Destinatarios

* Profesionales que desempeñan tareas de investigación, conservación, capacitación o desarrollo en alguno de los temas de taller, en organizaciones del Estado o en empresas privadas.

* Jóvenes investigadores y profesionales, así como estudiantes avanzados, que se están iniciando en tareas de ese tipo, con vistas al desarrollo de una especialización en la materia.

Requisitos para participar en las Jornadas

* Realizar una pre-inscripción, preferentemente por correo electrónico, enviando nombre, institución, dirección electrónica y teléfono o fax, e indicando el tipo de actividad en desarrollo relacionada con los temas abordados en las jornadas.

* Abonar una inscripción de $50 (no es necesario envío anticipado).

Exposición de libros y trabajos

Durante las jornadas funcionará una exposición de trabajos en forma de posters y de libros aportados por CYTED y por los organismos participantes.

Lugar del evento

Microcine de la Universidad Nacional de San Luis - Rectorado
Ejército de los Andes 950. San Luis, Argentina

Información e inscripciones

Ing. Elba Gabutti. egabutti@fices.unsl.edu.ar
Tel: 02657-430947 int 135
Dr. Néstor O. Maceira,
nmaceira@sanluis.inta.gov.ar
Tel 02657-42261/423249/433250
Ing. Agr. Hugo Bruno Molinero.
asanluic@inta.gov.ar
Tel 02652-422535

Comisión Organizadora

Gonzalo Halffter (Coordinador Internacional - CYTED)
Néstor Maceira (Coordinador Nacional - EEA San Luis, INTA)
Elba Gabutti (FICES, UNSL)
José Giulietti (EEA San Luis, INTA)
Hugo B. Molinero (AER San Luis, INTA)
Coordinadores temáticos:
J. Simnonetti (Univ. de Chile), O.T. Solbrig (Univ. de Harvard), T. Schlichter y N. Maceira (INTA)

MultiGráfica MG

Segundas Jornadas Iberoamericanas sobre Diversidad Biológica

San Luis, 7 al 11 de junio de 1999

Por un desarrollo rural que valore y conserve la diversidad de la vida

ORGANIZAN

CYTED
PROGRAMA IBEROAMERICANO DE CIENCIA Y TECNOLOGÍA PARA EL DESARROLLO
SUBPROGRAMA XII
DIVERSIDAD BIOLÓGICA

INTA
Macroregión Gran Cuyo

Secretaría de Agricultura, Ganadería, Pesca y Alimentación

Universidad Nacional de San Luis

AUSPICIAN

Secretaría de Recursos Naturales y Desarrollo Sustentable

Biodiversity: the natural patrimony being lost [1]

Geraldo Stachetti Rodrigues [2]
Embrapa Meio Ambiente

The negative impacts of development activities on biodiversity originate from common market demands, while the consequences of these impacts result in ecological and environmental costs of difficult measurement:

How much is a species worth?
How to valuate biodiversity?

"Biological diversity is simply the end result of four billion years of evolution" (Barbier et al. 1994). Thus, applying a simple market approach to value biodiversity represents a reductionist view of its ecological worth. In truth, biodiversity is the unfolding result of an evolutionary process occurred at a time scale of magnitude manyfold that of civilization, and through natural mechanisms impossible to recreate by technological means, that is, it is irreplaceable. Hence, a more appropriate way to calculate the value of biodiversity (as well as other categories of natural resources) should consider the incident energy required along the period of its formation or evolution. Such an approach would account for a restoration value, in terms of the ecological investment involved in its primordial formation, notwithstanding comparisons with manufactured goods of a totally diverse nature (Maceira et al. 1996, Odum 1994).

The energetic valuation takes into account contributions from nature usually disregarded by the economic system. Solar energy (expressed in *joules - sej*) is the basic unit for all sources, stocks and flows in the system. In order to account for energy contributions in economic terms (macroeconomic monetary value – *EM$*), one applies the relationship between national total energy expenditure and the gross domestic product (GDP) of the economy (Odum 1996).

