Parliament of Victoria's Inquiry into Ecosystem Dealine

The devastating impact of animal exploitation activities

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Submission in response to the Parliament of Victoria's inquiry into ecosystem decline: The disastrous impacts of animal exploitation activities

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Cover image: William Edge, "Beef cows and calves grazing on grass in south west Victoria, Australia, eating hay and silage", Shutterstock ID 1735428902

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". . . if we could recognise who we really are, rather than beings who were magically and separately created from the rest of nature, and if we could come to grips with that reality, then maybe we could be aroused from the stupor that we find ourselves in and begin to save ourselves."

Ann Druyan

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1. INTRODUCTION

"It's becoming clear that nowhere is safe from the heat for Australia's bats. Their habitat has been destroyed to the point that they simply can't find appropriate shelter when temperatures rise. This agony is the result of years of government ignorance and inaction, and it's beyond unacceptable that the flying foxes are without a recovery plan nearly 20 years after they were recognised as a threatened species."

Evan Quartermain, Humane Society International

On Friday 25th January 2019, the temperature across Victoria reached 45°C. The combination of heat, low humidity and strong winds was too much for flying bat populations from Melbourne to Bairnsdale in the state's east to bare, with thousands falling dead from tree canopies.²

A year later, the flying foxes who survived, along with animal populations across 12.6 million hectares, were confronted with catastrophic bushfires. A team from the University of Sydney, headed by ecologist Chris Dickman, has conservatively estimated that more than one billion animals perished.³

The Parliament of Victoria's inquiry into ecosystem decline is clearly addressing an urgent need.

This submission focuses primarily on the loss of terrestrial and marine ecosystems arising from society's exploitation of animals.

The economic cost of such exploitation has largely been ignored by governments around the world. However, the COVID-19 pandemic, which is believed to have arisen from an animal food market in Wuhan, China, has demonstrated the previously almost unimaginable financial and societal consequences of exploiting animals.

The pandemic's enormous cost may be tiny relative to the cost of historical and ongoing destruction of natural ecosystems arising from animal-based food industries. Much of that destruction could be reversed, and further destruction prevented, if we were to transition away from animals as a food source.

Committee members and others who read this submission may regard such a transition as fanciful or extreme. However, millions of people around the world, like this writer, are living healthy, rewarding and fulfilling lives while seeking to avoid harming animals.

Such transitional measures are essential and achievable, with massive additional benefits in relation to the climate emergency, human health and the avoidance of animal cruelty.

Our ability to retain a habitable planet is at stake.

I thank the Legislative Council Environment and Planning Committee for the opportunity to submit.

2. EXECUTIVE SUMMARY

- Governments, industry and the community may be oblivious to, or seek to ignore, the adverse impacts on ecosystems of animal exploitation activities. This may be due to factors such as: (a) entrenched belief systems; (b) strong links between the farmed animal sector and environmental groups; (c) political pressure; and (d) sophisticated marketing and public relations activities of those seeking to profit from such activities.
- 2. Animal-based foods are a grossly and inherently inefficient source of nutrition. That inefficiency causes the current food system to utilise far more resources, including land, than would otherwise be required.
- 3. Land clearing is an obvious threat to ecosystems and has formally been recognised as such under the federal Department of Agriculture, Water and the Environment's listing of key threatening processes.
 - Around 66 per cent of Victoria's native vegetation has been cleared since Europeans arrived, much of it for animal agriculture. In percentage terms, it makes Victoria Australia's most heavily cleared state.
- 4. We are facing a climate emergency that requires an emergency response. We will not overcome the emergency without implementing all available measures, including a general transition away from animals as a food source.
 - The climate emergency is dramatically affecting the natural environment and the animals who inhabit it.
- 5. The Australian farmed animal sector uses sophisticated marketing and public relations techniques in an effort to gain support on environmental grounds and to overcome negative perceptions of its dramatic impacts. It is essential to see the reality and ignore the marketing spin.
- 6. Species such as brown trout and certain pasture grasses have been introduced with devastating consequences.
- 7. Critically important marine ecosystems are being decimated by the combined effects of climate change and the loss of predator species that would normally control other species such as sea urchins, which remove kelp forests and seagrass meadows.
- 8. Logging is a form of animal exploitation in that it utilises animal habitat for financial gain. In Victoria, it has adversely affected the habitat of the critically endangered Leadbeater's possum, the vulnerable greater glider, and others.
- 9. Time is running out to retain a habitable planet. Loss and fragmentation of habitat are almost impossible to reverse in a time frame that is meaningful to the survival of threatened species. It is critically important to retain what remains.

