8. Marine Fauna

Key Findings

- Two approaches were tested to evaluate condition of selected marine fauna in two NRM regions: single species accounts and a surrogate measure of habitat condition.
- The two accounts describing the condition of populations of southern right whales and dugongs have demonstrated that single indicators of condition are sufficient for asset condition accounting when they also represent elements of vigour and resilience of the species.
- Surrogate measures of condition of marine fauna are more problematic as they require a detailed understanding of a range of ecological factors.
- Reference condition benchmarks were established using historical information based on species observations of populations in the NRM regions.

Introduction

Two regions, Natural Resources Eyre Peninsula and SEQ Catchments, provided marine fauna accounts. SEQ Catchments trialled two approaches in their assessment of marine fauna.

The two marine fauna accounts for specific marine species are examples of sensitive marine animals. Sensitive marine animals have protected status under the Commonwealth's EPBC Act and include species of sharks and rays, mammals such as whales, seals and dugongs, marine reptiles such as turtles and sea snakes, and seabirds. Measures of status and trends in abundance are often collected for such species because of their conservation interest or status. With the exception of these groups, and commercially exploited fish species, few marine fauna are monitored on a regular basis. Even with protected status, population monitoring is the exception rather than the rule.

Comparison of Approaches

Classification of Assets

Two regions provided species-level accounts. Natural Resources Eyre Peninsula contributed an account for the regional population of southern right whales at the head of the Great Australian Bight; and SEQ Catchments compiled an account for a regional population of dugongs in Moreton Bay.

SEQ Catchments also tested an approach for using marine habitat extent (seagrasses, saltmarsh, mangroves, and undisturbed beaches), to give an indication of the overall condition of all marine fauna in Moreton Bay.

Selection of Indicators

Indicators contributing to the marine fauna accounts are described in Table 52.

The most relevant indicator for measuring condition for these groups is relative abundance or depletion. The indicator 'female-calf pairs' for southern right whales was selected because it captured elements of vigour and resilience, by reflecting the current reproductive performance of the populations. Records of the actual numbers of the dugong and southern right whale populations were used to construct the accounts.

SEQ Catchments' marine fauna account is based on the surrogate indicator 'habitat'. The premise was that the presence of certain habitat types would mean the presence of area-specific fauna. The proposed composite index for the surrogate indicator of marine fauna habitat includes measures of habitat extent only, as measures of habitat quality were not available.

Table 52: Assets and indicators for Marine Fauna Accounts

REGION	Faunal groupings	Indicators of condition	Measure
Natural Resources Eyre Peninsula	Southern right whales at the head of Bight	Relative abundance	Number of mother-calf pairs
SEQ Catchments	Dugongs	Relative abundance	Population numbers
SEQ Catchments	Marine fauna	Habitat extent	Composite index [extent measures of seagrasses, saltmarsh, mangroves, undisturbed beach]

Table 53 provides a draft standard for indicator selection and data, developed as part of the trial, both to assist in compiling marine accounts and in evaluating the accounts (Sbrocchi and Smith unpub).

Table 53: Draft standard for indicator selection and data quality for marine fauna accounts

Accreditation Grade	Sensitive Groups (eg. Iconic Species)
5	• Depletion estimated from full time series of abundance and measured locally on a regular frequency (less than five years) • Reference measures are inferred from statistical techniques, with quantitative measures representing pristine populations
4	• Depletion estimated from full time series of abundance and measured locally infrequently (more than five years) • Reference measures are inferred from statistical techniques, with quantitative measures representing pristine populations
3	• Depletion estimated from full time series of abundance and measured locally infrequently (more than five years) • Value for reference inferred by experts
2	• Depletion estimated from a substantial period of time series of abundance • Value for reference inferred by experts
1	• Current abundance and reference condition both estimated by experts opinion
Not Accredited	• No attempt to define pre-exploitive reference condition

Estimation of Reference Benchmarks

Dugong population numbers were hind-cast by leading experts in the field, based on dugong diet requirements and the availability of food sources (see Manning 2014).

Reference benchmarks for southern right whale pairs were estimated by scientists using known relationships between local population sizes of southern right whales and global populations of that species, using contemporary and historical (pre-whaling) data (**Table 54**). This was based on several assumptions:

- Historical whaling activity and decline in populations were consistent across the global population
- Whale populations have recovered at equal rates around the world (7% increase) (Bannister 2001; International Whaling Commission (IWC) 2001)
- Southern right whales in Australia constitute 17% of the global southern right whale population (International Whaling Commission (IWC) 2001)
- Southern right whales at head of Bight make up 2.1% of the total Australian population (Poole and Wiebkin 2014). This proportion has been used to hind-cast a reference value for female-calf pairs.

