



3. Management for nature conservation

3.1 Extent and representation of natural assets and ecosystem services in parks

Indicators

- Representation of terrestrial bioregions in parks
- Representation of marine bioregions in parks
- Extent and representation of native vegetation in parks
- Extent and representation of marine habitats in parks
- Extent and representation of wetlands in parks
- Representation of flora and fauna in terrestrial parks
- Significance of park habitats for threatened species
- Representation of marine flora and fauna
- Sites of geodiversity significance in parks
- Ecosystem services provided by parks

Context

Victoria's parks play a critical role in conserving representative and adequate examples of the State's biodiversity and ecological processes. Many of the State's largest and least disturbed ecosystems, as well as many of its most threatened communities and species, are protected within parks. Parks also play an important role in protecting remnant vegetation within more developed urban environments. These indicators summarise the extent and conservation status of terrestrial, wetland and marine ecosystems and species represented within the parks network.

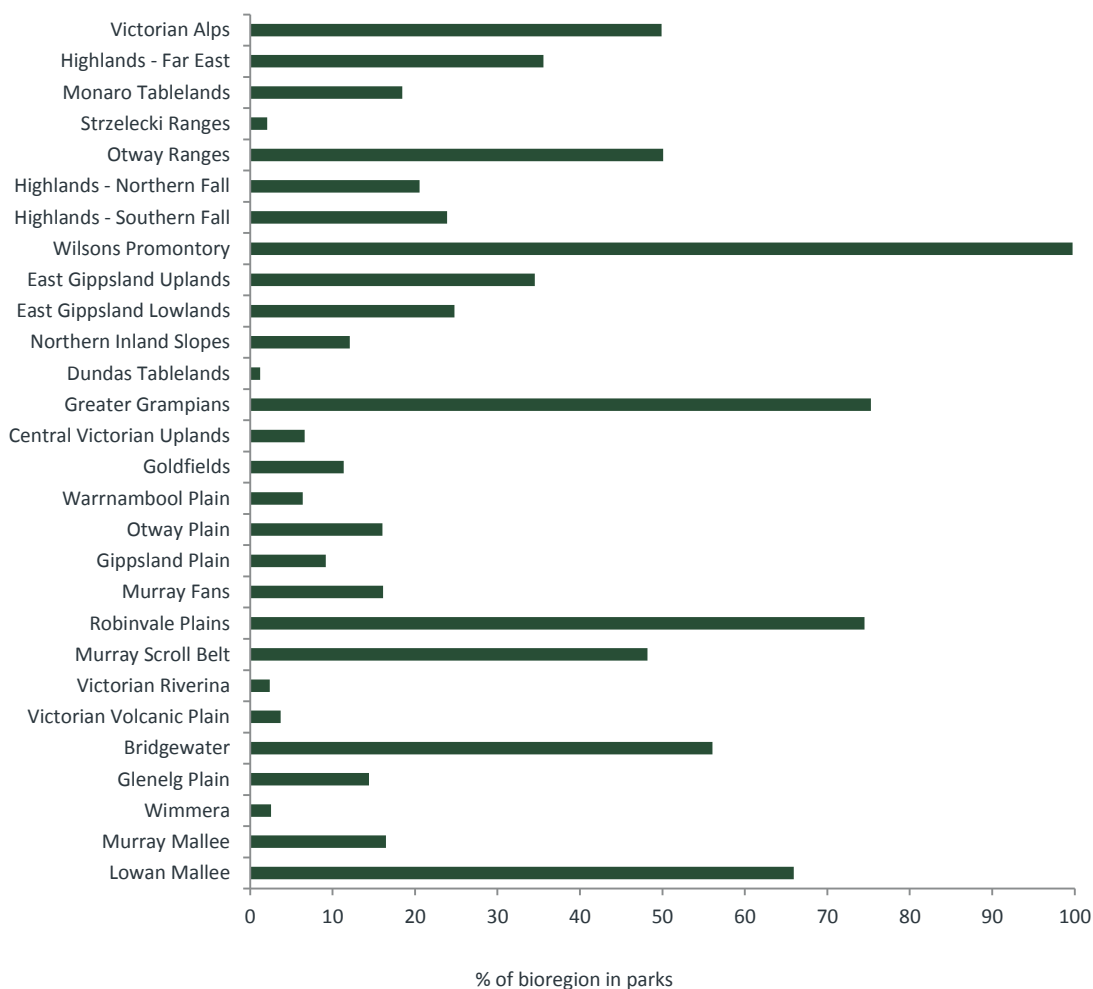
Ecosystem services are the benefits people obtain from the ecosystems. Parks provide the community with a wide range ecosystem services which benefit Victoria's economy and livability. Victoria's parks provide tangible services such as provision of clean filtered water, climate and heat regulation, storm protection for coastal communities, conservation of soil resources, pollination and pest control services for agriculture, nurseries for fish breeding. Other services such as recreation, spiritual and community and health related services are included in visitor and community indicators.

Representation of terrestrial bioregions in parks

Bioregions are relatively large land areas characterised by broad, landscape-scale natural features and environmental processes that influence the functions of entire ecosystems. Victoria has 28 bioregions, which form the basis of planning for biodiversity conservation (Appendix 3.1).