3. THE BIG PICTURE

Animal exploitation activities adversely affect the environment in many ways, including habitat loss, ecosystem imbalance, climate change and pollution.

Despite these and other tragic outcomes, the exploitative practices are seldom meaningfully challenged by governments or environmental groups who generally ignore clear scientific evidence indicating that current practices are unsustainable.

There is little community pressure to change those practices. This section offers some possible reasons.

3.1 The carnist mindset

The concept of "carnism" was established by Harvard-educated psychologist and author Dr Melanie Joy.⁴

She describes carnism as an invisible belief system or ideology under which it is acceptable to exploit certain animal species but not others. The animal advocacy organisation, Voiceless, has suggested that carnism is a subset of speciesism which, like racism and sexism, is a form of prejudice or discrimination.⁵

Melanie Joy says: "Because carnism is invisible, people rarely realise that eating animals is a choice, rather than a given. In meat-eating cultures around the world, people typically don't think about why they eat certain animals but not others, or why they eat any animals at all. But when eating animals is not a necessity, which is the case for many people in the world today, then it is a choice – and choices always stem from beliefs."

It is invisible largely because it is the dominant belief system. In that way, it is much like background noise that has continued for an extended period, to the point where we have become oblivious to it.

Whether the outcomes of animal exploitation are animal suffering, environmental degradation or adverse human health, the carnist mindset can contribute to people being oblivious to obvious solutions.

3.2 Links between the farmed animal sector and environmental groups

Strong links have existed for many years between the farmed animal sector and environmental campaign groups. They have included key organisational positions, significant levels of funding and, in one instance, a gift of a high-tech building.^{6,7,8}

This writer does not claim the links have influenced any person or organisation or that any person or organisation has sought to influence others. However, it may be useful for anyone interested in the relevant issues to be aware of them. The carnist mindset referred to in the previous item may have played a part in the arrangements becoming established.

3.3 Direct political pressure

Lobby groups, including farmers' organisations with a strong focus on animal-based food production, can play a major role in shaping government policies.

An example is the Victorian Farmers Federation, which describes itself as "an active, powerful lobby group dedicated to the interests of farmers . . .".9

In January 2018, it issued a "stern warning to government" condemning a proposal to introduce the concept of sentience to animal welfare legislation. 10

The Federation's office is located at the top end of Collins Street in Melbourne, around a two-minute walk from the Premier's office and 5 minutes from Parliament House.

3.4 Sophisticated marketing and public relations

The farmed animal sector is extremely proficient at influencing community sentiment and behaviour through sophisticated marketing and public relations techniques. A strong example is Meat and Livestock Australia (MLA).

MLA's reasons for existence are research, development and marketing on behalf of cattle meat, sheep meat and goat meat producers. MLA also works closely with meat processing and live export organisations to develop programs that address key industry issues, manage projects and communicate outcomes.

Its stated core purpose is to foster the prosperity of the red meat industry. 11

There may be an inherent tension between MLA's marketing and communication roles on the one hand and R&D on the other, as negative research findings on sustainability or other matters would hardly be good for marketing or public perception.

MLA has won prestigious advertising and PR industry awards, including Marketing Team of the Year and Advertiser of the Year. The campaigns have been developed by high profile marketing firms such as: The Republic of Everyone; The Bravery; Totem; One Green Bean; BMF; and The Monkeys.

MLA has even gained access to schools, utilising material accessible via its marketing and promotional pages in the form of so-called "national curriculum study guides", classroom posters, lesson and activity sheets, virtual excursions, virtual reality roadshows, digital lessons and online board games.¹³

Claims regarding environmental sustainability appear to be a key weapon in its marketing efforts, including for critically important export markets.

3.5 A look at the past

People and organisations entrenched in current practices and systems may object to measures they consider radical even when those measures are essential to deal with a crisis. That is how most Americans seem to have felt about war in Europe and the Pacific before the Japanese bombed Pearl Harbor.

Here's how Janet Larsen from the Earth Policy Institute described the situation in a 2009 interview concerning climate change:

Interviewer: "That war-footing that's been spoken about by a few people, and can you just basically tell our audiences about the kind of World War 2 analogy?"

Janet Larsen: "Well, certainly. Sometimes social change happens rather gradually, and other times it happens immediately. You go to bed one night and you wake up, and you're in a new world and it's that latter case that is what happened in the United States back in 1941, December 7th, when the Japanese bombed Pearl Harbour. Before that point, most Americans were rather reluctant to get involved in a massive war being fought on the far sides of two distant oceans. They didn't feel affected, and there was very little public support to get involved."

