January 9, 2013

Environment Canada Comments on SEEA Experimental Ecosystem Accounting Consultation Draft

1. General Comments

The document represents a very large step in defining and clarifying the key concepts and relationships that will be necessary to future progress in describing and measuring the linkages and interrelationships between ecosystems, the economy and society.

Apart from the draft itself, the international process of exploration, experimentation and sharing of ideas and concepts and the community of practice that has formed around the Experimental Ecosystem Accounts has provided, and continues to provide, a focal point for national experimentation, learning by doing, and learning from each other. That is a huge benefit of the process, and one that deserves to be acknowledged.

Although the draft contains a statement of objectives, the overall purpose of the work is not well addressed in the document. This is a critical point, as the "why" of the work will condition the "what" and the "how". What problem(s) are we trying to solve? Are we doing this because "the compass is broken" – i.e., national policymakers need better information to make good decisions based on an appropriate valuation (or at least appreciation) of the role of ecosystems in the economy? Or are we trying to find the value of nature that is already inherent in the currently measured value of commodities traded in the market (or that may emerge as new property rights are defined)? The implications of each approach regarding whether they would indeed fix the "broken compass" should be laid out. From an environmental policy department point of view, this goes to the very heart of the matter of whether the information that eventually is produced will eventually be helpful to inform environmental policy. A clear purpose statement at the opening of the document would be helpful.

There no discussion of what we mean by "value". The implied meaning in the draft is "value that is comparable to what would obtain in a private market transaction, if we were talking about a privately-traded good". This meaning then conditions the techniques of valuation, in the sense of leading to a recommendation to avoid measuring consumer surplus. It is worth noting that this is <u>not</u> the environmental economist's notion of the value of natural assets, which is referred to as Total Economic Value (TEV). If the intent of the exercise is to inform public policy decisions about nature, then the applicable standard should be the TEV, not a simulated market price. If the intent is to measure "significance" as value more broadly understood, then a broader set of concepts would apply that would encompass TEV and also other modes of measuring signficance in other-than-economic terms. This may be the case considering the interest in geospatial mapping that will require science-based measures of ecosystem condition-capacity (which is a type of significance). It may also include measures related to human well being such as are cited in systems like GPI.

From an environmental policy perspective, the bottom-line issue is that there exists a situation of market failure, in which natural inputs are more valuable than they are "given credit for" in the marketplace. Indeed, this undervaluation and the associated negative externality are considered to be the principal cause of the environmental problem under consideration.

In addition, environmental policy treats the environment as a public good whose analysis proceeds best using techniques of public policy analysis (such as cost-benefit analysis). From this perspective, consistency with national accounting practices -- applicable to private market transactions -- ought to be a secondary concern – the prime concern should be to fix the compass.

A possible compromise could be to note that the estimates of value derived through the proposed methodology *are based on <u>currently observed</u>, <u>non-optimal</u> prices, and as a consequence are <u>in no way intended to represent the full value of nature to the economy</u>. For this reason, they can be seen to represent a "lower bound" on the true value of nature.*

The final draft should be transparent about the implications of the choices that have been made about i) the appropriate definition of value to be used, i) the assumption of comparability to a situation of market exchange; and iii) , the consequences those choices in terms of informing policy decisions. Ideally, this should appear at the beginning of the document.

2. Specific Comments

Chapter 1

1.24 states that "the over-arching objective of developing an accounting structure" is "the integration of environmental and economic information to inform policy discussion and environmental management". Integration into an existing framework can imply important tradeoffs in terms of the type of information that is allowed into the system. This can sometimes lead to a loss of information. In the present case, the information that is being lost is the consumer surplus that is relevant to the public policy decision.

Indeed, even if consumer surplus is captured by survey methods, it is worth noting that people are often not aware that something has value to them simply because they do not know of the environmental mechanisms through which benefits accrue to them. For example most people probably do not realize that cutting down all the trees in a rural area for farming has significantly negative effects on water quality, air quality, bird and other wildlife habitat, etc. They can certainly tell you how much it matters to them in terms of their own preferences to know that the trees are there – whether for aesthetic or other experiential benefits - but they will not likely have a clue about the actual cost to mitigate these other costs – some of which will be borne by them.

