

# Investing in or wreaking further destruction upon nature? Valuation of Ecosystem Services From an Earth Jurisprudence Perspective

“There is something fundamentally wrong with treating the earth as if it were a business in liquidation.” ~Herman Daly

“For if one link in nature's chain might be lost, another might be lost, until the whole of things will vanish by piecemeal.” ~ Thomas Jefferson

Without the services and processes of nature's ecosystems, human beings would cease to exist. Nonetheless, human beings as a species continue to act in ways wholly contrary to this truth. At the hand of man, virtually all of the Earth's ecosystems have been dramatically transformed, with vast losses of biodiversity attributable to “habitat loss, invasive species, pollution, population growth, and over-exploitation of species for consumption.”<sup>1</sup>

Ecosystem services are the direct and indirect benefits that people obtain from ecological systems.<sup>2</sup> They are the, “conditions and processes through which natural ecosystems, and the species that are part of them, help sustain and fulfill human life.”<sup>3</sup> Well put by J.B. Ruhl and James Salzman, ecosystem services, which include air and water purification, detoxification and decomposition of waste, climate regulation, drought and flood mitigation, and pest control, to name a few, “Quite literally underpins human society.”<sup>4</sup> Ecosystem services are valuable in ways which may be of immense value but may not be readily apparent.<sup>5</sup>

Human activity has disrupted ecosystem services through the destruction of natural habitats, , pollution the land, air, and water, soil erosion, and harmful agricultural practices.<sup>6</sup>

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<sup>1</sup> Banking on Biodiversity, Ricardo Bayon, The WorldWatch Institute, State of the World 2008: Innovations for a Sustainable Economy, at p. 125, citing to the Millennium Ecosystem Assessment.

<sup>2</sup> Ecosystem Services: Benefits Supplied to Human Societies by Natural Ecosystems. Issues in Ecology, Number 2, Spring 1997. Available at [www.esa.org/science\\_resources/issues/FileEnglish/issue2.pdf](http://www.esa.org/science_resources/issues/FileEnglish/issue2.pdf). Last visited on April 29, 2009.

<sup>3</sup> Id.

<sup>4</sup> J.B. Ruhl and James Salzman, The Law and Policy Beginnings of Ecosystem Services. 22 Journal of Land Use and Environmental Law 157 (2007).

<sup>5</sup> *Supra* footnote 16.

<sup>6</sup> Ecology Society of America, Ecosystem Services Factsheet, available at [www.esa.org/ecoservices/comm/body.comm.fact.ecos.html](http://www.esa.org/ecoservices/comm/body.comm.fact.ecos.html). Last visited on April 28, 2009.

In the United States alone, 55 percent of all grasslands, savannas, and barren communities and 17 percent of all forests were found to be critically endangered, meaning they had deteriorated by 98 percent.<sup>7</sup> With natural resources being continuously depleted, reports indicate a decline in populations of vertebrate species of nearly one-third from 1970 to 2003. The ecological footprint of human beings has become so large that the Earth is no longer able to regenerate on a parallel playing scale.<sup>8</sup> Throughout the 20th century, the global human population quadrupled from approximately 1.5 billion in 1900 to roughly six billion as of the year 2000, whereby the consumption of natural resources increased sixteen-fold.<sup>9</sup>

In light of the present environmental crisis, we are faced with a dilemma: The valuation of ecosystem services is viewed increasingly as one possible remedy to reduce the devastation upon nature; a remedy that has both its pros as well as its cons. Valuation of ecosystem services drives us further into an economic model, contrary to ensuring the genuine recognition of the inherent rights of the natural world. Valuation fosters the commoditization of nature as a resource for human consumption. The valuation system likely undermines the protection of nature and the Earth community.

However, this economic model of valuation may prove effective on certain levels that would bring us closer to the ultimate goal of protection than we are currently at, particularly in consideration of the general mindset of citizens and politicians alike. Valuation provides a tangible quantifier for nature's services, and decision-makers will be able to incorporate this concrete number in rendering more informed decisions.

Ricardo Bayon suggests that in a society where there are "more bowling alleys than wetlands," we are suffering the symptoms of an economic system with wrong values, suffering from a problem of externalities.<sup>10</sup> Externalities refer to the detrimental side-effects, such as pollution, stress, congestion, loss of biodiversity, and the like, that are the output of our present economy-based society.<sup>11</sup>

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<sup>7</sup>Endangered Ecosystems of the United States: A Preliminary Assessment of Loss and Degradation, by Noss, La Roe, and Scott, Figure 1.1(B), available at <http://biology.usgs.gov/pubs/ecosys.htm>. Last visited on April 19, 2009.

<sup>8</sup> Human footprint too big for nature, WWF, October 24, 2006, available at <http://www.panda.org/index.cfm?uNewsID=83520>. Last visited on October 22, 2009.

<sup>9</sup> IUCN, The World Conservation Union. Depend on Nature: Ecosystem Services supporting Human Livelihoods, p.15. Available at [http://ecosystemmarketplace.com/documents/cms\\_documents/DependonNature.pdf](http://ecosystemmarketplace.com/documents/cms_documents/DependonNature.pdf), last visited on April 19, 2009.

<sup>10</sup> *Id.*, at 124.

<sup>11</sup> The Problem of Externalities, by Peter Barnes. September 19, 2005. Available at <http://onthecommons.org/content.php?id=634>. Last visited on April 18, 2009.

Does the valuation of ecosystem services contribute to the well-being of both the environment and humanity or merely accelerate a greater sense of commoditization of the natural world?

An increased recognition of ecosystem services

In the past decade, a dramatic shift has transpired in recognizing the essential services ecosystems provide. Ecosystems are a member of the Earth community that have frequently been taken for granted. Past policy implementation has failed to recognize and give homage to nature's services, opting to balance the scales instead toward human interests and economics.

Lawmakers and think-tanks have now begun to understand ecosystem services and incorporate them within their organizations, focusing on ecosystem valuation, protection, and restoration.

One such example is the organization Forest Trends, which was developed with the objective of promoting economic systems through commerce sustained by ecosystem services, sustainable management of forest ecosystems by companies, and focusing on ecosystem service revenue being shared with local communities.<sup>12</sup> The Katoomba Group, launched by Forest Trends, is an international organization specifically established to further ecosystem service valuation and advance the surrounding markets.<sup>13</sup> The Katoomba Group has advised discussions on policy addressing financial incentives for conservation throughout the world<sup>14</sup> and was responsible for the 2005 launching of The Ecosystem Marketplace, the world's first global market information program for ecosystem services.<sup>15</sup>

With the now overwhelming quantity of devastated ecosystems and with the help of grass-roots organizations, surfacing issues have promoted citizens and lawmakers alike to investigate further the services nature has always free-flowingly provided. According to the Millennium Assessment,

Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and

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<sup>12</sup> Forest Trends: Building Sustainable Forests, Mission, available at [www.forest-trends.org/index.php](http://www.forest-trends.org/index.php). Last visited April 22, 2009.

