Frumhoff, P. C., D. C. Goetze, and J. H. Hardner. 1998. Linking solutions to climate change and biodiversity loss through the Kyoto Protocol's Clean Development Mechanism. UCS Reports, Briefing Papers. Union of Concerned Scientists, Cambridge, Massachusetts, USA.
Kaimowitz, D., and A. Angelsen, 1998. Economic models of tropical deforestation: a review. Center for International Forestry Research, Bogor, Indonesia.
Luckert, M. K. 1999. Are community forests the key to sustainable forest management? Some economic considerations. Forestry Chronicle **75**:789–792.
Machlis, G. E., and J. E. Force. 1988. Community stability and timber-dependent communities. Rural Sociology **53**: 220–234.
Markopoulos, M. 1998. The impacts of certification on community forest enterprises: a case study of the Lomerio Community Forest Management Project, Bolivia. IIED Forestry and Land Use Series Number 13. International Institute for Environment and Development, London, UK.
McLain, R., and E. Jones. 1997. The importance of redefining "community" for sustainable natural resource management: the case of mushroom harvesting in the USA. IIED Sustainable Agriculture Gatekeeper Series Number 68. International Institute for Environment and Development, London, UK.
Ostrom, E. 1990. Governing the commons. Cambridge University Press, Cambridge, UK.
Peluso, N. L. 1994. Rich forests and poor people. Resource control and resistance in Java. University of California Press, Berkeley, California, USA.
Schmink, M. 1987. The "rationality" of tropical forest destruction. Pages 11–30 *in* J. C. Figueroa Colon, F. H. Wadsworth, and S. Branham, editors. Management of the forests of tropical America: prospects and technologies. Institute of Tropical Forestry, Southern Forest Experiment Station, USDA Forest Service, Rio Piedras, Puerto Rico.
Sithole, B., and B. Edziwa. 1998. Ignorance or ignorant extension? Zimbabwe Science News **32**:35–41.
Smith, A. 1994. Incentives in community forestry projects: a help or a hindrance? Rural Development Forestry Network Paper 17c. Overseas Development Institute, London, UK.
Southgate, D. 1998. Tropical forest conservation: an economic assessment of alternatives in Latin America. Oxford University Press, Oxford, UK.
Viana, V. M., J. Ervin, R. Z. Donovan, C. Elliot, and H. Gholz, editors. 1996. Certification of forest products: issues and perspectives. Island Press, Washington, D.C., USA.

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LAND CONVERSION AND THE PRODUCTION OF WEALTH

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Most townships and counties (in the United States) have adopted zoning ordinances whose principal purpose is to set rules for the orderly conversion of natural lands into developed properties.

—Randall Arendt (1996:xvii)

Ecologists have a passion for dispassionate objectivity. As biologists they strive to avoid the mysticism and teleology found in Plato's "vital forces," Lamarck's "innate drives" and "invisible fluids," Spencer's "Social Darwinism," or other early examples of bad science. It is therefore noteworthy that the ESA and a committee of its members (Dale et al. 2000) offer principles, guidelines, and prescriptive actions for managing the use of land derived from science itself rather than from human-derived norms informed by science (McShae 1991).

THE PERILS OF MAKING THE OBJECTIVE NORMATIVE

This effort seeks to evade the perils of making the objective normative in at least three ways. First, in describing principles for land use many objective terms are used in quasi-normative ways. These include nutrient pools, organic matter, previous ecological conditions, turbidity, functional species groups, abundance, habitat disturbance, biomass, matter and energy transfers, complex food webs, biodiversity, productivity, focal species, native species, and so on. To find normative use in these principles one has to assume these descriptive terms are somehow implicitly prescriptive. They seem to derive normative content from a presumed global or ideological intrinsic value for ecosystems, enmasse, as appreciated by ecologists. While readers may share this appreciation, it is useful to inquire about the source of this appreciation. The approach is scientifically comfortable and it does avoid getting bogged down in the philosophical quagmire of ecological teleology. It may also run the risk of being so prescriptively vague as to yield little operational guidance to land managers and planners. In fairness, this may in part be a result of attempting to devise a set of principles, guidelines, and actions for managing land use at a national level in a socio-political context in which land-use decisions operate largely at local

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levels. Following a popular dictum modified by R. T. T. Forman to think globally, plan regionally, and act locally, it may be worthwhile to consider further refining these recommended guidelines and actions so that they could apply more specifically at regional and local levels.

