Monitoring wilderness as a social value in WA marine parks

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Executive summary

Wilderness and seascape have been identified as important social values for marine parks in Western Australia and appear in a number of approved marine park management plans. Ways of monitoring them, however, remain elusive.

This report reviews global and Australian approaches to defining 'wilderness' values and determines their relevance for use by the WA Department of Parks and Wildlife. It also recommends operational protocols for characterising, measuring and monitoring 'wilderness' with respect to the condition-pressure-response framework of the current Western Australian Marine Monitoring Program.

Material sourced nationally and internationally regarding the management of terrestrial wilderness informed the recommendations that follow. A heavy reliance on terrestrial wilderness research and practice was necessary because the idea of wilderness in marine protected areas has received virtually no attention to-date. Particularly useful were the methodologies and indicators deployed by the National Wilderness Inventory in Australia in the early 1990s and the wealth of research conducted in the United States over the last three decades into wilderness quality and particularly wilderness experiences and solitude. Based on this material and an understanding of current practices within the WA Department of Parks and Wildlife the following recommendations are made.

RECOMMENDATION 1. Use the following definition for wilderness areas in the WA marine reserve system.

A marine wilderness in Western Australia is a relatively undisturbed seascape, predominantly free of direct and indirect human impacts and industrialization, including but not limited to above and under water noise, light pollution, facilities, roads and permanent structures (onshore and offshore), and should be capable of remaining as such through effective management. Visitors to these areas should be able to experience solitude, largely determined by seeing few other people.

Such wilderness areas should also be of a size and distance from human habitation and disturbance to support natural processes and biodiversity in the long-term. The Department's Policy Statement 62 *Identification and Management of Wilderness and Surrounding Areas* suggests a minimum size threshold of 8,000 ha in temperate areas and 20,000 ha in arid and tropical regions for terrestrial wilderness areas. These sizes could be provisionally used for marine wilderness.

The cultural rights and interests of indigenous Australians regarding their traditional and cultural use should be fully incorporated in governance and management.

RECOMMENDATION 2. Use a two-tiered approach to monitoring wilderness in WA's marine parks, with Tier 1 addressing the location, boundaries and area of wilderness, and Tier 2 monitoring the quality (i.e. condition) of the wilderness. For terrestrial wilderness this quality is often regarded as dependent on remoteness, solitude and naturalness. Use existing data and methodologies wherever possible.

The information required for Tier 1 can be obtained from existing data sets, many of them spatial and available digitally (e.g. remoteness from settlement; remoteness from roads, tracks and marine infrastructure). Tier 2 monitoring will require periodic visitor surveys to determine what attributes of wilderness quality are important to visitors and how well these attributes are performing. With minor modifications, the Department of Parks and Wildlife's standardised questionnaire-based visitor survey would be a suitable survey instrument, allowing the importance and performance of key attributes of wilderness quality to be monitored. Candidate attributes include visitors' perceptions of: noise; number of people; boat traffic; human-made structures; remoteness; and 'naturalness'. Collectively these attributes would be expected to capture wilderness quality.

RECOMMENDATION 3. Progress field testing and review of the approach to monitoring marine wilderness recommended in this report in consultation with marine park staff, planning branch, the Marine Parks and Reserves Authority and Conservation Commission (given their policy and audit role with respect to KPIs), and the Social Research Unit.

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1. Project brief/scope

This desk top study is a response to a request by the WA Department of Parks and Wildlife to:

AIM 1. Review global and Australian approaches to defining 'wilderness' values and determine their relevance for use by the WA Department of Parks and Wildlife.

AIM 2. Characterise Western Australian marine park specific stressor pathways on 'wilderness' so that representative, sensitive, scientifically defendable, cost effective, practical and systematic condition and pressure metrics can be identified for use in long term monitoring of 'wilderness' values in Western Australia.

Wilderness and seascape have been identified as important social values for marine parks in Western Australia, and appear in a number of approved marine park management plan, however, ways of monitoring them have remained elusive. This report addresses wilderness values. It tackles an urgent need identified in the WA Department of Parks and Wildlife Science Project Concept Plan *Monitoring 'Seascapes' and Wilderness' as Social Values in Marine Parks* (unpublished, dated November 2013). Concept Plans identify topics of high research and management priority for the Department.

The following specific outputs were requested:

OUTPUT 1. Recommended operational protocols for characterising, measuring and monitoring 'wilderness' by the Western Australian Marine Monitoring Program (WAMMP) in WA marine parks.

OUTPUT 2. A case study from one or more marine parks, that shows the process for identifying areas where high value 'wilderness' values exist, and how monitoring should be initiated and conducted through time.

This technical report addresses Aims 1 and 2, and Output 1. Follow-up research conducted in close collaboration with marine park managers and other specialist staff in the Department of Parks and Wildlife will be required to achieve Output 2. This report, through providing Output 1, will significantly progress activities towards achieving Output 2. Material for this review was sourced from peer-reviewed international literature, books, reports and approaches taken by other protected area agencies (generally accessed via agency websites).

2. The history of wilderness

When looking back around 250 years in European (including American) history, wilderness was a place that was 'savage', 'desolate' and 'barren' and inspired feelings of 'terror' and 'bewilderment' (Cronon, 1996). Prior to this, many of the strongest associations of the word were biblical, for example Moses and his people wandered in the 'wilderness' for forty years and the 'wilderness' was where Christ struggled with the devil and endured temptation (Cronon, 1996).

This view shifted during the 19th century, particularly in the United States of America. Increasingly, people wanted to go and see areas of 'wild beauty' for themselves (Cronon, 1996; Holden, 2008). In turn, areas of perceived environmental importance began to be given official recognition. For example, Yosemite National Park was declared the world's first official national park in

1872, with others following not long after (including NSW's Royal National Park which was the world's second official national park) (NSWNPWS, n.d.). Along with these legislative changes, pioneers in the field of 'environmentalism' such as Henry David Thoreau, Aldo Leopold and later, Rachel Carson, drew attention to the reasons 'wilderness' should be valued and protected, rather than feared (Carson, 1999; Leopold, 1970; Thoreau, 1862).

Traditionally, land managers have been averse to designating wilderness areas, with an often-cited reason being reduced commercial and hence economic opportunities due to the exclusion of motorised transport from wilderness areas (Power, 1996). Economic disadvantage, however, is not necessarily the case. Lands with wilderness qualities are relatively scarce and can provide a 'classic' economic opportunity by allocating a scarce resource to meet human objectives, such as recreation and nature experiences (Power, 1996). Other benefits of wilderness areas can include ecosystem services, such as provisioning services (biodiversity, water, food etc.) and regulating services (regulation of climate and waste treatment, ecosystem processes) (Kosoy & Corbera, 2010; MEA, 2005).

3. Defining wilderness

There is a diverse range of definitions for wilderness, however, common themes are evident including remoteness, naturalness, solitude and a lack of, or limited, facilities (Dudley, 2008; Higham, 1998; Kliskey, 1998; Kliskey & Kearsley, 1993; Sloan, 2002) (Appendix 1). The IUCN assign terrestrial wilderness areas as a Category Ib protected area (Dudley, 2008).

Newsome and Lacroix (2011) describe three main perceptions that constitute a 'natural' experience, namely visual, audible and olfactory traits, and suggest activities or features that detract from them (Table 1). It should also be noted that people's perception of what a natural or wilderness area is will depend on their understanding and perceptions of nature and naturalness, as well as their education level, life experience, cultural background, and their hobbies and interests (Newsome & Lacroix, 2011).

3.1 United States of America – wilderness definition

Many wilderness managers and researchers use definitions derived from the *Wilderness Act 1964* (USA) (Bergstrom et al., 2005; Day et al., 2012; Hobbs et al., 2009; Leung & Marion, 2000; Manning & Anderson, 2012) (Appendix 1). The *Wilderness Act 1964* (USA) states:

> A wilderness […] is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

Table 1. Characteristics of a 'natural experience' and possible detractors

Perception of the natural environment	Characteristic of a natural experience	Detracting features and activities
Visual	Natural vegetation Native wildlife Unmodified streams, rivers and wetlands Natural coastlines Wilderness landscapes Night sky Aurora	Obtrusive buildings and structures, cleared areas, plantations, pipelines, electricity pylons, wind turbines, eroded areas, presence and spread of exotic species, presence of domestic animals, nutrient enriched algal blooms, litter, road kill, bright lights, lighting from buildings
Auditory	Bird song, dawn chorus, frogs during their breeding season, calls at bird colonies, cicadas, communication amongst mammals (lions, gibbons, lemurs, wolves)	Excessive vehicle noise, motorised boats, aircraft, generators, loud talking at hides, loudspeakers/shouting, music, machinery (chain saws), car alarms, dogs barking
Olfactory	Natural ecological processes: vegetation, wildflowers, humus, seashores	Decay from nutrient enriched algal blooms/polluted water, exhaust fumes from vehicles

Note: Perceptions of the natural world are primarily visual and auditory. Some stimuli are more significant in some settings than others. For example, the sound of gibbons in an Asian rainforest, (auditory), wildflowers in Western Australia (visual and olfactory) or landscapes in Antarctica (visual). In volcanic landscapes the olfactory and auditory stimulus of a fumerole can mirror that of an urban environment except that it is the combined experience of landscape and the sense of wildness and authenticity of the volcanic landscape (environmental context) that combines to provide a natural experience.