Table 54: Sources of data used to derive reference benchmarks and trend for southern right whales in the Great Australian Bight

Metric	Historical pre-whaling	Regulated cessation of whaling (1978)	1997	2009	2010
Southern right whales world-wide	58,000#	300#	7,000#		
Southern right whales in Australia	15,000#	n.d.	1,200#	3,000*	3,500**
Female-calf pairs in head of Bight	315	1^	n.d.	63*	65**

** Bannister (2009), ^ Bannister (2001) , # International Whaling Commission (IWC) (2001), @ Bannister (2008), ** Bannister (2010)*

Data Sources and Analysis

Southern right whale data were sourced from a range of reports (Bannister 2001; Bannister 2008; Bannister 2009; Bannister 2010; Bannister 2014), PhD theses (Pirzl 2008) and whaling records (International Whaling Commission (IWC) 2001). This demonstrated the existence of an enormous amount of data, and the challenge of sourcing relevant data for the purposes of environmental accounts.

Dugong data were sourced from multiple institutions (Table 55), and the methods and indicators were judged to be similar enough for use in the accounts.

Table 55: Data sources for dugong population trends, Moreton Bay, Queensland (Manning 2014)

Survey year	Estimated population	Data source
1976	283	Lear (1977)
1977	210	Heinsohn (1977)
1979	307	Heinsohn and Marsh (1980)
1985	168	Marsh et al. (1990)
1988	458	Marsh (pers. comm)
1990	569	Preen (1993)
1993	664	Preen and Marsh (1995)
1995	1019	Lanyon (2003)
2001	493	Lawlor (pers. comm.)
2005	421	Marsh and Lawler (2006)

Calculation of Indicator Condition Scores

Indicator condition scores were measured as abundance relative to pre-impact abundance. This is referred to as depletion. Pre-impact abundance is the reference condition and corresponds in population terms to carrying capacity. In general, later abundance will be less than the carrying capacity due to human impacts, but some species might increase at times above carrying capacity at the time of pre-impact. This can occur for a number of reasons including natural population fluctuations and changes in food availability, or predation arising from other human impacts on the ecosystem. Both southern right whales and dugong populations have remained well below their reference condition in recent decades.

Indicator Condition Scores

Indicator condition scores for dugongs in South East Queensland (Table 56), whales in Eyre Peninsula (Table 57) and the marine fauna habitat (Table 58) were calculated by comparing population measures to the reference benchmark.

Table 56: Indicator Condition Scores (ICS) for dugongs in South East Queensland, showing the measures used to calculate the scores and the *Econds*.

DUGONGS	1750	1976	1977	1979	1985	1988	1990	1993	1995	2001	2005
Dugong population (count)	4,000	283	210	307	168	458	569	664	1,019	493	421
Indicator condition score	100	7.075	5.25	7.675	4.2	11.45	14.225	16.6	25.475	12.325	10.525

Table 57: Indicator Condition Scores (ICS) for whales in Eyre Peninsula, South Australia, showing the measures used to calculate the scores and the *Econds*.

SOUTHERN RIGHT WHALES	1750	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Female-calf pairs using head of Bight (number)	315	30	37	55	43	20	63	55	42	67	55
Indicator Condition Score	100	10	12	17	14	6	20	17	13	21	17

Environmental Condition Index (*Econd*)

Econds for dugongs and whales were each constructed from a single indicator. A single indicator for each species is appropriate when it is based on an actual survey or estimate of the number of individuals in a population. *Econds* were not calculated for the marine fauna habitat in the SEQ region because it required clearer articulation of the assumptions between habitat and marine fauna condition to make this surrogate appropriate (see **Supplementary Material 4**). An overall assessment of faunal status for a region would obviously be strengthened by assessing a range of species.

It is possible to compare *Econds* of the dugong population in the Moreton Bay with *Econds* of the southern right whale population in the Great Australian Bight (**Table 58** and **Figure 54**), because they are based on a common indicator (abundance) and use the same definition of reference condition.

