survival Commission at the iucn, wrote, "iucn, together with the World Conservation Monitoring Centre, has amassed large volumes of data from specialists around the world relating to species decline [worldwide], and it would seem sensible to compare these more empirical data with the global extinction estimates. In fact, these and other data indicate that the number of recorded extinctions for both plants and animals is very small." They add,

> Known extinction rates [worldwide] are very low. Reasonably good data exist only for mammals and birds, and the current rate of extinction is about one species per year.... If other taxa were to exhibit the same liability to extinction as mammals and birds (as some authors suggest, although others would dispute this), then, if the total number of species in the world is, say, 30 million, the annual rate of extinction would be some 2,300 species per year. This is a very significant and disturbing number, but it is much less than most estimates given over the last decade.63

Note, however, that this hypothesis of 2,300 extinctions per year is not based on empirical evidence; it is instead derived from a theoretical model of extinctions as a percentage of total species and a high guess of total species. A more likely estimate of total species might be five to ten million, which, inserted into the model, would yield about 380 to 770 extinctions per year. If those numbers still sound alarming, keep in mind, first, that they represent only about 0.008 percent of species per year and, second, that they are probably significantly exaggerated. Even at that rate, it would take over five hundred years to eliminate 4 percent of all species on earth. What is more, as already noted, the same book contains repeated admissions that the model predictions of high extinction rates were repeatedly falsified by field investigation.

That is not surprising to those familiar with the serious weaknesses in the species-area curve and island biogeography theories from which the hypothetical extinction rates are derived. Subjected to careful critique, they turn out to vastly overestimate real extinction rates. In part, this is because they fail to describe ecosystems as they really are, and they unrealistically attribute to large, connected regions (e.g., the Amazon rain forest) the characteristics of isolated islands.[64] This means it is likely that the real extinction rate is much lower than 0.008 percent of species lost per year.

In short, the lack of sound data to support claims of species extinction rates continues.[65] Instead, the observational data indicate very low rates of extinction. A World Conservation Union report in 1994 found extinctions since 1600 to include 258 animal species, 368 insect species, and 384 vascular plants–about 2.5 species lost per year.[66] Consider the loss of species in the United States:

> Of the first group of species listed in 1973 under the Endangered Species Act, today [1995] 44 are stable or improving, 20 are in decline, and only seven, including the ivory-billed woodpecker and dusky seaside sparrow, are gone. This adds up to seven species lost over 20 years from the very group considered most sharply imperiled…. Under [conservation biologist E. O.] Wilson's loss estimate of 137 species per day, about 1.1 million extinctions should have occurred globally since 1973. As America contains six percent of the world's landmass, a rough proration would assign six percent of that loss, or 60,000 extinctions, to the United States. Yet in the period only seven actual

> U.S. extinctions have been logged…. And the United States is the most carefully studied biosphere in the world, making U.S. extinctions likely to be detected.
>
> If plants and insects are included in the calculation, 34 organisms fell extinct in the United States during the 1980s, according to a study by the Department of the Interior. This is clearly worrisome, but at an average of 3.4 extinctions per year, nothing like the rate of loss claimed by pessimists.67

The significance even of these small numbers is open to debate because, while most people think of a species as genetically defined, the Endangered Species Act (esa) defines species very differently. The Act says, "The term 'species' includes any subspecies of fish or wildlife or plant, and *any distinct population segment* of any species of vertebrate fish or wildlife which interbreeds when mature" (emphasis added).[68] The trouble with this definition is that when most people unfamiliar with the esa think of a species as being in danger of becoming extinct, they think this means no individual organism of that genetic definition will be left anywhere–or, since the esa applies to the United States, at least there. (This popular perception certainly lies behind the fear that "species" extinction forever removes elements from the global gene pool.) But in reality, it may only mean that a given population segment of that genetically defined species is endangered; it is entirely possible that plenty of other specimens may thrive in other locations. Many citizens who support expensive policies to prevent species extinctions might reconsider if they knew that rather than preventing real extinctions, they were only preventing the removal of a geographically defined segment of an otherwise thriving species.

None of this means that there are not particular species that are, in fact, endangered and that can benefit from careful conservation efforts. But as field ecologist Rowan B. Martin points out, when monetary values are more fully aligned with other human values, the institutional arrangement allows for the maximization of both values:

> Western scientists, activists, and agencies favor the creation of reserves in developing nations to preserve biological diversity. However, this strategy is often an unworkable form of "eco-imperialism." Recent studies show that the majority of reserves are failing to conserve biodiversity, are financially unsustainable, and were irrelevant to 95 percent of the people in the countries

where they were located. An alternative strategy, which has had considerable success, is empowering local people to control the wildlife resources in their area. In many parts of Southern Africa, where full rights of access and control over wildlife have been granted to landholders (of both private and communal land), biodiversity is better conserved in the areas surrounding national parks than in the parks themselves. Additionally, the areas surrounding the parks are economically more productive than the state-protected areas. In Southern Africa and other parts of the world, conservation of biological resources would be a profitable activity and not a cost if the correct institutional arrangements were developed, including a stronger reliance on private property and communal tenure systems.69

V. Environmental Market Virtues[70]

We have already argued that economic growth itself is an important step toward environmental protection. It makes good stewardship affordable and technically possible. Nonetheless, economic growth by itself is not enough. Human initiative needs to take place within an institutional framework that promotes environmental stewardship. Therefore, we need to examine more closely what is institutionally necessary to help further the goal of environmental protection.

While some concerns about the environment are overstated, others are quite real and need our attention. The fact that the world is not experiencing overpopulation or destructive, manmade global warming or rampant species loss does not mean that a change in policies or practices is not needed to address other issues.

Christians have every reason to embrace an appropriate environmental ethic, one that honors creation but distinguishes it from the Creator. However, simply recommending reformation of our worldview is not sufficient. Our ability to act responsibly toward nature has been hindered by our alienation from God. The original Fall and our continued rebellion mean that we act selfishly, that we have limited knowledge, and that we often fail to recognize the full potential in the created order. In view of these failings, we must not rely on worldview alone to lead us to good decisions about creation but must also examine the other influences of decision making, namely, information and incentives.