1.42 It is excellent that there is recognition of non-linear change and the importance of resilience in ecosystems. Unfortunately the science behind ecosystem resilience and critical thresholds (tipping points) is still quite early in development. It would be desirable if indicators or "early warnings" of critical thresholds could be included as measures of ecosystem assets. Canada is considering work in this area (decision pending).

1.15 In considering the trade-offs between alternative uses of ecosystems, it can be important to acknowledge that what seem like individual trade-offs may have cumulative effects, and that trade-offs can occur with multiple ecosystems at different scales.

Chapter 2

The diagrams on pages 17 and 18 are very helpful in distinguishing between ecosystem services and ecosystem processes, which is a key distinction. Figure 2.1 is particularly impressive, as it succeeds in distinguishing between processes and services, between separate ecosystem assets, and nesting economic and other human activity within the broader context of ecosystems. However, as much as distinguishing between services and processes is an important step forward, it contains the danger that processes, since they would not be valued in this framework, could be assumed to "have no value", whereas in fact they may be critical. A simple thought experiment using Figure 2.1 can serve to illustrate. Within the proposed framework, the inter-ecosystem flows would not be valued. However, if this is water, and someone builds a dam between the two ecosystems, the effects could be disastrous for one or both ecosystems. A note on this, emphasizing the systemic nature of what we are talking about, would be useful. An analogy may be drawn from using the human body as a metaphor of a living system and asking "what is a person's heart worth?". Obviously, impairing or removing the heart would threaten the life of the individual, making this a nonsensical question outside of its systemic context, unless one is prepared to answer that the heart is worth the totality of what the human life is worth, however that may be measured. In this context, the better question to ask is how important, how critical is the heart to the health and well-being of the person? What positive measures to preserve the person's health and well-being does that imply?

Figure 2.3 on page 20 risks confusing the picture, particularly the arrow between the biophysical environment and ecosystem services boxes. This reintroduces the notion of “supporting services” and characterizes them as a flow underlying ecosystem services. A potential solution to this could be to “nest” the “ecosystem services”, “benefits” and “abiotic services” boxes within a large box called “biophysical environment”. In terms of a model that includes the economy (which it will need to), it is missing a production step between the services and benefits boxes.

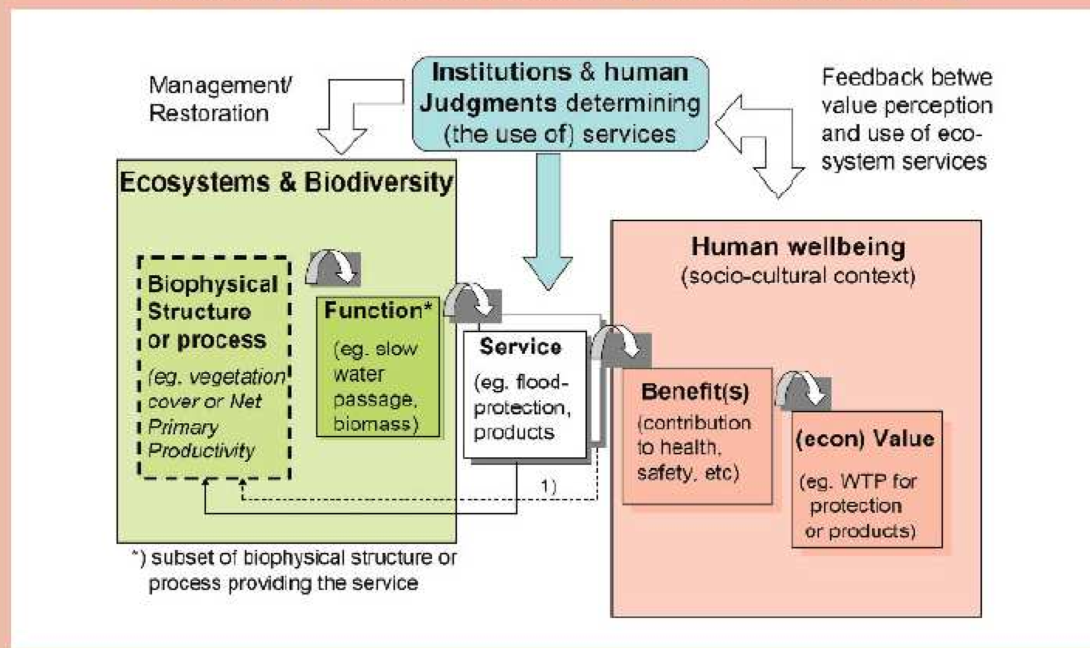
As an alternative, it may be worth considering the diagram put forward in the TEEB for National and International Policy Makers (reproduced below). This is based on a very well established model used and often adapted by practitioners in the field of EG&S. The segments could be elaborated to show the CICES categories, in which case the SNA would reflect the final box on the right.