(Newsome & Lacroix, 2011, 320)

3.2 Marine definitions of wilderness

The designation and management of marine protected areas has lagged behind terrestrial conservation efforts and borrows both ideals and practices from terrestrial protected areas (Barr et al., 2014; Shafer & Benzaken, 1998; Sloan, 2002). Marine definitions of wilderness predominantly use wording that could be used in a terrestrial setting and adopt a preservationist or no-take stance (Davis, 1999; Sloan, 2002).

Difficulties in applying the concept of wilderness to the marine environment relative to its application in the terrestrial environment were noted in Day et al.'s (2012) report for the International Union for Conservation of Nature *Guidelines for Applying the IUCN Protected Area Management Categories to Marine Protected Areas*. They noted that if a marine area is "relatively undisturbed and free from human influences, qualities such as 'solitude', 'quiet appreciation' or 'experiencing natural areas that retain wilderness qualities' can…be achieved by diving beneath the surface" (Day et al., 2012, 20). In coastal settings with tourism opportunities wilderness areas can be fragile and difficult to manage due to crowding and damage to natural features (Rollins, 1998).

3.3 Wilderness in Australia

The National Wilderness Inventory was initiated by the federal government in 1986 to assist wilderness conservation and management planning. The first handbook (*National Wilderness Inventory Handbook of Principles, Procedures and Usage)* was published in 1993. The National Wilderness Inventory (NWI) relies wilderness quality as a key measure. Variation in wilderness quality across the landscape has been mapped using four wilderness quality indicators – remoteness from settlement (i.e. from places of permanent occupation), remoteness from access (i.e. from established access routes), apparent

naturalness (i.e. degree to which the landscape is free from the presence of permanent structures associated with modern technological society – distance from roads and cleared land boundaries selected), and biophysical naturalness (i.e. the degree to which the natural environment is free from biophysical disturbance caused by the influence of modern technological society – grazing and logging were the disturbance agents selected) (Lesslie & Maslen, 1995). The associated wilderness mapping exercise in the early 1990s relied solely on pre-existing spatial data to source information on the four quality indicators. These data were spatially collated to provide a wilderness quality index with scores ranging from 0 to 20, with 20 for the highest quality areas.

In 1988, the Land Conservation Council of Victoria was tasked to conduct a special investigation into wilderness in Victoria. In their search for a definition of wilderness, they acknowledged that unifying themes across definitions of wilderness were a particular environmental setting characterized by remoteness, naturalness and being essentially unmodified. The definition the Land Conservation Council settled on was "a large area with landforms and native plant and animal communities relatively unaltered or unaffected by the influence of the European settlement of Australia" (Land Conservation Council, 1991, 4). Mackey et al. (1998) identify that there must also be a distinction between wilderness quality and wilderness areas. They define wilderness quality as "the extent to which any specified unit area is remote from and undisturbed by the impacts and influence of modern technological society" (Mackey et al., 1998, 2). Wilderness areas however, "are places where wilderness quality is recognized and valued by society and are defined using arbitrary thresholds of remoteness, naturalness and total area" (Mackey et al., 1998, 2).

The Australian High Court overturning the idea of Australia as *terra nullius* (an 'empty' country) in 1992 had significant implications for wilderness. It opened up the debate in Australia (that was also underway elsewhere) about the 'place' of indigenous people in wilderness areas. The Australian Conservation Foundation (ACF) played a leading role in the subsequent discussions and provided a careful definition of wilderness embracing indigenous, recreational and biodiversity interests. In terms of indigenous people, the ACF (1999) noted that much of the land regarded as wilderness has been used or occupied by indigenous Australians for millennia. In terms of the wilderness experience, such areas should be free of, and often remote from, any "land use activities, infrastructure and related features associated with modern technological society" (ACF, 1999, 1). For biodiversity, acknowledgement of the great age of the lands and waters of Australia, having provided an evolutionary environment resulting in a wealth of unique plants and animals, sees wilderness areas acting as critical reservoirs for biodiversity.

4. The characteristics of wilderness

The identification of wilderness quality, determining wilderness areas, and managing to achieve wilderness values are all essential tasks for land managers. Although there is overlap between these categories they are widely used to help identify, describe and categorise wilderness.

4.1 Wilderness quality

Wilderness quality is used in the Australian NWI as the key measure. It encompasses remoteness and naturalness (Lesslie & Maslen, 1995). The first is

relatively easy to measure using pre-existing spatial data on the distance from settlements and roads. The second is much more difficult with the NWI process using creative surrogates for naturalness such as the extent of stock grazing and forest logging to reflect (lack of) naturalness.

4.2 Wilderness areas

A number of different approaches can be used to identify wilderness areas. Four of the most common approaches are briefly overviewed below.

a) Objective and perceived wilderness

McKenry (1980) describes two ways of distinguishing wilderness areas. 'Objective wilderness' areas have to satisfy certain physical and environmental criteria, for example, a minimum core area of 25,000 ha and a core of at least 10 km in width. This approach is exemplified by the Australian NWI methodology.

'Perceived wilderness' is based on the subjective criteria of individuals and as such, may differ to locations identified as objective wilderness areas in some cases (McKenry, 1980). A growing body of work is using Public Participation GIS to obtain societal perceptions of the location of wilderness values. Recent studies have used a web-based GIS platform available to the public to locate wilderness, for example for Kangaroo Island, South Australia (Brown & Weber, 2012) and most recently for the state of Victoria (Brown & colleagues, in prep., as of June 2014). Of interest, areas that people perceive and map as having wilderness values may not align with 'objectively' delineated wilderness areas (McKenry, 1980).

b) Management factors

Management factors can also be used to classify, design and manage wilderness areas, using frameworks such as the Recreation Opportunity Spectrum (ROS) (Table 2). The ROS was developed to try and mitigate the adverse effects of increasing levels of use on both the environment and visitors' experiences. It enables managers to identify a number of opportunity classes, from wilderness (labeled 'primitive' in Table 2) through to developed classes/areas. Areas can then be managed, by manipulating physical, social and managerial factors, to create a range of recreation experiences while at the same time protecting important elements of the natural environment (Newsome et al., 2013) (Table 2).

The ROS has been applied worldwide to identify opportunity classes, the features of each class (described using physical, social and managerial factors) and then associated management needs. A New Zealand application suggests additional site attributes that can contribute to identifying opportunity classes, including wilderness (Figure 1) (Kliskey, 1998).

Table 2. Recreation opportunity classes with 'primitive' equating with 'wilderness'

Management factors	*Classes*			
	Primitive	*Semi-primitive*	*Roaded natural*	*Developed*
Physical				
Access	No motorised use	No motorised use	Motorised use and parking	High levels of motorised use and parking
Remoteness/ naturalness	Remote and completely natural	Completely natural	Appears predominantly natural	Natural background, site dominated by modification
Size	Large	Moderate	No size criteria	No size criteria
Social				
Contacts with other visitors	Few contacts	Low to moderate	Moderate along roads and tracks	High to very high along roads and tracks and at developed sites
Acceptability of visitor impacts	Not acceptable	Minor impacts accepted	Moderate impact in specific areas, such as campsites, accepted	Substantial impacts evident and accepted
Managerial				
Level of site development	No site development, no structures	Natural-appearing setting, structures rare and isolated	Roads, site facilities for comfort and security	Roads and site facilities for intensive use including resorts
Regulation	No on-site regulation, reliant on self-policing	On-site regulation if present, subtle	Moderate regimentation/ regulation via site design and signs	Controls obvious and numerous via design, signs and staffing
Example				
Natural area tourism site	'Wild' campsite in a wilderness area	Designated site for hikers in a national park	Campsite/ picnic area in most national parks	Built accommod-ation/interpret-ation centre/ resort village in or adjacent to a natural area

(Newsome et al., 2013, 213)

c) Classical versus romantic wilderness

The "classical perspective" of wilderness is a view that sees the creation of livable, usable spaces, such as urban areas, as a mark of civilization and progress (Holden, 2008). Wilderness is untamed and dangerous, and regarded as uncivilized.

On the other hand, the "romantic" approach is one in which untouched spaces have the greatest value, with wilderness assuming deep spiritual significance (Holden, 2008). This romantic approach, which was reflected in changing societal perceptions of terrestrial and coastal areas, particularly during the 18th and 19th centuries, was accompanied by the middle and upper classes visiting such areas for reasons of health and recreation.

Management factors	Range of recreational opportunity setting classes				
	Urban	Rural	Backcountry	Remote	Wilderness
1. Access					
Roads	sealed	gravel or dirt			
Tracks	maintained track		unmarked route		
Conveyance	car	horse	feet		
2. Nonrecreation resource	compatible on a large scale	depends on nature and extent			incompatible
3. Onsite management					
Extent	very extensive	moderate extent			none
Obviousness	very obvious	natural-appearing			none
Complexity	very complex	not complex			none
Facilities	many facilities	occasional			none
4. Social interaction	frequent	occasional	infrequent		none
5. Acceptability of visitor impact					
Magnitude	high degree	moderate degree			none
Prevalence	prevalent over broad area	prevalent over small areas			none

Figure 1. ROS class descriptions for Nelson, New Zealand (Kliskey, 1998, 83)

d) Continuum of wilderness

This concept looks at wilderness consisting of two key attributes, namely naturalness and freedom from human control (Aplet et al., 2000) (Figure 2). These qualities describe two independent qualities of wilderness and wilderness acts as a function of them both. As Aplet et al. (2000) explain it, the wilderness manager's job is to manage these characteristics simultaneously, which is where difficulties and trade-offs can occur.