<sup>13</sup> The Katoomba Group, available at [www.katoombagroup.org](http://www.katoombagroup.org) (last visited April 20, 2009).

<sup>14</sup> *Id.*

<sup>15</sup> See The Katoomba Group's Ecosystem Marketplace, [www.ecosystemmarketplace.com](http://www.ecosystemmarketplace.com).

spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling.<sup>16</sup>

With the help of such exhaustive assessment tools as the Millennium Assessment, a international report to inventory ecosystems, governments have also begun integrating valuation of ecosystem services into their policy. In 2003, the U.S. Environmental Protection Agency formed a Science Advisory Board specifically geared toward valuing the protection of ecological systems and services.<sup>17</sup> In December 2009, the U.S. Secretary of Agriculture announced the new addition to the USDA: The Office of Ecosystem Services and Markets, which will have the task of organizing many federal agencies in endeavors related to developing the necessary technical guidelines and scientific methods for ecosystem service valuation with the goal of addressing global climate change.<sup>18</sup>

Interest in ecosystem services has also been sparked through a decrease in biodiversity. In a study conducted by Noss, LaRoe, and Scott, a significant decline in biodiversity was found, highlighted by the identification of more than 30 critically endangered, 58 endangered, and more than 38 threatened ecosystems.<sup>19</sup> A recent global study concluded that in the last half-century alone, 90 percent of all large fish have been depleted from the world's oceans, primarily at the hand of harmful industrial fishing practices.<sup>20</sup> Although ecosystems may seem less tangible than species, ecosystem protection and restoration provides habitat to all species; likewise, loss of ecosystem contributes to loss of species.<sup>21</sup>

As an example of specific incidences of human impact, 2006 study evaluated coffee pollination by bees in two distinct coffee growing regions: an area in Indonesia with little human impact with forests neighboring agro-forestry, and an area in Ecuador with high human impact and little remaining forest.<sup>22</sup> Scientists examined the pollination of bees in the light of different

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<sup>16</sup> Millennium Assessment, Preface, page vii. Available at

<http://www.millenniumassessment.org/documents/document.766.aspx.pdf>. Last visited on October 22, 2009.

<sup>17</sup> Sci. Advisory Bd., Request for Nominations for Experts for a Panel on Valuing the Protection of Ecological Systems and Services, 68 Fed. Reg. 11, 082-01 (Mar. 7, 2003), referenced by Ruhl and Salzman, *Id.*

<sup>18</sup> Natural Path, USDA Office of Ecosystem Services and Markets, January 6, 2009, available at [www.naturalpath.com/sustainability/usda-office-ecosystem-services-and-markets](http://www.naturalpath.com/sustainability/usda-office-ecosystem-services-and-markets). Last visited on April 26, 2009.

<sup>19</sup> *Supra* footnote 1.

<sup>20</sup> Study: Only 10 percent of big ocean fish remain, by Marsha Walton, CNN, March 14, 2003, available at [www.cnn.com/2003/TECH/science/05/14/coolsc.disappearingfish/](http://www.cnn.com/2003/TECH/science/05/14/coolsc.disappearingfish/). Last visited on April 19, 2009.

<sup>21</sup> *Supra* footnote 2.

<sup>22</sup> Roland Olschewski et al., Economic Evaluation of Pollination Services: Comparing Coffee Landscapes in Ecuador and Indonesia, 11 *ECOLOGY AND SOCIETY* 7 (2006), available at [www.ecologyandsociety.org/vol11/iss1/art7](http://www.ecologyandsociety.org/vol11/iss1/art7). Last visited on April 19, 2009.

forest-destruction scenarios; to attempt to assess the value of biodiversity and ecosystem services, scientists looked into net revenues from coffee and their correlation to pollination services.<sup>23</sup> They also assessed the effects of changes of land use.<sup>24</sup> The outcome was that crop revenues exceeded coffee pollination values, generating incentives to convert forests, even if coffee plantation owners were to require government compensation for pollination services.<sup>25</sup>

### Valuation of Ecosystem Services

The Convention on Biological Diversity found that, “At least 40 percent of the world’s economy and 80 percent of the needs of the poor are derived from biological resources.”<sup>26</sup> Increased biodiversity yields increased opportunities for medical discoveries, economic development, and a greater proclivity to adapt to new challenges such as climate change.<sup>27</sup>

Valuation of ecosystem services provides a tool by which the prevailing concept of economic systems may interface with ecological systems.<sup>28</sup> While it may seem that nature is implicitly without economic value, several academic groups have contrived tools in an attempt to place a value on the services that ecosystems naturally provide.

The Millennium Report, focusing on the benefits to humans, has proposed various values for currently non-marketed ecosystem services.<sup>29</sup> One source of ecosystem service valuation included looking at recreational benefits, giving the example of coral reefs in the Hawaiian Islands, which could be valued at somewhere from \$300,000 to \$35 million per year.<sup>30</sup> Water quality may also be valued, estimating the value in protecting a 360 kilometer area in the United States’ Catawba River over a five-year period to be \$346 million.<sup>31</sup> Another component of ecosystem services, native pollinators, increased the value at a single 1,100-hectare Costa Rican coffee farm by \$60,000 per year.<sup>32</sup> Flood control is a large source of value for ecosystem

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<sup>23</sup> *Id.*

<sup>24</sup> *Id.*

<sup>25</sup> *Id.*

<sup>26</sup> Convention on Biological Diversity, Statement from the Executive Secretary, Ahmed Djoghlaif, at the 2008 CIC Markhor Award Ceremony for Outstanding Conservation Performance, 27 May 2008, Bonn, Germany, available [www.cbd.int/doc/speech/2008/sp-2008-05-27-markhor-en.doc](http://www.cbd.int/doc/speech/2008/sp-2008-05-27-markhor-en.doc). Last visited on April 19, 2009.

<sup>27</sup> *Id.*

<sup>28</sup> EPA: EPA and NatGeo: Putting a Price on Paradise, February 4, 2009, available at [http://epa.gov/nerl/features/eco\\_services.html](http://epa.gov/nerl/features/eco_services.html)

<sup>29</sup> Millennium Report, Economic Values Associated with Ecosystem Services, Box 5.2, p. 136. Last visited on April 20, 2009.

