Marine and Coastal
National Environmental Science Program
FACT SHEET | JUNE 2022

Frameworks and data to account for environmental and socioeconomic assets and settings

Decision makers seek to account for the socioeconomic values of environmental assets. However, understanding the available frameworks and data can be a barrier. We address this here by summarizing the available data for core building blocks of environmental accounts and provide case studies to demonstrate how they are applied to support decisions in varied contexts.

The United Nations' Statistical Commission adopted the System of Environmental Economic Accounting (SEEA) Central Framework in 2012 as an international standard for environmental economic accounting to evaluate how the economy uses natural resources, economic instruments used to measure the environment (environmental expenditure, taxes, subsidies, investments) and extend the System of National Accounts principles by including environmental assets. After testing and experimentation, alongside growth in interest in ecosystem accounting, the Central Framework was supplemented by a complementary draft standard for ecosystem accounting. After a process of revision with the involvement of many experts from different disciplines, the SEEA-Ecosystem Accounting (SEEA EA) framework was developed and adopted in March 2021 (Chen *et al*. 2020; United Nations *et al*. 2021).

Recognising that SEEA EA has been adopted for use by the Australian Government, we accept its general approach as 'given', and consider ways in which additional insights can be added to, or 'blended' with SEEA EA, to ensure that our systems for collecting data are robust enough to adequately capture a full range of information across core components of the entire system.

Figure 1 illustrates the four 'building blocks' of ecosystem accounts in a SEEA EA framework: the measurement of stocks of biophysical or ecosystem assets; the condition of the ecosystem assets; the flows of goods and services that the ecosystem assets provide; and the estimated value of the assets and services to Australians.

We describe the overall types and availability of data for each of these four building blocks below.

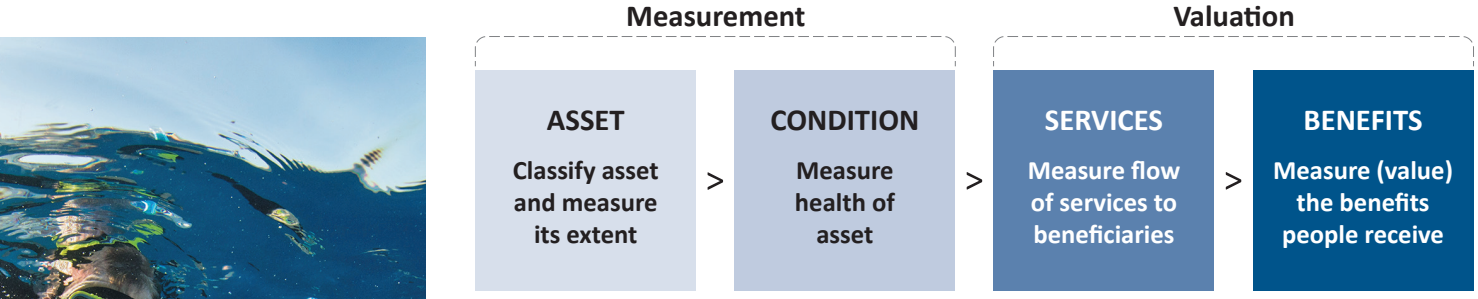

Figure 1: The components of the System of Environmental Economic Accounts – Ecosystem Accounting (SEEA-EA) approach. The approach starts with measurement of the ecosystems (assets and condition) and then considers the value of these assets (in terms of services and benefits). Adapted from DELWP (2015).

Snorkeling in the Great Barrier Reef.
Image: Gretta Pecl

ASSETS

The framework explicitly identifies that the type of asset ultimately influences environmental and socio-economic outcomes. The types of services and ultimate benefits provisioned by a seagrass bed are inherently different to those of a coral reef. The fundamental starting point for environmental accounts and understanding the overall contribution of nature to people is thus mapping the extent and type of ecosystems present as the natural assets that we are measuring.

