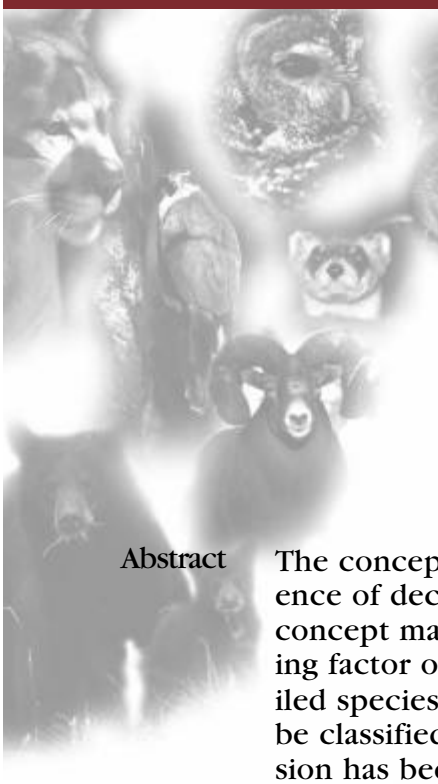

Economic growth as the limiting factor for wildlife conservation

by Brian Czech

Abstract The concept of limiting factor includes the lack of welfare factors and the presence of decimating factors. Originally applied to populations and species, the concept may also be applied to wildlife in the aggregate. Because the decimating factor of economic growth eliminates welfare factors for virtually all imperiled species via the principle of competitive exclusion, economic growth may be classified as the limiting factor for wildlife conservation. The wildlife profession has been virtually silent about this limiting factor, suggesting that the profession has been laboring in futility. The public, exhorted by neoclassical economists and political leaders, supports economic growth as a national goal. To address the limiting factor for wildlife conservation, wildlife professionals need to become versed in the history of economic growth theory, neoclassical economic growth theory, and the alternative growth paradigm provided by ecological economics. The Wildlife Society should lead the natural resources professions in developing a position on economic growth.

Key Words carrying capacity, competitive exclusion, ecological economics, economic growth, limiting factor, neoclassical economics, niche breadth, steady state economy

Economic growth is an increase in the production and consumption of goods and services and is a function of population and per-capita consumption (Heilbroner and Thurow 1987). The most common gauges of economic growth in the United States are gross domestic product (GDP), the annual sum of all goods and services produced and purchased in the nation, and gross national product (GNP), which equals GDP plus net property income from abroad (Begg et al. 1994). Economic production comes from 3 main sectors: agricultural-extractive, manufacturing-industrial, and services, although government is sometimes cited as a major sector (Cramer and Jensen 1994).

Agriculture requires a conversion from uncultivated to cultivated land. Wildlife professionals have long recognized that, based on trophic principles, agricultural plant communities are less capable of supporting diverse animal communities than the uncultivated plant communities they replace (Leopold 1966, National Research Council 1982). Natural resource extraction tends to remove, destroy, or deplete wildlife habitat components (i.e., food, water, cover, and space; National Research Council 1970). Agricultural, extractive, and industrial infrastructure reduces the space available to wildlife, and pollution degrades the other components of species' habitats (Robinson and Bolen 1989, Anderson 1991).

It is less clear how wildlife conservation is affected by the services sector. Economic theory proposes that services may provide for economic growth with little or no consumption of natural resources and therefore little degradation of wildlife habitat (Simon 1996). However, not all economists view the potential growth of the

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services sector as unlimited (Goodland 1992), and economic activities that consume no natural resources exist only in theory (Costanza 1980). The health services, for example, require the manufacture and transport of instruments, equipment, and drugs. Drug manufacturing entails using toxic and ozone-depleting substances. Hospital waste must be transported and disposed of and requires the construction and operation of special incineration facilities (Stanners and Bourdeau 1995).

Furthermore, for services to be economically viable, a sufficient number of consumers must purchase them (Blight and Shafto 1984). Consumers must be fed, clothed, and housed. They must have transportation to the site where the service is provided. They must come to afford nonconsumptive services by providing goods and services of their own, many of which do require the consumption of resources and the associated liquidation of wildlife habitat. In today's "information economy," much of the information purchased is used to produce and consume goods and services.

Economic growth and wildlife conservation are conflicting goals, based on these simple precepts. Yet, there has been virtually no published discussion of the implications of economic growth to wildlife conservation by wildlife professionals. The indexes to all volumes (1973–1998) of the *Wildlife Society Bulletin* contain no references to economic growth. Economic topics are limited entirely to wildlife valuation and microeconomic case studies (e.g., Wallace et al. 1991). The *Bulletin* is representative of a general paucity of macroeconomic discussion in natural resources journals. I found 97 citations containing the keywords "economic growth" in BIOSIS© for the period 1992–1998 and Biological Abstracts© for the period 1989–1991. Only one was about wildlife conservation in the United States (Rasker and Hackman 1996).