The proportion of Victoria’s terrestrial bioregions protected in parks varies between 100% at Wilsons Promontory National Park to less than 3% for Dundas Tablelands. Those bioregions that are the most well represented in parks included Wilsons Promontory, Greater Grampians and Lowan Mallee, while those bioregions least represented are Dundas tablelands, Strzelecki Ranges, Victorian Riverina, Wimmera and Victorian Volcanic Plain.

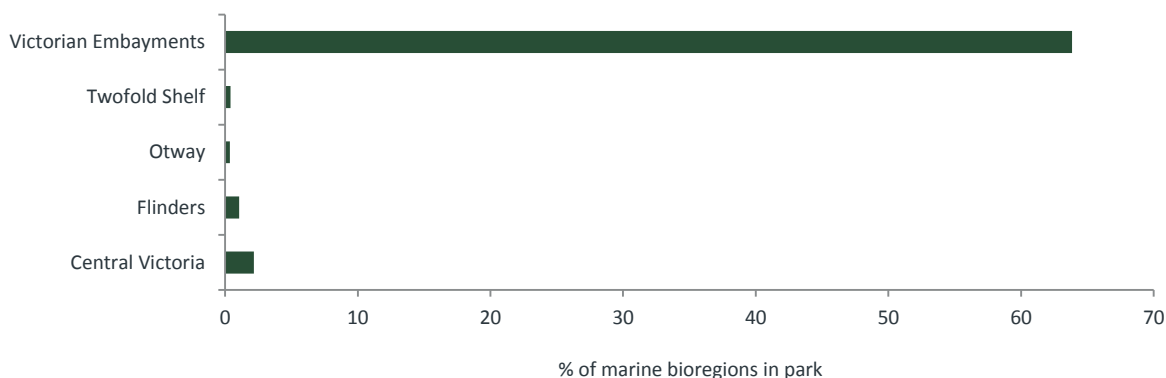
Figure 3.1.1 Percentage of terrestrial bioregions in parks



Representation of marine bioregions in parks

Victorian marine bioregions are included in the national categorisation for marine environments (the interim Marine and Coastal Regionalisation for Australia, IMCRA) (Appendix 3.2). Within Victoria, the Victorian Embayments marine bioregion is the most well represented of Victoria's marine bioregions that are protected in parks and reserves with Twofold Shelf, Otway and Central Victorian Bioregions the least well represented.