Box 1.2: How does loss of biodiversity affect ecosystem services and benefits to society?

Ecosystems are components of biodiversity; at the same time, species and their diversity are essential components within ecosystems. Biodiversity plays a fundamentally, though variable, role in the provision of ecosystem services. If an entire ecosystem is lost, this has a significant structural impact with direct human, social and economic costs. If other components of biodiversity are lost, this leads to a change in the services provided by an ecosystem but such changes can be more subtle, making ecosystems less stable and more vulnerable to collapse.

The extent and rate of changes to ecosystem services will depend on many factors such as: abundance of species/biomass (e.g. carbon storage); quality and structure of habitats and ecosystems (e.g. landscape values and tourism); and level of diversity (e.g. genetic variety within crops helps to maintain their resistance to diseases). Some ecosystem services (e.g. pollination, many cultural services) are a direct consequence of species' detailed composition and diversity. For others (e.g. flood regulation), the role of physical structures and processes at the ecosystem scale is more important (for more detailed scientific discussion, see **TEEB D0**.

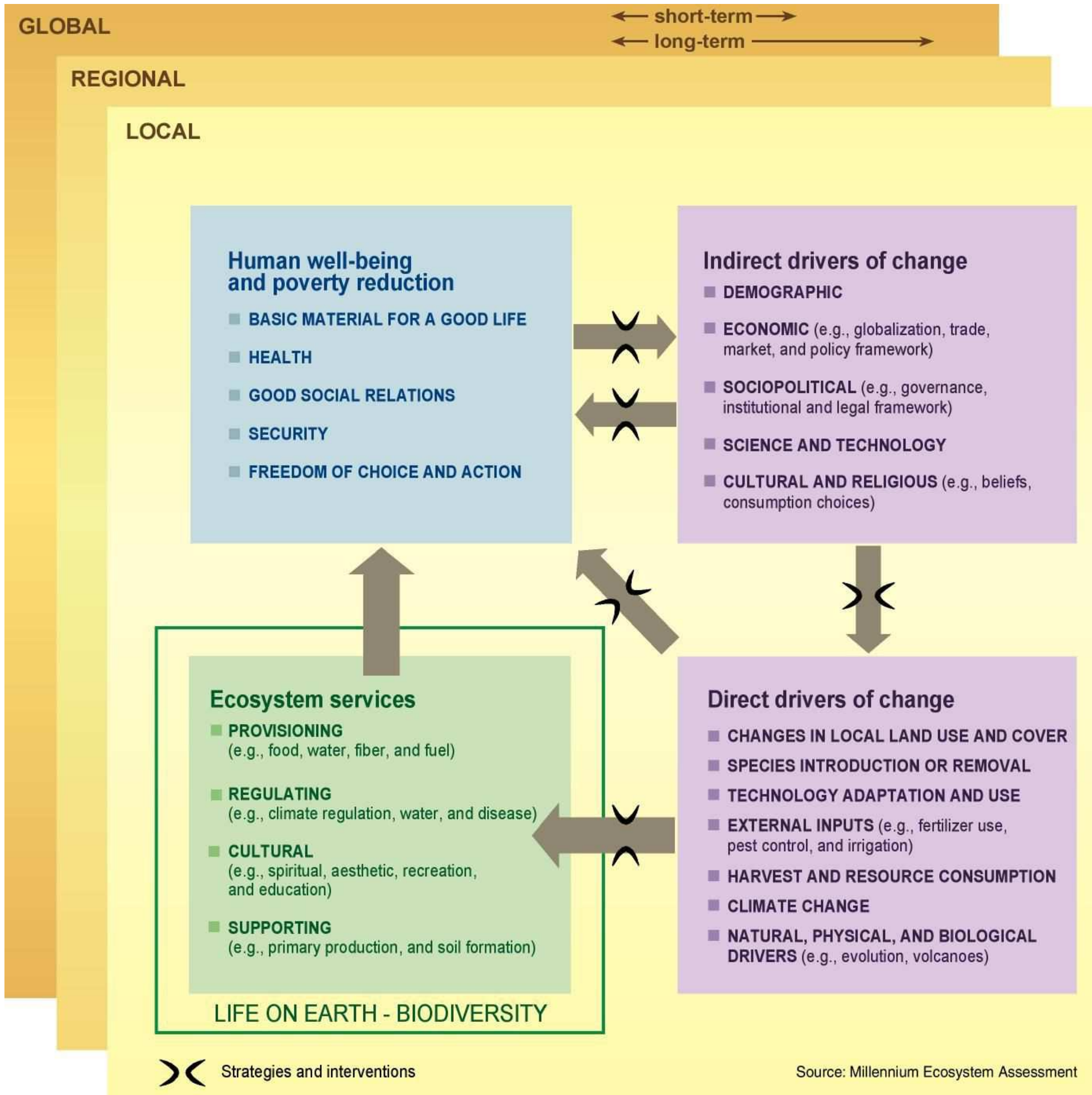
The pathway from ecosystem structure and processes to human wellbeing