Admittedly, in using the keyword approach to literature searching, there are publications that escape notice. Thus, one periodically encounters publications in which negative impacts of economic growth on wildlife conservation are clearly identified (e.g., Smith 1994). Unfortunately, such publications are the exception; the more common approach is to relegate statements on economic growth to passing comments in the discussion section in resigned fashion, as if the topic were taboo.

My goal is to provide wildlife professionals with theoretical and normative rationale for becoming involved with economic growth issues in and out of academia. My objectives are to: 1) evaluate economic growth as the limiting factor for wildlife in the aggregate, 2) trace the history of economic growth theory, 3) describe the status of economic growth as an American ideal, 4) assess the position of the wildlife profession on economic growth, 5) introduce a nascent economic paradigm called "ecological economics," and 6) recommend research programs and policy positions.

Economic growth as the limiting factor for wildlife conservation

Limiting factors and related concepts

Wildlife management consists of managing animals, habitats, and the activities of people (Leopold 1933, Shaw 1985, Robinson and Bolen 1989). The management of a desirable species consists of identifying the limiting factor and reducing its influence in the appropriate ecological sector (i.e., animals, habitats, or people). Aldo Leopold (1933:39) defined limiting factor as "the one [wildlife productivity factor] which *has to be moved first,* usually the one to which the application of a given amount of effort will pay the greatest returns, *under conditions as they stand.*" The significance of the concept is profound, as Leopold's italics suggested, because wildlife biologists who invest resources in nonlimiting factors labor in relative futility.

Wildlife populations can be limited by "welfare" and "decimating" factors (Leopold 1933:25). Welfare factors include the basic habitat components of food, water, cover, and space; and special features like roosting sites and mineral deposits. Welfare factors are limiting by their absence. Decimating factors tend to limit populations by their presence, e.g., hunting, accidents, and predators. Wildlife management has historically focused on providing more welfare factors and reducing or mitigating the impacts of decimating factors.

Welfare and decimating factors may represent different sides of the same coin. For example, a deer population may disappear when a subdivision replaces its habitat. In the subdivision, fountains and bird feeders containing water may be abundant, as well as a variety of palatable browse in the landscaping. The biologist may thus identify the welfare factor of security cover (nearly all of which was replaced by houses, open landscaping, and subdivision infrastructure) to be limiting. Alternatively,

Most relevant to wildlife conservation, ecological economics theorizes that there are biophysical constraints to the scale of the economy and that testing these constraints threatens our ecosystem and, ultimately, the economy itself.

the biologist could consider the decimating factor of subdivision development to be limiting, because development eliminated the security cover, thus causing the extirpation of the deer. Although either conclusion may be correct, the identification of subdivision development as the limiting factor would be more informative, in the sense that it would reveal the cause of the extirpation.

Bailey (1984:201) recognized the logical challenge to isolating a limiting factor when a decimating factor depletes a welfare factor, and he proposed the terminology that a lack of welfare factors "limits" a population, whereas presence of decimating factors "depresses" a population. In the example, subdivision development would be the "depressing factor" and security cover would be the "limiting factor." While "limiting factor" has taken firm root in wildlife ecology, "depressing factor" is virtually nonexistent in wildlife terminology. (In March 1998, the Sabio© literature retrieval system of the University of Arizona revealed no citations referenced with the key phrase "depressing factor.") Furthermore, using both terms would tend to defeat the purpose for which Leopold originally designated the term limiting factor, i.e., identification of the single most relevant cause preventing a wildlife population from realizing its productive potential.

The term limiting factor is "…now used more generally to describe any environmental condition or set of conditions that approaches most nearly the limits (maximum or minimum) of tolerance for a given organism" (Allaby 1994:232). In other words, Leopold's (1933) terminology has been retained; welfare and decimating factors are commonly designated as limiting.

The limiting factor concept applied to wildlife in the aggregate

In the aforementioned example, bat, vole, and frog populations might also be displaced by the subdivision. Bats may be lost because of the elimination of roosting snags, voles because of the elimination of tall grassy meadows, and frogs because of the subdivision's drainage system. Perhaps populations of dozens of species are displaced. Identifying the decimating common denominator of subdivision development as the limiting factor for the wildlife community is more efficient and causally informative than identifying the decimated welfare factors for each species. Although the concept of limiting factor is usually defined to apply to individual populations or species (e.g., Anderson 1991:473), the example illustrates its utility as a concept for the general practice of wildlife conservation at any scale.