Figure 3.1.2 Percentage of marine bioregions represented in parks

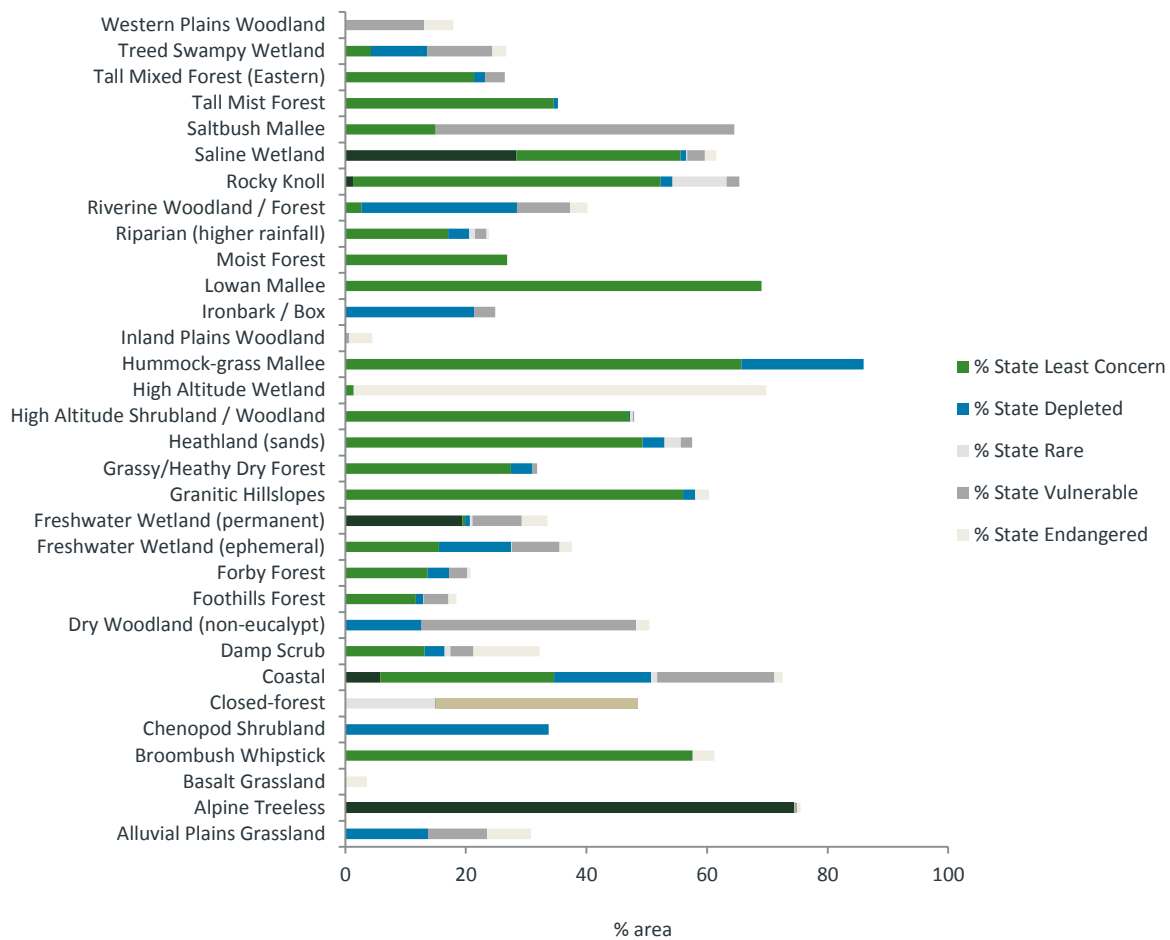


Extent and representation of native vegetation in parks

The Victorian parks network plays a crucial role in protecting representative examples of Victoria's diverse vegetation types, including rare and depleted remnant vegetation. Vegetation types (represented as Ecological Vegetation Divisions or EVDs) are reflective of climate, soils and topography.

While all EVDs occur in Victoria's parks network to some extent, the level of representation varies greatly. The most well-reserved groups included Hummock-grass Mallee (86% of total area), Alpine Treeless (77% of total area), Coastal and High Altitude Wetland (70 % of total area). The least well-represented EVDs include Basalt Grassland and Inland Plains Woodland (4% of total area), Foothills Forest and Western Plains Woodland (18% of total area) and Forby Forest (21% of total area). The representation of EVDs in parks is partly a reflection of past land use with the pre-1750 extent of some EVDs now highly depleted within Victoria due to past land uses.

Figure 3.1.3 Percentage of area of Ecological Vegetation Divisions (EVDs) in parks by conservation status



Source: DEWLP datasets

Extent and representation of marine habitats in parks

Marine Protected Areas including marine national parks, marine sanctuaries and marine and coastal parks conserve a broad range of marine habitats from rocky reefs to seagrass meadows, mangroves, saltmarsh and soft sediment.

Figure 3.1.4 Extent of marine habitat types

Marine habitat	Total area (hectares)
Intertidal reef	219 ¹
Sub-tidal reef	21,812
Soft sediment	70,125
Mangrove	3,435
Saltmarsh	3,775
Seagrass	20,164

¹ Only includes intertidal reefs in MPA's. Intertidal reefs that fall within terrestrial (coastal) parks have not yet been accurately estimated, but are a significantly larger area. Source: Parks Victoria

Extent and representation of wetlands in parks

Wetlands in Victoria are classified into eight different wetland types based on their water depth, frequency of inundation and salinity. They include marine and coastal zones, inland and man-made wetlands. There are over 1000 wetlands found within Victoria's parks network with the most depleted wetlands protected to varying degrees (Appendix 3.3). Internationally significant Ramsar listed wetlands are largely protected within the Parks Victoria managed network. Permanent saline, semi-permanent saline wetlands and deep freshwater marshes are the most well represented wetlands in the parks network.

Wetland types in parks

Figure 3.1.5 Extent and representation of wetlands in parks

Wetland Type	1788 Pre-European Total Ha	2013 State Total Ha	2013 Park Estate Total Ha	2013 % State Total
Deep freshwater marsh	176705	54886	27543	50
Freshwater meadow	181297	118925	26914	21
Permanent open freshwater	70684	190744	45026	24
Permanent saline	155755	154338	11710	76
Salt works	0	2014	580	29
Semi-permanent saline	67447	70319	43037	61
Sewerage pond	0.0	3981	89	2
Shallow freshwater marsh	127077	54618	15849	29
Total	778966	649825	276146	43

Ramsar wetlands in parks

Ramsar wetlands are wetlands of international importance listed under the International Ramsar Convention on Wetlands. There are eleven Ramsar sites in Victoria with ten of these all or partially managed by Parks Victoria (Appendix 3.4).

Figure 3.1.6 Extent and representation of Ramsar wetlands in parks

Ramsar Wetland	Total park area Ramsar wetlands (Ha)	Statewide area of Ramsar wetlands (Ha)	% Representation of Ramsar areas in parks
Barmah Forest	29216	29307	99.7
Corner Inlet	59197	67235	88.0
Gippsland Lakes	24645	61152	40
Gunbower Forest	10328	20220	51
Hattah-Kulkyne Lakes	978	978	100
Kerang Wetlands	5738	9795	57
Lake Albacutya	5656	5660	100
Port Phillip Bay (Western Shoreline) and Bellarine Peninsula	9693	22647	43
Western District Lakes	32631	32675	100
Western Port	54002	59972	90.0
TOTAL	232086	309642	75

Representation of flora and fauna in terrestrial parks

Native flora in parks

The Victorian parks network plays an important role in conserving representative examples of the State's native flora. Of the 5145 native species of flora that have been recorded in Victoria, 4728 (92%) are recorded in Victoria's parks network. The parks with the largest number of native species recorded include the Alpine, Grampians, Wilsons Promontory, Great Otway, Croajingalong and Snowy River national parks (see Appendix 3.5).