<sup>30</sup> *Id.*

<sup>31</sup> *Id.*

<sup>32</sup> *Id.*

services, exemplified through the Muthurajawela Marsh in Sri Lanka, a 3,100-hectare coastal peat bog, whose flood-controlling capacity provides approximately \$5 million of benefits in one year alone.<sup>33</sup>

DeGroot and associates, in their 2002 article, sought to provide a conceptual framework for the valuation of the functions, goods, and services provided by ecosystems by looking at a limited number of ecosystem functions: regulation, habitat, production, and information.<sup>34</sup> Regulation refers to the functions of natural ecosystems in balancing bio-geochemical cycles, such as gas regulation and biospheric processes, including the regulation of clean air, water, and soil.<sup>35</sup> The habitat function focuses on an ecosystem's contribution to biodiversity by providing a habitat and site for reproduction for plants and animals.<sup>36</sup> Next, the production function is an ecosystem's capacity to convert energy, water, and carbon dioxide into carbohydrates, which then produce more biomass, creating a variety of ecosystem services, such as converting energy from the sun into edible plants and animals.<sup>37</sup> The final function of information encompasses opportunity for human appreciation, enrichment, and cognitive development, such as through providing natural space for recreation or for aesthetic appreciation and value.<sup>38</sup>

The World Changing Team suggests an alternate means by which ecosystem services might be measured.<sup>39</sup> World Changing seeks to value ecosystem services by looking at those to whom the good or service may be of value, providing a view of supply and demand and assessing the value of not only the present cost, but also of potential future benefits.<sup>40</sup> World Changing also suggests placing ecosystem services on a scale pursuant to a "hierarchy of needs," giving the example of a bushel of wheat, which may be trivial economically but morally essential from the standpoint that it may nourish and save a destitute family.<sup>41</sup> They also include an adaptive measure, clarifying that ecosystem service valuation has natural limitations, and that

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<sup>33</sup> *Id.*

<sup>34</sup> A typology for the classification, description and valuation of ecosystem functions, goods and services, R.S. de Groot, et al, *Ecological Economics* 41 (2002) 393 - 408, available at [www.ecosystem-services.org/iaicrn2015/ourwiki/images/DeGroot\\_etal\\_2002\\_EcologicalEconomics.pdf](http://www.ecosystem-services.org/iaicrn2015/ourwiki/images/DeGroot_etal_2002_EcologicalEconomics.pdf). Last visited on April 26, 2009.

<sup>35</sup> *Id.*, at p.395.

<sup>36</sup> *Id.*

<sup>37</sup> *Id.*

<sup>38</sup> *Id.*

<sup>39</sup> World Changing Team, *Ecosystem Goods and Services Series: Valuation 101*, Feb. 12, 2007, available at [www.worldchanging.com/archives/006048.html](http://www.worldchanging.com/archives/006048.html). Last visited on April 18, 2009.

<sup>40</sup> *Id.*

<sup>41</sup> *Id.*

there will be fluctuations as with any market, comparable to the commoditization of oil.<sup>42</sup> Obvious versus subtle worth is World Changing's final component, noting that where the appeal of some ecosystems may be more readily visible, like a frequently visited scenic mountain, a boggy wetland would have more indirect benefits.<sup>43</sup>

Valuation has also been assessed through looking at an individual's willingness to pay revealed through market pricing, through circumstantial evidence (otherwise characterized as imputed willingness to pay) and through expressed willingness to pay, as indicated through surveys.<sup>44</sup>

### The Purpose of Ecosystem Service Valuation

Through ecosystem service valuation, a primarily anthropocentric monetary figure is placed on nature's output so that it may be marketed and traded. After assessing a monetary value on services, this value may be weighed in decision making, rendering decisions that are informed and, optimistically, more responsible. It may also promote conservation of ecosystems.<sup>45</sup>

The GEO-4 report suggests that at present, three main markets for ecosystem services are emerging.<sup>46</sup> The first market includes watershed management, which would include control of flooding, erosion and sedimentation, as well as protection of water quality, and maintenance of aquatic habitats and dry season flows.<sup>47</sup> The second market is protection of biodiversity, including product eco-labeling, ecotourism, and payments for wildlife habitat conservation.<sup>48</sup> The final market is carbon sequestration.<sup>49</sup>

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<sup>42</sup> *Id.*

<sup>43</sup> *Id.*

<sup>44</sup> Ecosystem Valuation, Essentials, Section 3, Overview of Methods to Estimate Dollar Values, [www.ecosystemvaluation.org/1-03.htm](http://www.ecosystemvaluation.org/1-03.htm)

<sup>45</sup> U.S. Forest Service, Valuing Ecosystem Services: Capturing the true value of nature's capital, p.2, available at [www.fs.fed.us/ecosystemservices/pdf/ecosystem-services.pdf](http://www.fs.fed.us/ecosystemservices/pdf/ecosystem-services.pdf).

<sup>46</sup> U.N.E.P., GEO-4 Report, page 490, available at <http://www.unep.org/geo/geo4/media/>. Last visited on April 29, 2009.

<sup>47</sup> *Id.*

<sup>48</sup> *Id.*

<sup>49</sup> *Id.*

The U.S. Forest Service adds that markets could be sustained utilizing public payments and support services, through private contracts or deals, through governmental use of tax incentives and subsidies, and trading of rights under a regulatory cap.<sup>50</sup>

Examples of past practices contributing to  
devastation and loss of ecosystem services

On all too frequent occurrences, past government action or inaction seeking to maximize financial benefit has resulted in disaster on not only the affected ecosystems, but also on all surrounding life. Now, ecosystems have suffered vast degradation, and cities are facing the imminent need to invest millions and sometimes billions of dollars to recreate and protect those essential ecosystems.<sup>51</sup> The goal of ecosystem service valuation is for governments, prior to taking action, to become aware of the values of potentially affected ecosystems to avoid further decisions with similar detrimental consequences.

New Orleans

Over the past 70 years, the State of Louisiana has lost approximately 1,900 square miles of wetlands, which have been drained to build roads, malls, and promote other commercial ventures.<sup>52</sup> Wetlands serve as a natural form of storm protection.<sup>53</sup> The surge of Hurricane Katrina into the city of New Orleans was “[t]he direct result of poorly constructed levees, an ill-conceived navigation channel, and the destruction of millions of acres of coastal wetlands.”<sup>54</sup> Larry Schweiger, the president and CEO of the National Wildlife Federation said, “We can and must do better to prevent the worst impacts of global warming and restore the wetlands and barrier islands along our shores that serve as buffers against these storms.”<sup>55</sup>

Now, after Hurricane Katrina reaped total devastation on the city of New Orleans, Louisiana has put in place a \$14 billion wetland restoration plan to protect 10,000 square kilometers of marsh, swamp, and barrier islands to assist in the reduction of storm surges like

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<sup>50</sup> U.S. Forest Service, Valuing Ecosystem Services: Capturing the true value of nature’s capital, page 2, available at [www.fs.fed.us/ecosystemservices/pdf/ecosystem-services.pdf](http://www.fs.fed.us/ecosystemservices/pdf/ecosystem-services.pdf).

<sup>51</sup> Millennium Assessment, Economic Values Associated with Ecosystem Services, Box 5.2, page 138.

<sup>52</sup> New Orleans: Loss of wetlands opens floodgates to disaster. By David Osborne. The Independent, September 1, 2005. Available at: [www.independent.co.uk/news/world/americas/new-orleans-loss-of-wetlands-opens-floodgates-to-disaster-505039.html](http://www.independent.co.uk/news/world/americas/new-orleans-loss-of-wetlands-opens-floodgates-to-disaster-505039.html)

<sup>53</sup> *Id.*

<sup>54</sup> National Wildlife Federation, Hurricanes and Global Warming, Hurricane Katrina Anniversary Report Card, available at [www.nwf.org/hurricanes/](http://www.nwf.org/hurricanes/). Last visited on April 21, 2009.