Wildlife encompasses all wild species, thus the limiting factor for wildlife conservation at the national scale is probably a ubiquitous phenomenon. Theoretically, phenomena with aggregate limiting factor potential include natural phenomena like solar radiation, social phenomena like overharvest, and socially induced natural phenomena like global warming. As with populations and species, treating the limiting factor may involve treating natural phenomena (analogous to managing animals and habitats) or social phenomena (managing people).

The limiting factor for a population is not necessarily the limiting factor for all family units within the population, and the limiting factor for a species is not necessarily the limiting factor for all populations of the species. Likewise, the limiting factor for wildlife conservation does not necessarily apply to all species. Theoretically, a limiting factor may threaten many species while benefiting others. However, the beneficiaries of environmental disturbance operating at orders of magnitude faster than mundane geological processes tend to be r-selected, "weedy," exotic species of lesser economic and psychological value than the victims (Meffe and Carroll 1994).

Identifying the limiting factor for a wildlife population or community can be tricky, but often it is obvious, especially when broad categories of factors are designated. In the example, perhaps it was difficult for the biologist to ascertain which aspect of subdivision development (house construction, landscaping, or infrastructure installation) was most problematic for each species, but it was obvious that subdivision development was the limiting factor for the species assemblage. At the national scale, data compiled by Czech and Krausman (1997) indicate that nearly all species listed by the United States Fish and Wildlife Service as threatened or endangered have declined because of human economic activity. As measured by GNP, the scale of this activity in the United States has increased from approximately 0.8 to 7.7 trillion dollars during the period 1929–1997 (United States Bureau of Economic Analysis 1998). In some cases other factors were involved, but economic activity was directly associated with the decline of all species except (arguably) the Florida saltmarsh vole (Moseley 1992). Urbanization, agriculture, outdoor recreation and tourism, domestic livestock and ranching, reservoirs and other water diversions, pollution, mineral and petroleum extraction, industrial activities, logging, silviculture, road construction and maintenance, aquifer depletion, and harvest were the major categories of human economic activity identified. Other categories of endangerment included modified fire regimes, genetic problems, disease, and interactions with other species. However, these other categories are a function of economic activity or of wildlife population declines caused primarily by

economic activity (Czech and Krausman 2000, Czech et al. in press).

Based on these findings, it is logical to classify economic growth as the limiting factor for wildlife conservation. If the human economy shrank, whether via population or per-capita consumption, then populations of many species would be expected to increase, except in cases where the damage was irreversible. For example, the passenger pigeon, a famous casualty of one economic sector (i.e., market hunting) is gone, regardless of subsequent economic trends. Economic growth indeed appears to be "the ultimate cause of the biodiversity crisis" (James 1994:1161). Even Congress, while not explicitly using the concept of limiting factor, acknowledged the impact of economic growth on wildlife conservation in the first sentence of the Endangered Species Act of 1973:

> "The Congress finds and declares that various species of fish, wildlife, and plants in the United States have been rendered extinct as a consequence of economic growth and development untempered by adequate concern and conservation."

To address the limiting factor for wildlife conservation and thus avoid laboring in futility, wildlife professionals need to address the topic of economic growth. To do so, they require knowledge about economic growth theory. As with most topics, a historical overview of economic growth theory is helpful in developing this knowledge.

The history of economic growth theory

The first coherent theory of economic production was physiocracy, which formed in France during the 1760s (van Meerhaeghe 1980). The physiocrats believed that agriculture was the sole source of production (Cleveland 1987). They also theorized that there was a fixed ratio of agricultural to manufactured products (Brenner 1966). As the French countryside was usurped by farming, therefore, the economy would cease to grow. However, physiocracy was invalidated to some extent by technical and political developments (Heilbroner 1992).

In the wake of physiocracy, the classical economists prevailed. Adam Smith, David Ricardo, Thomas Malthus, and John Stuart Mill rejected the physiocrats' hypothesis that manufacturing was an unproductive economic sector and labor displaced land as the basis of value (van Meerhaeghe 1980). Nevertheless, Malthus (1803) hypothesized that populations would grow until they exceeded the productive capacity of the land and would thus suffer the misery of forced reduction (as with r-selected wildlife species). Ricardo's portrayal of *Homo sapiens* was slightly more sanguine than that of Malthus: human economy would eventually equilibrate around carrying capacity, whereupon crowding and pestilence would ensue (Sundrum 1990).

Observing the Industrial Revolution unfold, scholars including Alfred Marshall, Irving Fisher, and Arthur Pigou were instrumental in building a neoclassical theory of economic growth (Brenner 1966). Perhaps the most relevant distinction of neoclassical economics is the importance it placed upon capital (i.e., human-made capital like buildings and machines) as a factor of production. The neoclassical economists "simply took the productivity of capital as one of the technological facts of life…. And that is essentially the position taken by economists today" (Miller and Upton 1974:21).