Another way this effort seeks to evade the perils of making the objective normative occurs in resting on an accurate but oversimplified representation of American land-use institutions. The form and relationships of these institutions are described with the implicit presumption that human land use is essentially an enterprise of free choice. All the normative obligations may be understood to rest with the interaction of owners and government, to be informed to a good path by science. If this is so, and science is largely free of normative content, then why bother offering ecological land-use principles? Prescriptive norms come from a sophisticated dialogue between values and facts, not an evasion of values. Beyond operating at smaller spatial extents, such as the regional extents suggested above, what qualities might a more satisfying characterization of land-use planning contain?

A useful, deeper understanding of land-use processes would be more objective and akin to ecology. Land-use decisions are processes by which agents who have power over places seek to optimize the distribution of costs and benefits in time, space, and among other agents to their own advantage (Plotkin 1987). Land agents are heavily constrained by history, trajectories of landscape patterns, by markets, by laws, by cultural attitudes, by technology, by politics, by personal perceptions and the inertia attendant to all of these. The measure of costs and benefits and thereby land-use choices is on the margin and subjective, but affected by complex systems of intersubjective accountability among agents across time and space. Ecological guidelines will find easier conceptual docking ports—and thus become more relevant to these choice-making processes—if they too operate on the margin and offer measures of value that compute inside those decision-making interactions. This is especially difficult because the adaptive evolutionary processes of land-use change and accountability have in recent history been constrained by different time and space scales than those of ecosystems.

The third way of evading the perils of normative science lies in proposing guidelines for land use that fail this test of relevance to land-use choices. The guidelines are good rules of thumb and reflect ecological ideas we believe every land agent should understand (Christensen 1996). But given current institutional structures, do they offer a better legal device for empowering ecological interests than having endangered species act as proxies for ecosystems? And, do they tell decision makers, on the margin, just how important or valuable it is to save this patch of habitat, prevent that nonnative specie from spreading over some few hectares, save this single habitat connection or large area, avoid the depletion of these few ecological resources, or just how effective some particular mitigation of ecological damage is (Rapport et al. 1998)?

Without such valuations, however incomplete, contingent, or uncertain, ecological values will most often lose to those for which markets, laws, local control, and culture provide measures in comparable currencies of value through systems of interaction and accountability. Ecological values will remain costs to be distributed widely in space, time, and among other people in exchange for more immediate and concentrated benefits to private landowners, nearby communities, or to the interests having strong influence upon land-conversion decisions. Providing the theoretical and empirical basis for such marginal evaluations of ecological worth may require considerable advances in accepted ecological science and philosophy (Rolston 1994). Meanwhile, an exploration of just what such evaluations would need to respond to might be helpful. One such concern is the relation between land conversion and the production of wealth.

Land Conversion and the Production of Wealth

Converting land from one cover type to another is a fundamental way to produce wealth in free-market economies. The quote from Arendt (1996) at the beginning of these comments speaks to some of the ways we institutionalize these wealth-producing cultural processes at local levels in the United States. To illustrate this wealth-producing effect, we offer here some representative per hectare dollar values (1999 U.S. dollars) from western Oregon's southern Willamette River Basin for various land cover types (Table 1). Comparable average values will likely vary in other regions of the country and can be obtained from local realtors, land developers, and the classified section of regional newspapers. While these figures can range within a given cover type due to variations in the qualities of land, homes, and commercial or industrial uses, they are indicative of rates of value change between cover types over the past decade in the southern Willamette Basin.

It should be stated clearly that there are significant costs incurred in accomplishing these land conversions. The provision of urban services and infrastructure is a source of many jobs, both directly and indirectly, in urban areas. However, the number of hectares undergoing such conversion nationally provides compelling evidence that there are sufficiently powerful incentives at work propelling people and institutions in the United States to absorb these costs. Profit is one such incentive. Figures from the ESA report tally 5.3×10^6 ha being converted in the United States from forest, cropland, pasture, and range uses into

TABLE 1. Comparison of valuation of land cover types in the southern Willamette River Basin (western Oregon, USA), illustrating the wealth-producing effects of converting land from one cover type to another.