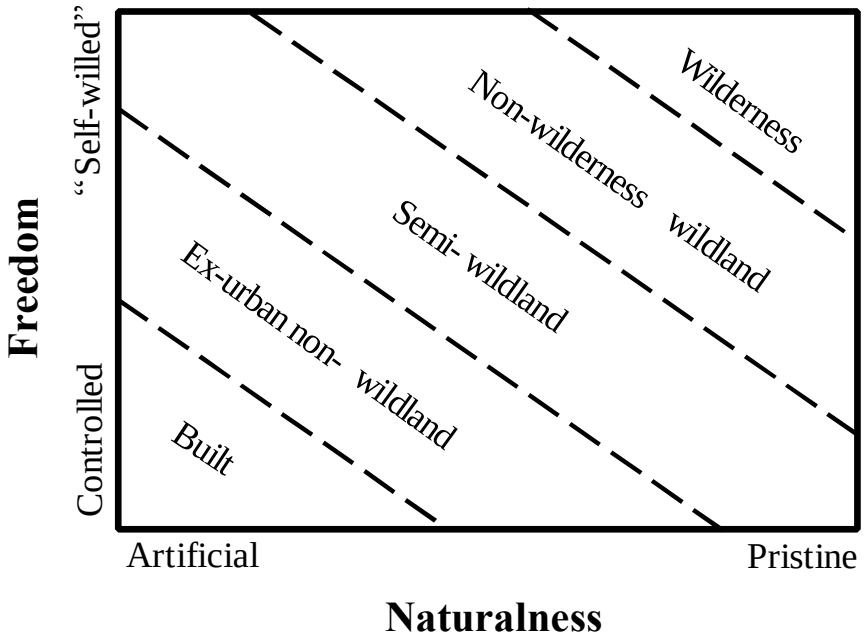

Figure 2. The continuum of wilderness (Aplet et al., 2000, 3)

4.3 Wilderness values

Remoteness, solitude and naturalness are key values for wilderness mentioned in the literature (Appendix 2). While a value such as remoteness can be measured objectively (such as distances from fixed infrastructure or noise and/or light pollution), others such as solitude require subjective measures based on human perceptions (e.g. tolerance to crowding, visitor satisfaction).

a) Remoteness

Remoteness can be defined as possessing no means of mechanical transportation and free from mechanical sights, sounds & smells (Aplet et al., 2000; Lesslie & Maslen, 1995). In other words, wilderness areas should be free of roads and any types of mechanised transport (with the exception of fire and emergency services) (Aplet et al., 2000; CALM, 1991).

b) Solitude

Solitude in natural areas refers to a lack of visual and audible human presence (Sloan, 2002) and is mentioned by numerous authors as a key value for wilderness (Aplet et al., 2000; CALM, n.d.; Day et al., 2012; McCool et al., 2007; Rollins, 1998). Perceptions of solitude are influenced by the number of people seen (Hall, 2001). Solitude can be determined using a variety of measures including number of encounters with other people (at a site or while travelling), noise and light pollution (above and below the water), and a lack of technological access (i.e. phone and internet) (Aplet et al., 2000; Davis & Tisdell, 1995; Newsome et al., 2013; Rollins, 1998; Tasmanian Parks and Wildlife Service, 1999). All three measures can be undertaken objectively, for example, by counting the number of people in a wilderness area, or subjectively, for example by asking people for their perceptions regarding crowding, pollution and access to telecommunications (Manning, 2011).

For marine wilderness, there is the added opportunity and complexity that solitude can be achieved (or lost) by diving under the water (Day et al., 2012). Thus, there is the opportunity for 'solitude' to be achieved and managed for above and below water in marine wilderness areas. Barr et al. (2014) from their survey of wilderness professionals identified solitude as one of the top five attributes for marine wilderness.

Measuring solitude has proved to the easiest way of accessing and trying to understand the 'wilderness experience'. This has been achieved in wilderness research and management through measuring 'crowding' (the opposite of solitude) (Manning, 2011). Visitors are asked, via a questionnaire, to self-report on how many people they have seen at a particular site or along a particular trail and then to ask them how many they would have preferred to have seen (Manning, 2011; Newsome et al., 2013). These preference data can then be used to determine a crowding threshold, that is, the number of visitors beyond which crowding becomes unacceptable.

Although relatively easy to measure, crowding has, however, provided limited insights to defining, understanding, and measuring the quality of the wilderness experience. Borrie and Bizrell (2001) address the ongoing problems in defining and measuring wilderness quality in their review chapter *Approaches to Measuring Quality of the Wilderness Experience.* They

summarise four main approaches to measuring quality of the wilderness experience. The first is 'satisfaction' approaches that rely on visitors' perceptions of onsite conditions. The WA Department of Parks and Wildlife has a comprehensive system in place for collecting this information, via questionnaires administered by district staff. Such data can also be interrogated by managers using importance-performance analyses to help determine where management resources are most needed (Moore & Taplin, 2014; Tonge & Moore, 2007; Wade & Eagles, 2003). Measuring crowding fits within this suite of approaches.

The second is a 'benefits-based' approach, where the interest is psychological outcomes from visiting wilderness. The link between the setting and psychological outcomes is still being investigated so this approach is largely in the research rather than management domain. 'Experience-based' approaches, the third set of approaches, are also more in the research than management domain, but do provide important insights into how all elements of a visit (pre-, during and post-visit to a wilderness) influence the holistic experience. These approaches also emphasis the importance of both cognitive and affective (emotional) elements of visiting a wilderness. The fourth set, of meaning-based approaches, has an even broader basis than an experience-based approach, through a focus on the role of wilderness in peoples' lives.

c) Naturalness and natural processes

Although it can be argued for these to be defined independently, they are used interchangeably in many circumstances and for the purposes of this report have been combined. As illustrated in Figure 2, naturalness has been described as one of the key attributes of wilderness, with the gradient of naturalness ranging from artificial to pristine (Aplet et al., 2000). The assumption that wilderness areas maintain their naturalness and natural processes is supported across the literature (Bergstrom, 2005; Barr et al., 2014; Liquete, 2013; NSWDECC, 2008; Sloan, 2002), with Aplet et al. (2000) describing naturalness as a function of three criteria; the degree to which an area maintains its natural composition, the degree to which it remains unaltered by human-made structures, and the degree to which it is unpolluted.

5. Wilderness in Western Australia

5.1 Wilderness in WA parks

A commitment to wilderness by the WA government is evident in the *Kimberley Science and Conservation Strategy*, released in 2011, with the Kimberley Wilderness Parks described as the 'centrepiece' (Department of Parks and Wildlife, n.d.). Within the WA *CALM Act 1984*, wilderness is mentioned twice (Part V Division 2 Section 62 (1) and Part VIII Division 2 Section 98 (1) a ii), however, it is not defined. In CALM's Policy Statement 62, *Identification and Management of Wilderness and Surrounding Areas*, wilderness quality, wilderness area and wilderness values are all clearly defined (Appendix 1). This Policy Statement appears to have been strongly influenced by the NWI.

'Wilderness quality' is determined by remoteness and naturalness, with the Policy Statement relying on the NWI as the national standard for measuring

quality. According to Policy Statement 62 'wilderness areas' will have a wilderness quality rating of 12 or more (on the scale of 0 to 20, as per the NWI) with a minimum size threshold of 8,000 ha in temperate areas and 20,000 ha in arid and tropical regions. 'Wilderness values' are somewhat vaguely defined in this Policy Statement as attributes to be protected from the impacts of modern technological society.

5.2 Wilderness in WA management plans

According to DEC's *Management Planning Manual* (2009),[1] wilderness areas should meet the NWI criteria for such areas, with wilderness quality mapped within the planning area by the Information Management Branch. The first WA terrestrial management plan completed by the Department of Parks and Wildlife (i.e. by its predecessor the Department of Conservation and Land Management) to comprehensively define and describe wilderness was the *Fitzgerald River National Park Management Plan 1991-2001.*

Within this plan, wilderness is defined as "essentially an undisturbed area or a 'window into the past' where management intervention is kept to an absolute minimum and the number of visitors is low because of the area's remoteness and where visitors travel on foot" (CALM, 1991, 20). Wilderness quality is described as "the extent to which land or water is remote from, and substantially undisturbed by, the influence of modem technological society" (CALM, 1991, 20).

In terms of marine parks, currently three of the eleven extant marine parks include wilderness as a social key performance indicator (Table 3), with each plan providing a slightly different definition (Table 4). Methods for monitoring wilderness values in marine parks are not included in these plans; the need to provide and implement these methods provided the impetus for this report.