Table 58: Indicator Condition Scores (ICS) for marine fauna habitat in South East Queensland and South Australia, showing the measures used to calculate the scores and the *Econds*.

Marine Fauna	1750	1987			2001			2002			2003			2006		
Habitat	Reference Benchmark	Measure	ICS	*Econd*	Measure	ICS	*Econd*	Measure	ICS	*Econd*	Measure	ICS	*Econd*	Measure	ICS	*Econd*
Habitat Index				90			80			80			61			72
Seagrass	30,000	27,085	90								18,392	61				
Mangroves	17,207				15,099	88		15,159	88					15,243	89	
Salt marsh	7,542				4,382	72		4,405	72					5,220	69	
Coral																
Undisturbed beach	1,874													1,095	58	

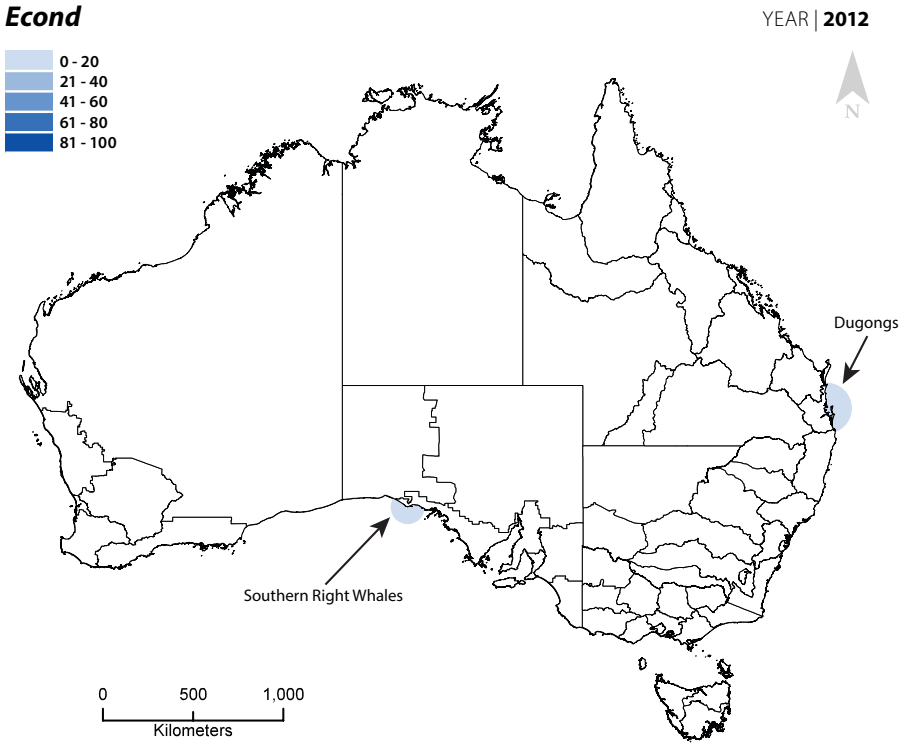

Figure 54: *Econds* for Southern Right Whales in Eyre Peninsula, VIC in 2012, and dugongs in SEQ Catchments, QLD in 2005

These two marine species accounts have been prepared using historical survey data which shows changes in the condition of these populations. **Figure 55** shows the change in abundance in the dugong population from the mid-1970s to the mid-2000s. It shows the population was highly depleted in the early 1970s (*Econd* less than 10, i.e. 10% of initial abundance), then partially recovered over the decade from 1985 to 1995 when the *Econd* reached 25, and then subsequently declined to 11 in 2005. The *Econd* for southern right whales (**Figure 55**) used data on abundance collected since the early 1990s, also expressed relative to pre-exploitation abundance. The increasing trend for the recent period, against a pattern of significant seasonal variation, highlights the ongoing recovery of Southern Right Whales since commercial whaling was banned in the 1960s. This trend at the head of Bight also reflects the global trend for this species, growing at an average annual rate of increase of about 7% (Bannister 2001; International Whaling Commission (IWC) 2001).