Neoclassical theory also has incorporated the concept that technological development enables an ever more efficient production process (Solow 1988) and that increases in "human capital" (i.e., ideas resulting from education and research) have the same effect (Lucas 1993, Romer 1994). Human capital is viewed by neoclassical economists as the "ultimate resource" that makes it possible for economic growth to continue without limit (Simon 1996).

Neoclassical economists view economic growth as a benchmark of societal progress (Heilbroner 1992). When it comes to wildlife conservation and other environmental issues, they portray the challenge as adjusting the market system to incorporate, or internalize, all values (Cleveland 1991, Norgaard and Howarth 1992, van Dieren 1995). They generally deem it unnecessary to explore the implications of the natural sciences for economic growth theory, and they tend to acknowledge neither the significance of unknowable values nor the existence of incalculable values (Krishnan et al. 1995).

In addition to having a historical background in neoclassical precepts, wildlife professionals who intend to address the limiting factor for wildlife conservation should be aware of the social context of the factor. For example, when conservationists addressed market hunting (a limiting factor for many species at the dawn of the twentieth century), it was important to understand the sources of the demand for wildlife products and the culture of those employed in the hunting (Trefethen 1975). This understanding helped conservationists perform the "people management" function of wildlife management. Likewise, managers today need an understanding of the social construction of economic growth.

Economic growth as an American ideal

Public opinion on economic growth

The influence of neoclassical economics on society

might be arguable, but economic growth is inarguably an American ideal. It is thought to provide material and psychological comfort and is identified as prerequisite to full employment (Shaw et al. 1997). It is viewed as a natural outcome of capitalism, which is commonly viewed by many as the only economic counterpart to democracy (Adler 1991), which in turn is the American political ideal (Heilbroner and Thurow 1987).

Czech and Krausman (1999) conducted a nationwide survey on public opinion toward species conservation and socioeconomic institutions that affect conservation and found that maintenance of economic growth was rated very important (75.4 on a visual analog scale from 0 to 100). It was rated at the same importance level as property rights and the conservation of species. Ecosystem health and democracy were rated at a higher level, and the availability of resources for future generations was rated highest.

The equality of value ascribed to economic growth and property rights, the latter of which are protected by the United States Constitution, indicates the intensity with which Americans cherish economic growth. On the other hand, the equality of value ascribed to economic growth and species conservation suggests that Americans may relinquish their exuberance over economic growth if the trade-offs between economic growth and species conservation are readily apparent. Presumably, the public would not rate economic growth as high if it thought that economic growth was inconsistent with species conservation, ecosystem health, or especially with the availability of resources for posterity.

American leadership on economic growth

American leaders propound economic growth politically, legislatively, and bureaucratically. For example, during the nationally televised vice-presidential debate of 9 October 1996, candidate Jack Kemp exhorted, "We should double the rate of growth, and we should double the size of the American economy" (Washington Post 1996:A26). His opponent, Al Gore, sanctioned the economic growth race by replying, "Well, the economy is growing very strongly right now…. The average growth rate is also coming up. It is higher than in either of the last two Republican administrations" (Washington Post 1996:A26).

In her annual report for fiscal year 1992, Secretary of Commerce Barbara Hackman Franklin (1992:1) announced that "commerce has supplanted military and security issues as the main concern among nations" and that the Department of Commerce had rallied "to advance a seven-point agenda for fostering economic growth." In his annual report for fiscal year 1994, the late Secretary of Commerce Ronald Brown (1994:III) described the Department of Commerce as "promoting economic growth through [a series of activities]." These pronouncements represented the ideologies of back-to-back Republican and Democratic administrations, respectively. Thus the primary, perennial, and bipartisan goal of a large, cabinet-level department is economic growth.

Theoretically, political exhortation would not favor an agenda unless the public was already in favor or predisposed to favor it, because politicians who take unpopular positions are unfit in the process of political selection. The causal relationship between political exhortation and public support for economic growth is a chicken–egg puzzle, but one thing is relatively clear: There is abundant academic support for economic growth, especially in neoclassical economics. The vast majority of the American public has probably had little formal economic training, and that which they have received would have been neoclassical. Therein lies the predisposition to concur with political exhortations for economic growth.