In the marine environment the overall availability of extent and resolution of ecosystem or habit mapping varies by jurisdiction. While the map products available may be coarse or incomplete, dependent on location, there are datasets available across the marine environment that at least provide a coarse understanding of the types and extent of habitats present. The below table summarizes type of data and data sources as an indication. These are datasets available at a national extent. Individual states and territories will often have additional data products at finer resolution.

Asset	Description and data reference
Benthic and pelagic bioregionalisation	• Bioregionalisations provide a picture of the spatial distribution of the broadscale physical and biological components of Australia's marine jurisdiction. • 2005 National Marine Bioregionalisation of Australia https://data.gov.au/data/dataset/2005-national-marine-bioregionalisation-of-australia
Benthic habitat	• Extent maps of benthic habitats in the intertidal and subtidal region including mangrove, seagrass, macroalgae, coral reef, rock dominated, and sediment dominated. • National Intertidal Subtidal Benthic (NISB) Habitat Classification Scheme
Reefs (Rocky or coral)	• Reefs and shoals are of particular interest often for managing. These have been mapped at based on bathymetric mapping. Resolution varies substantially. Individual state and territory benthic habitat maps could be acquired to address resolution issues. • Reefs and shoals http://www.ga.gov.au/mapspecs/topographic/v6/appendixA_files/Marine.html
Coral reefs	• Coral reef type (based on bathymetry and tidal range) and extent. • Allen Coral atlas https://allencoralatlas.org/atlas/#3.24/-28.9795/119.5767
Mangroves	• Mangrove canopy cover (based on landsat fractional coverage) provides a measure of both extent and health of mangroves • Mangrove Canopy Cover 25m 2.0.2 https://cmi.ga.gov.au/data-products/dea/191/dea-mangrove-canopy-cover-landsat
Species	• Range extent and occurrence records of marine species at national (fishmap) and global (aquamaps) scale. • Fishmap https://fish.ala.org.au/ • Aquamaps https://www.aquamaps.org/
Threatened species and ecological communities	• Threatened species and ecological communities are of particular relevance for management given their listed status. Accounting for them in decision making frameworks and accounts can provide critical signals of overall ecosystem health and management success. • Species of National Environmental Significance (public grids) GIS data • Ecological Communities of National Environmental Significance

CONDITION

The condition of an asset is defined as the overall health of the asset and is typically measured relative to a baseline benchmark. This reflects that the provision of services is linked not only to the presence of an asset but also its overall health. For example, the number and diversity of fish found on a healthy reef would be larger than on a degraded reef which directly impacts the types and flows of services that reef provisions. Unfortunately condition of assets are rarely mapped and uniformly available and thus data would have to be case specific and collected relative to a particular question or place.

SERVICES

Services measure the type of service as well as the flow in terms of who is receiving the services. Thus, understanding the types of marine uses is one way of mapping the extent and nature of services derived in a particular place or from a specific marine asset. In the marine environment these services commonly include commercial fishing, recreational fishing, shipping, boating and other recreational activities, extractive uses such as oil and petroleum drilling, and aquaculture. Of these uses, data is available for commercial and recreational fishing (noting variability in scale and reliability of data dependent on jurisdiction), shipping, and extractive uses such as oil and petroleum drilling. However, the remainder of services often have to be mapped based on surrogate measures – for example mapping housing density as a proxy for recreational uses on the coastline or boat ramps for recreational boating. Services are likely to be measured using a wide range of physical units (such as kgs of fish, number of registered boat licences, counts of visitor numbers). While the spatial patterns of services can be useful for decision making, their varied units mean that they cannot be meaningfully summed or their relative importance easily assessed which is a major barrier to their inclusion in account frameworks.

We summarize the uses that are reported on at national scales below. These are only a portion of the marine uses – for example significant industries such as aquaculture and offshore renewable energy production are not captured below. These data could be accessed at a state or territory level but no national products are accessible.