Environmental problems are traditionally seen as a result of market failure and as ample justification for the government to involve itself in the economy much more directly and forcefully to solve these problems. But it is an error to assume that, just because the market does not presently solve certain problems, government can effectively intercede to do so. Information and incentives are very much affected by the institutional order of a society. The social institutions pertinent to environmental and resource issues are the rules that assign responsibility–that is, property rights that determine who can take what actions and who gets a hearing with regard to those actions. These rules are crucial determinants of what information is generated and what incentives the decision makers face.

Property rights generate appropriate information and incentives to the extent that they embody three characteristics: exclusivity, liability, and transferability. Exclusivity means that the owner of a resource is able to capture a return from using the property in a way that is advantageous to other people, and it also means that an owner can exclude others from benefiting from the use of the property unless they have secured the owner's permission. If exclusivity does not exist, a resource will be overused. For instance, on the American frontier there were no exclusive rights to North American buffalo. If a buffalo hunter decided to postpone the shooting of any particular animal, he had no assurance that he would have the option to exercise that right in the future. The only way he could be assured of an exclusive right to a buffalo was to shoot it. Live buffalo were owned by everyone; dead ones belonged to the person who killed them. Is it any wonder that such a property rights system led to the near-extinction of the species?[71]

Liability forces a resource owner to bear the costs of actions that harm others. If property rights fully embody liability, costs are not imposed on others without their willing consent. For instance, if a person allows another person to impose harm on him–that is, to use up some of the grass on his cattle ranch to feed his livestock–that person must receive what he believes to be adequate compensation for the harm. If liability were not fully attached to one's property–that is, one's cattle–a person could drive cattle across someone else's land, allowing them to remove some of the grass without providing compensation. Pollution is a notable example of an incomplete property right, of liability not being present. It is exactly analogous to the cattle example; individuals can use up some of another's resource–clean air–without appropriate compensation.

Transferability encourages owners to look for ways of using property that benefit others, a central obligation of the Christian faith. The fact that a piece of property can be bought or sold means that a resource owner who ignores the wishes of other people does so at a cost to himself, a reduction of wealth. If rights are not transferable, no such wealth loss is associated with ignoring the wishes of others. In other words, transferability encourages people to seek out and engage in the most mutually beneficial property arrangements possible.

Thus, the attributes of exclusivity, liability, and transferability are essential for a well-functioning property rights system, one that fulfills the biblical mandate of holding individuals accountable for their decisions. If any one of those attributes is missing, people can act irresponsibly with regard to creation, at least in part because they do not have adequate information or appropriate incentives to make sound decisions.[72]

The information available to a decision maker is very much a function of property rights because people, in the process of trading, generate indexes of value for various uses of property. For instance, a landowner who knows there is coal on his land can readily obtain information through the price system about how others in society value that coal. If that individual also holds rights to the coal, that same information contains incentives for the owner to take actions that satisfy other people, namely, to make coal available to them. Since part of the biblical mandate with regard to creation is to use it for humankind, it would seem to be appropriate to be aware of and respond to people who desire to use coal as a fuel source.

But is mining the coal the only use for that land? What if mining leaves ugly scars on the earth's surface, permanently reducing certain individuals' aesthetic enjoyment of that land? How does a price system take those desires into account? Will coal be mined while aesthetics are ignored? The price system does not adequately represent all desires, and its failure to do so is caused by a lack of appropriate property rights. If the landowner had exclusive control over view rights to her land, she could charge an appropriate fee, and the price system would communicate to her whether the land was more valuable left in its pristine state or mined for coal.

The fact that property rights are sometimes not well defined and enforced is at the heart of environmental despoilment. The lack of a full rights structure means decision makers do

not have appropriate incentives and information. Therefore, it is not surprising that resource misuse occurs when property rights are incomplete. Of course, simply pointing out the lack of adequate property rights is not a solution to the environmental problem, but it provides some general guidance. We do not necessarily want to fully define rights to all resources; in some cases, the transaction costs of doing so are too high. But many property rights problems are not intractable, and the property rights framework is a useful way of looking at environmental issues.

For instance, air and water are the major resources suffering from pollution in certain places because they are usually treated as common property, that is, property where no one has exclusivity. Any individual who uses a particular airshed or watershed to dispose of waste does not face the full cost of his action; instead, the costs are spread over all the potential users of that resource, resulting in what has been called the "tragedy of the commons."[73] The answer to this problem is to attempt to restructure property rights so that exclusivity, liability, and transferability exist. Sometimes there are legal barriers to property rights' definition and transfer, as in the case of water law in many states, and those barriers can be removed. In others, the government must take positive steps to force decision makers to bear the full costs of their actions. For instance, a tax per unit of air or water pollution increases the costs of using the air or water as a waste disposal mechanism. If the tax is set at the correct level (if it accurately represents the cost of pollution–a difficult proposition when set outside of a market framework), the decision maker faces the correct incentive structure. He can continue to pollute if he is willing to pay the cost, and, if he does, the additional benefits to society from the polluting activity exceed the additional costs. In all likelihood, under such a tax the polluter will decide to reduce emissions–but not to zero.

Another way of altering property rights in air is through "the bubble concept." Under such a structure, people residing in a particular airshed, through some government entity, would decide how much pollution they are willing to tolerate. Rights to the pollution would then be available to producers in the area. The rights could be either handed out on the basis of historical production or auctioned off to the highest bidder. An important element of such a system would be transferability; for the rights to result in the greatest production at the lowest cost, each pollution right would need to be fully transferable within the airshed. Then each producer would face an appropriate incentive structure and could decide if it

would be cheaper to purchase pollution rights and continue polluting at the company's historical rate, or to adopt pollutant-reducing technology, or to shut down.

Each of these proposals involves government action of some sort. Because the definition and the enforcement of property rights are at least, in part, a function of government, an alteration of those rights will probably involve government. However, one must carefully specify the type of action appropriate when suggesting that government is the answer to environmental problems. Seeing the problem as one of inadequate property rights gives positive guidance about how government can be most effective–through the clear specification of rights and the fuller defense of them. Unfortunately, too often, government's involvement in resource issues has not been framed in a property rights context and hence has not been as effective as possible.