"After Pearl Harbour was bombed, one month later, President Roosevelt could stand before the country giving his State of the Union address and in that address, he announced this incredibly ambitious arms production goals. He said we're going to produce 45,000 tanks, 60,000 planes, 20,000 anti-aircraft guns and 6 million tons of merchant shipping."

"These are enormous numbers and after that he called in the leaders of the American auto manufacturing companies and he said, 'We're going to need all your capacity to help us achieve these goals', and apparently the leaders of these companies um'd and ah'd and said, 'Well you know, Mr President, we will do our best. That will be difficult, but you know, we are making these cars, but we're going to try'.

"And his reply was along the lines of, 'You don't understand. We're not going to be producing any cars. We're going to be devoting all of our resources to this war effort.'

"And indeed between early 1942 and 1944, there were essentially no cars produced in this country, but instead they were churning out planes and tanks, and toy factories started manufacturing compasses, and spark plug factories were churning out machine guns. Those that made corsets were then making grenade belts."

"So, we, in just a matter of months, we completely restructured the US economy. And this is the kind of massive and rapid scale restructuring that we're saying we need to confront the challenges we're facing today. Mainly, this is what we need to do to stop climate change from spinning out of control."

Larsen may have been happy to add ecosystem collapse to climate change in the final sentence if she were considering our current circumstances.

4. ANIMAL FARMING IS GROSSLY AND INHERENTLY INEFFICIENT

Animal-based foods are a grossly and inherently inefficient source of nutrition. That inefficiency causes the current food system to utilise far more resources, including land, than would otherwise be required.

The inefficiency was quantified in a 2018 paper in the journal Science by Joseph Poore and Thomas Nemecek.¹⁴ The authors reported that farmed animals occupy 83 per cent of global farmlands but only account for 37 per cent of protein and 18 per cent of calories in our food system, as demonstrated in Figure 1.

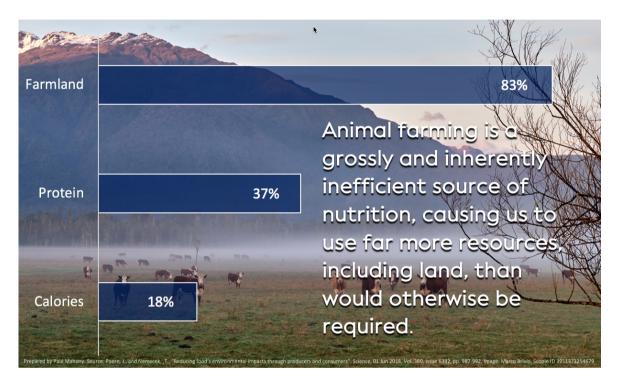


Figure 1: Farmed animals share of global farmland and contribution to protein and calories.

The authors estimated that a general transition to an animal-free diet would reduce food production's land use by 3.1 billion hectares (or 31 million square kilometres). That is an area slightly larger than: (a) Africa; (b) four times the contiguous United States; or (c) four times Australia, as represented in Figure 2.

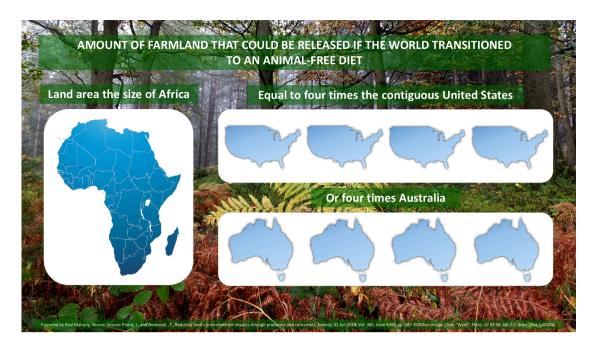


Figure 2: Amount of farmland that could be released if the world transitioned to an animal-free diet

Similarly, two Austrian research teams have shown that, in 2000, 58 per cent of the planet's appropriated plant growth was fed to farmed animals and supplied 17 per cent of humanity's calorie intake globally. Only 12 per cent was consumed directly by humans and provided 83 per cent of calories. For protein, the comparison was around 40 per cent from animals and 60 per cent from plants.¹⁵

A 2009 report from the PBL Netherlands Environmental Assessment Agency reported: 16

"... a global food transition to less meat, or even a complete switch to plantbased protein food [was found] to have a dramatic effect on land use. Up to 2,700 Mha of pasture and 100 Mha of cropland could be abandoned, resulting in a large carbon uptake from regrowing vegetation. Additionally, methane and nitrous oxide emissions would be reduced substantially."

The authors said a plant-based diet would reduce climate change mitigation costs by 80 per cent. A meat-free diet would reduce them by 70 per cent. Their assessment was based on a target CO2 concentration of 450 ppm. The issue is even more critical when aiming for lower levels.