Uses	Description and data reference
Commercial fishing	• Fishing collected nationally based on logbooks. Data available under license from AFMA. • Collated national data summary available of AFMA fishing data (2011–2014, 0.1degree grid, metric effort number of operations converted to effort presence/absence) collated as part of the National Environmental Science Program (NESP) Project C1 national scale pressures https://www.nespmarine.edu.au/project/project-c1-improving-our-understanding-pressures-marine-environment • Data collected by states and territories available under license except for Queensland which has publication available data on spatial extent of commercial fishing in Queensland: Qfish https://qfish.fisheries.qld.gov.au/
Shipping	• National scale shipping data is held by the Australian Maritime Safety Authority including shipping lanes (high-volume shipping traffic) and other measures of shipping activity based on Automatic Identification System (AIS). • From 1999–2011 Australia shipping was tracked through the Australian Ship Reporting System (AUSREP). From 2012 onward this changed to the Automatic Identification System (AIS). The data presented here are summaries of the tracks of vessels between the points identified by either Australian Ship Reporting System (AUSREP) or AIS, summarised to the number of KM per 0.1 deg grid square. • Collated data from AMSA are presented in NESP Project C1 national scale pressures: https://www.nespmarine.edu.au/project/project-c1-improving-our-understanding-pressures-marine-environment
Ports	• Ports are a major infrastructure that connects coastal and marine systems and anchor marine uses (e.g. shipping). Australian port infrastructure data available at national scale http://data.gov.au/dataset/australian-ports
Offshore petroleum	• Geoscience Australia has developed the National Offshore Petroleum Information Management System (NOPIMS) as an online data discovery and delivery system for all Australian offshore petroleum wells and surveys. https://www.ga.gov.au/nopims

>>

Uses	Description and data reference
Recreational boating and fishing	• Data on recreational vessel registrations for all states and territories (except NT) collated by NESP project E4 Peel *et al*. 2019 https://www.nespmarine.edu.au/project/project-e4-recreational-fishing-commonwealth-waters • Data on recreational vessel registrations for NT summarized for Ostwald *et al*. https://www.sciencedirect.com/science/article/pii/S0308597X21002256 • Fisheries agencies have collected recreational catch and effort surveys at varying regularity. These data can be accessed from relevant state agencies and are summarised in the NESP D6 project https://protect-au.mimecast.com/s/31zMCq7BJXt8JxDnzUZswG9?domain=nespmarine.edu.au • Random utility model (RUM) of recreational fishing which provides support as a behavioural use model at national scale.
Tourism and recreation	• Significant amounts of visitor data is collected by Tourism Research Australia https://www.tra.gov.au/ providing easily accessible summary information on international, domestic overnight and domestic daytrip visitors by specific tourism region (for example, Tropical North Queensland). Consistently collected since 2005 for international visitors and since 1998 domestic. • Summarised information by type of activity/destination available. • By region tourism industry data as contribution to economic activity (e.g. gross value added by sector) available.
Coastal communities and access	• Coastal community population density and characteristics provide socio-economic context for the volume of population that is accessing the coastal and marine environments. This data can be accessed via the census https://www.abs.gov.au/census

BENEFITS

Benefits or values of services require case specific detailed understanding of the context, beneficiaries, and thus the values they place on the services. This requires case specific data. While the overall context can be derived from data on coastal communities (e.g. census data) these do not necessarily fully identify the beneficiaries of services or the values they place on these services. This is further complicated for recreational services that attract beneficiaries from beyond coastal communities including overseas.

The SEEA EA approach seeks to monetise the flow of benefits, enabling aggregate values to be determined, and relative importance of different benefit flows to be compared. We provide a summary of three case studies to demonstrate the type of case specific data that may be required when moving to quantifying values or completing valuations.

