CAPTURING SCIENCE IN ACCOUNTS

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Thank you very much for the opportunity to speak at this conference.

I wish to acknowledge the many scientists over several hundred years who have spent lifetimes exploring the mysteries of complex, interacting natural systems, and who continue to ask questions about the very nature of how ecosystems have evolved, are functioning today, and their future prospects in any new climate era.

I also wish to acknowledge and applaud the endeavours of all those seeking to embrace, or bolt on, to the System of National Accounts new ways of measuring and recording environmental data. Such data will be increasingly vital in the way societies develop policies to ensure the sustainable management of natural resources and environmental values. This conference offers us a great opportunity to exchange views on environmental-economic accounting and I hope in this presentation to provide a science perspective.

It is a great honour to follow Ken Henry who in his address to the NATSTATS 2010 conference quoted from the report by Stiglitz and others:

…what we measure shapes what we collectively strive to pursue---and what we pursue determines what we measure.

This statement is as applicable to science as it is to other fields because both individually and collectively scientists seek to measure "things" in order to make sense of what they are investigating, or in other words, to seek to reduce uncertainties in our understanding of natural system dynamics .

It is clear to me that many of the issues confronting statisticians and economists who see value in producing "environmental accounts" that science <u>must</u> play a role in offering data and information as well as interpretation of information that will determine the integrity and hence value of measurements to decision makers.

My perspective on these issues arises from my background in the geosciences, especially physical geography. I have been fortunate to have worked with a range of scientists interested in natural resources in universities and research institutions, in the learned academies, and in government.

Working across the disciplines that are captured by natural science in Australia reveals a range of constraints that may hinder the way science can assist environmental accounting.

First, what motivates a scientist—curiosity, questioning, a desire to explore uncertainties, to publish in peer reviewed literature, and to use and develop new "toys".

Second, what drives a scientist to seek competitive funds to do the necessary field work, experiments or modelling that form the basis of natural science, and for how long can they be funded to sustain those efforts?

Third, how prepared are many scientists to communicate outside their chosen speciality, or silos, within the broader science community, let alone to policy makers and other interested groups?

Fourth, is the current funding model and institutional arrangements compatible with any long term commitment to problems confronting natural resource management and environmental accounting in this country, a nation that must confront the consequences of inter annual and decadal variability as well as the potential impacts of climate change?

And, *finally* can scientists do an adequate job in communicating their methods and language to others who seek information to help make an economic or management decision?

There are many examples where scientific discoveries have influenced government policy; the splitting of the atom is one.

But in natural science in recent years, I get most excited by the impact of all the observations, experiments and modelling of atmospheric and ocean systems that underpin policies of emissions reduction.

An incredible example of collective scientific endeavour that highlights the high probability, as defined by the IPCC that humans are impacting on climate, is contained in the records from the deep ice cores of Antarctica.

Information on the composition, or condition of the atmosphere over time, can be coupled with more recent direct measurements rising greenhouse gas levels including from Cape Grim in Tasmania.

Such observations have led to a level of national and international agreements on the need for action.

Yet having good science and even communicating it to governments may not always be enough if there is not an appropriate institutional and political structure that accepts the warnings of science. The collapse of the cod industry from eastern Canada sends many lessons. Here signals from biological science were of little value as governments allowed industry continued to exploit fish stocks to the very limit.

In 1996 the Australian Government released its first National State of Environment Report stimulated by agreements at Rio in 1992. I was invited in 1998 to Chair the second SOE report that came out in 2001. There have been subsequent reports in 2006 and 2011.

The intent of SOE was to include the latest scientific data, information and knowledge.

Every five years, teams of scientists come together to produce data on a raft of indicators covering a range of natural assets.

In 2001, and I believe for subsequent reports, we suffered from data deficiencies, data accessibility and consequent difficulties in interpretation that would assist in understanding ecosystem function and services.

But some key messages did emerge in 2001 such as Australia's position on the "league of shame" on land clearing which influenced policies on native vegetation protection.

SOE was supported by the then very active Land and Water Audit. The audit not only mapped the condition of dry land salinity such as in SW WA , but also through the modelling work of hydrologists and groundwater scientists were able to project future expansion; this work assisted in government investment in salinity remediation.

The 2011 SOE report took another approach and benefited from the experience of previous reports and had more reliable data at its disposal. For instance it was now possible at national level to show trends in forest cover change.

In summarising information, SOE 2011 adopted a broad grading system coupled with an approximation of confidence in the evidence using arrows and circles. The question arises as to how you can use such qualitative portrayal of information to make economic or management decisions.