For instance, in terms of air and water pollution, the common governmental response has been through a command-and-control approach. Under such a system, government specifies the amount of pollution that can occur from each source and, in many cases, also specifies the technology to be used in reducing emissions. Numerous studies have shown that for any goal achieved through command-and-control, a bubble concept with transferable rights could achieve the same level of pollution reduction much more cheaply.[74]

The oft-repeated suggestion that government ownership and management of resources are solutions to environmental problems might seem to be appropriate when private property rights and markets have failed to lead to sound resource management. However, this suggestion ignores the fact that under government ownership, it is very difficult to construct property rights so that decision makers face appropriate incentives and receive correct information.

An excellent example of how governmental attempts at stewardship can create perverse incentives involves the Endangered Species Act (esa). This legislation, rather than creating incentives for people to act as good stewards of their own land and of its plant and animal inhabitants, often has exactly the opposite effect by making people fearful of losing use of that land. Richard Stroup, one of the originators of the New Resource Economics, describes the incentives of the esa in this way:

> Under the Endangered Species Act, the owner must sacrifice any use of the property that federal agents believe might impair the habitat of the species–at the owner's expense. Furthermore, if the owner either harms the species or impairs its habitat, severe penalties are imposed. The perverse incentives created by the law may well lead an owner to surreptitiously destroy that animal or plant–or any habitat that might attract it.75

Utah State University political science professor Randy Simmons observes that "the Supreme Court declared in its Tellico Dam decision that the act defines 'the value of endangered species as incalculable,' that endangered species must 'be afforded the highest of priority,' and that 'whatever the cost' species loss must be stopped (*tva v. Hill,* 437 U.S. 187, 174, 184 [1978])."[76] Such a zealous legislative commitment ignores the full scale of human values that a free economy otherwise allows to show through in the pricing system. But such a commitment by government turns the real value of a species from an asset into a liability–for instance, from the satisfaction one feels from having a rare species live on one's land to the fear of losing the use of land essential to one's livelihood. As field ecologist Rowan Martin argued earlier about wildlife resource preserves in southern Africa, empirical observation confirms that, when monetary values are more fully aligned with other (such as environmental) values, the institutional arrangement allows for the maximization of both values.

How do we know that the desires represented through property rights and the markets are truly scriptural? Is it not possible to have a well-functioning market system and still have resources put to ungodly uses? At this point, the biblical environmental ethic must inform the private-property system. An institutional structure that embodies exclusivity, liability, and transferability in its property rights will accurately represent the desires of members of society and will also encourage resource owners to respond to those desires. Full accountability–a biblical concept–will be in place. However, one must remember that Scripture most often discusses accountability in the context of responsibility to God, and the accountability being discussed here is accountability to other people, which is an entirely different concept.

All of this reaffirms the need for a biblically based view of nature and of man so that the desires represented in the marketplace will come closer to God's desires. At the same time, however, it is not clear that any alternative democratic institutional structure would

lead to a more godly environmental policy. The biblical mandate of valuing nature but making use of it does not offer much guidance as to the particulars of resource use. Evidently, God has allowed man to work out those details on the basis of his own perceptions of needs–with those needs appropriately informed by an awareness of God and his principles.

We are limited by human desires, as imperfect as they might be, as our standard to measure how resources should be used. God has given us the opportunity and responsibility to manage his creation, and it therefore seems appropriate to have an institutional structure that reflects human desires and holds individuals accountable as to whether they use their resources according to those desires. Such a structure is the system of property rights described earlier. If this seems a weak defense of property rights, that may be because it is. One can conceive of many cases where a system of well-defined and enforced property rights results in resource use that seems to violate God's standards. However, it is difficult to conceive of another property rights structure that does better at making sure God's standards are not violated. The two most obvious alternatives–common property and government ownership–both suffer from such obvious faults, such as the tragedy of the commons, that they are clearly inferior choices.

Despite this rather lukewarm endorsement of private-property rights as the correct mechanism for controlling resource use, several facets of such a system deserve some approbation. Such a rights structure allows for expression of certain aspects of the biblical principles outlined in the first section of this paper.

First, a private-property system will not produce zero pollution in the sense of stopping all alteration of the environment; but neither will it allow economic growth at all costs with material desires superseding all others. If property rights are fully defined and enforced, some emissions will still foul our air, not all water will be of pristine quality, and the use of nonrenewable resources will not drop to zero. However, the significant difference between this potential system of private-property rights and the the one that currently exists is that actions altering the environment would take place only if all users of the environment were convinced that those actions were to everybody's mutual advantage. In other words, there would be no uncompensated losers. A person who valued an unspoiled view more than someone else valued a factory smokestack in the middle of that view would win out. The factory smokestack would not exist, at least not at that location. Such a property rights

system would not stop economic growth but would allow it to occur only if the benefits were valued more highly than what was given up to get that growth. Such an approach to resource use seems appropriate, as we are to appreciate and value God's creation, but also see it as usable for human purposes.

Another component of a private-property rights system is that it does not depend on complete social agreement for action to take place. Diversity is permitted by virtue of the fact that a person who has strong feelings about resource use that differ from the group consensus can, under such a system, express those feelings through prices and markets. This can be of particular importance to Christians or environmentalists who find themselves at odds with prevailing wisdom about the environment. If such beliefs represent a minority position, they are much more likely to find expression in a system of private-property rights than under alternative rights arrangements.

Finally, a private-property rights system permits the fullest realization of the image of God in the human person. Genuine problems require genuinely creative solutions, and property harnesses human creativity to the realization of human needs. As history has repeatedly shown, it is the creative spirit of the human person that permits wise stewardship, and institutions that encourage this spirit are more likely to also facilitate environmentally sound ends.

But can we be assured that future generations will have a place in a free economy? What of God's concern for all people of all times? Is there not a chance that a system based on private-property rights will cater exclusively to the desires of the present generation compared to the needs of future ones? Again, the appropriate question to ask is, Compared to what? What alternative institutional arrangement will do a better job than one that embodies transferable property rights? It would be nice to posit a theocracy headed by an omniscient saint, and if that were a realistic alternative, markets would come out second-best. However, if we stick to real-world possibilities, well-defined rights that can be bought and sold look quite good indeed.

Contrast, for a moment, a resource being managed under two alternative regimes. Let us say that a resource is exhaustible; hence, it is important to give future generations some voice in the choice about the appropriate rate of use. Under the first regime, a pure democracy controls the use of the resource. With different expectations by members of

the population about the resource's future value, the average perception will dominate. In other words, if the present generation thinks that, on average, the resource has a future value (discounted to the present) greater than its value in present consumption, it will be preserved. On the other hand, if the average expectation of the resource's future value is less than its value in present consumption, it will be consumed.