6. Wilderness designation and monitoring in marine protected areas: available and potential indicators

Although wilderness is mentioned in a marine management plans for protected areas in handful of Australian states, none of these plans provide recommendations regarding its monitoring (Tables 3 & 4).[2] Two of the Western Australian management plans give an indication of what wilderness might entail.

[1]This manual is currently being revised.

[2] This conclusion was reached following a review using Google Scholar, based on various combinations of the terms 'coastal', 'marine', 'protected area', 'wilderness' and 'management plan'. Australian marine protected area management plans were also individually searched via the relevant agency websites.

Table 3. Social values of WA marine parks

Social	Seascapes	Wilderness	Aquaculture & pearling	Coastal & island use	Commercial fishing	Education	Indigenous & European heritage	Maritime heritage	Nature-based tourism	Recreational fishing	Recreational water sports	Scientific research	Mineral and petroleum development	Ports & shipping
North Kimberley MP		✓	✓		✓		✓		✓	✓		✓	✓	
Camden Sound MP			✓		✓		✓		✓			✓	✓	
Horizontal Falls MP														
Roebuck Bay MP (not intertidal)	✓		✓		✓		KPI	✓	✓	✓		✓		
80 Mile Beach		KPI			✓		✓		✓	✓		✓	✓	
Rowley Shoals MP	KPI	KPI							✓	✓	✓	✓	✓	
Montebello/Barrow MR			✓		✓			✓	✓	✓	✓	✓	✓	
Dampier Arch. MR	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓		✓

Ningaloo MR	KPI	KPI		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Shark Bay MR	KPI			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Jurien Bay MP	KPI		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Marmion MP	KPI			✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Shoalwater Islands MP	KPI		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Swan Estuary MP	✓			✓	✓	✓	✓		✓	✓	✓	✓		
Walpole and Nornalup MP	KPI					✓	✓		✓	✓	✓	✓		
Capes MP	✓				✓	✓	✓	✓	✓	✓	✓	✓		

(Extant plans are in black font, proposed plans are grey) (Source: K. Friedman, personal communication, 11 February 2014).

The Rowley Shoals management plan describes wilderness as 'A remote and isolated location with minimal infrastructure and low visitor levels provides a wilderness experience for visitors." The Ningaloo plan describes "Areas of secluded coastline and remote coastal waters offer opportunities for remote experiences that are integral to the Ningaloo experience."

Table 4. Analysis of the inclusion of wilderness in Australian marine protected area management plans

State / Territory*	Plans mentioning wilderness	Plans measuring wilderness
Commonwealth	0	0
SA	6	0
NT	0	0
Qld	0	0
Vic	12**	0
NSW	1	0
Tas	Tas has marine reserves but no individual management plans were available online	0

* See Table 3 for WA details

** Vic has the 'Wilderness Coast Walk' referred to in numerous plans, but they have no KPIs for measuring 'wilderness'

A number of United States marine sanctuary plans mention wilderness, but this is predominantly in the context of the *Wilderness Act 1964* and none of them use its condition or other facets of its management as a key performance indicator. The same conclusions were drawn from examinations of marine management plans from the United Kingdom, Spain and Italy. The use of the term 'seascape' tended to be more common then 'wilderness' among plans searched (e.g. in the *United Kingdom Marine Policy Statement*), however this was not investigated further.

Although wilderness has received limited attention in marine protected area management plans, indicators potentially suitable for monitoring marine wilderness do exist in other documents (e.g. journal articles, books, reports) or are currently being used in terrestrial management plans to report on other related values (see Appendix 3).[3] Many of the ecological indicators used more generally for terrestrial and marine protected areas could be used to report on

[3] Potential marine and coastal wilderness indicators were sourced from Google Scholar and the Murdoch University Library Database (which sources over 15,000 journal titles) using a combination of the terms 'coastal', 'marine', 'protected area', 'wilderness' and 'indicator'. Australian marine protected area management plans were individually searched through the relevant agency websites, and international plans were searched in a similar fashion (with search terms 'USA', 'marine sanctuary', 'management plan'). The terms 'ecological', 'management' and 'social' were later included to broaden the search and provided the structure for organizing Appendix 3.

the condition of the latter, for example, indicators such as the status of highly valued flora and fauna. The potential management-focused indicators listed in Appendix 3 allow trends in development (e.g. buoys, boat ramps etc) to be tracked as well as any associated impacts.

Potential social indicators for wilderness, similarly to ecological and management indicators, can be drawn from those applied more widely/generally to protected areas. Included are crowding and visitor satisfaction (Appendix 3). All of the potential ecological and social indicators can be objectively measured. In contrast, many of the potential social indicators are subjective and depend on the perceptions of visitors and managers, for example, perceptions of crowding (Manning, 2011).

7. WA Marine Monitoring Program and other monitoring frameworks

7.1 WA Marine Monitoring Program

The Western Australian Marine Monitoring Program (WAMMP) was established in 2008 by the Department of Conservation and Environment (now the Department of Parks and Wildlife) to provide an integrated, strategic program for monitoring ecological assets and social values as well as reporting on the Department's management effectiveness (Friedman et al., in prep.). The Program is guided by the pressure-state-response framework (Figure 3), described as a condition-pressure-response (CPR) framework for the Department by Simpson & Friedman (in prep.). The pressure-state-response framework has underpinned state of the environment reporting globally for several decades (OECD, 1993).

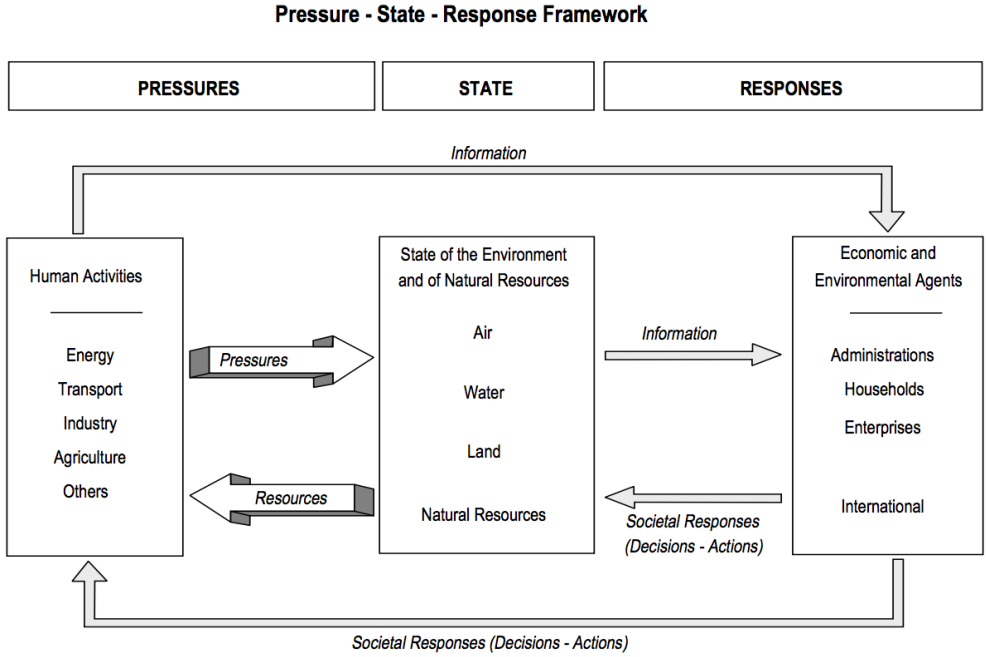

Figure 3. Pressure-state-response framework underpinning state of the environment reporting and the Department of Parks and Wildlife WA Marine Monitoring Program (OECD, 1993, 10)

Of most relevance to this report, the WAMMP aims to provide quantitative evidence on the status and trends in selected indicators of asset condition (equates to ecological and social values), the pressures on these assets, and

management responses. Key performance indicators (KPIs) – a subset of assets prioritized for assessment to measure the overall effectiveness of management – are a particular focus in the WAMMP (Friedman et al., in prep.). Wilderness is identified as a KPI in a number of marine management plans, with the means to measure it yet to be determined. Changes in asset conditions due to anthropogenic pressures underpin the selection of ecological indicators and associated pressures in the WAMMP (Simpson & Friedman, in prep.).

Although the pressure-state-response/condition-pressure-response framework has proved widely applicable and valuable in developing ecological indicators, it requires a modified interpretation in determining social indicators. Such a re-interpretation is essential for marine parks where one of the primary values or assets, and associated 'conditions', is meaningful experiences for visitors, as well as the more widely acknowledged and managed value of ecological integrity. Wilderness epitomizes this duality of requirements with both ecological and social aspects. To successfully use the condition-pressure-response framework to develop wilderness indicators for marine parks requires an interpretation of visitation and the visitor experience as assets or values. It is then possible to identify associated conditions and indicators and design a monitoring system for wilderness as a social value within this framework.

7.2 Other monitoring frameworks

The most widely applied framework for planning and managing wilderness is the Recreation Opportunity Spectrum, partnered by the Limits of Acceptable Change Framework (Newsome et al., 2013). This approach allows managers to monitor the physical, social and managerial settings in a wilderness area and adjust management accordingly. Elements of the Department of Parks and Wildlife current visitor survey program allow reporting on elements of these settings. It is rarely if ever applied to wilderness areas in isolation, and is usually applied across a number of different zones or even across a group of parks (Brown et al., 2006). Its application to marine wilderness areas would best be achieved as part of an agency-wide commitment, which is beyond the scope of this report.