1) One function is usually involved in the provision of several services and the use of services usually affects the underlying biophysical structures and processes in multiple ways. Ecosystem service assessments should take these feedback-loops into account.

Source: Adapted from Haines-Young and Potschin 2009 and Maltby 2009

An important issue with Figure 2.1 is that the flow of services from ecosystems to human subsystems seems one-way. To fully capture the systemic character of the human-ecosystem relationship, it would be good to also account for the reverse flow of human pressures on ecosystems. Some diagrams show this as a feedback loop, for example, the diagram from the Millennium Assessment pasted below.



The concept of expected ecosystem flows is introduced, and the idea that the capacity of an ecosystem asset to generate a basket of ecosystem services is understood to be a function of the condition and quality of that ecosystem. While this is very intuitive, clear and satisfying from a conceptual point of view, two very significant issues arise when one thinks ahead to how these will be measured in practice. Apart from measuring actual services, which will be very challenging from a data and valuation perspective, measuring *expected* services introduces the necessity of modeling and forecasting. Second, specifying the model will be difficult, as since ecosystems are living and unpredictable entities, the relationship between condition, extent, and capacity to provide ecosystem services is likely non-linear (this latter aspect is acknowledged in para 4.2) . Despite this, clarifying these concepts and relationships, which the section does well, is a significant step forward toward having a useful model of how the world works. Our sense from the recent ACES conference and other sources is that significant work is underway globally on developing such models.

In tables 2.1 and 2.2, it would be helpful to have a couple of illustrative entries to anchor what we are talking about. In table 2.1, are we talking about bushels of wheat (“Ag”) and number of logs (“timber”). Or are these vectors of commodities? In table 2.2, are the indicators compared to 100% of something? How do tables 2.2. and 2.1 relate to one another? Table 2.3 is confusing, it seems to confound the concepts of stock and flow. Normally, a flow is what happens between two recordings of stock values, we have opening stock, closing stock and the flow is the difference between these two values. Thus it is difficult to understand what “expected ecosystem flows at the end of the accounting period” means. Also, the comment in section 2.82 that “in situations where “sustainable” use is being made of the ecosystem, the estimation of total ecosystem flows is not possible” is not explained. If this is because the number would be infinitely large over an infinitely long timeframe, the total ecosystem flows could still be measured over a meaningful time frame, say 20 years.

The discussion of benefit transfer and the scaling of data (s.2.5.2) seems out of place in chapter 2, which otherwise focuses on biophysical measures. S. 2.113 could also be omitted for the same reason. This would help solidify the overall logic of the paper which seems otherwise to move from key concepts, through the biophysical basis, aggregation and valuation.

2.31Normalizing each indicator to a common point in time does not necessarily tell us a consistent story regarding ecosystem health, resilience and proximity to tipping points. Given the complexity of ecosystems, the reference condition of one indicator may be less optimal given a change in the condition of another indicator.

2.70 Defining a “unit of atmosphere” at the scale of the basic spatial unit (BSU) is not consistent with the actual natural processes involved . Atmospheric processes are always at least regional in scope and more often national or global.