Presuppose that all energy metabolized by organisms is channeled, one way or another, toward reproduction. Consider that the spawning of new species is an autocatalytic reaction (even if an imperfect one, once it is subject to mutation) mediated by positive feedback coupled with the building up of available niches. Consider also that the energy propelling this process is the total solar energy incident on earth (9.44E24 sej/year) (Odum 1994) and that evolution of higher organisms has been proceeding for 600 million years (since the beginning of the Paleozoic Eon). Assume that the outcome of this long process is an estimated pool of 5 million species (Wilson 1992). Convert energy inputs to monetary values by the equivalency offered by Odum (1994), as 1.5E12 sej/EM$.

Deriving from these stated assumptions, one species would represent:

Incident energy: 9.44E24 sej/yr
Span: 6.0E8 years
Diversity: 5.0E6 species

---

[1] Some concepts presented in this contribution were part of a conference by the author at the "Seminário Nacional Conservação da Biodiversidade em Ecossistemas Tropicais: Avanços Conceituais e Revisão de Metodologias de Avaliação e Monitoramento." Rio de Janeiro, 24 e 25/7/96.

[2] Embrapa Meio Ambiente, CP 069, Jaguariúna, SP. CEP 13820-000. E-mail: stacheti@cnpma.embrapa.br

Macroeconomic value of energy: 1.5E12 sej/EM$

Total energy input (equivalent to embodied energy into present biodiversity)
9.44E24 sej/yr * 6.0E8 yrs = **5.66E33 sej**
Total energy embodied per species
5.66E33 sej / 5.0E6 species = **1.13E27 sej/species**
Energetic monetary value per species
1/1.5E12 sej/EM$ * 1.13E27 sej/species = **7.53E14 EM$/species**
Energetic monetary value for present biodiversity
7.53E14 EM$/species * 5.0E6 species = **3.76E21 EM$**

The energetic monetary value embodied into biodiversity (3.76E21 EM$) can be compared, for instance, with values calculated by Odum of EM$ 6.3E14 for all world's infrastructure (bridges, roads, cities, etc.), or EM$ 6.3E16 for all cultural and technological information – which replacement times would be 100 and 4,000 years, respectively, against 600 million years for biodiversity, assumed our conservative estimates.

Several objections could be raised regarding the assumptions of this exercise. For instance, not all energy incident on earth is strait forwardly utilized by living beings, hence, the excess should be discounted. On the other hand, one may object that a large proportion of species spawn from organic evolution became extinct throughout the eons, and this amount should also be discounted. Counter arguments to such reasoning must imply that even if not fully absorbed by the biosphere, the incident energy causes the climatic patterns, biogeochemical cycles, and natural catastrophes and extremes of environmental change. Obviously, all these phenomena constitute the very ecological factors determining the pace and direction of evolution. By the same token, the past existence of presently extinct species influenced directly the rhythm of evolutionary change. In other words, it may be assumed, for example, that were not for the influence of the last glacial period, which certainly entailed massive extinction, men could be still securing sustenance from the gathering of food and rudimentary hunting, and dwelling in the twilight of caves...

Far from offering an estimate of the monetary value to be paid for biodiversity, or the market bill to be charged for the extinction of species, the present exercise offers a basis for comparison of the intrinsic worth of biodiversity, in ecological terms. Despite the valid contention that the estimated values would represent a marketplace absurd, the analysis evidence how little an utilitarian worldview values the irreplaceable goods of nature, whose function present science still in great extent ignores, and whose conservation the collective behavior insists in derogating.

Genetic patrimony and ecological worth – conservation ethics

The energetic valuation evidences a high intrinsic ecological worth of biodiversity. However, two seminal questions remain:

What is it that is really lost when species, populations, and ecosystems become extinct?
How is the distribution of value in the natural patrimony of biodiversity?

Depreciation of biodiversity implies several consequences:
1. Terminal disappearance of species, notably those rare,

2. Loss of the services rendered by ecosystem's functioning, such as water and air depuration, soil genesis and protection, climatic balance, cycling of matter and regulation of energetic flows, scientific and educational information, cultural and artistic inspiration, among many others (Barbier et al. 1994, Myers 1996), and
3. Species and strains of immediate economic interest (Smith and Schultes 1990).

The value assigned to species pertaining to each of these three categories may vary according to a function of their abundance.

Individuals component of rare or dwindling species would have a high value, due to the impossibility of replacement or recovery, after a certain (though unknown) inferior limit of abundance is reached; in other words, these few individuals would be repository of the whole species' genetic pool, and the safeguard against extinction.