Of central importance to any monitoring program for protected areas is identifying where it is located in the monitoring and assessment hierarchy. Globally, current approaches to monitoring the management effectiveness of protected areas can be considered on four different, complementary levels (Leverington et al., 2010): (1) evaluating the coverage of protected area systems; (2) evaluating the relationship between protected areas and large scale environmental impacts (e.g. forest clearing, fishing); (3) assessing protected area management effectiveness (PAME) (e.g. NSW, Victorian State of the Parks reporting); and (4) detailed monitoring and reporting on the condition and trends of specific protected area values (e.g. species and ecosystems of interest, such as coral reefs). The WAMMP provides information at level 4. If its contribution to adaptive management is to be realized (Friedman et al., in prep.; Simpson & Friedman, in prep.), then it seems important that it interfaces with level 3 assessments, which to-date have not been undertaken for WA protected areas.

Leverington et al. (2010) recommend, in their global analysis of protected area management effectiveness, that if adaptive management is to be achieved, then fourth level assessments need to be combined with third level ones. This

suggests that the WAMMP would ideally be embedded in an agency-wide (or perhaps as a starting point, a WA marine reserve system wide) management effectiveness evaluation framework (see Hockings et al., 2006). Such frameworks include not only condition (i.e. context), outputs and outcomes, but also planning, inputs and processes (Hockings et al., 2004).

8. Recommendations for monitoring wilderness in WA's marine parks

8.1 Defining wilderness areas in WA's marine parks

No legislated national wilderness designation exists in Australia, even though wilderness is an element used in protected area planning in most States. As numerous publications note, however, there seems to be agreement amongst "professionals and the interested lay public" (McKenry, 1980, 83) that the title 'wilderness area' should only be bestowed on areas complying with certain criteria (e.g. size of area, size of core area, absence of roads, ecological integrity) (Aplet et al., 2000; CALM, 1991; Lesslie & Maslen, 1995; McKenry, 1980).

A suggested definition for wilderness areas in the WA marine reserve system follows. It reflects the values attributable to wilderness as well as drawing on definitions developed in Australia and elsewhere.

RECOMMENDATION 1. Use the following definition for wilderness areas in the WA marine reserve system.

A marine wilderness in Western Australia is a relatively undisturbed seascape, predominantly free of direct and indirect human impacts and industrialization, including but not limited to above and under water noise, light pollution, facilities, roads and permanent structures (onshore and offshore), and should be capable of remaining as such through effective management. Visitors to these areas should be able to experience solitude, largely determined by seeing few other people.

Such wilderness areas should also be of a size and distance from human habitation and disturbance to support natural processes and biodiversity in the long-term. The Department's Policy Statement 62 *Identification and Management of Wilderness and Surrounding Areas* suggests a minimum size threshold of 8,000 ha in temperate areas and 20,000 ha in arid and tropical regions for terrestrial wilderness areas. These sizes could be provisionally used for marine wilderness.

The cultural rights and interests of indigenous Australians regarding their traditional and cultural use should be fully incorporated in governance and management.

References. ACF (1999), Brailovskaya (1998), CALM (1991), CALM (n.d.), Day et al. (2012), Mackey et al. (1998), Rollins (1998), Sloan (2002), Tasmanian Parks and Wildlife Service (1999).

8.2 Monitoring framework and indicators for wilderness in WA's marine parks

The CPR framework detailed in the Department of Parks and Wildlife's WAMMP was used to generate the following values, pressures and indicators for marine wilderness (Table 5).

Table 5. Marine wilderness monitoring approach and indicators generated using the WAMMP condition-pressure-response framework

Value/asset	Description of condition	Pressure										Potential indicator
		Commercial fishing	Recreational fishing	Mass tourism	Pollution	Litter	Dredging	Oil & gas development	Mining	Lack of staff capabilities	Poor infrastructure planning	
1. *Wilderness area:* features warranting designation of an area as 'wilderness'	• Remoteness from settlement (i.e. from permanently occupied places) • Remoteness from access (i.e. from established access routes and points (e.g. major shipping lanes, boat launch ramps, campgrounds) • Remoteness from operational leases and licences (e.g. pearling leases) • Minimum size threshold (variable between regions) and minimum core width		X								X	• Distance from settlement and access infrastructure • Distance from lease and licence boundaries • Minimum threshold size (i.e. area) and core width • Areas with wilderness value identified by the public and other stakeholders using Public Participation GIS
2. *Remoteness:* freedom (within the wilderness area) from mechanical sights, sounds & smells	• Free from infrastructure (e.g. roads, dive trails, buoys, markers) • Motorised watercraft acceptable*	X		X				X	X		X	• Amount of infrastructure *in* the wilderness area
3. *Solitude (above & below water):* lack of visual and audible human presence, perception of solitude	• Few (no?) other people in sight or sound • Experiencing solitude • Access to telecommunications networks acceptable**	X	X	X						X		• Aerial surveys of visitor numbers & patterns of use • Crowding, i.e., a perception of 'too many' people at the destination or while travelling • Visitor satisfaction

												• Visitor complaints • Noise or light pollution above & below water
4a. *Naturalness – apparent:* freedom of seascape from permanent structures associated with modern technological society	See Conditions etc for 2. Remoteness (above)	X		X	X			X	X		X	
4b. *Naturalness – biophysical:* freedom of natural environment from biophysical disturbance from modern technological society	Freedom from disturbance agents such as fishing, pollution	X	X		X	X	X	X	X			• Number of leases and licences if any) • Extent and levels of polluted water, air or land

* Motorised travel in terrestrial wilderness is not acceptable, however, the vast distances encountered in the WA marine environment make such a requirement untenable.
** Telecommunications (e.g. mobile phones) have not been considered appropriate in terrestrial wilderness, however, such technology is essential for safety and even navigation in marine environments.

As noted earlier, the WAMMP generally characterizes humans as pressures on the ecological values of marine parks. Table 5 takes as a starting point, for developing a monitoring program for wilderness, the perspective that visitation and the visitor experience are an asset to be protected and enhanced. It is then possible to identify indicators and design a monitoring system for wilderness as a social value.

Four assets (values) collectively encapsulate wilderness in the WA marine reserve system: wilderness areas themselves, and their qualities of remoteness, solitude and naturalness. Each asset is described by a unique set of conditions, with indicators providing information on the status of these conditions. A number of related pressures have been generated and listed in Table 5 but should be regarded as provisional until the hypothesized causal relations between these pressures and conditions have been further investigated. The WAMMP emphasizes the importance of understanding these relationships (Simpson & Friedman, in prep.).

These assets can be considered within a two-tiered monitoring system. Suggestions regarding what might be measured (indicators) and how are given in Table 6.[4]

RECOMMENDATION 2. Use a two-tiered approach to monitoring wilderness in WA's marine parks, with Tier 1 addressing the location, boundaries and area of wilderness, and Tier 2 monitoring the quality (i.e. condition) of the wilderness. For terrestrial wilderness this quality is often regarded as dependent on remoteness, solitude and naturalness. Use existing data and methodologies wherever possible.

The information required for **Tier 1** can be obtained from existing data sets, many of them spatial and available digitally (e.g. remoteness from settlement; remoteness from roads, tracks and marine infrastructure). **Tier 2** monitoring will require periodic visitor surveys to determine what attributes of wilderness quality are important to visitors and how well these attributes are performing. With minor modifications, the Department of Parks and Wildlife's standardized questionnaire-based visitor survey would be a suitable survey instrument, allowing the importance and performance of key attributes of wilderness quality to be monitored. Candidate attributes include visitors' perceptions of: noise; number of people; boat traffic; human-made structures; remoteness; and 'naturalness'. Collectively these attributes would be expected to capture wilderness quality.

The focus of **Tier 1** is the delineation of wilderness areas, based on remoteness from development and the size of the area, accompanied by a minimum width. Larger areas are suggested for more remote regions. These distances and areas can be obtained from pre-existing spatial data sets, the approach taken in the NWI (Lesslie & Maslen, 1995). An alternative approach, reliant on public input, is using Public Participation GIS, a web-based tool for obtaining societal views regarding where wilderness values are evident (Brown & Alessa, 2005; Brown & Weber, 2012).

[4] Although Table 5 importantly lists indicators against conditions and pressures, Table 6 provides a more simple and accessible overview of what might be monitored.

Table 6. Methodologies and sources for indicator data

Practical indicators	**Methodologies and sources of data***
Tier 1. Wilderness area	
Remoteness from development Size	Existing spatial data sets (O) *PP GIS mapping (P)*
Tier 2. Wilderness quality (i.e. remoteness, solitude, naturalness)	
Human presence (~solitude) -Amount of noise -Number of people -Amount of boat traffic -Number of structures Remoteness -Distance from coastal access -Distance from population centres Naturalness -Presence unique of natural features	*Existing spatial data sets including Department of Parks and Wildlife's RECDATA database (O)* *Aerial surveys of visitor numbers and patterns of use (O)*** Visitor questionnaires (existing data from visitor surveys or additional items/new questionnaires) (P)**

O – objective. P – perceived.