<sup>55</sup> *Id.*

Katrina. Louisiana remains a poignant example of the essence of ecosystem services and what governments should not permit – and the devastating results that can otherwise transpire.

### The Aral Sea

Past government policy geared toward economic prosperity in the area of the Aral Sea had a devastating effect on not only the surrounding ecosystems, but also on the human society.<sup>56</sup> To foster greater cotton yields, smaller irrigation systems were “upgraded” into massive irrigation systems, reducing the flow of water into the sea to a trickle.<sup>57</sup> While the cotton growers did indeed reap immediate benefits, the Aral Sea fishing industry has capsized altogether, and 35 million people can no longer access the much-needed sea for water or food, nor even for transportation purposes.<sup>58</sup>

In addition, human health has been adversely affected as a result of the loss of the Aral Sea, with increased rates of disease, increased occurrences of reproductive issues such as infertility and miscarriages, and birth abnormalities, with one in every 20 babies affected – far above that of surrounding nations.<sup>59</sup>

### South Africa

Because invasive tree species are encroaching on various ecosystems, South Africa is now faced with a serious problem.<sup>60</sup> The invasive tree species threaten the native species and the flow of water, having repercussions on economic growth and threatening the well-being of humans.<sup>61</sup> The invasive trees, such as black wattle and blue gum, which were previously planted for their shade-providing capacities, are now responsible for the diminishing the supply of water, increasing soil erosion, and intensifying wildfires.<sup>62</sup> In response, the South African government initiated and continues the Working for Water Program, which invested \$131 million dollars toward clearing the trees between 1995 and 2001.<sup>63</sup> The Working for Water Program also aides in

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<sup>56</sup> Millennium Assessment, *Ecosystems and Human Well-being: Current State and Trends*, p. 139.

<sup>57</sup> *Id.*

<sup>58</sup> *Id.*

<sup>59</sup> *Id.*

<sup>60</sup> Invasive alien plants in South Africa: how well do we understand the ecological impacts? David M. Richardson and Brian W. van Wilgen, *S. African Journal of Science*, 100, January/February 2004, available at [www.dwaf.gov.za/wfw/Docs/Papers/SAJSFeb2004richardson.pdf](http://www.dwaf.gov.za/wfw/Docs/Papers/SAJSFeb2004richardson.pdf). Last visited on April 22, 2009.

<sup>61</sup> *Id.*

<sup>62</sup> HDRA, *Realistic approaches to the management of Prosopis species in South Africa*, 2005, available at [www.gardenorganic.org.uk/pdfs/international\\_programme/SouthAfricaProsopisBrief.pdf](http://www.gardenorganic.org.uk/pdfs/international_programme/SouthAfricaProsopisBrief.pdf). Last visited on April 26, 2009.

<sup>63</sup> *Id.*

the alleviation of poverty as it employs over 29,000 marginalized persons, as it has over the past 14 years.<sup>64</sup>

### Recent Ecosystem-Service Valuation Projects

Governments and citizens are starting to catch the drift: For humans to continue life as we know it, we must learn to coexist with nature. The following examples cite several groups' recognition of the importance of ecosystem services, demonstrated through large-scale programs designed to rebuild what humans have destroyed.

#### Elwhah and Glines Dams, Washington, United States

In the 1990s, a Washington State environmental impact analysis was conducted using the contingent valuation method (CVM).<sup>65</sup> CVM uses direct surveying of individuals to estimate how much they would be willing to pay for specific environmental services.<sup>66</sup> The study explored removing two dams that block the migratory patterns of fish and harm the local Indian Tribe, which relies on the salmon and river for their physical, spiritual and cultural well-being.<sup>67</sup> The dam removals could bring substantial fishing benefits, more than tripling the present salmon populations.<sup>68</sup>

Despite the high cost of removing the dams and the built-up sediment therein, with estimated costs of \$100 to \$125 million U.S. dollars, Washington residents supported the removals and expressed a willingness to pay approximately \$73 U.S. dollars per household, which would sufficiently cover the cost of the dam removals.<sup>69</sup>

After much negotiation, the biggest dam removal project to date is set to commence in stages over the next three years, between 2009 and 2011.<sup>70</sup>

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<sup>64</sup> Hopebuilding, South African program to clear invasive trees creates jobs, reduces poverty, available at <http://hopebuilding.pbworks.com/South-African-program-to-clear-invasive-trees-creates-jobs,-reduces-poverty>.  
<sup>65</sup> UNEP, Global Environmental Outlook, GEO-4 Report, Box 1.13 Valuing the removal of the Elwha and Glines Dams, page 32, available at [www.unep.org/geo/geo4/report/GEO-4\\_Report\\_Full\\_en.pdf](http://www.unep.org/geo/geo4/report/GEO-4_Report_Full_en.pdf). Last visited April 20, 2009.

<sup>66</sup> Ecosystem Valuation, Methods, Section 6, Contingent Valuation Method. Available at [www.ecosystemvaluation.org/contingent\\_valuation.htm](http://www.ecosystemvaluation.org/contingent_valuation.htm). Last visited April 19, 2009.

<sup>67</sup> *Supra* note 20.

<sup>68</sup> *Id.*

<sup>69</sup> *Id.*

<sup>70</sup> *Id.*

## Costa Rica

In 1996, in light of high deforestation rates, Costa Rica implemented a program designed to encourage landowners to manage and maintain forests sustainably, and to replant trees in deforested areas by offering financial compensation.<sup>71</sup> Landowners enter into 20-year contracts with the government, whereby the landowners are paid for relinquishing their land-use rights, agreeing to manage or protect the forests on their land during the contract period.<sup>72</sup> The Costa Rican Government receives funding for the initiative primarily through a five percent tax on fuel, and also through selling carbon offsets and through a watershed protection program.<sup>73</sup>

### Perrier's Water quality contract

An example of private entities engaging in commoditization of ecosystem services is the contract between Perrier, the upscale water bottling corporation, and their upstream neighbors.<sup>74</sup> After Perrier's source of water had been contaminated, the corporation opted to pay their neighbors for using improved farming practices using less nitrates and pesticide, and through planting trees to restore the natural water purification process around their source of water.<sup>75</sup>

### Catskill Watershed, New York

At one time New York City water, provided by the Catskill Mountain, was rated some of the best water of any city in the nation – that is, until the water system was overtaken by sewage and agricultural runoff.<sup>76</sup> In the early 1900s, the legislature enacted policy permitting the municipality to build dams, reservoirs, and aqueducts in the Catskill waters, and also permitted water filtration procedures to be bypassed.<sup>77</sup> Countless construction projects ensued, as well as a massive influx in population.

Ninety percent of the city's water, a whopping 1.3 billion gallons of water consumed on a daily basis by the more than nine million New York City residents, comes from the reservoirs of

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<sup>71</sup> U.S. Forest Service, Valuing Ecosystem Services: Capturing the true value of nature's capital, page 2, available at [www.fs.fed.us/ecosystemservices/pdf/ecosystem-services.pdf](http://www.fs.fed.us/ecosystemservices/pdf/ecosystem-services.pdf). Last visited on April 29, 2009.