Cover type	Value/ha (U.S. $)†	Multiplier‡
Dryland agriculture	~$5000	...
Irrigated agriculture	~$10 000	2×
Land prepared for homes (i.e. provided with sewer, water, power, roads, sidewalks, streetlights, fire hydrants, etc, but not yet homes	~$296 000	59×
Land with 10 single-family detached homes (fully serviced)	~$1 265 000	253×
Land with commercial uses (fully serviced)	~$1 551 000–2 761 000	310–552×
Land with industrial uses (fully serviced)	~$1 949 000–12 674 000	390–2535×

† In 1999 U.S. dollars, rounded to the nearest $1000.
‡ Compared to dryland (unirrigated) agriculture.

urban uses between 1982 and 1992. For discussion purposes, using assumptions of $5000/ha value before conversion and an area-weighted average based on typical metropolitan proportions in the Willamette River Basin of land in residential (56% of total urban area), commercial (16%) and industrial (8%) uses, with the balance being roads and vegetated open space, this places the average value of these converted lands, without subtracting the costs of making the improvements, at ~$590 000/ha. This value, times the number of hectares converted nationally between 1982 and 1992 equals $>\$3.1 \times 10^{12}$.

The institutional processes and procedures that have been erected at local levels to manage land conservation and development are fueled by this wealth. They are well developed and deeply ingrained. There is a strong and direct connection between this wealth and the quality of social services (schools, park and recreational facilities, libraries, police/fire protection, sewer and water treatment, transportation systems, etc.) provided in communities. This is the edifice in which, as stated previously, ecological values will remain costs to be distributed and externalized to others in exchange for more immediate, monetizable benefits. Ironically, in many urban areas it is precisely the wealth produced from land development that funds ecological-restoration efforts.

It is in this arena of wealth-motivated land-conversion decisions that we find ourselves, attempting to follow through on the ESA Committee's guideline to "... implement land use and management practices that are compatible with the natural potential of the area." When faced with the wealth-production possibilities indicated by the thumbnail sketch of converted-land values from the Willamette Basin, the challenge to ecological science and planning is to make an equally compelling case for the marginal value of foregoing the short-term gain to sustain the ecological processes, structures, and functions over the long term. The tools at hand for pragmatically combining ecological science and land-use planning are in early stages of refinement, but they are promising (Schoonenboom 1995, Steinitz et al. 1996, Nassauer 1997). These tools are neither pervasive nor deeply ingrained in our decision-making processes. Their application requires a careful attention to the ecological and institutional particularities of place. Their refinement and dissemination would benefit from a national program of coordinated regional/local test beds in which their merits could be compared and contrasted in more systematic ways. We conclude by considering the audiences for the ESA principles, guidelines, and actions at national, regional, and local levels.

ON USE AND AUDIENCE

If successful, the ESA white paper (Dale et al. 2000) will be a focus of discussion and debate. Its authors are to be commended for undertaking the task. As is reasonable for an organization such as ESA, the white paper is national in scope. At this national level, likely audiences are ESA's sibling organizations for allied professions: the American Planning Association, the American Institute of Architects, the American Society of Foresters, the American Society of Landscape Architects, the Urban Land Institute, and comparable organizations of agronomists, realtors, land developers, and others. There are also the land-management agencies with national purview and non-governmental land-conservation organizations with national agendas and many others which we do not list.

At regional levels, the audiences are less obvious. It may be that those regional organizations and planning authorities that do exist operate at the most appropriate spatial extent for adaptive planning and coordinating local actions. Johnson et al. (1999), in their text *Bioregional Assessments,* review a series of regional case studies in North America. These offer examples of different institutional docking ports for the recommendations made by ecological assessments at regional scales. Johnson and Herring argue that the case studies to date have largely been assessments of the past, and that what is needed are anticipatory assessments, which look forward in time and explore the ecological implications of plausible future land-use and management possibilities. Such approaches offer the ability to see, side by side, the comparative advantages and disadvantages of various, specific land-use options. It may require the use of multiple currencies to conduct such

comparisons (e.g., terrestrial biodiversity, aquatic biodiversity, water consumption rates, land area consumed by urbanization, etc.) but if the same set of currencies is used to compare across land-use alternatives, then progress may be made towards bringing a wider array of valuations to bear in making land-use decisions. This would be particularly relevant to decisions regarding transportation and water-supply systems that transcend local extents.