* Normal font: recommended approach; italised font: suggested possibilities

** These methods have relevance to monitoring across marine parks, not only marine wilderness.

The focus of **Tier 2** is wilderness quality, generally described by remoteness, solitude and naturalness. Although very little research has been undertaken on wilderness in marine parks, two publications on perceptions of marine wilderness quality (Barr et al., 2014; Shafer & Benzaken, 1998), which had highly congruent results, provide guidance on what can be monitored. Three types of perceptions were evident and important: human presence; remoteness; naturalness. Pre-existing spatial data sets can also be used for Tier 2 infrastructure and remoteness monitoring, including RECDATA database holds asset information for most parks and reserves managed by the Department of Parks and Wildlife.

Human presence (~solitude) (Table 6) has both objective (amount of noise, number of people) as well as subjective (perceptions of noise, perceptions of number of people) elements. Measuring devices could be installed to measure noise and numbers of people. Aerial surveys provide extensive, comprehensive count and pattern data on visitor use (Smallwood et al., 2011). However, given that wilderness is largely (although not exclusively) a social value, it is essential to understand what is important to people and then how they perceive the 'performance' of what is important to them. The following example from a recent marine park visitor survey by the Department of Parks and Wildlife illustrates how visitors' perceptions regarding the importance and performance of attributes can be surveyed (Figure 4).

Q7. Your experiences of the features of Marmion Marine Park? *(Please complete both A and B)*

If you have no experience of the aspect, please still tell us how important it is to you (A), then circle the 'No experience' in (B).* **Aspect**	(A) As a visitor to Marmion Marine Park, how important is each aspect to the quality of your visit? *Please circle one number per aspect*					(B) How satisfied were you with your experience regarding each aspect during this visit to Marmion Marine Park? *Please circle one number per aspect*					
	Not at all important	Not very important	Somewhat important	Very important	Extremely important	Not at all satisfied	Not very satisfied	Somewhat satisfied	Very satisfied	Extremely satisfied	No experience
Being in a marine park	1	2	3	4	5	1	2	3	4	5	*
Pre-visit information about the marine park was easy to obtain	1	2	3	4	5	1	2	3	4	5	*
Useful signage/markers in the marine park	1	2	3	4	5	1	2	3	4	5	*
Access to friendly, responsive marine park staff	1	2	3	4	5	1	2	3	4	5	*
Interesting information on culture (e.g. maritime history, non-Aboriginal heritage)	1	2	3	4	5	1	2	3	4	5	*
Able to enjoy nature in this marine park	1	2	3	4	5	1	2	3	4	5	*
Sightings of native wildlife/birds	1	2	3	4	5	1	2	3	4	5	*
Useful visitor guides/maps in the marine park	1	2	3	4	5	1	2	3	4	5	*
Not too many other visitors present	1	2	3	4	5	1	2	3	4	5	*
Being able to view panoramic vistas, reefs, rock platforms and beaches	1	2	3	4	5	1	2	3	4	5	*
Interesting information on Aboriginal culture	1	2	3	4	5	1	2	3	4	5	*
Access to public moorings and anchorages	1	2	3	4	5	1	2	3	4	5	*
The presence of groynes, seawalls and breakwaters	1	2	3	4	5	1	2	3	4	5	*
Access to boat ramps and jetties	1	2	3	4	5	1	2	3	4	5	*
Diversity of marine habitats including sandy sea floors, intertidal reefs and rock platforms	1	2	3	4	5	1	2	3	4	5	*
Access to Little Island	1	2	3	4	5	1	2	3	4	5	*
Sightings of Australian sea lions	1	2	3	4	5	1	2	3	4	5	*
Being able to relax on the beach	1	2	3	4	5	1	2	3	4	5	*

Figure 4. An example of how the perceptions of marine park visitors regarding wilderness qualities could be surveyed (Source: A. Smith, pers. comm. 2014)

Several possibilities for collecting these perceptions from visitors regarding marine wilderness exist: interpreting visitor perceptions from current data collected through the Department's annual questionnaire-based visitor surveys; adding item(s) to this questionnaire to obtain information specific to marine wilderness perceptions; or designing and administering a visitor questionnaire specifically designed to monitor these perceptions. 'Naturalness' remains problematic to measure and continues to be a contested concept (Hobbs et al., 2009). Asking people if they perceive an area as natural is a possible solution.

8.3 Progressing development of a monitoring system

This report has provided an important first step in establishing a method for monitoring wilderness as a marine social value, within the WAMMP framework. Steps to implementation are detailed within Recommendation 3 below.

RECOMMENDATION 3. Progress field testing and review of the approach to monitoring marine wilderness recommended in this report in consultation with marine park staff, planning branch, the Marine Parks and Reserves Authority and Conservation Commission (given their policy and audit role with respect to KPIs), and the Social Research Unit.

Testing through to implementation is likely to include:

(1) Obtaining feedback from Department of Parks and Wildlife staff and others listed above on the recommended approach in this report.

(2) Determining the suitability and availability of existing spatial data sets.

(3) Determining if a wilderness index can be calculated and is helpful (one was developed for the NWI).

(4) Modify the existing visitor questionnaire (Figure 4) to collect data on marine wilderness quality.

(5) Trialing over a six-month period in several marine parks.

(6) Including wilderness monitoring in the WAMMP monitoring, evaluation and reporting system.

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Appendix 1 - Definitions of wilderness

REF #	Author	Year	Title	Journal	T/M*	Definition of wilderness
1	Bergstrom et al.	2000	*An Organizing Framework for Wilderness Values*	N/A	T	A land area "without permanent improvements or human habitation", "which generally appears to have been affected primarily by the forces of nature" and "has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition" (Wilderness Act (USA), 1964).
2	Dudley (IUCN)	2008	*IUCN Guidelines for Applying Protected Area Categories*	N/A	Both	Category Ib protected areas are usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.... (Next taken from p67) For example, categorization with respect to wilderness values (Ib) is not usually appropriate for an area that will require indefinite active management interventions to maintain these values.
3	Kliskey & Kearsley	1993	*Mapping multiple perceptions of wilderness in southern New Zealand*	Applied Geography	T	4 properties of wilderness perception 1. Absence of human impacts 2. Aspects of vegetation and forest (naturalness) 3. Isolation 4. Remoteness The study distinguished four levels of user-perceived wilderness that provided the experience of wilderness to the respective users. Naturalness based on vegetation was part of the wilderness experience, but was not distinguished from the impact of other factors. Duelli et al. (2007) has gone so far as to suggest that wilderness is always linked to naturalness (allowing natural processes) and unmanaged nature (no visible human interference).
6	Mackay et al	1998	*The Role of Wilderness in Nature Conservation*	N/A	T	1. Definitions of 'wilderness' A critical distinction must be made between concepts and definitions of (a) wilderness quality and (b) wilderness area: a. **Wilderness quality** is the extent to which any specified unit area is remote from and undisturbed by the impacts and influence of modern technological society. b. **Wilderness areas** are places where wilderness quality is recognized and valued by society and are defined using arbitrary thresholds of remoteness, naturalness and total area. Given this important distinction we argue that: variation in wilderness quality across the landscape can be measured using explicit, repeatable and quantitative methods. The National Wilderness Inventory (NWI) uses a particular set of indicators developed by one of the authors (RGL); **wilderness quality** is defined as a function of levels of disturbance associated with modern technological society and, as such, does not deny the reality of aboriginal history; **wilderness areas** are indeed cultural constructs to the extent that threshold

						criteria are intrinsically value-based and their existence is fundamentally controlled by the demand for and supply of remote and natural places. Wilderness areas are large areas in which ecological processes continue with minimal change caused by modern development... Indigenous custodianship and customary practices have been, and in many places continue to be, significant factors in creating what non-indigenous people refer to as wilderness and wild rivers. (Commonwealth of Australia 1997 p.130.).
7	Rollins	1998	*Using social science research in the management of coastal wilderness settings*	N/A	M	Wilderness areas are areas of pristine natural settings, with few facilities and little evidence of human induced change. These are places where natural processes and natural energy flows are sustained "as they existed in the absence of human influences" (Hendee, Stankey & Lucas 1990).
8	Gillson & Willis	2004	*As Earth's testimonies tell': wilderness conservation in a changing world*	Ecology Letters	T	Whereas traditional approaches to wilderness conservation were underpinned by the assumption that ecosystems should be stable and pristine, contemporary ecological paradigms recognize that nature is in flux (Pickett et al. 1992; Pickett & Ostfeld 1995).
9	Govt of USA		*The Wilderness Act 1964 (USA)*	N/A	T	A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.
10	Day et al. (IUCN)	2012	*Guidelines for Applying the IUCN Protected Area Management Categories to Marine Protected Areas*	N/A	M	Usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition. In the 2008 Guidelines, Category Ib is called 'wilderness area' but the concept of 'wilderness' is more difficult to apply to the marine environment than to land. Provided a marine area is relatively undisturbed and free from human influences, qualities such as 'solitude', 'quiet appreciation' or 'experiencing natural areas that retain wilderness qualities' can however be achieved by diving beneath the surface. **Thus**