<sup>72</sup> *Id.*

<sup>73</sup> *Id.*

<sup>74</sup> Case Studies of Markets and Innovative Financial Mechanisms for Water Services from Forests, D. Perroot-Maitre et al, May 2001, available at [www.forest-trends.org/documents/publications/casesWSofF.pdf](http://www.forest-trends.org/documents/publications/casesWSofF.pdf). Last visited on April 29, 2009.

<sup>75</sup> *Id.*

<sup>76</sup> Ecosystem Service Fact Sheet, available at [www.esa.org/ecoservices/comm/body.comm.fact.ecos.html](http://www.esa.org/ecoservices/comm/body.comm.fact.ecos.html). Last visited on April 27, 2009.

<sup>77</sup> Catskill Watershed Corporation, Investing in the future, A brief history, available at [www.cwconline.org/about/ab\\_hist.html](http://www.cwconline.org/about/ab_hist.html). Last visited on April 27, 2009.

the Catskill Mountain and Delaware River Region. New York had no choice but to remedy the water quality issue and began to look into artificial filtration systems<sup>78</sup>. The artificial filtration systems came with an estimated cost of somewhere between six and eight billion dollars.<sup>79</sup>

Instead of employing the artificial filtration methods, the City of New York opted to invest in restoring the Catskill's Watershed for just \$660 million, a fraction of the price of the filtration plant.<sup>80</sup> Now, extensive regulations are in place for farmers within the watershed area, projects are more stringently regulated and permitted, the City has solicited surrounding lands, constructed improved infrastructure, implemented new waste management practices, and initiated an environmental and economic partnership program.<sup>81</sup>

### Ecuador

The Ecuadorian Compensation for Ecosystems Services seeks to combat land degradation through conservation of forests.<sup>82</sup> With the help of the United Nations and Conservation International, Ecuador will now strive toward sustainable land management as well as alleviation of poverty in the surrounding ecosystems.<sup>83</sup> Regional reforestation and conservation projects will be encouraged through financial compensation.<sup>84</sup>

### Puget Sound, Oregon

In a recent report, a group of scientists and environmentalists contributed to the Ecosystem Service Valuation project of Puget Sound, a heavily populated area outside of Seattle.<sup>85</sup> The assessment recognizes the priceless nature of ecosystems in and of themselves, but places a financial price on the jobs that ecosystem provides. The economic benefits that Puget Sound natural capital provides are valuable, and some of them can be determined through the assessment, finding that

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<sup>78</sup> *Id.*

<sup>79</sup> *Id.*

<sup>80</sup> *Id.*

<sup>81</sup> New York City Department of Environmental Protection 2006 Watershed Protection Program Summary and Assessment, pages xxi-xxii. Available at [www.cwconline.org/about/ab\\_hist.html](http://www.cwconline.org/about/ab_hist.html). Last visited on April 28, 2009.

<sup>82</sup> U.N. Convention to Combat Desertification, The Global Mechanism, Compensation for Ecosystem Services in Ecuador, [www.global-mechanism.org/products-services/regional-initiatives/cesecuador](http://www.global-mechanism.org/products-services/regional-initiatives/cesecuador). Last visited on April 29, 2009.

<sup>83</sup> *Id.*

<sup>84</sup> *Id.*

<sup>85</sup> Earth Economics, *A New view of the Puget Sound Economy: The Economic Value of Nature's Services in the Puget Sound Basin*, available at [www.eartheconomics.org/A\\_New\\_View\\_of\\_the\\_Puget\\_Sound\\_Economy.pdf](http://www.eartheconomics.org/A_New_View_of_the_Puget_Sound_Economy.pdf). Last visited on April 29, 2009.

... ecosystems within the Puget Sound Basin provide between \$7.4 and \$61.7 billion in benefits to people every year. If the “natural capital” of the Puget Sound basin were treated as an economic asset, the asset value would be at least \$243 billion and \$2.1 trillion.<sup>86</sup>

Ecosystem services are measured under the guise of the degradation upon not only the economy, but also upon the quality of human life.<sup>87</sup> Three Oregon counties have experienced record flooding, tied to the loss of natural flood protection in watersheds and to climate change; damage to human health due to air, water and soil pollution; loss of water quality; an increase in number of endangered species; elevated costs for storm water systems; climate change impacts; loss of aesthetic and recreation value, all of which are attributable to human activity.<sup>88</sup>

Although the Oregon study is the most expansive valuation of ecosystem services to date, because ascertaining a true picture of output is exceedingly difficult, only 12 of the 23 ecosystems could be so much as valued.<sup>89</sup> With only a partial representation, valuation of single ecosystems fails to represent the entire value and may render an incorrect total valuation.<sup>90</sup>

### Tampa Bay Project

The Environmental Protection Agency has begun a new study assessing the values of the ecosystem services of Tampa Bay, Florida’s largest open water estuary.<sup>91</sup> Research is directed at analyzing ecosystem service impacts from the current as well and future populations, which will be accomplished through the following program goals:

- Delineate and quantify ecosystem services provided by the Tampa Bay ecosystem
- Assess the likely changes in environmental stressors and land use patterns through 2050
- Model the relationships among stressors, ecosystem structure and functioning, and ecosystem services
- Place values on Tampa Bay's ecosystem services in terms of human well-being
- Model multiple future scenarios of different land-use changes and projected impacts on ecosystem services and human well-being
- Develop a Web-based tool to characterize effects of land use changes on ecosystem services and human well-being addressing such needs as storm surge issues, potential

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<sup>86</sup> Earth Economics, *A New view of the Puget Sound Economy: The Economic Value of Nature’s Services in the Puget Sound Basin*, 2.

<sup>87</sup> *Id.*

<sup>88</sup> *Id.*

<sup>89</sup> *Id.* at page 5.

<sup>90</sup> Water Science and Technology Board (WSTB), *Valuing Ecosystem Services: Toward Better Environmental Decision-Making* (2004), page 197, available at [www.nap.edu/openbook.php?record\\_id=11139&page=197](http://www.nap.edu/openbook.php?record_id=11139&page=197). Last visited April 21, 2009.