Figure 3.1.7 Parks with more than 800 native flora species

Park Name	Number native flora Species
Alpine National Park	1853
Coopracambra National Park	902
Croajingolong National Park	1155
Grampians National Park	1526
Great Otway National Park	1273
Little Desert National Park	802
Murray - Sunset National Park	804
Snowy River National Park	1211
Wilson's Promontory National Park	1221
Yarra Ranges National Park	889

Endemic flora species in parks

344 endemic flora species have been recorded in Victoria. Of these, 36 species are endemic to a single park. The Grampians National Park has twelve endemic species and the Alpine National park has seven endemic species. Other parks with endemic flora species include the Burrowa-Pine Mountain, Chiltern-Mt Pilot, Great Otway, Little Desert, Mount Buffalo, Snowy River, Wilsons Promontory and Yarra Ranges national parks, as well as a number of reserves.

Figure 3.1.8 Number of endemic flora species to a park

Park Name	Number of endemic flora species
Alpine National Park	7
Bunyip State Park	1
Burrowa - Pine Mountain National Park	1
Chiltern-Mt Pilot National Park	1
Dergholm State Park	1
Grampians National Park	12
Great Otway National Park	1
Inverleigh F.R	1
Lerderderg State Park	1
Little Desert National Park	1
Lower Glenelg National Park	1
Maldon H.A.	1
Marble Gully - Mount Tambo N.C.R.	1
Mount Buffalo National Park	2
Murray - Sunset National Park	1
Yarra Ranges National Park	1

Conservation status of flora

Rare and threatened species include those protected under the *Flora and Fauna Guarantee Act 1998* (Vic) (FFG Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC). Many other species are considered threatened but not under legislative protection and are allocated a Victorian conservation status.

Rare and threatened flora species

Victoria's parks network plays an important role in protecting and conserving the state's rare and threatened flora. Of the 1857 listed rare and threatened flora species recorded in Victoria, 646 (90%) are recorded in Victoria's parks network. The Alpine National park has by far the largest number of rare and threatened flora species in the parks network with an additional nine parks containing more than 100 rare and threatened flora species (Appendix 3.6)

- 280 (84%) of the 332 flora species that are FFG Act listed in Victoria have been recorded in Victoria's parks network;
- 121 (88%) of the 137 flora species that are EPBC Act listed have been recorded in Victoria's parks network;
- 118 FFG listed flora species have at least 75% of their statewide distribution in parks and 63 FFG listed species have 100% of their statewide distribution located in parks.

Figure 3.1.9 Parks with more than 75 rare and threatened flora species recorded

Park Name	Number Threatened Flora Species
Alpine National Park	459
Coopracambra National Park	116
Croajingolong National Park	172
Grampians National Park	184
Great Otway National Park	116
Hattah - Kulkyne National Park	117
Little Desert National Park	75
Mount Buffalo National Park	93
Murray - Sunset National Park	188
Murray River Park (proposed)	123
Snowy River National Park	158
Wilson's Promontory National Park	116

Native Fauna in parks

Victoria's parks network plays an important role in conserving the diversity of the State's fauna. Of the 1405 native species of fauna that have been recorded in Victoria, 1,102 (78%) are recorded in Victoria's parks network. The parks with the largest number of fauna species include the Alpine, Grampians, Great Otway, Croajingolong and Yarra Ranges national parks (Appendix 3.7).

Figure 3.1.10 Parks with more than 250 native fauna species

Park Name	Number Fauna Species
Alpine National Park	447
Bunyip State Park	261
Cape Conran Coastal Park	295
Chiltern-Mt Pilot National Park	295
Croajingolong National Park	366
Grampians National Park	416
Great Otway National Park	412
Hattah - Kulkyne National Park	315
Kinglake National Park	263
Lake Tyers State Park	276
Little Desert National Park	255
Murray - Sunset National Park	329
Murray River Park (proposed)	281
Plenty Gorge Parklands	258
Snowy River National Park	266
Wilson's Promontory National Park	300
Wyperfeld National Park	295
Yarra Ranges National Park	346

While all faunal groups are represented within the parks network, some groups such as aquatic and other invertebrates

Figure 3.1.11 Representation of faunal groups in parks

Taxon category	Number of species recorded in parks network	Number of species recorded in State	% statewide total
Amphibians	52	55	94.5
Aquatic invertebrates	110	236	46.6
Fish	74	100	74.0
Invertebrates	52	77	67.5
Mammals	90	96	93.8
Marine birds	2	6	33.3
Mussels, decopod crustacea	40	58	69.0
Non-passerine birds	183	197	92.9
Passerine birds	165	167	98.8
Reptiles	139	147	94.6
Waders	66	73	90.4

Endemic fauna species in parks

Nine endemic fauna species have been recorded in Victoria's parks network. These include the Yarra Ranges, Wyperfeld national parks and Cape Conran Coastal park.

