Economic Value of Nature

Of what economic value is nature

one of the main flaws of a market based economy is that the prices and cost estimates rarely reflect the full costs of environmental damage and losses to sustainable uses

difference between **direct costs** and **externalities**

In past natural areas and biodiversity were given no commercial value
→ only the potential profits were part of the equation

tended to favor nonsustainable uses:
fisheries → overfishing
mining → damage to land and waters
timber → loss of forests
agriculture → loss of praries and soil
low raw land values → little value unless developed

and increased pollution
eg. salinization
eg. siltation

need to develop ways to estimate some of these external costs:
the value of lost productivity
costs of cleanup of a damaged ecosystem
increases in disease, homelessness, etc

Can make a strong argument that economics are one of the strongest reasons to preserve nature:

I. Direct Economic Values
A. Timber
B. Nontimber raw materials
C. Industrial Chemicals & Products
D. Medicines and Pharmaceuticals

II. Future economic Potential
A. Future Commercial Products
B. Gene Banks for agruculture and livestock

III. Tourism

IV. Nature's Services

A. Habitat and refuge for diversity & nursery areas for commercially important species

B. Water Supply and Flood Control

C. Waste & Nutrient recycling, water purification & Pollution Control

D. Early Warning System

E. Climate Regulation

F. Pollination and Agriculture

G. Biological Pest Control

V. Social Values and Human Costs of Nonsustainable Uses

VI. Aesthetic, Cultural, Moral and Ethical Values

I. Direct Economic Values

A. Timber

lumber, plywood, veneer, particleboard

total world wood consumption ~ 3.7 B tonnes/yr (3.7 B m^3/yr)

exceeds use of steel and plastic combined

international trade in timber, pulp and paper = $114 B/yr

90% of legal and recorded trade is from temperate and boreal forests

→ soon half of this will be for paper alone

most of paper produced worldwide is made from virgin logs

only ~1/3rd comes from recycled wastepaper

developing countries produce most wood but use only ~20% themselves

timber, paper and pulp comprises ~ half of consumption
~1.66 B tons/yr

timber could be harvested sustainably but today only ~0.1% is logged this way

~ half of wood cut worldwide is used for fuelwood and charcoal

→ mostly in developing countries

Amazon will be world's top timber source in coming decades

Africa will be second

→ European companies have tended to dominate here

Asian Companies have bought 8.6 M acres in Brazil (96 AAS)

in next 2 years will be 22.2 M or 15% of harvestable forest

most amazon loggers favor this

→ they are competing to sell land and sawmills to Asians

regional demand for lumber has sagged and Asians represent money and jobs

July 96: Brazil's president, Cardoso, decreed

2 yr suspension for new logging concessions for mahogany and other rare hardwoods

he also said current concessions will be revoked for any companies not practicing sustainable logging

Firewood

>1/2 people in world depend on firewood or charcoal as main source of heating and cooking fuel

~1.5 B people can no longer find enough ave = ~1m^3/person/yr

B. Nontimber raw materials

eg. food, fiber, fuels, fertilizers, art objects, etc

providing these services requires healthy ecosystems

eg rattan trade (Asia)

$2.7 Bil/yr

in Thailand value of Rattan exports is 80% of legal timber exports

eg. market for 4 "obscure" plants in Oregon forests

beargrass, huckleberries, solal and sword fern

= $72 Mil/yr

in some areas value of nontimber products may exceed timber value of same area

1989 study (Peters, Gentry, Mendelsohn, Nature June 29,1989) estimate:

that the net value of sustainable collection and sale of fruits, oils, rubber, and medicines from Amazonian rain forest would generate over $6330/ha/yr

vs cutting a rain forest for timber yields $1000/ha for one time use or $490/ha/yr from selective cutting

or tree plantation on a hectare of cleared forest is worth $3184/yr

or pastureland on one ha of cleared forst is worth $2960/yr

C. Industrial Chemicals & Products

many important compounds come from or were 1st discovered in wild organisms

eg. rubber tree, antibiotics, aspirin, dyes, foods and spices, paper & clothing, etc

if forests and their inhabitants are used sustainabily it could be a continuing source of these and as yet unknown commercial products

D. Medicines and Pharmaceuticals

US → 25% of all prescriptions and 60% of non prescription drugs contained active cmpds extraced from natural products (1996)

global pharmaceutical industry = $200B/yr
→ global forest derived drugs ~$40-100 B/yr

eg. digitalis → heart
quinine → malaria
antibiotics → fungi
aspirin → pain relief
taxol → anticancer

of 76 pharmaceutical products derived from plants only 6 can be artificially synthesized at commercial levels

in some cases, collecting medicinal plants provides significant income to indigenous peoples

eg. Belize- gathering medicinal plants yields 2-10 x's the annual income of slash/burn farmers

not just plants, all kinds of organisms

eg. microorganisms (bacteria and fungi)
→ produce over 3000 antibiotics

eg. snakes → antivenoms, anticoagulants
amphibians → neurochemicals
corals → antiviral cmpds
sponges → antitumor cmpds
seaslugs → painkillers