						Category Ib areas in the marine environment should be sites of relatively undisturbed seascape, significantly free of human disturbance (e.g. direct or indirect impacts, underwater noise, light pollution etc.), works or facilities and capable of remaining so through effective management.
11	Duelli et al.	2007	*The Role of Value Systems in Biodiversity Research*	N/A	T	**Wilderness:** The term wilderness today means different things to different people, but it is always linked with naturalness (allowing natural processes), unmanaged nature (no visible human interference), and "authenticity" (Schnitzler and Borlea 1998). Whether secondary nature in formerly cultivated areas can be called wilderness is a matter of debate (Crist 2004). Wilderness areas have a very high appeal for eco-tourism and adventurous recreational activities (Bennett 1994; Bauer 2005). Wilderness can be seen as one aspect of biodiversity, but it may neither correlate with other aspects of biodiversity such as species richness, nor with other values such as ecosystem services or species conservation. Depending on the aim of a nature reserve, it should either remain untouched (wilderness, natural dynamics), or be managed according to a specific goal and reserved for public use (education, recreation, tourism).
14	Kliskey	1998	*Linking the Wilderness Perception Mapping Concept to the Recreation Opportunity Spectrum*	Environmental Management		A wilderness experience is a state of mind unique, ostensibly at least, to natural environments. The common characteristics that emerge from studies of wilderness attitudes refer to: solitude, freedom, naturalness, aesthetic appreciation, spiritual values, and mystical dimensions of the wilderness experience (Hendee and others 1978, Stankey and Schreyer 1987).
16	Eagles & McCool	2002	*TOURISM IN PARKS & PAs (Cpt 7 - Monitoring of Tourism in National Parks and Protected Areas)*	N/A		The use of wilderness for personal reflection and redemption is a common theme, especially in the USA. This is an ancient biblical theme developed into a landscape and leisure phenomenon by the liberal Protestant Christian tradition in that country. In this theme, wilderness is a place away from normal life. It is a place to be alone, or with a small group. It is a place where nature is paramount, not people. There is danger in such a place, and each person must face this danger with a minimum of technology. It is a place of reflection, a place that prepares a person for the challenges of normal life outside the wilderness. (p3)
18	ACF	2012	*64 - Wilderness & Indigenous Cultural Landscape in Australia*	N/A	T	Wilderness areas are substantial tracts of natural lands, that are essentially free of, and often remote from, the land use activities, infrastructure and related features associated with modern technological society'. 4.1 The prime objective of wilderness management is the long-term preservation of wilderness conditions as a means to protect biodiversity and natural and cultural values. 4.2 Because areas with wilderness condition in Australia are also frequently indigenous cultural landscapes where the ongoing management action and responsibility of indigenous

						peoples are integral to the land and seascape, another objective of wilderness management is to ensure the maintenance and restoration of indigenous peoples' traditions and ceremonies.
19	Manning & Anderson	2012	*Managing Outdoor Recreation – Case Studies in the National Parks (Cpt 9 - Protecting Biscayne's Underwater Treasures)*	N/A	M	See ref 9 (USA Wilderness Act)
20	Kalamandeen & Lindsey	2007	*Demything "wilderness": implications for protected area designation and management*	Biodiversity Conservation		Wilderness – without permanent or significant habitation
22	Hobbs et al.	2009	*Guiding concepts for park and wilderness stewardship in an era of global environmental change*	Frontiers in Ecology and the Environment	T	Derived from the US Wilderness Act in which wilderness is defined as a place "where the Earth and its community of life are untrammelled by man" and therefore argues against intervention. To be untrammelled, a place should not be intentionally controlled or manipulated for any purpose, even for the conservation of biodiversity (Cole 2000). National Park Service (NPS) policy is more amenable to intervention, stating that intervention in natural biological or physical processes will be the exception, not the rule, but that it is appropriate "to restore ecosystem functioning that has been disrupted by past or ongoing human activities" (NPS 2006). In the future, park and wilderness-area managers will need to operate across this entire spectrum, from non-intervention to active transformation.
23	Leung & Marion	2000	*Recreation Impacts and Management in Wilderness: A State-of-Knowledge Review*	N/A	T	Derived from the Wilderness Act, these mandates state that wilderness areas "shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas [and] the preservation of their wilderness character..." (Public Law 88-577, 1964).
25	Sloan	2002	*History and the Application of the Wilderness Concept in Marine Conservation*	Conservation Biology	Both	"An area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain" (from USA Wilderness Act); wording implies large areas relatively undisturbed by humans yet this needs to accommodate the pursuits of education, spiritual renewal, solitude & recreation in as natural a setting as possible.

30	Aplet et al.	2000	*Indicators of Wildness: Using Attributes of the Land to Assess the Context of Wilderness*	N/A		See ref 9 (USA Wilderness Act)
32	Hall & Higham	2000	*Wilderness Management in the Forests of NZ: Historical Development & Contemporary Issues in Environmental Management*	Frontiers in Ecology and the Environment	T	See ref 9 (USA Wilderness Act)
34	Cole	1994	*The Wilderness Threats Matrix: A Framework for Assessing Impacts*	N/A	T	(USA Wilderness Act) "Preservation of natural conditions and wilderness character, and provision of outstanding opportunities for solitude or a primitive and unconfined type of recreation".
39	Land Conservation Council (VIC)	1991	*Wilderness - Special Investigation: Final Recommendations*	N/A	T	A large area with landforms and native plant and animal communities relatively unaltered or unaffected by the influence of the European settlement of Australia.
40	Hammitt & Symmonds (Weaver, Ed.)	2001	*Cpt 21 - Wilderness (in The Encyclopaedia of Ecotourism)*	N/A	T	There is no global definition of 'wilderness'. What constitutes wilderness ultimately depends upon the value placed on an area by people and institutions, and the area itself relative to the surroundings and alternatives. However, the two major aspects of all definitions of wilderness that distinguish it from other environments are degree of 'naturalness' and 'solitude-primitiveness'. Ecotourism and other forms of wildland recreation in wilderness must be dependent on the natural processes and solitude experiences of wilderness areas. Manipulation of ecological processes to restore naturalness, and of social processes to restore solitude are permissible in wilderness, but the forces of nature must dominate those of humans.
41	Newsome et al.	2013	*Natural Area Tourism - Ecology, Impacts & Management*	N/A	Both	"Areas where the Earth and its community of life have not been seriously disturbed by humans and where humans are only temporary visitors".
42	Cronon	1996	*The Trouble with Wilderness: Or, Getting Back to the*	Environmental History	T	Far from being the one place on earth that stands apart from humanity, it is quite profoundly a human creation-indeed, the creation of very particular human cultures at very particular

			Wrong Nature			moments in human history.
43	European Wilderness Society	N.D.	*Wilderness is …*	N/A	T	Wilderness areas are large unmodified or only slightly modified natural areas without human intervention. There is no extractive use allowed in wilderness areas, which means that activities such as hunting, fishing, mining, logging, grazing, grass cutting, road and building construction are not accepted inside of the wilderness area. The only management interventions are those aimed at maintaining or restoring natural ecological processes and the ecological integrity. However, visitors have the opportunity to enjoy wilderness on a sustainable way. The most characteristic feature of wilderness is a natural dynamic without interference. Removing broken trees after snowfall can create a feeling of 'a tidy forest' but the missing dead wood deprives forest ecosystems of nutrition, species and important ecological processes.
44	CALM	N.D.	*Policy Statement No 62 - Identification and Management of Wilderness and Surrounding Areas*	N/A	T	"**Wilderness quality**" means: the extent to which a location is remote from and undisturbed by the influence of modern technological society. The national standard for measuring wilderness quality is the National Wilderness Inventory, also known as the Australian Land Disturbance Database. Wilderness quality is measured using four wilderness quality 'indicators' that represent the two essential attributes of a wilderness area; remoteness and naturalness. "**Wilderness area**" means: an area that has a wilderness quality rating of 12 or greater and meets a minimum size threshold of 8,000 hectares in temperate areas or 20,000 hectares in arid and tropical areas. A wilderness area is gazetted under section 62(1)(a) of the Conservation and Land Management Act 1984 by the Minister on any land that is vested in the Conservation Commission of Western Australia. "**Wilderness values**" means: attributes of a wilderness area that should be protected from the impacts of modern technological society. *For the purposes of this policy, a wilderness area is generally defined as an area: that is substantially unmodified by modern technological society; that is sufficiently large and remote to make the long term protection of its biodiversity and natural systems practical; where ecological processes remain essentially intact; and where opportunities exist for solitude, inspiration and self-reliant recreation.*
45	Tasmanian Parks and Wildlife Service	1999	*Tasmanian Wilderness WHA Management Plan 1999*	N/A	T	A wilderness area is an area that is of sufficient size to enable the long-term protection of its natural systems and biological diversity; substantially undisturbed by colonial and modern technological society; and remote at its core from points of mechanised access and other evidence of colonial and modern technological society. Explanation of terms used in the definition: The phrase 'colonial and modern technological society' is used in recognition that: Aboriginal custodianship and customary practices have been, and in many places throughout Australia continue to be, a significant factor in creating what non- Aboriginal people describe as

						wilderness; and non-Aboriginal people perceive and value ‘naturalness’ as the absence of impacts of colonial and modern technological society. The phrase ‘substantially undisturbed’ recognises that: there may be relatively minor evidence of previous activities of colonial or modern technological societies in the area (there are few, if any, wilderness areas totally unaffected by such activities); all wilderness areas are, and will continue to be, affected to some extent by external influences (eg pollution and climate change); and emergency and essential management operations may have some continuing impact on the naturalness of the wilderness area. The expression ‘remote at its core’ recognises that the boundary of some areas may be near or adjacent to mechanised access or settlements.
46	CALM	1991	*Fitzgerald River National Park Management Plan*	N/A	T	"Wilderness" is essentially an undisturbed area or a 'window into the past' where management intervention is kept to an absolute minimum and where the number of visitors is low because of the area's remoteness. Visitors travel on foot (NPNCA, 1990). To be viable, it is generally agreed that wilderness areas need to be sufficiently large (minimum size of 10 000 ha or 5 000 ha on remote coastline) and should have a 'core' area which is at least 3 km from the zone boundary or any maintained road (Preece and Lesslie, 1987).