Lord Howe Island view from the water.
Image: (c) Matt Curnock

Summary of Case Studies

Geographe Marine Park, Western Australia

The marine park attracts visitors for commercial and recreational purposes, including fishing and whale watching, and the park is home to many species of fish and other animals such as whales. The key objectives of this work to develop pilot ocean accounts were to: (i) Provide structured environmental, cultural, social, and/or economic information to contribute to the Monitoring, Evaluation, Reporting and Improvement (MERI) system informing ongoing management of the marine park; (ii) Improve understanding of how ocean accounts can assist the sustainable management of marine resources; and (iii) Trial the internationally accepted frameworks and Technical Guidance on Ocean Accounting in an Australian marine context and assess feasibility for broader application. The work focused on the four key ecosystems present in the region (seagrass meadows, sandy bottoms, rocky reefs, and kelp forests), and on the four key groups of users (fisheries, recreation and tourism, carbon sequestration, and vessel parking and transportation). Further information on the case study available in IDEEA Group (2020).

Port Philip Bay, Victoria

The bay provides water filtration services (denitrification) to Melbourne and the catchments, and also provides other important services including sediment stabilisation, maintenance of nursery populations and habitat, carbon sequestration and storage, and opportunities for recreation and tourism. The objectives of this study were to (i) examine what data are available to develop ecosystem accounts for the Bay; (ii) build and present a set of pilot accounts; and (iii) to make recommendations about future data collection and methodological challenges. The work focused on the four key ecosystems present in the bay (seagrass, saltmarsh, reef, and sediments), and three key benefits provided to users (recreation and tourism, fishing and aquaculture, and climate change mitigation). Further information on the case study can be found at Eigenraam *et al*. (2016).

Great Barrier Reef, Queensland

The Great Barrier Reef (GBR) is the largest living structure on Earth spanning 2,300km, is recognised as one of the seven wonders of the natural world, and was listed as a world heritage site in 1981 for its unique natural attributes and enormous scientific and environmental importance. Two case studies are included below.

1. **Deloitte Access Economics (2017):** This study assessed the economic, social, icon and brand value of the GBR, seeking to gauge the value of the Reef to Australians and to understand how the international community values it; thus seeking the highlight the importance of protecting the Reef from various pressures/threats that it faces. This study used a total economic value approach (rather than SEEA EA) to estimate the value of the Reef, including option and non-use values in addition to the use values, of which tourism and recreation uses are the most significant. The study also explored, but did not attempt to monetise, the value of the Reef from the perspective of Aboriginal and Torres Strait Islander Traditional Owners. The study also used an Input-Output approach to estimate the economic contribution of the Reef, separately highlighting the number of jobs created and the contribution of the Reef to the regional, Queensland, and Australian economy. For comparison between the types of data that TEV and SEEA EA use we have focused our summary of the Deloitte report to the TEV component. The TEV analysis sought to answer the question "what is the economic value of the reef in an intact state". It thus focussed on the non-use value components in addition to the values arising from uses of the Reef. Implicit to this analysis is the decision-making action that an agency would be faced with – is the reef more valuable in an intact state and thus the action is to largely protect it from extractive or 'use' values; or are the use values greater and thus the action is to allow continued extraction (and ongoing degradation).
2. **Stoeckl, Condie & Anthony (2021):** This study adopts an ecosystem services approach to assess the value of interventions designed to protect the ecosystem services of the Reef, seeking to understand the potential value of benefits arising from preventing damage to the Reef from climate change and Crown of Thorns starfish. The analysis sought to answer the question "what is the value of protecting the Reef from these threats".

The table below presents data used within our case studies. Key: √ relevant to study and data available and included; x noted in study as relevant but not included as data not available; otherwise left blank as not mentioned as relevant to study. For details on data sources for each record in the table please see the metadata record: https://metadata.imas.utas.edu.au/geonetwork/srv/eng/catalog.search#/metadata/4fca5250-7381-4a09-b02d-4b7347c495a5