Now take the same resource, and the same population with the same set of preferences and expectations, but make the present/future allocation on the basis of transferable property rights. In this case, the resource is more likely to be preserved for the future because it is not the average perception about the future value of the resource that counts, but instead the perception of those most optimistic about its future value who express themselves in the marketplace. These individuals will purchase the resource in the expectation of a high future value, hold it out of consumption, and, in the process, preserve it for future generations. In fact, for any resource to be used in the present, all who believe it has some value in the future must be outbid.

All of this is not to say that altruistic feelings for future generations are unimportant. Under either system, such sentiments can result in greater preservation for future generations. Notice, however, that the political approach depends entirely on altruism, or people caring for future generations, while the market order allows those preferences to be expressed but also rewards individuals who, for selfish reasons, decide to withhold resources from present consumption.

Giving future generations a voice is a bit awkward. Their preferences will be expressed only in people who exist presently, so it is useful to have someone stand in for them today; they need agents to represent them. These agents cannot know perfectly the desires of people not yet born, but they can make educated guesses about these desires. In the market arena, these agents are either unselfish contributors to the future or speculators acting on their perception of future demands for resources. If their perceptions are correct, their wealth increases; if they guess incorrectly, they suffer a wealth loss. Thus, these agents have strong incentives to be well informed and to predict correctly the needs of future generations.

In a world where Christian charity and concern for others are sometimes in short supply, it is useful to have a mechanism that allows for future needs to be met, by those acting

charitably and those pursuing profit. Again, institutional design is a fundamental component of a system that satisfies God's desire that we think not only of this generation.

Thus, freedom, property rights, and a legal framework that ensures that accountability attaches to freedom and property, work together to minimize pollution and improve human welfare. As Carl Pope, president of the Sierra Club, has noted, this sort of approach "would yield restrictions on pollution more stringent than those embodied in any current federal and state pollution laws,"[77] without necessarily sacrificing human welfare in the process.

The more fully, then, a society embodies a Christian worldview, and the more its decision makers–private and public–embrace that value framework and operate with the information and incentives provided by a private-property legal regime with exclusivity, liability, and transferability, the more decisions with environmental impact are likely to be responsible and to minimize harm to people and the larger environment. The Christian worldview can be promoted by preaching, teaching, writing, and the like. But the information and incentives essential to proper decision making, even assuming a Christian worldview, are best generated by the price system of the free economy.

Conclusion

Patrick Moore, one of the founders of Greenpeace International, said in an interview in the *New Scientist* in December 1999, "The environmental movement abandoned science and logic somewhere in the mid-1980s ... political activists were using environmental rhetoric to cover up agendas that had more to do with class warfare and anti-corporatism than with the actual science...." What we have said above indicates that Moore was right in his critique of the movement to which he made such an important early contribution. Too often, modern environmentalism has become anti-human, anti-freedom, anti-economic development, and anti-reason. It is time to reverse this trend.

On the basis of a biblical worldview and ethics, as well as of sound science, economics, and public policy principles, we believe sound environmental stewardship celebrates and promotes human life, freedom, and economic development as compatible with, even essential for, the good of the whole environment. While we do not rule out all collective action, we believe market mechanisms are frequently better means, in both principle and practice, to environmental protection. They are less likely to erode important human

freedoms and more likely to be cost-effective and successful in achieving their aims. While we understand that passions may energize in the pursuit of sound environmental policy, we also believe that reason, coupled with a commitment to "do justly, to love mercy, and to walk humbly with … God" (Mic. 6:8), must ultimately guide environmental policy.

Notes

1. Robert William Fogel, "The Contribution of Improved Nutrition to the Decline in Mortality Rates in Europe and America," in *The State of Humanity,* ed. Julian L. Simon (New York: Blackwell, 1995), 61—71.

2. E. Calvin Beisner, "Sixpence None the Richer: Economics–A Millennium of Human Progress," *World* 14 (July 31, 1999): 20—25. For voluminous statistics and able discussions on these and dozens of other elements of material progress, see Julian L. Simon, ed., *The State of Humanity* (New York: Blackwell, 1995).

3. See E. Calvin Beisner, *Prosperity and Poverty: The Compassionate Use of Resources in a World of Scarcity* (Wheaton, Ill.: Crossway Books, 1988), and *Prospects for Growth: A Biblical View of Population, Resources, and the Future* (Wheaton, Ill.: Crossway Books, 1990); and Nathan Rosenberg and L. E. Birdzell, Jr., *How the West Grew Rich: The Economic Transformation of the Industrial World* (New York: Basic Books, 1986).

4. Nicholas Eberstadt, "World Depopulation: Last One Out Turn Off the Lights," *Milken Institute Review* 2 (first quarter 2000): 38.

5. The classic work leading to biological egalitarianism is Peter Singer's *Animal Liberation: A New Ethics for Our Treatment of Animals* (New York: Random House/New York Review of Books, 1975). See also John Harris, Stanley Godlovitch, and Roslind Godlovitch,

Animals, Men, and Morals (New York: Taplinger Publishing, 1972); and Arne Naess, *Ecology, Community, and Lifestyle: Outline of an Ecosophy,* trans. and rev. David Rothenberg (Cambridge and New York: Cambridge University Press, 1989). For critique, see E. Calvin Beisner, *Where Garden Meets Wilderness: Evangelical Entry into the Environmental Debate* (Grand Rapids, Mich.: Eerdmans Publishing/Acton Institute, 1997), appendix 2; Thomas Sieger Derr, *Environmental Ethics and Christian Humanism* (Nashville, Tenn.: Abingdon Press, 1996), chapter 1, and "Human Rights and the Rights of Nature," *Journal of Markets and Morality* (forthcoming); Robert Royal, *The Virgin and the Dynamo: Use and Abuse of Religion in Environmental Debates* (Grand Rapids, Mich.: Eerdmans Publishing, 1999), chapter 4; and Charles T. Rubin, *The Green Crusade: Rethinking the Roots of Environmentalism* (New York: Free Press, 1994), chapter 4.

6. Quoted in Francis A. Schaeffer, "How Should We Then Live?" in *The Complete Works of Francis A. Schaeffer: A Christian Worldview* (Westchester, Ill.: Crossway Books, 1982), 5:159.