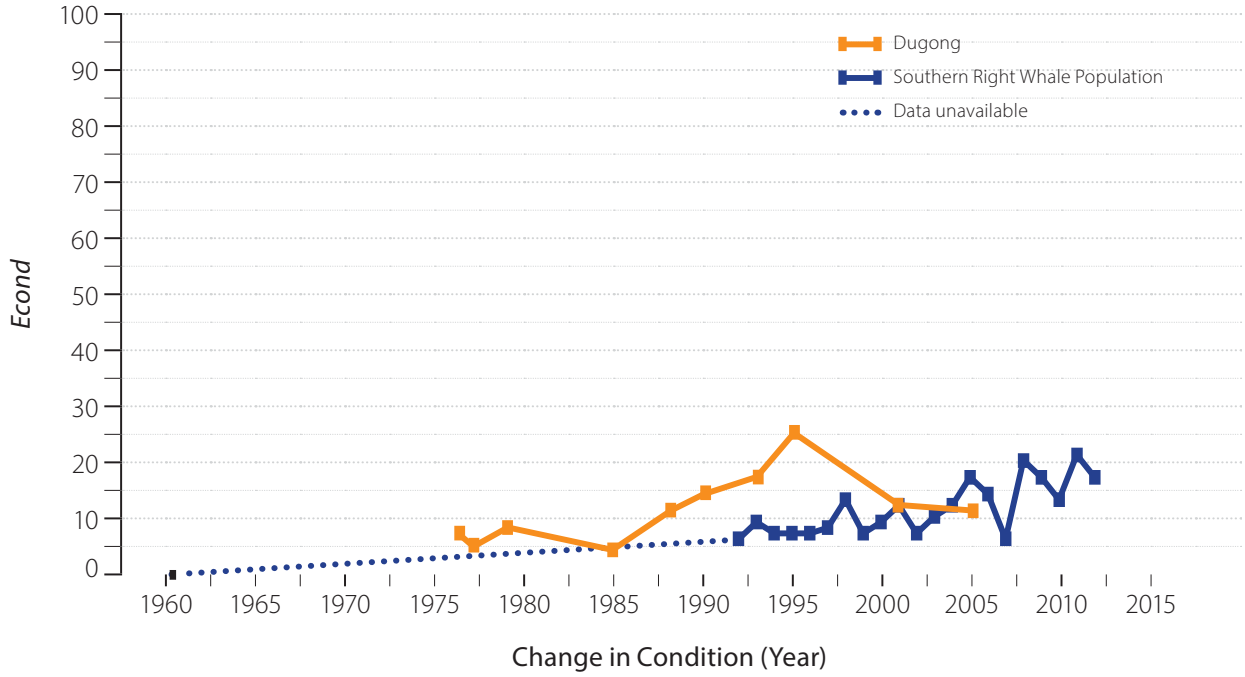

Figure 55: Condition of dugongs in Moreton Bay, Queensland (1976-2005) and Southern Right Whales in the Great Australian Bight, South Australia (1992-2012).

Figure 56 shows the same information presented as a longer times series to highlight the magnitude of changes in population of southern right whales since European settlement. The *Econd* of 100 in 1788 is established by the definition of the reference benchmark (see Glossary), and the *Econd* of 0 from the early 1960s is known from historical accounts. The trend from 1788 is speculative, and it is likely the depletion was much more rapid, followed by a long period of very low abundance.