		Case study location			
Data type	**User/ beneficiary of service**	**Geographe Bay Marine Park (WA)**	**Port Philip Bay (Vic)**	**Great Barrier Reef (Qld) (TEV)**	**Great Barrier Reef (Qld) (ES)**
Study method		SEEA EA	SEEA EA	TEV	Ecosystem Services
Valuation based upon		Exchange values	Exchange values	Welfare values	Welfare values
Year published		2020	2016	2017	2021
ECOSYSTEM EXTENT					
Seagrass meadows (ha)		✓	✓		
Rocky reefs (ha)		✓			
Sandy bottoms (ha)		✓			
Kelp forests (ha)		✓			
Mangroves/saltmarsh			✓		
Sediments			✓		
Coral habitats					✓
ECOSYSTEM CONDITION					
Seagrass meadows density score		✓			
Fish count (count)		✓			
Fish biomass (kgs)		✓			
Fish species diversity (count)		✓			
Abundance of specific fish species (count)		✓			
Whale migration sightings (count)		✓			
Condition data for specific identified ecosystems			⊗		
Reef condition index					✓

>>

		Case study location			
Data type	**User/ beneficiary of service**	**Geographe Bay Marine Park (WA)**	**Port Philip Bay (Vic)**	**Great Barrier Reef (Qld) (TEV)**	**Great Barrier Reef (Qld) (ES)**
CONTEXTUAL BIOPHYSICAL DATA					
Depth		✓	✓		
Sea surface temperature (climate change indicator)		✓			
Primary productivity hotspot		✓			
Chlorophyll-a (water quality indicator)		✓			
Dissolved oxygen (water quality indicator)			✓		
Water quality index (water quality indictor)			✓		
Nitrogen loads (water quality indictor)			✓		
Climate change scenarios and impacts on corals					✓
SERVICES AND BENEFITS					
Commercial fisheries (kgs of catch)	Industry	✓	✗		✓
Commercial fisheries ($ sales value of catch)	Industry	✓	✗	✗	
Commercial fisheries ($ Gross operating surplus)	Industry	✓			
Commercial fisheries ($ consumer + producer surplus)	Households/ Industry				✓
Commercial fishing vessels (Number)	Industry	✓			
Commercial aquaculture Industry (kgs produced)	Industry		✗		
Commercial aquaculture ($ value of production)	Industry		✗	✗	
Fish nursery services (kgs)	Environment	✓	✓		
Fish nursery services ($ value)	Environment	✗	✓		

>>

		Case study location			
Data type	**User/ beneficiary of service**	**Geographe Bay Marine Park (WA)**	**Port Philip Bay (Vic)**	**Great Barrier Reef (Qld) (TEV)**	**Great Barrier Reef (Qld) (ES)**
Recreational fishing (kgs of catch)	Households	✓	✗		
Recreational fishing (estimate $ value)	Households	✗	✗	✗	
Recreational fishing (number of fishing trips)	Households	✓			
Recreational fishing ($ value of fishing trips)	Households	✗			
Recreational vessels (number fishing visits)	Households	✓			
Recreational fishing ($ consumer + producer surplus value)	Households/ Industry				✓
Visitors to park for various recreation activities (number people)	Households	✓	✗	✓	
Visitors to park for various recreation activities ($ value)	Households	✗	✗	✓	
Tourism (domestic visitor numbers)	Industry	✓			
Tourism (domestic visitor $ value)	Industry	✗			
Tourism (domestic visitor numbers)	Households			✓	
Tourism (domestic visitor $ value)	Households			✓	
Tourism ($ consumer + producer surplus value)	Households/ Industry				✓
Vessel stops/parking (numbers of vessels parking for specified lengths of time)	Industry/ Households	✓			
Vessel stops/parking ($ value)	Industry/ Households	✗			
Coral harvesting (tonnes)	Households/ Industry				✓
Coral harvesting ($ consumer + producer surplus)	Households/ Industry				✓

>>

		Case study location			
Data type	**User/ beneficiary of service**	**Geographe Bay Marine Park (WA)**	**Port Philip Bay (Vic)**	**Great Barrier Reef (Qld) (TEV)**	**Great Barrier Reef (Qld) (ES)**
Carbon sequestration (tonnes carbon sequestered)	Government	✓	✓		
Carbon sequestration ($ value)	Government	✓	✓		
Dinitrification/water filtration services (tonnes of nitrogen processed)	Government		✓		
Dinitrification/water filtration services ($ value)	Government		✓		
Other ecosystem services beyond tourism & recreation incl regulating and supporting services				✗	
Traditional Owner values ($ estimate)				✗	✓
Medicinal option values ($ value estimate)					✓
Storm surge protection values ($ value estimate)					✓
Non-use value to Australians ($ annual value estimated using contingent valuation method from survey data)				✓	✓
Non-use value to international residents ($ annual value estimated using contingent valuation method from survey data)				✗	
Scientific research values				✗	
CONTEXTUAL DATA FOR SERVICES/BENEFICIARIES					
Population within coastal LGAs		✓			