In a 2013 paper, researchers from the Institute on the Environment at the University of Minnesota stated:¹⁷

"The world's croplands could feed 4 billion more people than they do now just by shifting from producing animal feed and biofuels to producing exclusively food for human consumption".

The lead author, Emily Cassidy, has said:

"We essentially have uncovered an astoundingly abundant supply of food for a hungry world, hidden in plain sight in the farmlands we already cultivate. Depending on the extent to which farmers and consumers are willing to change current practices, existing croplands could feed millions or even billions more people."

There are around 800 million under-nourished people in the world¹⁸, meaning that less than a quarter of the land would be needed for food production, leaving most free for rewilding, reforestation or afforestation.

If an individual business were operating with the level of efficiency demonstrated here, it would almost certainly be closed or its methods radically overhauled.

Section 5 considers the land use impact of the animal-based food system's inefficiencies in the Australian context.

5. EXTENT OF LAND USE CHANGE

Land clearing is an obvious threat to ecosystems and has formally been recognised as such under the federal Department of Agriculture, Water and the Environment's listing of key threatening processes.

Figure 3 shows the modification of Australia's native vegetation, with Victoria highlighted for the purpose of this submission.¹⁹

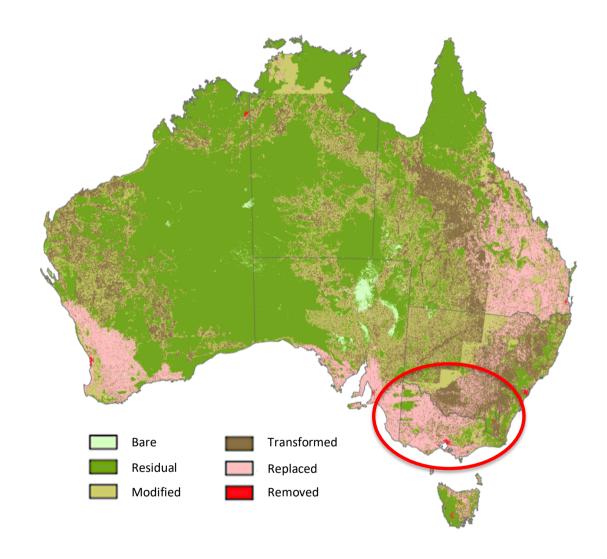


Figure 3: modification of Australia's native vegetation

Around 70 per cent of Australia's land mass is arid or semi-arid.²⁰ The remaining 30 per cent was covered by woodland before European settlement. Approximately half that 2.3 million square kilometre area has been cleared.²¹ Around 70 per cent of the clearing has been for animal agriculture.²²

Across Australia and Victoria, Figure 4 shows land use in 2010-11.²³

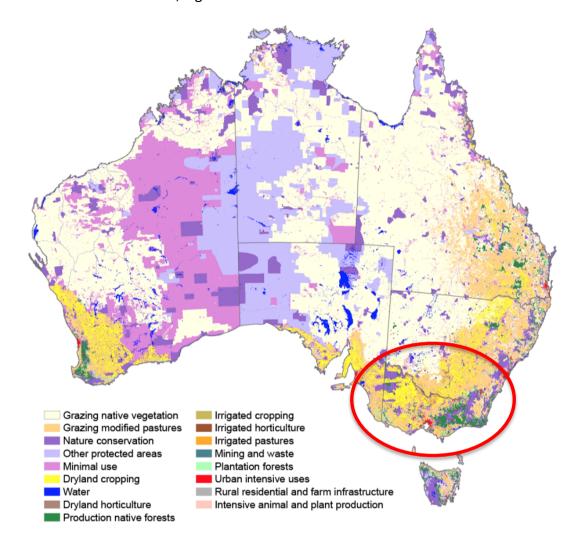


Figure 4: Land use in Australia 2010-11

The Hume Freeway is the main road link from Victoria's capital, Melbourne, to Sydney in New South Wales. The sparsely wooded grasslands observed by people travelling between the state capitals is very different from the pre-European landscape, which comprised mainly woodlands.²⁴

Around 66 per cent of Victoria's native vegetation has been cleared since Europeans arrived²⁵, leaving 34 per cent of its land area covered by native forests.²⁶ The cleared area is roughly equivalent to the area of Ireland, Switzerland and Netherlands combined. In percentage terms, it makes Victoria Australia's most heavily cleared state.²⁷

Figure 5 highlights the current usage of the cleared land within the state, including the extensive area that has been cleared for the grazing of farmed animals.