One can conclude that at one level the collective participation of hundreds of scientists in SOE reporting since 1996 has yielded lots of new information and has been a useful educational tool, but can natural science do better in informing policy through a system of environmental accounts based on measurements in ways that are of more direct value to a range of decision makers?

One approach that could work with the current state of knowledge, based on scientific observations and modelling, is to focus on *environmental condition of given natural asset.*

Many names are attributed to measuring the status of natural assets, like "condition", "health", and "integrity".

The condition of water, air, biota, soil, landform and other assets, can be derived by measuring elements of an assets composition, structure, diversity, and fecundity or reproductive capacity, against a *reference condition.*

It is possible for scientists working with natural resource managers and others to use an agreed set of *indicators* to "measure" condition preferably by applying a method of *sampling* within a natural regional framework.

Such measurements will inform the functioning and resilience of a particular natural system and thus provide information for the interpretation of the “health” of an asset.

Any economic or policy decision that needs to be made to maintain or improve that asset, or assets, will flow from judgements over the relative importance of any action within the range of resources available to a decision maker .

I will illustrate this approach with reference to three examples; one from animals, one from water in a catchment context; and a third from plants where weeds are important in defining condition.

The first example is the measurement of bird condition at a regional scale appropriate for management. Birds are often regarded by some ecologists as a measurable surrogate for the “health” of an ecosystem.

Measurements in an agricultural region in the central west of NSW have allowed the assignment of a condition value reflecting a spectrum from stable to extinct for birds that have been known to have occurred in the region.

Clearly there is considerable background science that underpins the development of such information that can then be summarised in comparison with the condition status of other animals.

The value of these condition assessments becomes more apparent when (1) you explore the processes that have led to the pattern---a science issue, and (2) make comparisons with other regions to see if management interventions/investments are appropriate—a policy issue.

The Healthy Waterways Partnership program in SE Queensland offers another example of condition measurements that constitute a type of regional environmental accounts.

In brief, this program demonstrates the capacity of science to measure change in a variety of indicators which can be brought together as indices and then communicated to the public through the use of a graphic score card system.

The program initially required a political driver because of community concern over the declining “health” of waterways.

But this stimulated a group of scientists to develop a conceptual model of river and estuarine system function leading to a sampling program allowing data and information on indicators of condition to be integrated into an interpretation trends in ecosystem health.

A third example of measuring, understanding function and consequent management is more personal. For several years I served as chair of one of the WONS committees: bitou and boneseed, invasive species introduced from South Africa to SE Australia.

Bitou bush now extends along 80% of the NSW coast. In the 1950s it was scarcely present. Large sections of the coast were then mobile dune sand.

Bitou was introduced as a quick fix to stabilise mobile sand and areas mined for heavy minerals; it then invaded natural dune vegetation so that with one exception there are hardly any mobile dunes and lots of plant cover; but it is very weedy and has quickly developed in many places as a monoculture due to its aggressive seeding capacity.

Extensive research has highlighted the biodiversity implications of this invasive species and the need for containment and eradication. As a weed it reflects poorly on the condition of plant cover in coastal national parks and reserves.

Lessons from the bitou bush saga are many, including how to assess weeds in any accounting process as the adverse impacts of different species of plant weeds on the Australian economy are understood to reach into the billions.

There is also the issue of accounting for the huge amount of volunteer (Dune and Coast care groups) effort combined with actions taken by local, regional and state authorities within any national framework.

How then can science best contribute to an environmental accounting process that highlights the various needs of policy makers and managers operating across local, regional, state and national institutions? How can those institutions best capture the interests of scientists, of new technologies available for observations and modelling, and of funding processes required to invest in long-term monitoring that must underpin reliable environmental accounts?

An institutional framework(s) is needed within which measurements of condition of natural assets can be made that will be of value in making economic, policy and management decisions at a relevant scale. Clearly many stakeholders are involved. But developing and sustaining such institutional arrangements that engages commitments from scientists is a big challenge.

Where scientists can contribute is providing the necessary conceptual and methodological support for long-term monitoring and the necessary interpretative and modelling skills to make sense of the information. The SEQ Healthy Waterways process is an exemplar in this regard.

The great challenge, therefore, is to engage the range of science expertise given all the various limitations facing scientists no matter where they work. SOE showed that we can achieve one end product every five years, but surely our collective efforts could be better directed if the institutional incentives are in place.

Let us explore further a model of asset condition accounts, which is the domain of many natural scientists, preferably within a natural region framework, that could sit alongside other forms of environmental accounts and thus provide opportunities for scientists to make their contributions—should this be one of the aims of SOE 2016?