7. See Michael B. Barkey, "A Framework for Translating Environmental Ethics into Public Policy," *Journal of Markets and Morality* (forthcoming); E. Calvin Beisner, "Stewardship in a Free Market," in *The Christian Vision: Morality and the Marketplace,* ed. Michael Bauman et al. (Hillsdale, Mich.: Hillsdale College Press, 1994), and *Where Garden Meets Wilderness: Evangelical Entry into the Environmental Debate* (Grand Rapids, Mich.: Eerdmans Publishing/Acton Institute, 1997), appendix 2; Thomas Sieger Derr, *Environmental Ethics and Christian Humanism* (Nashville, Tenn.: Abingdon Press, 1996), chapter 1, and "Human Rights and the Rights of Nature," *Journal of Markets and Morality* (forthcoming); and Peter J. Hill, "Biblical Principles Applied to a Natural Resources/Environment Policy," in *Biblical Principles and Public Policy: The Practice,* ed. Richard Chewning (Colorado Springs: NavPress, 1991), 169—182.

8. Scripture frequently defines justice procedurally as rendering impartially and proportionally to everyone his due in accord with the standards of God's moral law. Elements of this definition are found throughout Scripture: impartiality (Lev. 19:15; Deut. 16:19; 1 Tim. 5:21; James 2:1—9); moral desert (Prov. 24:12, cf. Matt. 16:27; Rom. 2:6; 13:7; 1 Cor. 3:8; Gal. 6:7—8); proportionality (Exod. 21:35—36; 22:1, 6; Lev. 24:17—21; Deut. 19:4—6); and conformity to a standard (Lev. 19:35—37; Deut. 25:13—16, cf. Job 31:6, Ezek. 45:10, and Mic. 6:8.). For a discussion of recent debates among evangelicals over the meaning and nature of justice and the implications this has for political economy, see Craig M. Gay, *With Liberty and Justice for Whom? The Recent Evangelical Debate*

over Capitalism (Grand Rapids, Mich.: Eerdmans Publishing, 1991).

9. James Gwartney and Robert Lawson, with Dexter Samida, *Economic Freedom of the World, 2000 Annual Report* (Vancouver: Fraser Institute, 2000), 15.

10. See, for example, Indur M. Goklany, "Richer Is Cleaner: Long-Term Trends in Global Air Quality," in *The True State of the Planet,* ed. Ronald Bailey (New York: Free Press, 1995), and "Richer Is More Resilient: Dealing with Climate Change and More Urgent Environmental Problems," in *Earth Report 2000: Revisiting the True State of the Planet,* ed. Ronald Bailey (New York: McGraw-Hill, 2000); Don Coursey, "The Demand for Environmental Quality" (St. Louis: John M. Olin School of Business/Washington University, 1992); Seth W. Norton, "Property Rights, the Environment, and Economic Well-Being," in *Who Owns the Environment?* ed. Peter J. Hill and Roger E. Meiners (Lanham, Md.: Rowman and Littlefield, 1998), 37—54; Gene M. Grossman and Alan B. Krueger, "Economic Growth and the Environment," *Quarterly Journal of Economics* 110 (May 1995): 353—377; and John M. Antle and Gregg Heidebrink, "Environment and Development: Theory and International Evidence," *Economic Development and Cultural Change* 43 (April 1995): 603—625.

11. Fernand Braudel, *The Structures of Everyday Life,* vol. 1 of *Civilization and Capitalism: Fifteenth through Eighteenth Century,* trans. Sian Reynolds (New York: Harper and Row, 1985), 41.

12. The rapid population growth is attributable almost entirely to declining death rates (i.e., rising life expectancy), not to rising birth rates. See Nicholas Eberstadt, "World Depopulation: Last One Out Turn Off the Lights," *Milken Institute Review* 2 (first quarter 2000), 37—48.

13. Computed from Fernand Braudel, *The Structures of Everyday Life*, vol. 1 of *Civilization and Capitalism: Fifteenth through Eighteenth Century,* trans. Sian Reynolds (New York: Harper and Row, 1985), 121; and *Statistical Abstract of the United States,* 1996, table 1105.

14. Computed from Braudel, 1:135.

15. Computed from E. Calvin Beisner, *Prospects for Growth: A Biblical View of Population, Resources, and the Future* (Wheaton, Ill.: Crossway Books, 1990), 127.

16. Computed from Braudel, 1:135. See also Richard J. Sullivan, "Trends in the Agricultural Labor Force"; George W. Grantham, "Agricultural Productivity Before the Green Revolution"; Dennis Avery, "The World's Rising Food Productivity"; and Thomas T. Poleman, "Recent Trends in Food Availability and Nutritional Well-Being," in *The State of*

Humanity, ed. Julian L. Simon (New York: Blackwell, 1995).

17. See Michael R. Haines, "Disease and Health through the Ages," in *The State of Humanity,* ed. Julian L. Simon (New York: Blackwell, 1995).

18. Both religious and civil liberty were important themes in the political thought of the seventeenth-century Scottish Covenanters, who carried on Knox's tradition. See John Knox, *On Rebellion,* ed. Roger A. Mason (Cambridge: Cambridge University Press, 1994); George Buchanan, *De Jure Regni Apud Scotos* (1579); Samuel Rutherford, *Lex, Rex* (1644); and Sir James Stewart of Goodtrees, *Jus Populi Vindicatum, or, The Right of the People to Defend Their Lives, Liberty, and Covenanted Religion, Vindicated* (1669).

19. See Julian L. Simon and Rebecca Boggs, "Trends in the Quantities of Education: USA and Elsewhere," in *The State of Humanity,* ed. Julian L. Simon (New York: Blackwell, 1995).

20. See Samuel H. Preston, "Human Mortality throughout History and Prehistory"; and Kenneth Hill, "The Decline of Childhood Mortality," in *The State of Humanity,* ed. Julian L. Simon (New York: Blackwell, 1995).

21. See William J. Hausman, "Long-Term Trends in Energy Prices"; Morris A. Adelman, "Trends in the Price and Supply of Oil"; Bernard L. Cohen, "The Costs of Nuclear Power"; John G. Myers, Stephen Moore, and Julian L. Simon, "Trends in Availability of Non-Fuel Minerals"; H. E. Goeller, "Trends in Nonrenewable Resources"; and Roger A. Sedjo and Marion Clawson, "Global Forests Revisited," in *The State of Humanity,* ed. Julian L. Simon (New York: Blackwell, 1995).