Figure 3.1.12 Total number endemic species parks estate

Park Name	Number Endemic Species
Wilson's Promontory National Park	1
Wyperfeld National Park	1
Snowy River National Park	1
Grampians National Park	1
Alpine National Park	2
Yarra Ranges National Park	1
Great Otway National Park	2

Conservation status of fauna

Rare and threatened fauna include those species protected under the *Flora and Fauna Guarantee Act 1998* (Vic) (FFG Act), the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC) as well as . other species are considered threatened but not under legislative protection but allocated a Victorian conservation status under the Victorian threatened species advisory list.

Rare and threatened fauna species

Victoria's parks network plays an important role in conserving the diversity of the State's rare and threatened fauna species. Of the 306 listed rare and threatened fauna species that have been recorded in Victoria, 277 (91%) are recorded in Victoria's parks network. Those parks with the largest number of rare and threatened fauna species include the Murray-Sunset, Croajingalong, Hattah-Kulkyne, Wyperfeld, Great Otway and Grampians national parks (Appendix 3.8)

- 177 (91%) of the 195 species that are FFG Act listed in Victoria, are recorded in Victoria's parks network;
- 53 (91%) of the 58 species that are (Commonwealth) EPBC Act listed are recorded in Victoria's parks network;
- 25 FFG listed species have at least 75% of their statewide distribution in parks and 10 FFG listed species have 100% of their distribution in parks

Figure 3.1.13 Parks with more than 50 rare and threatened fauna species recorded

Park Name	Number Threatened Fauna Species
Alpine National Park	59
Cape Conran Coastal Park	56
Chiltern-Mt Pilot National Park	52
Croajingolong National Park	81
Discovery Bay Coastal Park	55
Grampians National Park	63
Great Otway National Park	65
Hattah - Kulkyne National Park	70
Lake Tyers S.P.	52
Murray - Sunset National Park	85
Murray River Park (proposed)	51
The Spit W.R.	53
Wilson's Promontory National Park	55
Wyperfeld National Park	71

Significance of park habitats for threatened species

An important role of the Victorian parks network is to provide suitable habitat to enable a wide range of threatened species to survive and flourish. Based on a detailed assessment of 638 Victorian parks and reserves (including all National Parks Act parks and larger conservation reserves), these parks provide 516 threatened species with at least 80% of important available habitat in the state and 763 species with at least 60% of important habitat suitability in the state.

Figure 3.1.14 Number of species for which national parks and nature conservation reserves provide best habitat

Habitat importance in selected parks ¹	Threatened species type ²					Total number of species
	Critically endangered	Endangered	Rare	Vulnerable	Not specified	
80%-100% of best habitat	17	75	241	181	2	516
60%-80% of best habitat	4	34	158	59	2	257
40%-60% of best habitat	7	39	149	72	1	268
20%-40% of best habitat	7	58	152	96	1	314
0%-20% of best habitat	12	51	92	70	1	226
Total	47	257	792	478	7	1,581

Notes: ¹ 638 parks representing National Parks Act parks and larger nature conservation reserves were selected for assessment. ² The number of species for which parks provide important habitat was derived through a combination of condition and species distribution importance modelling from DEPIs' NaturePrint.

The Alpine, Grampians and Murray sunset national parks provide the most suitable habitat in the State for more than thirty threatened species.

Figure 3.1.15 Top 10 parks with greater than 80% of best habitat suitability in the State

Park name	Number of threatened species
Alpine National Park	127
Grampians National Park	66
Murray - Sunset National Park	38
Croajingolong National Park	32
Little Desert National Park	15
Wilson's Promontory National Park	12
Hattah - Kulkyne National Park	9
Mount Buffalo National Park	9
Wyperfeld National Park	8
Baw Baw National Park	8

Listed Flora and Fauna communities in parks

Forty flora and fauna communities throughout Victoria are listed as threatened under the Victorian Flora and Fauna Guarantee Act 1988. Victoria's parks network is critical to the protection of these communities with 37 communities (31 flora and 6 fauna) occurring in the parks network.

Figure 3.1.16 Flora and Fauna Guarantee Listed Communities in parks (flora)