2.80 “Measures of ecosystem condition should cover the main aspects of each ecosystem type that affect the ongoing functioning and integrity of the ecosystem.” This is the crux of the challenge faced by national environmental reporting systems (in Canada, the Canadian Environmental Sustainability Indicators are published by Environment Canada). The focus on carbon and biodiversity in the Experimental Accounts may not be a sufficient strategy for doing this well. This could be an area where environmental agencies and national environmental reporting systems could provide an important contribution.

Section 2.5.2 assumes that the issues associated with scaling data up or down, inferring data across similar ecosystems and combining many different results are primarily statistical in nature. It should not be overlooked that an intimate knowledge of ecological theory, ecosystem function and structure and complex systems will be needed to assess when and how these methods can be applied.

Chapter 3

Some illustrative “filling” of the cells in Tables 3.2 and 3.3 would be helpful to understanding.

3.10 The focus on final output of an ecosystem risks overlooking two things: 1) there may be cases where it is easier to measure a supporting service rather than the target ecosystem service; 2) the chain of supporting services are equal in importance if not more important than the final ecosystem service as it is more of a “web” of supporting services that can be necessary for more than one ecosystem service and potentially essential for the integrity of the whole system. Although the purpose of not measuring these services in order to avoid double-counting for accounting purposes is valid, there is a risk of downplaying the critical importance of supporting services.

3.26 Excellent to see a recognition that “…although an ecosystem asset may not provide ecosystem services directly, it may contribute important inter-ecosystem flows as part of the ecosystem processes that generate ecosystem services in other ecosystems.” Tracking these flows adequately will require expertise in ecology, ecosystems, and complex systems.

3.27 The accumulation of ecosystem services can also be affected by ecosystem degradation or rehabilitation. It is not a simple linear relationship. For example, a forest may accumulate timber as it grows but, eventually, as the forest matures that accumulation rate will change. Additionally, other ecosystem services will change and other values may come into play as it becomes an old-growth forest.

3.28 The idea of a “disservice” is very tricky. Some pest and disease outbreaks we see may be linked to human influence through climate change. It might be more accurate to consider some of these outcomes as indicators of ecosystem asset degradation. Also we should take care not to label important processes as a “disservice”. Forest fires may be seen as a disservice from a human perspective but a necessary part of ecosystem maintenance.

3.35 Could there not be also inter-country flows of ecosystem services? A large protected forest close to a border may provide filtered, clean air to the residents of the other country downwind.

3.38 Focusing only on biotic systems may miss some very important environmental issues. For example, CICES is missing a major regulating function which is the regulation of cosmic radiation via the ozone layer. On one interpretation, this is an abiotic process in the atmosphere that does not involve ecosystems. However, if we believe that humans are part of the ecosystem, and human activity is damaging the ozone layer, then the situation is not much different from carbon (in which case human activity is affecting the stock of carbon in the atmosphere). We are proposing carbon accounts, should we also be proposing ozone accounts? If not, why not? If not, then this important life-maintaining planetary process will not be accounted for in SEEA. There may be other such examples of critical environmental processes that will be excluded from the accounts based on the biotic/abiotic distinction.

3.53 The attribution of the use of regulating services with any estimate of volumes seems quite unlikely. For example, what is the diffusion pattern of "clean air" from a nearby forest and where are the different actors in relation to this at any given part of a day or week?

Section 3.4.4 The discussion on aggregation points to some very difficult issues. Deciding on weights or a common "currency" for different ecosystem services brings us back to an ongoing challenge of developing environmental indices. Very close collaboration with ecologists, complex systems scientists, environmental agencies and national environmental reporting systems will be needed to develop approaches for this.

3.68 It is very odd that, for tracking regulating services, things like air pollution are considered "enabling factors. The term "enabling factors" seems rather positive when really they are pressures or stresses that human society imposes on ecosystems.

3.73 While the criteria for prioritization of ecosystem services for accounting purposes seem reasonable the availability of data and methods are likely to drive decisions which will leave us with those services we can measure and not necessarily the important ones. There are areas where the science needs to be supported and pushed harder, especially for item "2" the likelihood of irreversible loss of ecosystem services.