* T=Terrestrial, M=Marine

Appendix 2 – Wilderness values

Value	Description/ indicator	Author
Solitude	The "opportunity to meet the wilderness, or its maker, personally, quietly, on terms only you prescribe"	**Aplet et al. 2000**
Remoteness	Possesses no "means of mechanical conveyance" and "free from mechanical sights, sounds & smells"	
Uncontrolled processes	Where historical ecological processes are maintained (e.g. flood, fire, migration etc.)	
Natural composition	Intact native ecosystem	
Unaltered structure	Refers to the spatial arrangements of the components of ecosystems (e.g. geomorphology, arrangement of veg. patches and spacing of trees in a stand)	
Lack of pollution	The expectation of "purity": clean water, fresh air, clean soil, darkness	
Remoteness from settlement	Remoteness from places of permanent occupation	**Lesslie & Maslen 1995**
Remoteness from access	Remoteness from established access routes	
Apparent naturalness	The degree to which the landscape is free from the presence of permanent structures associated with modern technological society	
Biophysical naturalness	The degree to which the natural environment is free from biophysical disturbance caused by the influence of modern technological society	

Appendix 3 – Potential wilderness indicators

Indicator type	Objective/ perceived	What to monitor	Metric/how to monitor	Refs	SMART
ECOLOGICAL					
Flora - marine	O	Loss/reduction of ground cover, height/growth/reproduction/biomass changes, loss of species, introduction of exotic species, changes in species composition/age structure	e.g. seagrass monitoring	Castley et al. 2009; Green et al. 2000; Marques et al. 2009	S, M, A, R, T
Flora - terrestrial	O	Loss/reduction of ground cover, height/growth/reproduction/biomass changes, loss of species, introduction of exotic species, changes in species composition/age structure, extent of diseased vegetation, selected plant species vigour, exposed tree roots, soil fauna and microflora	e.g. GIS mapping, on-site surveys	Castley et al. 2009; Graefe et al. 1990; Green et al. 2000	S, M, A, R, T
Fauna - marine	O	Breeding patterns, feeding/foraging, parental behaviour, other behaviour, presence/absence	Parent/offspring morbidity/mortality, changes in 'normal' behaviours (leaving offspring unattended due to visitor noise/light/photography etc.), composition changes (e.g. macro invertebrates, fish species/numbers)	Graefe et al. 1990; Marques et al. 2009	S, M, R, T
Fauna - terrestrial	O	Breeding patterns, feeding/foraging, parental behaviour, other behaviour, presence/absence	Parent/offspring morbidity/mortality, changes in 'normal' behaviours (leaving offspring unattended due to visitor noise/light/photography etc.)	Castley et al. 2009; Graefe et al. 1990	S, M, R, T
Habitat mapping (marine/coastal)	O	GIS/aerial surveys	Initial (benchmark) then subsequent monitoring regime	WA SOE 2007	S, M, A, R, T
Various	O	Threats e.g. recreation, livestock, mining, fire, exotic species, water	Presence/absence (flora/fauna),	Cole 1994; Manning	Indicator-dependent

		projects, atmospheric pollutants, adjacent lands	trampling, braiding of paths (if present), changes in species composition, presence of pollutants (ppm etc.), return of species (post-mining)	2011	
Total land area	O	Natural processes, ecosystem services	Changes over time	Lesslie & Maslen 1995	S, M, A, R, T
MANAGEMENT	**Objective/ perceived**	**What to monitor**	**Metric/how to monitor**	**Refs**	**SMART**
Extent of development					
Moorings/markers	O	Set numbers (dependent on size of area, numbers deemed appropriate, accessibility, seabed structure (e.g. sand vs reef/rock)	Scouring of seabed (e.g. m^2 around mooring), possibly using motion sensitive cameras	Newsome et al. 2013	S, M, A, T
Roads, site facilities	O	Numbers, distance from 'wilderness' area	Vehicle trackers, bookings, on-site surveys, visitor surveys, impacts on wildlife (reported wildlife deaths/injuries)	Newsome et al. 2013; LCC 1991; Lockwood et al. 2006	S, M, A, R, T
Artifactualism	O		Developed campsites, maintained tracks, logging, minimal human impact	Kliskey 1998	S, M, A, R, T
Rubbish	O	Amount / unit area			S, M, R
Activity limitations/ zoning	O	No motorised vessels, No use of sand dunes (motorised vehicles, sandboarding etc.)	Tracks, damage/unit area (flora)	Lockwood et al. 2006	R
Commercial tourism	O	Licences	Limit numbers, size of vessel/vehicle, limit season		S, M, A, R, T
Access	O	Traffic counters	Numbers/month/season/year	Newsome et al. 2013;	S, M, A, R, T

				WTO 2013	
Acceptability of visitor impacts	O, P	e.g. Rubbish/pollution / unit area, human noise after xpm, before xam, noise above and below water, erosion, damage to coral and other valued ecosystems from recreational use		Newsome et al. 2013, Aplet et al. 1999	S, M, A, R
Fishing	O	Commercial/recreational licences			M, A, T
% of area / park protected in no-take zones	O		Management plans	GBRMPA Annual Report 2004-05	S, M, A, R, T
Changes in coastal use	O	Recreation/tourism numbers at areas, VISTAT, development (housing, roads, power/telephone, tourism (e.g. hotels/resorts, tours etc.))	GIS, VISTAT	ANZECC 2000	M, R
Other					
Research	O	Approval process			S, M, A, R, T
Number research papers produced / cited	O		Numbers/year	GBRMPA Annual Report 2004-05	S, M, A, R
Number of internet hits	O		Numbers/month/season/year	Lockwood et al. 2006	S, M, A, T
Number of volunteer hours	O	Quality of results &/or impact on flora/fauna regeneration/ reproduction/ habitation	increase/decrease in veg/ fauna/ weed Numbers	Lockwood et al. 2006	S, M, A, R, T
Complaints (visitor and / or residents)	O, P	How many, what complaints are about	Numbers	Graefe et al. 1990	S, M, A, R, T

SOCIAL	Objective/ perceived	What to monitor	Metric/how to monitor	Refs	SMART
Visitor numbers and patterns of use					
Visitor (human) numbers	O	Numbers, number of visits/yr/month	Traffic counters, bookings (online, onsite), aerial surveys	Smallwood et al. 2011	S, M, A, R, T
Visitor (human) use	O	Intensity, consumptive vs non-consumptive use (if allowed), campsite vs 'natural' experience, location & seasons of use	Traffic counters, bookings (online, onsite), licensing (consumptive use), income from tourists	Weaver et al. 2001	S, R
Crowding/solitude	O, P	Number of people sighted/ unit area/ contact with others		Newsome and Lacroix 2011; Newsome et al. 2013	S, M, A, R, T
	O, P	Number of encounters by activity type and perceptions of encounters		Graefe et al. 1990	S
	O, P	Number of encounters by size of group and perceptions of encounters		Graefe et al. 1990	S
	O, P	Number of encounters by location of encounter and perceptions of encounters			S
Visitor satisfaction	P	Overall experience plus specific questions (e.g. crowding, noise etc.)	Expectation/importance vs satisfaction	Graefe et al. 1990	S, M, A, R, T
Other					
Wilderness areas - visitor vs manager perceptions of	P	Location, extent	Public participation GIS, other mapping approaches, surveys	Aplet et al. 1999; Brown & Weber 2012; Kliskey 1998; Manning 2011;	S, M, A, R, T

location & extent				McKenry 1980	
Remoteness*	O		Road access, maintained tracks, motorised travel, distance from permanent fixture/ human occupation	Aplet et al. 1999; CALM n.d.; Kliskey 1998; Newsome et al. 2013	S, M, A, R, T
Naturalness/ uncontrolled processes**	O		Exotics, size/landscape-scale, presence of logging/grazing	Aplet et al. 1999; Kliskey 1998; Lesslie & Maslen 1995	S, M, A, R

* This indicator could equally as well be included in the management indicators list.

** This indicator could equally as well be included in the ecological indicators list.