22. See William J. Baumol and Wallace E. Oates, "Long-Run Trends in Environmental Quality"; Derek M. Elsom, "Atmospheric Pollution Trends in the United Kingdom"; and Hugh W. Ellsaesser, "Trends in Air Pollution in the United States," in *The State of Humanity,* ed. Julian L. Simon (New York: Blackwell, 1995).

23. Mikhail Bernstam, "Comparative Trends in Resource Use and Pollution in Market and Socialist Economies," in *The State of Humanity,* ed. Julian L. Simon (New York: Blackwell, 1995), 520.

24. See Ronald Bailey, "Earth Day: Then and Now," *Reason* 31 (May 2000): 23.

25. Indur M. Goklany, "Richer is Cleaner: Long-Term Trends in Global Air Quality," in *The True State of the Planet,* ed. Ronald Bailey (New York: Free Press, 1995), 342—343.

26. Calculated from statistics in *Earth Report 2000: Revisiting the True State of the Planet,* ed. Ronald Bailey (New York: McGraw-Hill, 2000), 291—310.

27. Gregg Easterbrook, *A Moment on the Earth: The Coming Age of Environmental*

Optimism (New York: Viking, 1995), 582—585.

28. See Stephen Moore, "The Coming Age of Abundance," in *The True State of the Planet,* ed. Ronald Bailey (New York: Free Press, 1995); Lynn Scarlett, "Doing More with Less: Dematerialization–Unsung Environmental Triumph?" in *Earth Report 2000: Revisiting the True State of the Planet,* ed. Ronald Bailey (New York: McGraw-Hill, 2000); William J. Hausman, "Long-Term Trends in Energy Prices"; Morris A. Adelman, "Trends in the Price and Supply of Oil"; Bernard L. Cohen, "The Costs of Nuclear Power"; John G. Myers, Stephen Moore, and Julian L. Simon, "Trends in Availability of Non-Fuel Minerals"; and H. E. Goeller, "Trends in Nonrenewable Resources," in *The State of Humanity,* ed. Julian L. Simon (New York: Blackwell, 1995).

29. Riane Eisler, *The Chalice and the Blade: Our History, Our Future* (Cambridge, Mass.: Harper and Row, 1987), 174—175.

30. E. Calvin Beisner, "Anomalies, the Good News, and the Debate over Population and Development: A Review of Susan Power Bratton's Six Billion and More," *Stewardship Journal* 3 (summer 1993): 44—53.

31. Nicholas Eberstadt, "Population, Food, and Income: Global Trends in the Twentieth Century," in *The True State of the Planet,* ed. Ronald Bailey (New York: Free Press, 1995), 14—15.

32. Nicholas Eberstadt, "World Population Prospects for the Twenty-First Century: The Specter of 'Depopulation'?" in *Earth Report 2000: Revisiting the True State of the Planet,* ed. Ronald Bailey (New York: McGraw-Hill, 2000), 64. See also Nicholas Eberstadt, "World Depopulation: Last One Out Turn Off the Lights," *Milken Institute Review* 2 (first quarter 2000): 37—48.

33. On population in general, see E. Calvin Beisner, *Prospects for Growth: A Biblical View of Population, Resources, and the Future* (Wheaton, Ill.: Crossway Books, 1990), and "*Imago Dei* and the Population Debate," in *Where Garden Meets Wilderness: Evangelical Entry into the Environmental Debate* (Grand Rapids, Mich.: Eerdmans Publishing/Acton Institute, 1997); Julian L. Simon, *The Economics of Population Growth* (Princeton: Princeton University Press, 1977), *Population Matters: People, Resources, Environment, and Immigration* (New Brunswick, N.J.: Transaction, 1990), and *The Ultimate Resource 2,* rev. ed. (Princeton: Princeton University Press, 1996); Max Singer, *Passage to a Human World: The Dynamics of Creating Global Wealth* (Indianapolis: Hudson Institute, 1987); Michael Cromartie, ed., *The Nine Lives of Population Control* (Washington, D.C., and Grand Rapids, Mich.: Ethics and Public Policy Center/Eerdmans Publishing, 1995); and

Michael B. Barkey, Paul Cleveland, and Gregory M. A. Gronbacher, "Population, the Environment, and Human Capital" (forthcoming).

34. Robert C. Balling, *The Heated Debate: Greenhouse Predictions Versus Climate Reality* (San Francisco: Pacific Research Institute, 1992), 65—69.

35. Roy W. Spencer, "How Do We Know the Temperature of the Earth? Global Warming and Global Temperatures," in *Earth Report 2000: Revisiting the True State of the Planet,* ed. Ronald Bailey (New York: McGraw-Hill, 2000), 25.

36. National Research Council, *Reconciling Observations of Global Temperature Change* (Panel on Reconciling Temperature Observations: National Academy Press, 2000).

37. Corrected in 1999 for anomalies related to orbital drift and other problems discovered in 1998.

38. B. D. Santer et al., "Interpreting Differential Temperature Trends at the Surface and in the Lower Troposphere," *Science* 287 (February 18, 2000): 1228. See also Dian J. Gaffen et al., "Multidecadal Changes in the Vertical Temperature Structure of the Tropical Troposphere," *Science* 287 (February 18, 2000): 1242—1245; and David E. Parker, "Temperatures High and Low," *Science* 287 (February 18, 2000): 1216—1217.

39. "Global Warming Smokescreen," *World Climate Report* 5 (March 13, 2000); greeningearthsociety.org/climate/previous_issues/vol5/v5n13/feature.htm.

40. Robert C. Balling, *The Heated Debate: Greenhouse Predictions Versus Climate Reality* (San Francisco: Pacific Research Institute, 1992), 92, 102—103.