Chapter 4

This chapter addresses a key question, which is "how does ecosystem health relate to the capacity to generate ecosystem services"? The chapter develops the concepts and key relationships very well. Regarding the discussion of spatial variability in section 4.72 and surrounding paragraphs, the Wetlands Working Group of the Canadian Measuring Ecosystem Goods and Services (MEGS) project is experimenting with an approach that will attempt to gauge the *likelihood* that the intersection of people and potential ecosystem services will result in an ecosystem asset being "valuable" in the economic sense. Another principle underlying the MEGS wetlands work is that, where feasible and practical, the data should be organized in such a way as to support the estimation of EG&S and corresponding ecosystem asset values by others.

The discussions of carbon stock accounts and biodiversity accounts are interesting and informative.

Section 4.2.1, identifying the most relevant aspects to measure as the condition of ecosystems is a science question which must include an assessment of the integrity/health of the ecosystem now and over the long term. It would be good to note that this has been an ongoing quest in the development of environmental indicators related to issues of biodiversity, conservation and the sustainable use of natural resources and is a difficult challenge. Research is ongoing from the point-of-view of ecologists, complex systems scientists, environmental agencies and national environmental reporting systems.

Using a reference condition based on one point in time might be reasonable given that these are not target conditions but, it will be difficult to ensure that users think of them appropriately. There will be a tendency to view the reference condition as the target.

Chapter 5

Section 5.3 Notes the "given that the primary motivation for valuation in the SEEA Experimental Ecosystem Accounting is – eventually – integration with the National Accounts, this section also explores which valuation approaches are consistent with the SNA valuation principles". This seems to place consistency with existing statistical practice above the need to *appropriately* value nature's role in the economy. A far more important motivation for the experimental accounts ought to be the need for officially-sanctioned statistics to *send the right signals to policymakers*.

Much of Chapter 5 is focused on ensuring that estimation techniques are net of consumers' surplus. This proceeds from the incorrect assumption that the transaction we wish to model is a *market* transaction. In fact, the transaction we wish to model is the provision of a *public good*, which is the preservation of nature. Thus, in determining how much to spend on, for example, preserving a wetland, a public authority should take consumers' surplus into account, otherwise it will make a non-optimal (and potentially destructive) decision. Standard environmental cost-benefit analysis proceeds in this fashion – there is no attempt to eliminate consumers surplus from the benefit side of the equation. To do so would result in an undersupply of the environmental benefit in question. For these reasons, the goal of eliminating consumers' surplus from estimates of the value of nature is incorrect, and will result in decisions that are systematically biased against optimal environmental policy. From an environmental policy perspective, the correct value to use is Total Economic Value, not a simulated market price.

For example, the final sentence of 5.22, states that “A critical aspect here is that willingness to pay measures revealed by some approaches to valuation of ecosystem services do not reflect prices at which the service would be traded on a market”. In fact, that is appropriate, because the value that is being measured is *non-market value*, and the authors of studies are *appropriately* setting their experiments in this *non-market context,* with the key implied question being *how much tax would you be willing to pay for the provision of this much of a natural service?* If the individual is willing to pay the tax, it would be incorrect for the public authority to charge a lesser tax and provide a suboptimal amount of the natural service. To the extent that the eventual Accounts are to be used to inform policy, it should be made clear to users that the estimates of value are in the nature of lower bounds on the true value of nature.

5.33 notes that “market prices of the same or similar items when such prices exist will provide a good basis for applying the principle of market prices provided the items are traded currently in sufficient numbers and in similar circumstances”. These conditions do not obtain in the case of ecological goods and services.

In 5.36, it is correctly noted that, in the National Accounts, the cost of production approach is used to estimate education and health services. This has no analog in the natural world, as no-one has ever produced an ecosystem (except perhaps to repair or replace one that has been impaired or destroyed). It may be worth mentioning that the true value of education and health care services to society are in most cases far greater than the expenditures on these items. This is borne out by studies by the World Bank (*What is the Real Wealth of Nations?)*, which show that human capital is by far the largest explanatory variable for national wealth, particularly in developed countries. Cost does not equal value, particularly in synergistic systems.

Para 5.31 notes that in some cases of non-monetary transactions, like imputed rent or transactions within a corporation, the entire transaction must be constructed and then a value estimated for it. It is worth noting that in these cases, it is *reasonable* to compare the transaction to a market transaction, as the key estimation problem being solved in these cases is that the fictional transaction (e.g., imputed rent) occurs between an individual and him/her self. Thus it is inherently in the nature of a *private transaction*, and there is *no public goods component*. This is not the case for the value of nature, where there is a usually a very significant public goods component.

