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Ecosystem Services Deserve Better than "Dirty Paper" – Reply to Peter Calow

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We thank Calow [1] for his Letter supporting our recommendation for the use of the ecosystem services approach as the common currency for risk assessment and management [2]. However, he also expressed concern about capturing the preferences that the public have for the services that they get from ecosystems in a way that can be weighed against the inevitable cost of interventions. This is a valid concern.

Calow advocates monetary terms [1, 3]. As we noted, preferences (i.e., ecosystem services valuation) can be captured in monetary or non-monetary terms [2]. However, Calow [1] does not acknowledge that other systems of valuation can usefully inform decision-making. In contrast, we side with writer Carolyn Brown, who in her book 'The Trouble with Texas Cowboys', aptly noted that money is just dirty paper. There are other, arguably better ways to value ecosystem services.

Monetization of changes in ecosystem services has substantial uncertainty because most ecosystem services are not traded in markets; thus, they have no set monetary value. Other methods of valuing ecosystem services also have uncertainty. However, economic methods of valuation such as indirect revealed preference (e.g., determining a value for clean air by comparing property values in areas with clean air compared to areas with polluted air), avoidance of costs (e.g., natural sewage treatment resulting in negligible impacts [4] vs costly treatment plants), and contingent valuation (e.g., hypothetical surveys of how individuals value incremental changes) are unreliable [5]. Monetization of ecosystem services is not

always feasible, practical, nor desirable [6], particularly for complex social-ecological systems [7].

We fully agree with Calow [1] that the ecosystem services concept is anthropocentric – ecosystems have "rights" (i.e., we have duties toward them) because we value them for the benefits they provide for us. We also fully agree with a cost-benefit approach, with decisions based upon the preferences of those affected. But people and their well-being are more valuable than is capital accumulation [7].

We acknowledge that preferences based on money may be beneficial when considering aspects of some situations; however, this is not universally the case [8]. Complete reliance on monetary valuation in the case study of pesticide use to enhance banana production in Costa Rica [9] may be problematic rather than the opposite as Calow [1] suggests. The benefits of using pesticides are (relatively) easily quantified in monetary terms; however, the impacts on the nearby aquatic ecosystem (e.g., not just fish sold for human consumption but cultural values) cannot as readily be fully evaluated in such terms.

More importantly, economic valuation of ecosystem services will vary significantly geographically. For instance, some developing countries may be focused on obvious material benefits such as the products obtained from nature, whereas others honor the natural world for cultural and spiritual reasons. In contrast, developed countries in general have the luxury of focusing on less obviously material benefits such as habitat and cultural services. And adaptive preferences can be an issue, for instance the situation in which people are not willing to pay monetarily for parks because they have adapted to a world without parks [10]. Valuation of ecosystem services should be based on a common unit that can be aggregated and compared [6]; money does not always meet this essential criterion.

Environmental management and decision-making should focus on the effects that decision alternatives will have on ecosystem services [2,11]; quantification of those effects should rely on sound economic principles. Economics does not necessarily imply monetization; rather, it is the discipline "concerned with the way in which resources are allocated among alternative uses to satisfy human wants" [12]. As such, economics as a science is concerned with

understanding why people make the choices that they do. These choices need not be quantified in monetary terms. Calow seemingly equates monetization with economics; his arguments are based on economics yet couched in terms of money.

Non-monetary valuation (NMV) is well established, reflects the plurality of values attached to ecosystem services, and includes [13]: research techniques; participatory and deliberative tools; and, determination of non-monetary but quantifiable preferences. Monetary valuation comparatively evaluates entities that are not comparable, such as death, diseases, and environmental health. In contrast, as NMV does not require that all ecosystem services be expressed in the same unit, it recognizes that some values are not comparable [14]. Moreover, while monetary valuation cannot adequately capture critical thresholds beyond which ecological conditions and dynamics are uncertain, NMV allows definition of ecological tipping points or thresholds beyond which ecosystem services become endangered [15].

We generally favor NMV based on ecological standards, by which we mean impacts to ecosystem services [2]. This approach has been successfully used in the Amazon [16]; there is no reason that it cannot be further developed and applied globally to the benefit of human communities and their health [17], including human interdependence with the well-being of all life on the planet [18].

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