41. S. Fred Singer, presentation to the 1997 fall meeting of the American Geophysical Union; sepp.org/scirsrch/slr-agu.html. Singer's citations are from: [1] A. Trupin and J. Wahr, "Spectroscopic Analysis of Global Tide-Gauge Sea-Level Data," *Geophysical Journal International* 100 (March 1990): 441—453. [2] D. Bromwich, "Ice Sheets and Sea Level," *Nature* 373 (1995): 18. [3] S. L. Thompson and D. Pollard, "A Global Climate Model (Genesis) with a Land-Surface Transfer Scheme," *Journal of Climate* 8 (April 1995): 732—761. [4] H. C. Ye and J. R. Mather, "Polar Snow Cover Changes and Global Warming," *International Journal of Climatology* 17 (February 1997): 155—162. [5] D. A. Meese et al., "The Accumulation Record from the gisp^2 Core as an Indicator of Climate Change throughout the Holocene," *Science* 266 (December 9, 1994): 1680—1682.

42. Sherwood B. Idso, *Carbon Dioxide: Friend or Foe?* (Tempe, Ariz.: ibr Press/Institute for Biospheric Research, 1982), 73—80, esp. 73—74, and *Carbon Dioxide and Global Change: Earth in Transition* (Tempe, Ariz.: ibr Press/Institute for Biospheric Research,

1989), 67—107, esp. 68.

43. Sherwood B. Idso, *Carbon Dioxide and Global Change: Earth in Transition* (Tempe, Ariz.: ibr Press/Institute for Biospheric Research, 1989), 67—107.

44. Sherwood B. Idso, *Carbon Dioxide and Global Change: Earth in Transition* (Tempe, Ariz.: ibr Press/Institute for Biospheric Research, 1989), 108. See also *The Greening of Planet Earth,* video and transcript (Arlington, Va.: Western Fuels Association, 1992), 14; and Dennis Avery, "The World's Rising Food Productivity," in *The State of Humanity,* ed. Julian L. Simon (New York: Blackwell, 1995), 381.

45. Among the more important studies on the benefits of enhanced atmospheric co^2 to plants and, therefore, to agricultural productivity, see Sherwood B. Idso, *Carbon Dioxide and Global Change: Earth in Transition* (Tempe, Ariz.: ibr Press/Institute for Biospheric Research, 1989), and *Carbon Dioxide: Friend or Foe?* (Tempe, Ariz.: ibr Press/Institute for Biospheric Research, 1982). On global warming in general, see Robert C. Balling, *The Heated Debate: Greenhouse Predictions Versus Climate Reality* (San Francisco: Pacific Research Institute, 1992); Patrick J. Michaels, *Sound and Fury: The Science and Politics of Global Warming* (Washington, D.C.: Cato Institute, 1992); Patrick J. Michaels and Robert C. Balling, *The Satanic Gases: Clearing the Air about Global Warming* (Washington, D.C.: Cato Institute, 2000); Thomas Gale Moore, *Climate of Fear: Why We Shouldn't Worry About Global Warming* (Washington, D.C.: Cato Institute, 1998); Frederick Seitz, Robert Jastrow, and William A. Nierenberg, *Scientific Perspectives on the Greenhouse Problem* (Washington, D.C.: George C. Marshall Institute, 1989); and S. Fred Singer, *Hot Talk, Cold Science: Global Warming's Unfinished Debate* (Oakland, Calif.: Independent Institute, 1997).

46. "Study Finds No Support for Global Warming Fears," *Los Angeles Times,* March 16, 2000, metro section.

47. Jonathan A. Patz et al., "The Potential Health Impacts of Climate Variability and Change for the United States: Executive Summary of the Report of the Health Sector of the U.S. National Assessment," *Environmental Health Perspectives* 108 (April 2000).

48. Thomas Gale Moore, *Climate of Fear: Why We Shouldn't Worry about Global Warming* (Washington, D.C.: Cato Institute, 1998), 88.

49. Frank Cross, "Paradoxical Perils of the Precautionary Principle," *Washington and Lee Law Review* 53 (1996): 919, and "When Environmental Regulations Kill: The Role of Health/Health Analysis," *Ecology Law Quarterly* 22 (1995): 729—784.

50. Arthur B. Robinson, Sallie L. Baliunas, Willie Soon, and Zachary W. Robinson, "Environmental Effects of Increased Atmospheric Carbon Dioxide"; zwr.oism.org/pproject/s33p36.html.

51. See Jonathan H. Adler, ed., *The Costs of Kyoto: Climate Change Policy and Its Implications,* and a video by the same title (Washington, D.C.: Competitive Enterprise Institute, 1997).

52. Patrick J. Michaels, "The Consequences of Kyoto," *Cato Policy Analysis* 307 (Washington, D.C.: Cato Institute, May 7, 1998), 8, 5. "Even the former chairman of the IPPC, Bert Bolin, says that the present plan would, if fully implemented, cut warming 25 years hence 'by less that 0.1 degree C, which would not be detectable,' " Thomas Gale Moore, *Climate of Fear: Why We Shouldn't Worry about Global Warming* (Washington, D.C.: Cato Institute, 1998), 143.

53. John H. Cushman, Jr., "Religious Groups Mount a Campaign to Support Pact on Global Warming," *New York Times,* August 15, 1998, section A.

54. Richard S. Lindzen, "Global Warming: The Origin and Nature of the Alleged Scientific Consensus," *Regulation* 15 (spring 1992): 11.

55. Ibid., 8.

56. The Statement by Atmospheric Scientists on Global Warming and a list of signatories can be accessed at sepp.org/statment.html.

57. The Heidelberg Appeal and a partial list of signatories can be accessed at heartland.org.

58. The Leipzig Declaration on Climate Change and a partial list of signatories can be accessed at sepp.org/leipzig.html.

59. The Global Warming Petition developed by the Oregon Institute of Science and Medicine and a list of signatories can be accessed at oism.org/pprojects/s33p37.htm.

60. Robert M. May, "Conceptual Aspects of the Quantification of the Extent of Biological Diversity," in *Biodiversity: Measurement and Estimation,* ed. D. L. Hawksworth (London: Royal Society/Chapman and Hall, 1995), 13—20; Paul R. Ehrlich and Anne Ehrlich, *Extinction: The Causes and Consequences of the Disappearance of Species* (New York: Random House, 1981); John Tuxill and Chris Bright, "Losing Strands in the Web of Life," in *The State of the World 1998,* ed. Lester R. Brown, Christopher Flavin, and Hilary French (New York: W. W. Norton, 1998); Jessica Hellman et al., *Ecofables/Ecoscience* (Stanford, Calif.: Stanford University/Center for Conservation Biology, 1998); and Mark H. Williamson, *Island Populations* (Oxford: Oxford University Press, 1981).