<sup>91</sup> US-EPA, Ecosystem Services Research Program, Tampa Bay, available at [www.epa.gov/ecology/quick-finder/tampa-bay.htm](http://www.epa.gov/ecology/quick-finder/tampa-bay.htm). Last visited April 19, 2009.

benefits of natural habitats, filtering pollution, nurturing the food chain, supporting humans through the commercial fishing industry, and bees required for pollination.<sup>92</sup>

### Indicators of Earth Jurisprudence in the Valuation of Ecosystem Services

Earth Jurisprudence has been defined as, “The philosophy of laws and regulations that gives formal recognition to the reciprocal relationship between humans and the rest of nature.”<sup>93</sup> The primary difference between modern jurisprudence and Earth jurisprudence is the focal point: Modern jurisprudence is anthropocentric in nature, relying on the assumption that all laws are enacted solely for the benefit of human beings.<sup>94</sup>

The present legal attitude can be exemplified by concepts such as corporate rights and private ownership, which fail to take into account the existence of worlds outside of the human realm.<sup>95</sup>

Earth Jurisprudence is an emerging legal framework that, instead, centers on the inherent value of nature, departing from present legal thought and only diverging from this understanding in necessary and permissible situations.<sup>96</sup>

For legislation to be congruent with the ideals of an Earth Justice System, the policy must be one which, “Recognizes, honors, and protects the rights of the planet earth as a living reality and the rights of all of its species, including the human species, to exist and fulfill mutual self-supporting destinies.”<sup>97</sup>

Any time we are trying to advance law in accordance with the ideals of Earth Jurisprudence, such as in advancing the concept of ecosystem service valuation, we must ensure that we are articulating the reality that we as humans are a part of a larger system. We happen to be the voice responsible for drafting legislation and must consider the interests of the other members of the Earth community, attempting to steer away from the anthropocentric legal framework of which we are so accustomed. Earth Jurisprudence seeks to incorporate a different framework of rights, where all species have their own specific rights.

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<sup>92</sup> US-EPA, Ecosystem Services Research Program, Tampa Bay

<sup>93</sup> UKELA, Wild Law: Is There Any Evidence of Earth Jurisprudence in Existing Law and Practice? Page 3, Available at [www.gaiafoundation.org/documents/wild-law-report.pdf](http://www.gaiafoundation.org/documents/wild-law-report.pdf). Last visited April 29, 2009.

<sup>94</sup> *Id.*

<sup>95</sup> *Id.*

<sup>96</sup> *Id.*

<sup>97</sup> Thomas Berry and Earth Jurisprudence, Mike Bell, July 2001, available at [www.rainforestinfo.org.au/deep-eco/earth%20jurisprudence/Earth%20Justice.htm](http://www.rainforestinfo.org.au/deep-eco/earth%20jurisprudence/Earth%20Justice.htm). Last visited April 26, 2009.

In the non-living world, rights are role specific: in the living world rights are species specific. All rights are limited. Rivers have river rights. Birds have bird rights. Insects have insect rights. Humans have human rights. Difference in rights is qualitative not quantitative. The rights of an insect would be of no value to a tree or a fish.<sup>98</sup>

From this premise, our laws should be strategically designed to provide ecosystems with legal protection to promote the underlying need that we as humans need nature, and must maintain our capacity to relate to nature. Our laws should be designed with expressed recognition of the inherent value of nature, shying away from recognizing nature as merely an object of value for the human species.

The indicators developed by the Gaia Foundation's Carine Nadal used in assessing whether a law is consistent with the ideals of Earth Jurisprudence contain three sets of criteria: Earth-Centered Governance, Mutually Enhancing Relations to promote the well-being of the whole Earth community, and Community Ecological Governance.<sup>99</sup> These three prongs encompass what is known as Wild Law, or, "the rules, regulations and constitutional principles that give effect to Earth Jurisprudence."<sup>100</sup> How Wild is the concept of valuation of ecosystem services?

## Earth Centered Governance

Earth Centered Governance encompasses a respect for the intrinsic value of Earth and all its members.<sup>101</sup> This means that all members of the Earth are valuable and should be sustained to support nature and its diversity.

The first component of Earth Centered Governance recognizes that the Earth is its own unique entity, with intrinsic value irrespective of the value humans may choose to place. The underlying motivation for the ecosystem valuation service policy is wholly anthropocentric. Valuation is determined through human-driven interests. The potential exists to value ecosystem services based on different criteria. However, valuation for the suggested purpose of marketing or trading nature's goods and services wholly undermines any dignity for ecosystems as their own entity.

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<sup>98</sup> Thomas Berry, *Evening Thoughts: Reflecting on Earth as Sacred Community*, 10-11 (Sierra Club Books 2006).

<sup>99</sup> See Appendix 1.

<sup>100</sup> *Supra* note 84, page 4.

<sup>101</sup> *Id.*

The human based valuation largely considers ecosystems from the standpoint of benefit to humans: De Groot's criteria for valuation, regulation, habitat, production and information, while cognizant of the important role each ecosystem places, evaluate the ecosystem by the goods and services they provide.<sup>102</sup> Some of these goods and services are invaluable for purposes outside of humans, but the dominant rationale is goods and services as they may be quantified and valued for human use or consumption.

Secondly, Earth-Centered Governance provides that the overriding rationale should focus on environmental protection, placing responsibility on the humans implementing the policy, "To act in a way that is consistent with maintaining the natural environment to the extent possible."<sup>103</sup> The prevailing purpose of ecosystem valuation is sustainability of the natural world. Varying organizations and governmental entities have different motivations for supporting sustainability: Some are solely to ensure future generations' access to natural resources for their own benefit, while some organizations have policy consistent with genuine environmental protection.

To date, valuation of ecosystems is more conceptual than implemented. In actual execution of future policy and laws, there remains opportunity for humans to act in a manner congruent with genuine environmental protection, developing a balance among economics, nature, and humans.

Because so many of nature's services are not readily visible, valuations which have been completed thus far fail to incorporate the full picture.<sup>104</sup> While we lack the information to quantify sufficiently the trade-offs we will face, it is clear that trade-offs will be a real issue to contend with. Ultimately, decisions made after ecosystem services have been economically valued will require balancing objectives, including societal and economic objectives.

Ecosystem service valuation provides the benefit of a tangible monetary factor for ecosystem services, which will play a role in the decision-making process and may encourage environmental protection. The examples of Costa Rica, Ecuador, and New York have shown that environmental protection is possible and may be encouraged by valuation methods.

Ecosystem Service Valuation scores fairly well under the third component of Earth-Centered Governance, where the governing measure should be informed by the laws of nature,

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<sup>102</sup> *Appendix 2.*

<sup>103</sup> *Id* at page 5.

<sup>104</sup> See Earth Economics, *A New View of the Puget Sound Economy: The Economic Value of Nature's Services in the Puget Sound Basin.*

incorporating criteria such as limits that are within nature, biodiversity, and life cycles. There is no doubt that the present demand placed on many ecosystem services is not sustainable. The Millennium Report surmises that if the current trends in ecosystem services remain unchanged, it is highly likely human well-being will be greatly constrained.<sup>105</sup> The predominant goal of ecosystem service valuation is sustainability, including conservation and preservation of ecosystems, thus incorporating natural limits.

Lastly, to be truly Earth-centered, the measure must respect for the three key Earth Rights of an Earth community member. Thomas Berry suggests that these are:

...The right to be, the right to habitat, and the right to fulfill its role in the ever-renewing process of the Earth Community.<sup>106</sup>

Some key Earth rights are incorporated within valuation. Valuation expressly recognizes the role of ecosystems in the ever-renewing natural process, and ecosystems' importance for our continued existence and well-being. While past development strategies have frequently failed to embrace the importance of ecosystem services, delivering policy in denial of the implicit value of ecosystems themselves, it is possible that individual policy efforts may be directed in a way that harmoniously incorporates the three key rights. However, it is equally as likely that the developed policy would compromise those same rights, objectifying the natural world through the proposed economic tools of trading and marketing.