The position of the wildlife profession on economic growth

The wildlife profession in the United States is embodied by The Wildlife Society (TWS), a nonprofit scientific and educational organization of approximately 9,000 members, primarily in the United States and Canada but also in 53 other nations (The Wildlife Society 1999). The goals of TWS are to: 1) develop and promote sound stewardship of wildlife resources and the environments upon which wildlife and humans depend, 2) undertake an active role in preventing human-induced environmental degradation, 3) increase awareness and appreciation of wildlife values, and 4) seek the highest standards in all activities of the wildlife profession. The Wildlife Society is the sole certification authority for wildlife biologists in the United States.

Natural resources professionals have a history of taking positions on issues of importance to their profession. The Wildlife Society, for example, has taken positions on 24 issues, including human populations; toxic chemical compounds; threatened and endangered species; urban wildlife; alterations of stream, riparian, and wetlands habitats; petroleum development in Arctic, subarctic, and coastal regions; management and conservation of old-growth forest in the United States; federal cropland diversion programs; and recognition of wildlife needs in forest management (The Wildlife Society 1992). These are issues that affect wildlife conservation at the national and international levels, and they all have economic growth as a common causal denominator. Nevertheless,

many TWS members do not recognize economic growth as a problem, much less the limiting factor, for wildlife conservation.

On 14 January 1998, I solicited a discussion on economic growth on the TWS internet listserver (TWS-L@LISTSERV.VT.EDU). I proposed that, "In ecological terms, humans practice competitive exclusion of other species through economic growth." (Competitive exclusion is the doctrine that the proliferation of one species occurs at the expense of other species; Pianka 1974.) Of 41 respondents, 14 explicitly agreed with the argument, 6 explicitly disagreed, and 21 respondents fell within an intermediate level of agreement or provided peripheral comments. A common theme of the peripheral comments was that regardless of the truth of the argument, the propriety of TWS taking a position on economic growth was questionable. One respondent said, "But beware, my friend—if you persist in pointing out this basic truth, you might find yourself unemployed.…"

That comment may help to explain the reluctance of wildlife professionals to identify economic growth as problematic, but this reluctance may precipitate a dangerous perception. If wildlife professionals are forced to communicate in forums where economic growth is a topic, reluctance to reveal the dangers of economic growth might have the effect of supporting economic growth.

For example, on 7 January 1998, Arizona Congressman Jim Kolbe sponsored a public hearing in Tucson on the cactus ferruginous pygmy owl (*Glaucidium brasilianum cactorum*), a federally listed species (Udall Center 1998). A school district had been prevented from building a school at the desired site because the area was under consideration for critical habitat designation. Nearly a thousand people attended the hearing. High-ranking federal wildlife officials focused their presentation on the compatibility of species conservation and economic development. The subtle distinction between development (a qualitative process) and growth (a quantifiable variable) was not mentioned, so that many people may have left the hearing feeling reassured that economic growth was not a problem for wildlife conservation after all. The opportunity to educate the public on the mounting conflict between economic growth and wildlife conservation was foregone. Presumably this scenario is repeated throughout the nation at public hearings called under similar circumstances.

Some professional wildlife organizations take on the important task of demonstrating the economic value of wildlife, but contribute to the ideology that threatens wildlife in the process. For example, the International Association of Fish and Wildlife Agencies (1997:1) asserted, "New studies now show that annual spending by America's 14 million hunters amounts to a whopping $22.1 billion. By comparison and if hypothetically ranked as a 'corporation,' that revenue figure would put hunting in thirty-fifth place on the Fortune 500 list of America's businesses, right between commercial giants J.C. Penney and United Parcel Service." Hunting is an important conservation tool and a treasured cultural heritage, but in a macroeconomic sense, all permit sales are not equal. For example, when a hunter from the Northeast travels to Arizona to hunt elk (*Cervus elaphus*), petroleum is consumed and pollution is a byproduct. Hunting supplies and equipment must be produced and consumed to support the hunt. The hunter may require outfitting, meat packing, transportation, and taxidermy services. One or more wildlife agencies must administer the hunt. The production and consumption of these goods and services contribute to economic growth and the conservation problems associated therewith, whereas only a relatively small amount (usually a portion of the permit fee and the Pittman–Robertson excise tax on arms and ammunition) contributes to wildlife conservation.

In summary, The Wildlife Society has not taken a position on economic growth. Judging by a small e-mail survey, most wildlife biologists acknowledge that economic growth and wildlife conservation are incompatible, but a considerable portion do not. Those who do acknowledge the incompatibility tend to be reluctant to address the issue, while wildlife professionals in the highest levels of government formally take the position that economic development and wildlife conservation are compatible. Perhaps if wildlife professionals were conversant with a school of economics that dispelled the neoclassical theory of perpetual economic growth, they would be better situated to address economic growth as the limiting factor for wildlife conservation.