FFG Listed Communities represented in parks (flora)	Number of parks
Alpine Bog Community	2
Alpine Snowpatch Community	1
Caltha introloba Herbland Community	1
Central Gippsland Plains Grassland Community	2
Coastal Moonah (Melaleuca lanceolata ssp. lanceolata) Woodland Community	6
Cool Temperate Mixed Rainforest	3
Cool Temperate Rainforest Community	13
Creepline Grassy Woodland (Goldfields) Community	1
Devonian Limestone Pomaderris Shrubland Community	1
Dry Rainforest (Limestone) Community	2
Fen (Bog Pool) Community	2
Floristic Community 55-04 Western Basalt Plains (River Red Gum) Grassy Woodland	10
Forest Red Gum Grassy Woodland Community	8
Granite Foothills Spring Wetland (Northeast Victoria) Community	12
Grey Box - Buloke Grassy Woodland Community	2
Herb-rich Plains Grassy Wetland (West Gippsland) Community	2
Limestone Grassy Woodland Community	1
Limestone Pomaderris Shrubland Community	3
Montane Swamp Complex Community	1
Northern Plains Grassland Community	11
Plains Grassland (South Gippsland) Community	4
Red Gum Swamp Community No. 1	1
Rocky Chenopod Open Scrub Community	6
Sedge Rich Eucalyptus camphora Swamp Community	1
Semi-arid Herbaceous Pine - Buloke Woodland Community	3
Semi-arid Herbaceous Pine Woodland Community	3
Semi-arid Northwest Plains Buloke Grassy Woodlands Community	1
Semi-arid Shrubby Pine - Buloke Woodland Community	2
Strzleckis Warm Temperate Rainforest Community	4
Warm Temperate Rainforest (Coastal East Gippsland) Community	3
Warm Temperate Rainforest (Cool Temperate Overlap, Howe Range) Community	1
Warm Temperate Rainforest (East Gippsland Alluvial Terraces) Community	5
Warm Temperate Rainforest (Far East Gippsland) Community	2
Western (Basalt) Plains Grasslands Community	11

Figure 3.1.17 Flora and Fauna Guarantee Listed Communities in parks (fauna)

FFG Listed Communities represented in parks (fauna)	Number of parks
Butterfly Community No 1	1
Lowland Riverine Fish Community of the Southern Murray-Darling Basin	92
Port Phillip Bay Entrance Deep Canyon Marine Community	2
San Remo Marine Community	1
Victorian Mallee Bird Community	23
Victorian Temperate-Woodland Bird Community	1356

Representation of marine flora and fauna

Marine flora in parks

To date 334 native species of marine flora have been recorded in Victoria's marine national parks and sanctuaries. The park with the highest number of species is Port Phillip Heads Marine National Park. Further work in being undertaken to record and document marine biodiversity in these parks.

Figure 3.1.18 Parks with more than 50 marine flora species

Park name	Number of flora species
Port Phillip Heads Marine National Park	243
Bunurong Marine National Park	185
Wilson's Promontory Marine National Park	170
Point Addis Marine National Park	146
Eagle Rock Marine Sanctuary	89
Merri Marine Sanctuary	85
Cape Howe Marine National Park	83
Point Hicks Marine National Park	82
Merri Marine Sanctuary	81
Ricketts Point Marine Sanctuary	69
Marengo Reef Marine Sanctuary	60
Jawbone Marine Sanctuary	58
Mushroom Reef Marine Sanctuary	55
Point Cooke Marine Sanctuary	52

Marine fauna in parks

To date, 723 native species of marine fauna have been recorded in Victoria's marine national parks and sanctuaries. The Port Phillip Head marine national park has the largest number of marine fauna species. Further work in being undertaken to record and document marine biodiversity in these parks.

Figure 3.1.19 Parks with more than 100 marine fauna species

Park Name	Number Species in Park
Port Phillip Heads Marine National Park	392
Wilson's Promontory Marine National Park	295
Bunurong Marine National Park	269
Point Addis Marine National Park	213
Cape Howe Marine National Park	177
Point Hicks Marine National Park	171
Point Cooke Marine Sanctuary	153
Jawbone Marine Sanctuary	142
Wilson's Promontory Marine Park	135
Ricketts Point Marine Sanctuary	120
Bunurong Marine Park	101

Endemic marine species

There are at least 55 endemic marine species (35 flora and 20 fauna) recorded in 5 parks across the network.

Rare and threatened marine fauna species in parks

There are 60 listed rare and threatened marine fauna species recorded in Victoria's parks.

Figure 3.1.20 Parks with more than ten threatened marine fauna species

Park Name	Number Threatened Species Park
Port Phillip Heads Marine National Park	29
Merri MS	29
Churchill Island Marine National Park	24
Point Cooke Marine Sanctuary	20
French Island Marine National Park	20
Yaringa Marine National Park	20
Jawbone Marine Sanctuary	19
Point Addis Marine National Park	18
Cape Howe Marine National Park	18
Barwon Bluff Marine Sanctuary	17
Port Phillip	16
Bunurong Marine National Park	15
Western Port	15
Wilson's Promontory Marine National Park	14
Corner Inlet Marine National Park	13
Discovery Bay Marine National Park	13
Point Hicks Marine National Park	12

Twelve Apostles Marine National Park	11
Ninety Mile Beach Marine National Park	11
Beware Reef Marine Sanctuary	10

Sites of geodiversity significance in parks

Of the 292 geologically significant features identified in Victoria's parks network in 2010, 58 (37%) were recognised as having international, national or state significance.

Figure 3.1.21 Sites of geological significance in parks

Significance	Number in parks	Number state-wide	% of state total
International	4	27	15%
National	21	33	64%
State	33	97	34%
Total	58	157	37%
All (including regional significance)	292	1034	28%

Ecosystem services provided by parks

The natural resources of the parks network provides the foundation for providing a wide range of ecosystem services that benefit the Victorian community. These services including provisioning services (e.g. water supply), regulating services (e.g. climate regulation, water filtration and pollination for agriculture) cultural services (e.g. recreational, spiritual and health benefits) and supporting services (e.g. habitats for species). A summary of ecosystem services provided by Victoria's parks can be found in the Valuing Victoria's Parks report (see www.parkweb.parks.vic.gov.au).