61. Julian L. Simon and Aaron Wildavsky, "On Species Loss, the Absence of Data, and Risks to Humanity," in *The Resourceful Earth,* ed. Julian L. Simon and Herman Kahn (Oxford and New York: Blackwell, 1984), 171—183.

62. Timothy C. Whitmore and Jeffrey A. Sayer, ed., *Tropical Deforestation and Species Extinction* (London and New York: Chapman and Hall, 1992).

63. Ibid., 93—94.

64. Charles C. Mann and Mark L. Plummer, *Noah's Choice: The Future of Endangered Species* (New York: Knopf, 1995), chapter 3.

65. Julian L. Simon and Aaron Wildavsky, "Species Loss Revisited," in *The State of Humanity,* ed. Julian L. Simon (New York: Blackwell, 1995), 346—361; Rowan B. Martin, "Biological Diversity: Divergent Views on Its Status and Diverging Approaches to Its Conservation," in *Earth Report 2000: Revisiting the True State of the Planet,* ed. Ronald Bailey (New York: McGraw-Hill, 2000), 203—236; E. Calvin Beisner, "A Christian Perspective on Biodiversity: Anthropocentric, Biocentric, and Theocentric Approaches to Bio-Stewardship," in *Where Garden Meets Wilderness: Evangelical Entry into the Environmental Debate* (Grand Rapids, Mich.: Eerdmans Publishing/Acton Institute, 1997), 129—146.

66. Ronald Bailey, "Earth Day: Then and Now," *Reason* 31 (May 2000): 25.

67. Gregg Easterbrook, *A Moment on the Earth: The Coming Age of Environmental Optimism* (New York: Viking, 1995), 558—559 (adjusted to reflect today's figures). See also "Issue Brief: Endangered Species Act" at www.cei.org/EBBReader.asp?ID=728, and "Species Removed from the Endangered Species List (Delisted) through February 1997" at www.nwi.org/EndangeredSpecies/Delistings.html.

68. The complete Endangered Species Act may be accessed at nesarc.org/act.htm.

69. Rowan B. Martin, "Biological Diversity: Divergent Views on Its Status and Diverging Approaches to Its Conservation," in *Earth Report 2000: Revisiting the True State of the Planet,* ed. Ronald Bailey (New York: McGraw-Hill, 2000), 205.

70. This section is drawn largely from the work of Peter J. Hill, with his permission, especially from his "Biblical Principles Applied to a Natural Resources/Environment Policy," in *Biblical Principles and Public Policy: The Practice,* ed. Richard Chewning (Colorado Springs: NavPress, 1991), 169—182; "Can Markets or Government Do More for the Environment?" in *Creation at Risk? Religion, Science, and Environmentalism,* ed. Michael Cromartie (Washington, D.C.: Ethics and Public Policy Center/Eerdmans Publishing, 1995); and "Takings and the Judeo-Christian Land Ethic: A Response,"

Religion and Liberty 9 (March/April 1999): 5—7. Other studies indicating the importance of private property and free markets to environmental protection include Bernard J. Frieden, *The Environmental Protection Hustle* (Cambridge, Mass.: MIT Press, 1979); Terry L. Anderson and Donald R. Leal, *Free Market Environmentalism* (San Francisco: Pacific Research Institute, 1991); Terry L. Anderson, ed., *Multiple Conflicts over Multiple Uses* (Bozeman, Mont.: Political Economy Research Center, 1994); Elizabeth Brubaker, *Property Rights in the Defense of Nature* (London and Toronto: Earthscan/Environment Probe, 1995); John A. Baden and Douglas S. Noonan, ed., *Managing the Commons,* 2nd ed. (Bloomington: Indiana University Press, 1998); Timothy D. Terrell, "Property Rights and Externality: The Ethics of the Austrian School," *Journal of Markets and Morality* 2 (fall 1999): 197—207; and Michael B. Barkey, "Translating Environmental Ethics into Public Policy," *Journal of Markets and Morality* (forthcoming).

71. For a discussion of the American West and how different property rights systems affected stewardship practices, especially as these practices pertained to species preservation, see Terry L. Anderson and Donald R. Leal, *Free Market Environmentalism* (San Francisco: Pacific Research Institute, 1991), chapter 3.

72. The argument that an adequate information and incentive structure is necessary for good choices to result does not imply that only external incentives and information are all that matter in acting responsibly. As discussed earlier, the value structure of the individual is also crucial, and it is difficult to imagine a well-functioning property rights system without an adequate moral base.

73. In some cases, moral constraints are so strong that they override the badly structured incentives of common property. This usually occurs when the group is small and there is a deep level of commitment to one another and to a shared ideology. For instance, families, local churches, and certain clubs have elements of common property and yet are quite stable over long periods of time. Thus, not all common property arrangements are doomed to failure.

74. See, for instance, Michael Maloney and Bruce Yandle, "Bubbles and Efficiency: Cleaner Air at Lower Cost," *Regulation* 4 (May/June 1980): 49—52; and Michael Levin, "Statutes and Stopping Points; Building a Better Bubble at EPA," *Regulation* 9 (March/April 1985): 33—42.

75. Richard L. Stroup, "The Endangered Species Act: A Perverse Way to Protect Biodiversity," *PERC Viewpoints,* April 1992, page 1. See also Richard L. Stroup, "Endangered Species Act: Making Innocent Species the Enemy," *PERC Policy Series,*

April 1995.

76. Randy T. Simmons, "Fixing the Endangered Species Act," in *Breaking the Environmental Policy Gridlock,* ed. Terry L. Anderson (Stanford, Calif.: Hoover Institution Press, 1997), 82.

77. Excerpt from a speech by Jerry Taylor delivered on February 4, 1997, to the Environmental Grantmakers Association: "Environmentalism in a Market Society: Creative Ideas." Mr. Taylor adds, "That's certainly true if a pollutant is truly harmful or a significant nuisance, since individuals–not government authorities–would have the final say over how much pollution they were willing to tolerate on their property or person. That approval would also have the benefit of allowing an array of voluntary contractual relationships between polluter and polluted, internalize the cost of pollution (the holy grail of environmental economics), and minimize the transaction costs and inefficiencies caused by politicized rulemaking."