An introduction to ecological economics

Even after classical economics was undermined by the Industrial Revolution, there were skeptics who doubted the possibility of infinite economic growth, including John Stuart Mill (Daly 1993). The most famous skepticism in recent decades was promulgated by a group of about 30 intellectuals from various professions who first met in Rome in 1968. They devised a computer model that predicted a halt in economic growth prior to the year 2100 simultaneous with environmental catastrophe (Meadows and Club of Rome 1972). Their book, *The*

Limits to Growth, produced an outpouring of theory on economic growth. Neoclassical economists have adamantly disagreed with the book's conclusions, and the groundswell of support for *The Limits to Growth* has been actively suppressed (Bartlett 1998).

Shortly after *The Limits to Growth* was published, another book was published that had a lasting if less immediate impact. *Toward a Steady-State Economy* (Daly 1973) was written and edited primarily by economists and therefore contained more rigorous economic theory pointing toward the limits to growth. Revisions of *Toward a Steady-State Economy* have appeared twice under different titles (Daly and Townsend 1993). Although the term "ecological economics" did not become popular until the 1990s, *Toward a Steady-State Economy* may be viewed as the birth of the movement.

While "steady state" in some economics literature refers to stable ratios of economic parameters and associated steady GNP growth, ecological economists who advocate a steady state refer to a stationary (or mildly equilibrating) and sustainable GNP, whereby stocks of natural capital (e.g., soil, trees, fish populations) remain constant in the long run. Hereafter, the latter definition is used. The growth of GNP preceding a steady state economy resembles the population growth of K-selected wildlife species.

An essential distinction, much less subtle than the names suggest, is that between ecological economics and "environmental economics." Prior to 1973 and continuing today, environmental economics has addressed the environmental impacts of economic growth with microeconomic methods, but its macroeconomic assumptions are neoclassical (Harris 1995, Prugh et al. 1995). For example, environmental economics concurs with neoclassical economics in considering land, labor, and especially capital to be the primary, independent factors of production. Ecological economics classifies land, labor, and capital as intermediate production inputs and recognizes low-entropy energy and "natural capital" (including air, water, wood, minerals, fish, and wildlife) to be the primary factors of production (Cleveland 1991, Jansson et al. 1994). Compared to environmental economics, ecological economics views the market as far less sufficient for the equitable allocation and distribution of resources (Norgaard 1989). Most relevant to wildlife conservation, ecological economics theorizes that there are biophysical constraints to the scale of the economy and that testing these constraints threatens our ecosystem and, ultimately, the economy itself (Krishnan et al. 1995).

In addition to these theoretical distinctions, ecological economics comprises a broader interdisciplinary scope. While neoclassical economists have historically ignored the philosophical and technical contributions to economic theory offered by noneconomists, ecological economics welcomes the participation of diverse natural and social sciences. While neoclassical economics drives many scientists away with abstruse mathematics and esoteric jargon (van Meerhaeghe 1980), ecological economics intentionally connects with ecologists by using ecological terminology and concepts. In fact, ecological economics views economics as a subset of ecology and the economy as a subset of the ecosystem (Folke et al. 1994). Practitioners consider ecological economics to be the science and management of sustainability (Costanza 1991).

Ecological economics is an intellectual movement practiced largely by a 2,000-member International Society for Ecological Economics (ISEE), which was incorporated in 1989. The ISEE has members from 81 countries (International Society for Ecological Economics 1997). The Society publishes a monthly journal, *Ecological Economics*, and a quarterly *Ecological Economics Bulletin*. The goal of ISEE is to integrate and synthesize perspectives from a wide range of disciplines in order to achieve an ecologically and economically sustainable world.

Negative aspects of a steady state economy

The ambivalence of some wildlife professionals toward economic growth may result from the incidental, beneficial effects that economic growth has had for some species. For example, the construction of hydroelectric dams has created reservoirs that often support productive fish populations, and logging can improve habitat for elk and other species that benefit from edge effect and primary succession. Conversely, reservoirs and logging contribute to the endangerment of 161 and 109 federally listed species in the United States, respectively (Czech and Krausman 1997).

Any ecosystem modification short of annihilation will benefit some species and harm others. However, considering the principle of competitive exclusion and the vast breadth of the human niche, the human economy would seemingly have to grow at the expense of a vast array of other species (Figure 1). This phenomenon is indicated by studies of species endangerment (Chadwick 1995, Czech and Krausman 1997, Dobson et al. 1997, Foin et al. 1998, Wilcove et al. 1998) and by the integrated nature of modern human economies (Boulding 1993, Czech et al. in press), in which individual economic niches do not grow in isolation.