A troubling paradigm is presented regarding the three key Earth rights: While ecosystem service valuation expressly recognizes the necessity of ecosystems, impliedly their right to be, it tramples on that right by reinforcing property laws, exacerbating the mentality that anything can be bought or sold.

### Mutually Enhancing Relations

Mutually enhancing relations consider that the presence of humans is a part of nature, and as such play an essential role in promoting the well-being of all members of the Earth community.<sup>107</sup> Humans should exercise restraint on their own behaviors and enhance nature, as humans should reciprocally be enhanced by nature.<sup>108</sup> Valuation is troubling in this regard as commoditizing ecosystems through valuation seeks to serve as a mechanism of restraint on

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<sup>105</sup> Millennium Assessment, page 20.

<sup>106</sup> Evening Thoughts, by Thomas Berry, page 10.

<sup>107</sup> GAIA, p. 5.

<sup>108</sup> *Id.*

human behavior where morality does not otherwise step up to bat. Under valuation, humans take no independent initiative to moderate their own behaviors, nor are we encouraged to promote the well-being of all members of the Earth community.

Further, valuation does not fully embrace that nature is irreplaceable. For example, in wetland trading, it is exceedingly difficult to “create” wetlands. Legislation may require offsetting destruction of one wetland ecosystem through replication of an alternate wetland, yet such replication is not as efficient as the original ecosystem in its natural state.<sup>109</sup>

For governance to encompass mutually enhancing relations, the policy should evince recognition of the inter-connectedness of all members or components of the entire Earth community.<sup>110</sup> Ecosystem service valuation exemplifies Wild Law under this component; valuation expressly admits that humans cease to exist but for nature. Each service provided is expressly articulated and valued monetarily. Valuation breaks down every service and assesses why it is important, attempting to identify all services provided, even those that may not be readily apparent. Valuation implicitly recognizes the role of all ecosystems in maintaining all forms of life.<sup>111</sup>

The governance should further uphold reciprocity, demonstrated through recognition that, while human interests may be taken into consideration, such interests must be limited by responsibilities to the other members of the Earth community. Again, as valuation policies are vast and remain largely unimplemented, it is not clear how ecosystem services and the demand from humans will balance out. Although valuation programs tend to be incentive driven, the result will likely lead to increased awareness of the importance of ecosystems, and will ideally encourage humans to limit their behaviors as responsible members of the Earth community. Such a shift would involve drastic modification in our present consumption models, but is not outside of the realm of possibility.

A successful environmental policy should include a mechanism of conflict resolution for humans and nonhumans alike, also known as the “procedural indicator.” A “substantive indicator” of conflict resolution should also be included for the entire Earth community. Under both indicators, valuation fails as no form of conflict resolution is addressed. Conflict resolution could feasibly be incorporated into the policy, providing for penalties against those who failed to

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<sup>109</sup> *Supra* footnote 2, p. 129.

<sup>110</sup> See Appendix 1.

<sup>111</sup> See Appendix 2.

comply with valuation procedures. However, compliance with policies thus far have been incentive based, making penalties difficult to implement.

To establish mutually enhancing relations, a restorative mechanism for the well-being of the Earth community should be considered. Valuation recognizes not only ecosystems in their present state, but also in their natural state prior to human degradation. Considering the watershed program implemented in the City of New York, it is evident that a goal of valuation is to restore ecosystems to their natural healthy state. The restoration may be driven largely by benefits the ecosystem provides to humans.

In furtherance of mutually enhancing relations, the final factor to consider is the adaptive process that must be dealt with in light of evolving challenges. Our planet is currently faced with significant challenges. Many of the valuation techniques recognize that valuation may fluctuate, as would any other market, with increasing areas of concern. It may prove a challenge for governments to act quickly to take into account these fluctuations. Additionally, the time and cost of the valuation process would make it difficult for governments to participate in frequent valuation.

### Community Ecological Governance

Community Ecological Governance (CEG) is the “Practical expression of the intimate relationship between the human and natural worlds by which the human presence regulates its conduct so as not to cause irreparable damage to the environment and its ecosystems.”<sup>112</sup> Its essence is that regulation of conduct must come from the communities most involved.<sup>113</sup> CEG seeks to strengthen community and ecosystem resilience in facing climate change and pressures arising both economically and politically.<sup>114</sup> In ecosystem service valuation, the regulations must be driven by the human communities living in the ecosystem affected by the law as well as those nonhuman communities.

Therefore, CEG seeks for governance that encourages participation on behalf of all members of the Earth community in ecological governance. Ecosystem service valuation helps ensure that decisions are made with an awareness of their impacts on the surrounding ecosystems as well as the output of all ecosystems.

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<sup>112</sup> *Id* at page 6.

<sup>113</sup> *Id.*

<sup>114</sup> GAIA Foundation, Community Ecological Governance.

One of the EPA's goals for ecosystem services valuation is that it may serve as a tool to provide decision-makers with a better understanding of the impact of human activities on nature and how that may affect the ability of ecosystems to continue to provide ecosystem services.<sup>115</sup> Valuation, albeit developed by humans and thereby skewed toward human interest, provides decision-makers with a tangible, scientifically motivated object to balance. Valuations take into consideration a wide spectrum of services ecosystems provide, helping to ensure that lawmakers are better informed as to the impacts of their actions; however they may chose to balance the value with human interests and demands.

CEG also seeks legal recognition of public participation, including access to information and public participation in decision-making, access to justice guaranteed by right, as well as other key issues, which may be "traditional knowledge, cultural heritage, human rights, equitable access and benefit sharing, community land rights, co-management, self-determination and democracy." It is not clear how accessible valuation would be to the public, nor how large a role the public may play in the ultimate decisions.

The Ecuadorian Compensation for Ecosystem Services exemplifies the potential positive impact valuation could have on human rights. Through incentive-based programs, those who may have been living in poverty, primarily because of the devastation that has been wreaked on their ecosystems, may be compelled to participate in restoration and conservation efforts, thereby lessening the effects of poverty. South Africa has also sought to accomplish dual purposes through their initiative: Restore natural ecosystems by removing invasive tree species and alleviate poverty by employing a vulnerable population to complete the task.

Another beneficial result may be superior community relations fostered by commoditization. For example, it is not hard to imagine that the relations between the Perrier corporation and their neighbors would improve where the neighbors were being paid by Perrier to engage in healthier farming practices.

Valuation also is able to incorporate rights of indigenous persons, one of the primary motivators in the Washington based Elwah and Glines Dams projects.

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<sup>115</sup>US-EPA and NatGeo: Putting a Price on Paradise, February 4 2009, available at [http://epa.gov/nerl/features/eco\\_services.html](http://epa.gov/nerl/features/eco_services.html). Last visited on April 28, 2009.