In the case of relatively abundant species, whose existence is not threatened, such as the majority of those non-domestic species occurring naturally in agricultural fields, the individuals could be fundamentally considered as the repositories of the ecological role of the species for the balanced functioning and the resilience of the ecosystem they live in. The worth of each individual should reflect a fraction of the value of the total service rendered by the species to the ecosystem.

Finally, individuals of very abundant species (domestic ones included) would possess a value equivalent to the energy embodied during their life span, as defined by the marketplace (Figure 1).

It becomes clear that the expansion of agriculture and other development activities usually takes place by the numerical spread of species possessing small relative value over environments composed by species having a very high intrinsic value.

Consideration of this approach could bring about a different ethics for the conservation and exploitation of genetic resources and biological diversity. There is a need, however, for defining the equation that expresses the appropriate distribution of categories, the shape of the curve. What is the population level that determines the status of a species? Would it be possible to raise awareness on decision makers and the general public about the intrinsic value of plants, animals, and microbes inhabiting remote areas, away from immediate economic interests?

Let the debate continue.

The author is indebted to Dr. Nestor Maceira (INTA-San Luis), Dr. Gustavo Porini (Dirección de Fauna y Flora Silvestre), and Dr. Carlos Alberto Ferrando (INTA-La Rioja) for the provoking discussions that originated some of the ideas presented in this text. Acknowledgement should be addressed also to Dra. Maria Helena Zaccagnini (INTA-Entre Rios) and Dra. Vilma G. Carande (Colorado State University) for organizing the course "Economia Ecologica-el Manejo de la Sustentabilidad"- (Fundación ArgenINTA) where these discussions took place.

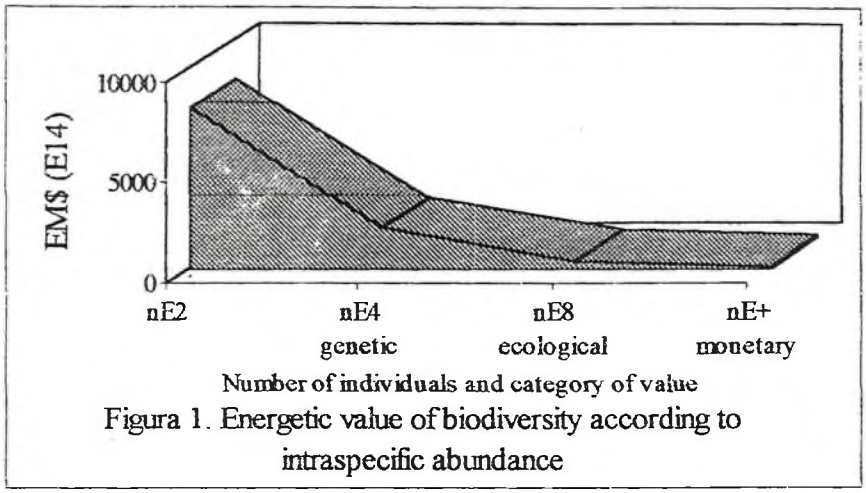

Figura 1. Energetic value of biodiversity according to intraspecific abundance

Bibliography

Barbier, E. B., J. C. Burgess, and C. Folke. 1994. *Paradise Lost? The Ecological Economics of Biodiversity*. Earthscan Publications Ltd., London.

Maceira, N., G. S. Rodrigues, G. Porini, and C. Ferrando. 1996. Valoración económica de la biodiversidad. Pages 14. Fundación ArgenINTA, Curso Economia Ecologica - El Manejo para la Sustentabilidad.

Myers, N. 1996. Environmental services of biodiversity. *Proc. Natl. Acad. Sci. USA* 93: 2764-2769.

Odum, H. T. 1994. The eMergy of natural capital. Pages 200-214 in A. Jansson, M. Hammer, C. Folke, and R. Costanza, eds. *Investing in Natural Capital: The Ecological Economics Approach to Sustainability*. Island Press, Washington, D.C.

Odum, H. T. 1996. *Environmental Accounting: Emergy and Environmental Decision Making*. John Wiley & Sons, Inc., New York.

Smith, N. J. H., and R. E. Schultes. 1990. Deforestation and shrinking crop gene-pools in Amazonia. *Environ. Conserv.* 17: 227-234.

Wilson, E. O. 1992. *The Diversity of Life*. Penguin Press, London.