At the most local levels, the influence of wealth produced from land conversion in the short term presents a formidable challenge to increasing the influence of the ESA principles, guidelines, and actions. To gain traction at this level, the ESA recommendations should become more particular to specific places. This should be done and we must thank the ESA Committee for a helpful first step.

LITERATURE CITED

Arendt, R. G. 1996. Conservation design for subdivisions. Island Press, Washington D.C., USA.

Christensen, N. L. 1996. Science and the sustainable use of land. Pages 273–293 *in* H. L. Diamond and P. F. Noonan, editors. Land use in America. Island Press, Washington D.C., USA.

Dale, V. H., S. Brown, K. A. Haeuber, N. T. Hobbs, N. Huntly, R. J. Naiman, W. E. Riebsame, M. G. Turner, and R. J. Valone. 2000. Ecological principles and guidelines for managing the use of land: an ESA report. Ecological Applications **10**:639–670.

Johnson, K. N., and M. Herring. 1999. Understanding bioregional assessments. Pages 352–355 *in* K. N. Johnson, F. Swanson, M. Herring, and S. Greene, editors. Bioregional assessments: science at the crossroads of management and policy. Island Press, Washington, D.C., USA.

McShea, D. 1991. Complexity and evolution: what everybody knows. Biology and Philosophy **6**:303–324.

Nassauer, J. I. 1997. Cultural sustainability: aligning aesthetics and ecology. Pages 65–83 *in* J. Nassauer, editor. Placing nature: culture and landscape ecology. Island Press, Washington D.C., USA.

Plotkin, S. 1987. Keep out: the struggle for land use control. University of California Press, Berkeley, California, USA.

Rapport, D. J., C. Gaudet, J. R. Karr, J. S. Baron, C. Bolen, W. Jackson, B. Jones, R. J. Naiman, B. Norton, and M. M. Pollock. 1998. Evaluating landscape health: integrating societal goals and biophysical process. Journal of Environmental Management **53**:1–15.

Rolston, H. III. 1994. Conserving natural value. Columbia University Press, New York, New York, USA.

Schoonenboom, I. J. 1995. Overview and state of the art of scenario studies for the rural environment. Pages 15–24 *in* J. F. Th. Schoute, P. A. Finke, F. R. Veenenklaas, and H. P. Wolfert, editors. Scenario studies for the rural environment, selected and edited proceedings of the symposium Scenario Studies for the Rural Environment, Wageningen, The Netherlands, 12–15 September 1994. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Steinitz, C., M. Binford, P. Cote, T. Edwards, Jr., S. Ervin, R. T. T. Forman, C. Johnson, R. Kiester, D. Mouat, D. Olson, A. Shearer, R. Toth, and R. Wills. 1996. Biodiversity and landscape planning: alternative futures for the region of Camp Pendleton, California. Harvard Graduate School of Design, Cambridge, Massachusetts. USA. ⟨http://www.gsd.harvard.edu/brd/brc.html⟩.

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A FEDERAL SCIENCE PERSPECTIVE ON LAND USE

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Gertrude Stein once said "anybody is as their land and air is." The people of the United States have a very deep connection with their land as individuals and as a society. That intimate relationship makes it both very important and very difficult to establish scientific principles that will help inform land use and management decisions. Land-use issues provide one of the major arenas in which ecosystem concerns often clash with human wants and desires. I applaud ESA for this contribution (Dale et al. 2000) and hope that it will encourage more Society members and other scientists to rise to the challenge of assisting individuals, communities, and policy makers in dealing with land-use issues.

At the turn of the last century, more than a hundred years into the Industrial Revolution, the global population stood at only about 1.6 billion (1.6×10^9) people. In 1999, we reached a new population milestone. Six billion of us are now sharing the planet, with the last billion added in only 12 yr. While global population has more than tripled over the last century, human expectations have also risen constantly. As a result, consumption of natural resources by the industrialized world has also risen to heights undreamed of even a few decades ago, with attendant changes to the biosphere. In just a geological instant in time, the world has gone from being "wild" to one in which humans

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