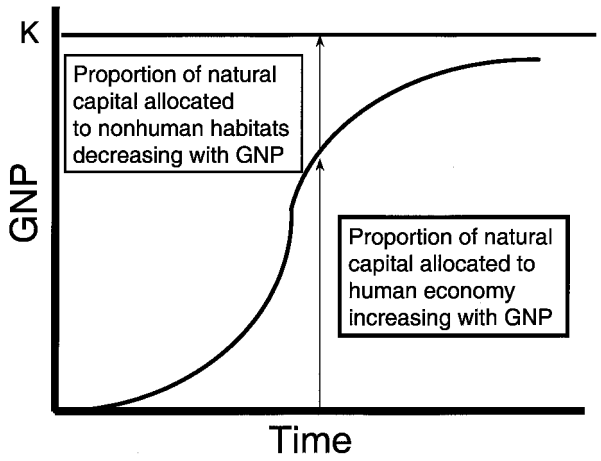

Figure 1. General relationship between human economic growth and nonhuman species conservation, given principles of competitive exclusion and niche breadth. K may be conceptualized as carrying capacity for human economy or as carrying capacity for species (including humans) in the aggregate. The latter concept would entail converting the Y-axis into a scale of the economy of nature (e.g., biomass).

Another concern is the effect of a steady state economy on conservation funding. Wildlife professionals in government agencies, especially the United States Fish and Wildlife Service, have perennially been faced with insufficient budgets (Clarke and McCool 1996). Therefore, funding from private sources has been welcomed. Land trusts, for example, are sometimes established in the private sector (Endicott 1993). Corporate landowners administer substantial wildlife management programs. Wealthy entrepreneurs are depended upon to purchase expensive big-game permits, with the proceeds going to state and tribal wildlife management programs (Czech 1995, International Association of Fish and Wildlife Agencies 1997, Czech and Tarango 1998). If the economy stopped growing, so would the profits for these types of private expenditures.

Yet to argue that economic growth is prerequisite to wildlife management funding and therefore wildlife conservation is to commit the "fighting fire fallacy" (Czech in press). This fallacy takes the form "Failure to perform A threatens B," when A constitutes the original threat to B. For example, one may assert that the cause of a disastrous fire is the failure to perform a backfire, i.e., the failure to "fight fire with fire." However, while one may stop a fire from consuming grass by using a backfire, backfires consume grass. Ultimately, if grass is to stop burning, fires must be kept from starting.

Likewise, one may assert that the cause of habitat-liquidating economic growth is the failure to purchase habitat, but if the funds for purchasing habitat come from habitat-liquidating economic growth, what has been gained? Physiocrats, classical economists, and ecological economists have compiled substantial theoretical and empirical evidence that all economic growth is based ultimately on the consumption of natural capital (Czech 2000). Consumption of natural capital amounts to the liquidation of wildlife habitats, so that private funding of habitat conservation seemingly entails the liquidation of habitat elsewhere.

This does not imply that privately funded habitat acquisition is bad for conservation, especially relative to other expenditures. It implies, however, that habitat will become unavailable for acquisition as habitat is liquidated to generate funding. The unlikely alternative is a perpetually growing economy on a perpetually diminishing productive land base, as habitat is acquired for conservation and thus taken practically out of economic production. If the latter alternative is not possible (as ecological economics asserts), then a steady state economy with a stable ratio of conserved habitat to economically productive land is a minimum requirement for wildlife conservation. In other words, negative conservation aspects of a steady state economy would be short-term; whatever long-term negative aspects may be associated with a steady state economy would pertain to something other than conservation.

Habitat liquidation is a prerequisite of economic growth, consistent with the principle of competitive exclusion. In the Florida Keys, mining, agriculture, and subdivision development are often found in close proximity. Photo by Brian Czech.

Perhaps the most problematic short-term conservation aspects of a steady state economy pertain to the psychology of conservation. For example, when wealth enables a corporation or individual to contribute to conservation programs, the wealthy entity gets involved in and informed about conservation issues. Even if the entity's wealth diminishes, the lessons learned and the intellect invested in conservation may continue to bear fruit for conservation socially and politically. In the transition to a steady state economy, a lesser number of entities are introduced to the conservation agenda via wealth. This apparent disadvantage is unclear, however, because wealth also enables corporations and individuals to contribute to activities that are detrimental to wildlife conservation.

Despite the complexity of ascertaining negative conservation effects of a steady state economy, one thing is clear: the conservation effects of a steady state economy would be a function of demography. Were a steady state economy established amidst a growing population, per-capita consumption and income would decline by definition. A greater proportion of resources would be allocated to basic human needs and less would be available for funding wildlife management. Were a steady state economy established amidst a stable population, assuming constant social and political priorities, the proportions of resources allocated to basic needs and wildlife programs would not change. Were a steady state economy established amidst a decreasing population, per-capita consumption and income would increase, as would the proportion of income available for wildlife conservation. This illustrates the primacy, but also the partiality, of the population parameter in determining economic scale, which also is a function of per-capita consumption.