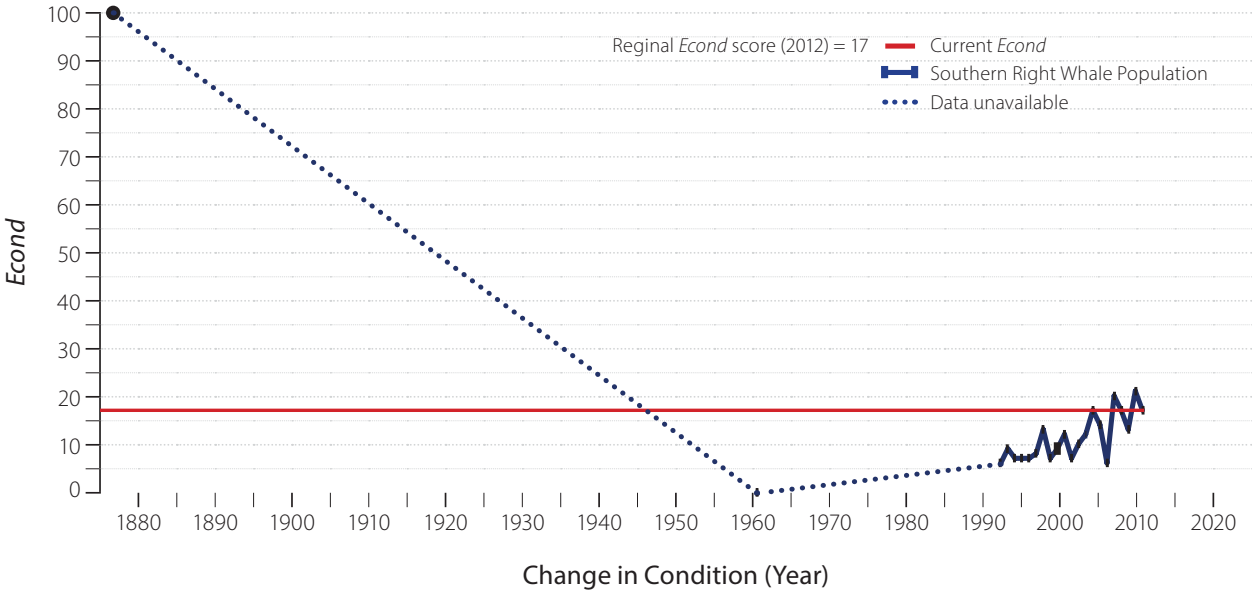

Figure 56: Trend in condition of Southern Right Whales in the Eyre Peninsula, 1788-2012.

Discussion

Econds for the two species of marine fauna in the Eyre Peninsula and SEQ Catchments regions were based on a single indicator condition score. Single indicators of marine fauna (dugong numbers and whale female-calf pairs) are an appropriate measure of condition because they are based on an actual survey or estimate of the number of individuals in a population.

The other broader accounting approach attempted in SEQ Catchments to describe the overall condition of marine fauna in the region involved using a surrogate indicator of habitat extent, comprising indicators of seagrasses, saltmarsh, mangroves and beaches. This is based on a conceptual link between the presence of habitat types and the presence of marine fauna. A similar measure of habitat quality formed the underpinning expert assessment of marine fauna condition ('biodiversity') in the 2011 *Australia State of the Environment* report (State of the Environment Committee 2011). This type of indicator was not accredited for the condition account in this trial (see **Supplementary Material 3**), but has promise in contributing to a marine fauna measure as it gives an indication of the potential carrying capacity of the marine ecosystem for habitat-dependent fauna.

The use of a habitat indicator relies on expert interpretation of information to ensure that the subsequent *Econds* reflect quality as well as extent measures. This is because marine fauna has complex dependencies on environmental conditions and on anthropogenic impacts that affect other aspects of condition besides extent. Marine scientists may be able to utilise this type of measure towards an expert elicitation process for assigning marine fauna condition scores. In the future, it may be more useful to adopt 'habitat defining groups' as a marine asset (Sbrocchi and Smith unpub). This asset may include coral reefs, rocky reefs, algal forests and seagrasses. If coastal habitat is of interest to managers, this asset may include saltmarsh, beaches, seagrasses and mangroves.

Conclusions

Data are already available for measuring condition for iconic marine species around Australia, although long and consistent time series are rare. New methods are under development to assess the population status of rare and protected species, including novel techniques such as close kin genetics. These are likely to increase the range of species that could be included in regional assessments. Furthermore, long term fauna population surveys provide opportunities for citizen science and other forms of community participation in regional environmental accounting.

The *Econd* used in the two regions is based on the same indicators – they both measure relative abundance (population level relative to un-impacted levels). This is a very useful measure as it is (relatively) easily determined for a broad range of species, and its interpretation is consistent, allowing for aggregation across species and comparison across regions. Species abundance can also be compared directly with results for commercially exploited species such as fish stocks.

The two methods used to determine reference status for individual species proved to be an important step in assessing condition. Determining population status, in some cases hundreds of years before surveys were undertaken, can be challenging, but a range of methods are potentially available. However, this information provides a greater appreciation of the relative condition of the species, which population numbers alone are not able to provide. This greatly enhances community understanding of the conservation status of the species.

The ability to compare *Econds* between dugong populations in one region with southern right whale populations in another region also produces clear benefits for policy makers. The two accounts show that while relative population numbers were similar in the 1980s, the southern right whale population is now three times greater and improving when compared to the population of dugong, which appear to be in continuing decline. The cessation of harvesting and other protective measures (such as protected calving areas at the head of Bight) have clearly been effective for the whales, while dugongs appear to be increasingly endangered from ongoing habitat deterioration, particularly extent of seagrass and various anthropogenic impacts.

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