II. Future economic Potential

A. Future Commercial Products

only ~1% of rainforest species have been examined for their potential uses

only ~5% of all plant species worldwide have been screened for pharmacological substances

eg. of 275 species found in 1 ha of rainforest
→ 72 species yielded products that could be exploited for direct economic gain

eg. of 842 individual trees
→ 350 yielded products with direct economic value

these investigations are long and extremely expensive:

eg. from 1960-1981 American Institute for Cancer Research investigated ~30,000 different plants that contained ~ 114,000 potential anticancer agents

→ only 5 substances were selected for clinical trials

→ only 1, taxol was approved for medical use

"potential" commercial products were not recognized as valuable until recently

eg. rubber tree's uses were completely unknown 150 yrs ago

est loss of potential pharmacological value from plants

that have already become extinct
= $12 B in US alone

the more rare species that grow under unusual conditions are often the ones most important and most likely to be destroyed

B. Gene banks for agriculture and livestock

foundation for all agricultural plants and animals

all modern crop varieties were originally produced using native plants

traits were selected over 100's or 1000's of years

most crops in US are domesticated species from tropics

1. inbred species require gene infusions

maintaining wild varieties of crop plants allows us to select for new traits or revitalize aging genetic stock

2. may want to look for new genes in same species that might be useful

eg. 1.5 M acres of California farmland is threatened by salinization

→ trying to find salt tolerant strains of plants that can grow there

eg. 1970 So Corn leaf blight
1st in Fla → wiped out $1 B corn
all US corn was based on 6 inbred lines
now have a resistant strain to this disease

3. also, many countries have "Germ Plasm Repositories" for domestic crops.

but some seeds, esp larger seeds, lose viability after a few years.

seeds are planted and new seeds are collected

may need to collect new wild seeds to augment diminishing seed stores

est value of "gene banks" (crop ancestors) =$66 B

III. Tourism

mainly "ecotourism"

observations and appreciation of wildlife and natural areas

tourism has become the largest sector of world economy

→ transforms wilderness into prosperity

US protects ~ 3% of all US land; >76M acres in alaska alone

→roads, timbering, motor vehicles etc are all prohibited

these areas are strictly controlled and are open to hiking, camping, canoeing

Parks

→ more intensive use; less fragile areas

US Natl Park Service was established >100 yrs ago

with estab of yellowstone

established "to preserve natural areas of public lands considered unique because of scenergy, history, wildlife, etc"

parks preserve another 76M acres in US

>100 countries have adopted our system of parks as a model

parks are intensively used

unfortunately while visitation has increased, maintenance budgets have been reduced

→ lead to commercialization of parks with increased vandalism, crime and crowds

tourism dollars are valuable commodities

→ now it pays to maintain rainforests

eg. Kenya

→ tourism is the largest single source of income for the country

eg. 1 ha of land in Kenyas Amboseli(?) Natl Pk brings in $40/yr; a similar area used for agriculture brings in $1/yr

eg. Companies hiring in Oregon have found that potential employees are willing to take less pay (?$500/month)

→ combined total is = to all states lumber and wood products payrolls

eg. panda reserve in China could take in $40 M/yr

Zimbabwe, the campfire project, l986, privatized wildlife

→ costs tourists/hunters $15,000 to kill a leopard

→ $25,000 to kill a rhino
ave profit if cattle were produced in reserve = 2.5%
ave profit for raising wildlife produced = 8%
very strict quotas
not saving the individual, trying to save the species
→ sustainable use
but animal rights folks go nuts

IV. Nature's Services:

A. Habitat and refuge for diversity & commercially important species

a fundamental service provided by nature is ensuring that ecosystems are relatively **stable** and **resilient**
= the ability to withstand disturbance and bounce back

as ecosystems are affected by human activities they become simplified

and become more brittle and more vulnerable to decline

some species act as "keystone species"
→ their destruction would likely permanently alter the ecosystem in which they are found

estuaries are thin fragile zone along coastlines where freshwater streams and rivers mix with salty ocean waters

these areas offer food and shelter for wading birds and water fowl

coastal and inland wetlands also support commercial fisheries:

→70% of US commercial fish species use coastal wetlands as part of spawning and nursery areas