In Austin, Texas, hotels tower over a bridge used by Mexican free-tailed bats (Tadarida brasiliensis), tourists, and entrepreneurs (above). Although urbanization and economic infrastructure occasionally provide habitat components, most species are displaced in toto, and some of the species benefited can scarcely be classified as "wildlife," as with the endangered Key deer (Odocoileus virginianus clavium; bottom). Photos by Brian Czech

Recommendations

No wildlife biologist can become an expert on all facets of ecology and management. However, there are some topics that all biologists should have a basic understanding of, and there are some issues that should unite TWS members whose collective goal is "to undertake an active role in preventing human-induced environmental degradation." With economic growth as the limiting factor for wildlife conservation, TWS members and all other biologists who subscribe to the goals of TWS should develop a basic understanding of economic growth and policy. Interaction with the International Society for Ecological Economics may be beneficial in this respect.

The position of The Wildlife Society (1992:4) on human population is that, "Burgeoning human populations continue to place an overwhelming and detrimental demand on many of the world's limited natural resources. Human degradation of terrestrial and aquatic communities is biologically inadvisable. Certain of these resources are irreplaceable, and others must be either preserved intact or managed carefully to ensure the integrity of the ecosystem and humanity. These resources will continue to decline or to sustain irreparable damage, despite scientific and technological advances, if the growth of the human population is not restrained." These statements are clearly true, but the mathematical abstraction of human population has no ecological impact of itself; it is the economic activities of the population that impact the ecosystem. As long as economic growth continues, whether via population or per-capita consumption, the ecological benefits of human population stabilization will remain evasive. It makes little sense to have a position statement on population growth without a complementary statement on economic growth.

A TWS position on economic growth should include the following principles: 1) as with the economy of nature, the human economy is constrained by biophysical limits; 2) history and theory demonstrate that economic growth proceeds at the expense of wildlife; 3) humans have the mental capacity to organize and limit their economic activity before reaching carrying capacity; 4) the closer to carrying capacity we get, the more wildlife populations will be lost, especially those of highly valued charismatic megafauna with large spatial requirements; 5) the closer to carrying capacity we get, the more wildlife species will be lost via the principle of competitive exclusion; 6) economic growth that too closely or too rapidly approaches carrying capacity may unleash unpredictable negative feedback processes that result in irreversible erosion of the earth's habitability for wildlife and humans; 7) a stationary scale of the human economy below carrying capacity is consistent with the goal of wildlife conservation and with the goal of economic sustainability; and 8) a steady state economy would not entail a reduction in standard of living, if accomplished in tandem with a stable population.

Care should be taken to place microeconomic case studies in their macroeconomic context. Much has been made of hunting revenues, hunting-related spending, and wildlife tourism, with little attention paid to how the money is generated or to what end much of it ultimately contributes (International Association of Fish and Wildlife Agencies 1997, Laughland and Caudill 1997). Research should help to determine at which level of consumption a hunting permit or program has a negative net effect on wildlife conservation. Other research in the service of wildlife conservation should increasingly focus on: 1) developing models of species endangerment that incorporate economic growth variables; 2) analyzing the veracity of claims to nonconsumptive economic sectors; 3) assessing the awareness of the general public, natural resources professionals, and other public officials about the problems posed by economic growth to wildlife conservation; and 4) ascertaining the effectiveness of public education methods pertaining to the wildlife conservation implications of economic growth. Theory development by wildlife scientists should focus on the contribution of ecological concepts, like carrying capacity, trophic levels, and competitive exclusion, to ecological economics models.

Finally, authors should be conscious of their selection of keywords and title phrases by which publications are referenced. If a policymaker directed staff to conduct a literature search on economic growth and conservation issues, the same paucity of literature would be encountered as I related in the introduction. This could result in the policymaker's claiming that conservation professionals had not identified economic growth as a problematic factor. For example, the preclusion of Smith's (1994) article in my literature search could have been prevented by the inclusion of "economic growth" in the title.

Conclusion

A plethora of evidence indicates that economic growth is the limiting factor for wildlife conservation, but it may take more discussion within the wildlife profession to develop the certitude required to take a position on economic growth. Once this certitude exists, the profession faces the issue of propriety. It may not be appropriate to enter into ethical debates pertaining to the allocation and distribution of resources. However, the wildlife profession clearly has a scientific and normative interest in the scale of the human economy. By taking a position on economic growth, TWS may set a productive example for professionals devoted to the conservation of other natural resources, resources upon which wildlife and humans depend.

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