Water services

Parks provide cost-effective living infrastructure to purify and filter water which benefits water consumers and agricultural producers. The forests, woodlands and wetlands of Victoria's parks improve water quality by naturally purifying and filtering water and reducing the release of soil sediment, pollutants and organic matter that would otherwise reach our waterways. Clean water is critical for human health and is also essential for water-based recreation.

Over one million hectares of Victoria's parks are utilised for water supply catchments that are used for either drinking water or agricultural production. 36 of the State's water supply catchments contain at least 50% of their area as park. 90% of Melbourne's water supply is captured from park catchments and the catchments of the Grampians National Park supply water to 45 towns and 7,000 rural properties. Appendix 3.9 provides a summary of water catchments in parks.

Figure 3.1.22 Water supply catchments in parks

Catchment Type	Area in the Parks Network (Ha)	State Wide Area (ha)	% in the Parks Network
Designated Water Supply Catchment	1,218,298.6	5,235,236.3	23.3
Special Water Supply Catchment	12,917.2	13,019.3	99.2

Additionally metropolitan parks play an important role in reducing the level of nutrients and toxicants that affect water quality and ecosystem health in urban waterways and bays. Improvement to water quality has flow effects to benefit recreational use and amenity of waterways.

Supply of water

Previous estimates of the water runoff delivered by 86 of Victoria's National and State parks have been estimated at 7,100 Gigalitres (GL) per year, equating to 34% of Victoria's total water runoff in 2005.¹

Recent modelling of nine of Victoria's National and State parks in non-metropolitan areas commissioned by Parks Victoria², including some of the State's highest yielding parks, has estimated that these parks provide

¹ SKM 2005, *Runoff from Victorian Parks*, Report prepared Parks Victoria. About 25% of the State's annual runoff (21,120 GL) is used for consumption in Victoria (4,993 GL in 2004-05 and 4,220 GL in 2012-13, Source: ABS 2013, Water Account, Australia, 2012-13). Entitlements for surface water was 6,423 GL in 2012-13 (Source: DEPI 2014, Victorian Water Accounts).

² Marsden Jacobs Associates 2014, *Valuing the Water Services provided by Victoria's Parks*. Report prepared for Parks Victoria

annual water flows of about 3,392 GL per year on average, or 16% of the states runoff. Water runoff generated from the Alpine National Park contributes around two-thirds of this flow.

Figure 3.1.23 Parks that provide more than 50% of the total water supply catchment

Park
Alpine National Park
Ararat Hills R.P.
Chiltern-Mt Pilot National Park
Grampians National Park
Great Otway National Park
Greater Bendigo National Park
Kara Kara National Park
Kinglake National Park
Kurth Kiln R.P.
Langi Ghiran State Park
Lerderderg State Park
Macedon R.P.
Mount Charlie F.R
Yarra Ranges National Park

Water filtration services

Compared to an alternative land use (agricultural grazing land) national parks reduce the volume of sediment flowing into waterways on average by around 92% (4165 tonnes of sediment for eight selected parks compared to about 47,000 tonnes under grazing land use).

Melbourne's metropolitan parks have a significant effect on maintaining the water quality of Melbourne's waterways and Port Phillip Bay. Metropolitan parks reduce the volume of Nitrogen flowing into waterways and the bays by around 85% (31 tonnes of nitrogen per annum for parks compared to about 213 tonnes per annum if residential land use).

Flood and stormwater regulation

Based on hydrological modelling, without parks the recurrence of peak flows would increase by more than 20% across most parks, and in some cases more than 50% (e.g. Yarra Range, Great Otway and Grampians national parks).

Without its metropolitan parks, Melbourne's stormwater management infrastructure would require a major increase in capacity to cope with this doubling of stormwater volume. Melbourne's metropolitan parks are estimated to provide 34 GL per year under the current land use as a park, but if the land was used for urban residential development the volume of stormwater runoff would be 74 GL per year.

Carbon storage and sequestration

Across the world, intact terrestrial, wetland and marine and coastal ecosystems of parks play a vital role in regulating the earth's climate by adding and removing carbon dioxide from the atmosphere and storing it in the form of organic carbon in plant (trunks, branches, foliage, and roots) biomass and soil. These ecosystems store more carbon than the atmosphere and are vital to influencing carbon dioxide-driven climate change.

Victorian parks are nationally and internationally significant for their ability to store carbon³. For instance, the mountain ash forests of the Central Highlands (including the Yarra Ranges National Park) have been shown to contain among the world's highest carbon biomass density of up to 1,867 tonnes of carbon per hectare, more than the forests of the Amazon

The estimated volume of carbon currently stored in Victorian terrestrial parks is around 270 million tonnes⁴ (almost 1 billion tonnes of carbon dioxide equivalent⁵), which is equivalent to around nine years of Victoria's total annual greenhouse gas emissions. The Alpine National Park accounts for nearly one quarter of the carbon stocks in the Victorian parks network, with around 70 million tonnes of carbon stored (see Appendix 3.10).