>>

		Case study location			
Data type	**User/ beneficiary of service**	**Geographe Bay Marine Park (WA)**	**Port Philip Bay (Vic)**	**Great Barrier Reef (Qld) (TEV)**	**Great Barrier Reef (Qld) (ES)**
MONETARY VALUE OF ASSET					
Non-use value to Australians ($ net present value estimated using contingent valuation method from survey data)				✓	
Non-use value to international residents ($ net present value estimated using contingent valuation method from survey data)				✗	
Direct use value to Australian tourists ($ net present value estimated using travel cost method from survey data)				✓	
Direct use value to international tourists ($ net present value estimated using travel cost method from survey data)				✗	
Direct use visitors to park for various recreation activities ($ net present value)				✓	

REFERENCES

Chen, W., K. A. M. Van Assche, S. Hynes, *et al*. 2020. "Ecosystem accounting's potential to support coastal and marine governance." Marine Policy ,112: 103758.

DELWP 2015, Valuing and accounting for Victoria's environment: Strategic Plan 2015-2020. Victoria, Australia

Deloitte Access Economics. (2017). At what price? The economic, social and icon value of the Great Barrier Reef. Deloitte Access Economics Pty Limited, Canberra, ACT, Australia https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-great-barrier-reef-230617.pdf

Eigenraam, M., McCormick, F. and Contreras, Z. (2016). Marine and Coastal Ecosystem Accounting: Port Phillip Bay. The State of Victoria Department of Environment, Land, Water and Planning, Melbourne, VIC, Australia https://www.environment.vic.gov.au/__data/assets/pdf_file/0025/49813/Marine-and-Coastal-Ecosystem-Accounting-Port-Phillip-Bay.pdf

IDEEA Group. 2020. "Synthesis report, Ocean accounting pilot for Geographe Marine Park". Institute for the Development of Environmental-Economic Accounting, Victoria, Australia https://eea.environment.gov.au/sites/default/files/2020-12/synthesis_report-gmp_ocean_accounts.pdf

Stoeckl, N., Condie, S., & Anthony, K. (2021). Assessing changes to ecosystem service values at large geographic scale: A case study for Australia's Great Barrier Reef. Ecosystem Services, 51, 101352. doi:10.1016/j.ecoser.2021.101352

United Nations *et al*. 2021. "System of Environmental-Economic Accounting – Ecosystem Accounting (SEEA EA)". White cover publication, pre-edited text subject to official editing. https://seea.un.org/ecosystem-accounting

Meet your knowledge holders

Diane Jarvis is a senior lecturer in Environmental Economics at James Cook University. Her research focuses on the interrelationships between the environment, the economy and society, seeking to inform economic and environmental policy decisions to promote both human wellbeing and improved land and sea management practices.

Vanessa Adams is an associate professor in conservation and planning at University of Tasmania. Her research focuses on understanding dynamic social-ecological systems to inform conservation decisions that improve ecosystems and the communities they support.

AUTHORS Diane Jarvis, Vanessa Adams, Swee-Hoon Chuah, Tim Langlois, Tracey Mahony, Matt Navarro, Emily Ogier, Gretta Pecl, Natalie Stoeckl

Marine and Coastal

National Environmental Science Program

Contact

Dr Diane Jarvis diane.jarvis1@jcu.edu.au

Dr Vanessa Adams vm.adams@utas.edu.au

www.nespmarinecoastal.edu.au

This project is supported with funding from the Australian Government under the National Environmental Science Program.