Para 5.40 is very explicit in recommending that “when there are no observable prices an attempt should be made to estimate what the prices would be if a regular market existed and the assets were to be traded on the date to which the estimate of the stock relates”. Notwithstanding the tremendous valuation challenges implied by this statement, it is incorrect in theory to apply this (market) logic to natural assets, for the reasons outlined above. The correct reference value is Total Economic Value in a public goods setting.

Para 5.53 is very explicit about *excluding services that directly affect human well-being,* such as positive health benefits due to air filtration services provided by an ecosystem *because they "may generate consumer surplus, which should be excluded from valuation for ecosystem accounting purposes.* This is a rather stark example of an ecosystem service that from a common-sense perspective *should* be included in a national accounting of the value of ecosystems, and is being excluded for reasons of consistency with the treatment of private transactions in the SNA. The conclusion that the health benefits of air filtration should be excluded for statistical-technical reasons will not likely sit very well with those concerned about environmental health.

Para 5.55 argues that when the costs of mitigation or adaptation are higher than the producer surplus, the producer surplus can be considered an upper bound on the value of the ecosystem service. Reading paras 5.53 and 5.55 together, one can imagine a situation in which a firm is allowed to go bankrupt because the cost of replacing natural mitigation is too high, however the fact that the ecosystem is also cleaning the air is not taken into account. Therefore the Total Economic Value of the ecosystem is not taken into account in the decision to allow the ecosystem to degrade, and the incorrect policy decision is made, negatively affecting both the business and consumer sectors.

Para 5.56 continues the theme of excluding the consumer surplus, even though this is a valid component of the Total Economic Value of ecosystem services and should be taken into account in policy decisions.

The theme of using only those techniques that exclude consumer surplus is repeated continually throughout the chapter. Because of this, the section tends to come across as if the objective of the exercise is to eliminate consumer surplus, rather than to appropriately value nature for public policy purposes.

5.65 appears to contradict 5.55, which had previously suggested that the producer surplus should be an upper bound on the replacement cost, if the replacement cost is initially larger.

5.67 mentions air purification, which seems to contradict 5.53 which suggested that air purification should not be measured because it is in the nature of consumers surplus. Within the context of 5.67, it is difficult to imagine a machine that would replace the air filtration services of an ecosystem. Thus the air filtration service seems to once again slip thorough the cracks.

5.69 is correct in stating that "in compliance markets, the price of carbon is strongly influenced by the regulatory setting of the market". This does not go far enough, however. In fact, the observed price in a regulatory market is an *artifact* of the system. It would not exist except for the regulations creating it and can be manipulated at will by the regulatory agency. It represents nothing more or less than a politically-mediated social response to a perceived environmental harm.

In the case of carbon, numerous attempts have been made to estimate the true price of damage via the social cost of carbon. Although those methods are far from perfect, they are better than using the compliance market price of carbon in every jurisdiction that *does not* have a regulated carbon market, because that automatically yield a price of zero in unregulated jurisdictions. The objective should be to arrive at the best value, which is not always the directly observed value.

This is true also of fish licenses, tree-cutting rights and markets for biodiversity credits (discussed in 5.74), all of whose prices will reflect the stringency of the regulatory system. Thus, in unregulated jurisdictions, the measured price of the natural inputs involved in all of these activities will be zero. This latter point is reinforced in 5.75, which notes that, in the case of biodiversity credits "the prices of the units strongly depend on the local ecological and institutional setting and that it cannot easily be translated to the value of biodiversity in other places", which seems to preclude (or at least strongly caveat) the use of benefit transfer techniques.

The same comments apply to voluntary carbon markets (5.70) – ultimately the supply of credits determines the price. 5.71 introduces the notion that the value of carbon can be relative to reductions from a baseline carbon trajectory. This necessarily involves forecasting both the baseline and the control scenarios, the expected damage from carbon emissions and educated guesses as to the behavioural response from pricing deforestation. Any price that is observed in such a market will reflect all of these considerations and most importantly the regulator's chosen level of stringency.