→95% of fisheries in Gulf of Mexico

in 1991, US fish valued at $3.3 B were caught

fish processing and sales industry generates 10 x's that amount

yet >40% of these areas in US have been damaged or destroyed
→ >300,000 acres/yr

wetlands have been converted to intensive aquaculture
in several countries:
eg. Phillipines: 78% of coastal wetlands
eg. Ecuador 70% of coastal wetlands

→ can bring $11,600/ha/yr for ~ 5-10 yrs

using natural mangroves for fish, game, fuel, wood, medicines etc could bring $1000-10,000/yr indefinitely

B. water supply and flood control

eg. if ~1/2 of Mississippi Basins lost wetlands were restored in strategic locations (3% of land total needed)

→ could control flood of 1993 magnitude that caused $12-16 B damage

C. Waste recycling, water purification, & pollution control

plants, bacteria, fungi can remove toxins from air, water and soil:

eg. CO2 and SO2 are removed by vegetation
eg. CO is removed by soil microorganisms
eg. Nox is removed by fungi and bacteria

eg would cost $100,000/yr to duplicate water purification and fish propagation value of 1 acre of wetland

worms, insects and microorganisms create and aerate soil and recycle nutrients

current agricultural and forestry practices destroy soil

erosion protection ~ $200/ha

water purification and storage is a major part of the water cycle

estimates for value of water recharge and storage services near large cities = $40,000/ha

for each 1% increase in wetlands, downstream flooding
decreases 3% -4%

total losses due to unsustainable wetland and soil

practices:
US = $44 B/yr
World = $400 B/yr

D. early warning system

some organisms are good indicators of degradation

eg. Bald Eagle
eg. Peregrine Falcon
eg. lichens
eg. stream insects

E. climate regulation

destruction of forests → decomposition and burning releases CO2 into the air

eg. 1 ha of "carbon storage" function of forests ~ $3000 value

F. pollination and agriculture

w/o plants cannot produce seeds

>90% of worlds flowering plants are animal pollinated

and 80% of worlds 1330 cultivated crop species are animal pollinated

1/3rd of US agricultural crops is insect pollinated

eg pollination US valued at $6.7 B/yr(2006)

120,000-200,000 animal species are known pollinators

also, >1000 species of birds and mammals

honeybee pollination services are 60-100 x's more valuable than the honey they produce

in US >1/2 honeybee colonies have been lost in the last 50 yrs (25% in last 5 yrs alone)

threates:
habitat fragmentation
loss of nesting and overwintering sites
intense wxposure to pesticides and herbicides
bioinvasions (eg Killer bees)

G. biological pest control

pesticides used in agriculture kill both pests and beneficial animals as well
→ becomes a vicious cycle of needing more and more pesticides

loss of these beneficial insects has led to a rise in vector-borne diseases

many wild populations are beneficial in less direct ways:

eg. Bat colonies in Texas can eat 250 tons of insects each night

eg. Bangladesh
exported frog legs in 70's and 80's
led to steep decline in frog population
increase in outbreaks of pests and disease
25% increase in pesticide imports
by 1989, Bangladesh was spending 3 x's as much each year on pesticides (430M) as it was earning from exporting frog legs

within 1 yr of banning exports frog population increased dramatically
pesticide imports dropped 30-40%

V. Social Values
and Human Costs of Nonsustainable Uses

eg. as rainforests are cleared the indigenous peoples usually suffer

greater chances of droughts or floods
new agricultural pests
loss of topsoil
sedimentation of streams and rivers
diminished yields from their crops
fewer fish in streams
shrinkng supplies of game, fruits, nuts

rising: alcoholism
drug abuse
domestic violence
homelessness
emigration

VI. Aesthetic, Cultural, Moral and Ethical Values

eliminating a few species won't cause ecosystem collapse

probably won't irreversibly affect human progress

but

Do we have the right to "play god"
not only with individual lives
but with whole species and ecosystems

we don't have "divine permission" to kill them

Do species have a moral right to exist independently of our need for them

→ we must be global stewards

"If I decide to accept your offer to buy our land, I will make one condition. The white man must treat the beasts of this land as his brothers. I am a savage and do not understand any other way. I have seen a thousand rotting buffaloes on the praries left by the white man who shot them from a passing train. What is man without the beasts? If all the beasts were gone, men would die from great loneliness of spirit, for whatever happens to the beasts also happens to the man. All things are connected. Whatever befalls the earth, befalls the sons of the earth."

- Chief Seattle

also biological diversity adds to our quality of life

eg. landscape beauty: birds, flowers, wildlife, etc

some animals and plants have cultural significance

others we may never "see" in nature, but its nice to know they are there

eg narwhales, rainforests, etc

"Human intelligence is bound to the presence of animals…they further, throughout our lives a refining and maturing knowledge of personal and human being"

-Paul Shepard
'Thinking Animals'