## Conclusion

Ecosystem service valuation focuses on nature as an object with a quantifiable and measurable value; this entails an implicit irony considering that nature has, since creation, free-flowingly provided these services. When we continue to develop law focused on humans, which fails to incorporate fully our interdependence with nature, such laws will fail to take us into the future. Ecosystem service valuation ensures that our planet in peril remains without rights, subject to the whims of legal and human exploitation.

While ecosystem service valuation provides nature its due consideration and a level of protection, to place value now on things that nature has been providing seems to perpetuate the destructive paradigm of economic value. Do we stick with this paradigm because it appears to be something humans can understand today or attempt to shift patterns of human consumption? Thus far, humankind and the laws by which we abide have failed to impose personal and communal restraint. In this regard, ecosystem service valuation could prove effective in taking an initial step toward raising the awareness of the general public of the essential role that nature fulfills. However, until we are all cognizant of the shift that must transpire and make concerted modifications, the integrity of the natural world will continue to remain unprotected.

A social, cultural, and legal shift are necessary to effect the true change requisite for healing our ailing Earth. “No piecemeal solution is going to prevent the collapse of whole societies and ecosystems ... a radical re-thinking of our values, priorities and political systems is urgent.”<sup>116</sup>

While ecosystem service valuation brings us closer to recognizing our interdependence on this planet, the concept fails to embrace the “why” factor. Humankind relies on nature for its very existence; slapping on a price tag takes us further into an economical framework, and further diminishes the inherent rights to which nature is entitled.

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<sup>116</sup> Water as a Commodity: The Wrong Prescription, by Maude Barlow. Foodfirst, Summer 2001, Vol. 7, No. 3, available at [www.foodfirst.org/en/node/57](http://www.foodfirst.org/en/node/57). Last visited April 18, 2009.

## Appendix One

*Indicators of Earth Jurisprudence*, Carine Nadal, available at [www.gaiafoundation.org/documents/wild-law-report.pdf](http://www.gaiafoundation.org/documents/wild-law-report.pdf), page 57.

### **1. Earth Centered Governance**

- 1.1. Respect for the intrinsic value of Earth and all its members/  
components
- 1.2. Dominant rationale is environmental protection
- 1.3. Governance informed by laws of nature
- 1.4. Respect for the 3 key Earth Rights of an Earth community member

### **2. Mutually Enhancing Relations to promote the well-being of the whole Earth community**

- 2.1. Recognition of interconnectedness between members/  
components of the Earth community
- 2.2. Reciprocity
- 2.3. Conflict resolution mechanism for interests/rights of humans and those of non-human members for the well-being of the whole Earth Community (procedural and substantive)
- 2.4. Restorative mechanism/process to (re)establish mutually enhancing relations for the well-being of the whole Earth community
- 2.5. Adaptive mechanism/process in light of evolving challenges to pursue mutually enhancing relations

### **3. Community Ecological Governance**

- 3.1. Participation of all members of the Earth community in ecological governance
- 3.2. Legal recognition of 3 key rights of public participation:
  - 3.2.1. Access to information
  - 3.2.2. Public participation in decision-making
  - 3.2.3. Right to access to justice
- 3.3. Respect of other key issues of CEG

## Appendix two

Table 1  
Functions, goods and services of natural and semi-natural ecosystems

Functions	Ecosystem processes and components	Goods and services (examples)
<i>Regulation Functions</i>	<i>Maintenance of essential ecological processes and life support systems</i>	
1 Gas regulation	Role of ecosystems in bio-geochemical cycles (e.g. CO <sub>2</sub> /O <sub>2</sub> balance, ozone layer, etc.)	1.1 UVb-protection by O <sub>3</sub> (preventing disease). 1.2 Maintenance of (good) air quality. 1.3 Influence on climate (see also function 2.)
2 Climate regulation	Influence of land cover and biol. mediated processes (e.g. DMS-production) on climate	Maintenance of a favorable climate (temp., precipitation, etc) for, for example, human habitation, health, cultivation
3 Disturbance prevention	Influence of ecosystem structure on dampening env. disturbances	3.1 Storm protection (e.g. by coral reefs). 3.2 Flood prevention (e.g. by wetlands and forests)
4 Water regulation	Role of land cover in regulating runoff & river discharge	4.1 Drainage and natural irrigation. 4.2 Medium for transport
5 Water supply	Filtering, retention and storage of fresh water (e.g. in aquifers)	Provision of water for consumptive use (e.g. drinking, irrigation and industrial use)
6 Soil retention	Role of vegetation root matrix and soil biota in soil retention	6.1 Maintenance of arable land. 6.2 Prevention of damage from erosion/siltation
7 Soil formation	Weathering of rock, accumulation of organic matter	7.1 Maintenance of productivity on arable land. 7.2 Maintenance of natural productive soils
8 Nutrient regulation	Role of biota in storage and re-cycling of nutrients (eg. N,P&S)	Maintenance of healthy soils and productive ecosystems
9 Waste treatment	Role of vegetation & biota in removal or breakdown of xenic nutrients and compounds	9.1 Pollution control/detoxification. 9.2 Filtering of dust particles. 9.3 Abatement of noise pollution
10 Pollination	Role of biota in movement of floral gametes	10.1 Pollination of wild plant species. 10.2 Pollination of crops
11 Biological control	Population control through trophic-dynamic relations	11.1 Control of pests and diseases. 11.2 Reduction of herbivory (crop damage)
<i>Habitat Functions</i>	<i>Providing habitat (suitable living space) for wild plant and animal species</i>	Maintenance of biological & genetic diversity (and thus the basis for most other functions)
12 Refugium function	Suitable living space for wild plants and animals	Maintenance of commercially harvested species
13 Nursery function	Suitable reproduction habitat	13.1 Hunting, gathering of fish, game, fruits, etc. 13.2 Small-scale subsistence farming & aquaculture
<i>Production Functions</i>	<i>Provision of natural resources</i>	
14 Food	Conversion of solar energy into edible plants and animals	14.1 Building & Manufacturing (e.g. lumber, skins). 14.2 Fuel and energy (e.g. fuel wood, organic matter). 14.3 Fodder and fertilizer (e.g. krill, leaves, litter).
15 Raw materials	Conversion of solar energy into biomass for human construction and other uses	15.1 Improve crop resistance to pathogens & pests. 15.2 Other applications (e.g. health care)
16 Genetic resources	Genetic material and evolution in wild plants and animals	16.1 Drugs and pharmaceuticals. 16.2 Chemical models & tools. 16.3 Test- and assay organisms
17 Medicinal resources	Variety in (bio)chemical substances in, and other medicinal uses of, natural biota	Resources for fashion, handicraft, jewelry, pets, worship, decoration & souvenirs (e.g. furs, feathers, ivory, orchids, butterflies, aquarium fish, shells, etc.)
18 Ornamental resources	Variety of biota in natural ecosystems with (potential) ornamental use	
<i>Information Functions</i>	<i>Providing opportunities for cognitive development</i>	