5.72, depending on markets to evolve in order to generate observable prices risks this important ecological service being underpriced (including zero price) in countries without such markets. 5.73 usefully acknowledges that "prices from voluntary markets and prices due to regulation may not equate to measures of societal willingness to pay". However, in the next sentence we read that "overall, it may be difficult to determine the extent to which prices from these markets contain elements of consumer surplus and hence are consistent with the SEEA concept of market price". Once again, avoiding any measurement of consumer surplus is seen to trump providing the right signals to policymakers.

S.5.84 proceeds on the assumption that what we should be attempting to measure is a market price, which is not the right context for this public goods problem. S.5.85 provides a conceptually correct way of eliminating consumer surplus, however, the estimation issues involved seem formidable to say the least, and for all of the reasons cited above, eliminating consumer surplus should *not* be seen as the prime objective of the exercise. The inherently public-goods nature of ecosystem assets means that the most appropriate tools to use to inform decisions about these assets should come from the economics of public goods, not the economics of privately-exchanged goods.

S. 5.89 and 5.90 provide an insightful treatment of the issue of non-linearity. However, in addition to being non-linear, ecosystems can behave in *discontinuous* ways (e.g., discrete jumps from one state to another). In this case, marginal analysis will not be applicable. In this connection, the excellent discussion of measurement of sustainability in the Report by the Commission on the Measurement of Economic Performance and Social Progress ("Stiglitz Report) may be relevant. For example, paragraph 3 on page 234 states that "the basic question is to build an indicator that would warn us, sufficiently in advance, whether we are or not on a sustainable growth path." On page 248, (para 6), the report argues against "the naïve assumption that market prices are good guides for this aggregation". The discussion also makes the point that any discussion of sustainability *necessarily* involves modeling, as the future-oriented nature of the issue precludes the existence of observable data. The question in the present context then becomes: "what should be the nature of the models used to predict the future, and how appropriate are they to the problem under consideration?"

The discussion of aggregation (5.98 – 5.101) is interesting and conceptually well-developed. The challenges of applying this advice in practice would be formidable. Importantly, to the extent that the values being aggregated are market values, the problems referred to earlier (i.e., treating an inherently public-goods problem as if it were a problem of private supply; assuming that market prices (or indices derived from market prices) can usefully inform a problem related to sustainability in the context of discontinuous systems)) will "carry through" to the aggregation step. In other words, the information coming out of the aggregation process will be no more informative than the information that was fed into the process. The same issue applies to benefit transfer, (of which there is a good discussion in 5.102 – 5.106).

Chapter 6

Para 6.1 notes that: "where new property rights are established and new transactions arise, there becomes an overlap between the aim of adjusting for environmental concerns and the inclusion of these transactions in the existing framework of the SNA. Thus, for example, the treatment of payments for tradeable emissions permits is an important issue for the SNA as there are actual transactions, assets and liabilities that must be recorded", and points to the need to understand the changing measurement boundary. As above, there is a danger that when no new property rights are created, the measured value of the environmental service and/or asset will be zero. This is actually the larger danger from an environmental protection perspective, as there will be no signal that any policy action needs to be taken.

The resolution of the choice presented in para 6.40 (whether the measures of ecosystem degradation in monetary terms are allocated to economic units in terms of the ecosystem degradation they cause through their economic and human activity, or the costs they incur (in terms of lost income as a result of degradation)) should be consistent with the theory of externalities and the actual impact of ecological damage. Only in a perfect world, with fully priced externalities under the “polluter pays” principle would the damages be incurred by the parties that caused it. However, in that case the externalities would no longer exist, as they would have been internalized. These leave allocating damages to the recipients of that damage as the only choice that is consistent with the theory of externalities.

S.6.43 and 6.44 jointly set a high, but realistic standard for the integration of estimates of ecosystem services, ecosystem degradation and related measures into standard economic accounts. The closing paragraph of 6.44 elaborates: first we need assessment of ecosystems in physical terms; second ,valuation techniques; third, aggregated measures of ecosystem services and ecosystem assets.

This is suggestive of a potential long term work plan, which would focus first on the biophysical basis, second on valuation and third on aggregation. This would provide time to more fully consider the approach to valuation in terms of the ultimate use of the data, which is (presumably?) to provide the right signals to policymakers regarding appropriate environmental policies. The question of the appropriate measurement boundary, and indeed whether monetary estimates based on marginal values are meaningful in some contexts (again, the test is whether the resulting information ultimately serves policy purposes well)