These modelled estimates of carbon storage are likely to be conservative as recent studies in the Central Highlands of Victoria (e.g. Yarra Ranges national park) indicate that carbon stocks can be significantly higher than modelled estimates.

More than 850,000 tonnes of carbon or over three million tonnes of CO₂ e equivalent carbon dioxide is stored within the mangrove, saltmarsh and seagrass habitats of selected marine protected areas

Figure 3.1.24 Major terrestrial carbon sinks of the Victorian parks network

Park	Estimated carbon stocks (million tonnes)	Approximate area (hectare)	Average tonnes of carbon per hectare
Alpine National Park	71	662,000	106
Murray-Sunset National Park	21	666,000	31
Snowy River National Park	16	115,000	142
Croajingalong National Park	15	87,000	176
Great Otway National Park	14	103,000	135
Yarra Ranges National Park	12	77,000	156
Wyperfeld National Park	10	360,000	27
Grampians National Park	9	168,000	54
Coopracambra National Park	7	38,000	191
Errindundra National Park	6	40,000	158
Wilson's Promontory National Park	5	47,000	107
Avon Wilderness Park	4	40,000	99

Source: DELWP datasets on modelled carbon stocks

³ Norris, J., Arnold, S. and Fairman, T. 2010. 'An indicative estimate of carbon stocks on Victoria's publicly managed land using the FullCAM carbon accounting model'. *Australian Forestry* 73. pp.209-219; Keith, H., Mackey B.g and Lindenmayer D.B. 2009, *Re-evaluation of forest biomass carbon stocks and lessons from the world's most carbon-dense forests*, PNAS Vol. 106, Number 28.

⁴ Data on carbon stocks based on Land carbon 3 model (DSE 2012) which used the National Carbon Accounting Toolbox Full Carbon Accounting Model along with DSE corporate data such as fire and harvesting history, vegetation type and soil type.

⁵ 1 tonne of carbon = 3.664 tonnes of carbon dioxide equivalent.

Coastal protection

Coastal and marine habitats including mangrove, salt marsh, seagrass and coastal dune protect important community coastal assets by absorbing wave energy, helping to minimise shoreline areas from storm damage, inundation and erosion. If intact, these ecosystems can provide highly cost effective natural buffers against incoming waves.

Victoria's parks protect over 80,000 hectares of intertidal and sandy coastal habitats along 722 km of the coastline. Of this around 300 km are located around coastal townships and communities. The majority of intertidal habitats that protect coastal communities are located in Western Port Bay (including Yaringa Marine National Park and Northern Westernport Nature Conservation Reserve, which cover over 90km of coastline) and northern Port Phillip Bay. Both locations are vulnerable to storm surges and very vulnerable to sea level rise. Sandy shore habitats that protect coastal communities include the Mornington Peninsula National Park, Nooramunga Marine and Coastal Park, Point Cook Coastal Park and Jawbone Flora and Fauna Reserve as well as the Gippsland Lakes Coastal Park. Note the parks network also includes approximately 550 km of rocky shoreline which, although is subject to increasing pressure from storm surges and sea level rise, has been considered as being of lower risk to coastal communities for this assessment

Figure 3.1.25 Coastal (non-rocky) habitats within the parks network

Shoreline habitat	Parks network (ha)	Parks coastline total (Km)	Coast near coastal communities (Km)
Coastal and sandy beach EVCs	48,720	527	160
Intertidal habitats	33,100	195	125
Total	81,800	722	285

Maintenance of nursery habitats

Marine and coastal parks provide an important service by providing healthy nursery habitats for the recruitment of juvenile species used for commercial and recreational uses such as fishing. Of particular importance is the role that parks play in protection and conservation of seagrass, mangrove and reef habitats, which are recognised around the world as providing essential nursery and recruitment services for many species.

Nearly 22,000 hectares of coastal wetlands that are located within the parks network provide nursery services, particularly seagrass and mangrove communities.

Pollination and seed dispersal

The forest, woodland and other habitats of the parks network provide a range of pollinator species such as insects, birds and bats that pollinate plants and trees which are essential for the development of fruits, vegetables and seeds for human use. Native and introduced pollinators support agricultural activity providing benefits to agricultural producers and consumers. More research is required to quantify the volume of pollination services provided by native species.

Pest control

Some groups of native species such as birds and bats are major predators of insects and other pests such as mice, including many crop and forest pests. CSIRO research has found that native vegetation can provide a reservoir of natural enemies, which have potential to suppress pest populations in agricultural crops.⁶

Victoria's parks network provides suitable habitats for 20 species of insectivorous bats and more than 120 species of insectivorous birds as well as many other insect eating species such as spiders, reptiles and mammals. These native species consume millions of insects each year and can act as natural controllers of pests and diseases on agricultural land to improve productivity.

⁶ <http://www.csiro.au/Outcomes/Environment/Biodiversity/ecosystem-service-pest-control-native-vegetation.aspx>