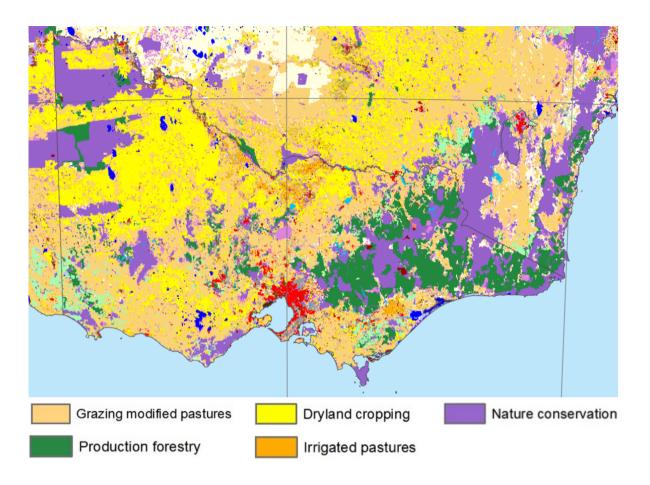


Figure 5: Land use in Victoria 2010-11

Without the grossly and inherently inefficient nature of animals as a food source, far less land would have been required in Victoria than has been utilised. Wool production has also been a factor but does the revenue from that product justify the enormous ecological cost?

In the most recent period on record, 2018-19, there were 2.1 million beef cattle and 13.9 million sheep in Victoria. ²⁸ The sheep number alone was more than twice the human population.

In the decades commencing in 1970 through to 2014, the percentage of land cleared for pasture nationally ranged from 74.6 to 80.8 per cent, as shown in Figure 6.29

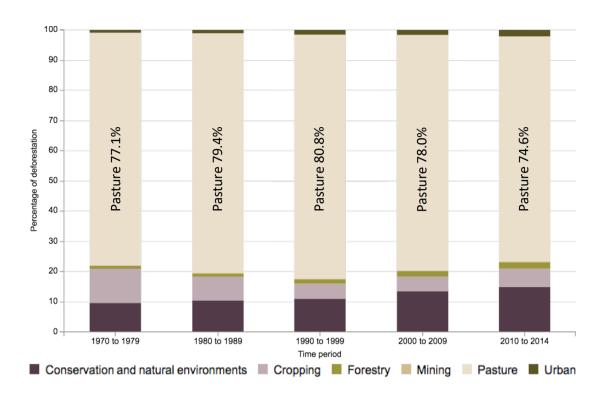


Figure 6: Deforestation trends by land use

In December 2015, seventy-four ecological communities in Australia were listed as threatened under the EPBC Act. Of those, thirty-one were listed as critically endangered, forty-one as endangered and two as vulnerable. Thirty were new listings since 2011.

EPBC Act—listed ecological communities are concentrated in south-eastern Australia. In particular, the Brigalow Belt IBRA region in Queensland, the Sydney Basin and Riverina IBRA regions in New South Wales, the Southern Volcanic Plain IBRA region in Victoria and the Murray—Darling Depression IBRA region all have high numbers of threatened ecological communities, as demonstrated in Figure 7.³⁰

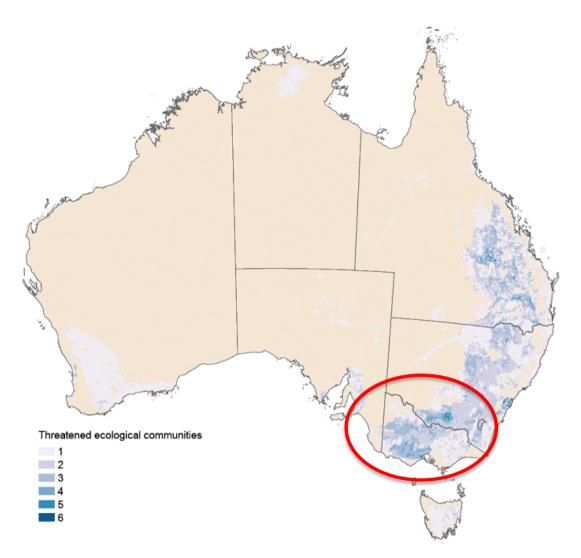


Figure 7: Threatened ecological communities in Australia

6. THE CLIMATE EMERGENCY

6.1 On the edge of a precipice

Politicians and mainstream media in Australia and overseas generally overlook or deliberately ignore exponential trending of climate change impacts. The community is led to believe that climate change's impacts increase gradually and that incremental measures will enable us to avoid widespread catastrophic outcomes.

Such a perception has been enabled by scientific reticence on the part of researchers and the conservative nature of the Intergovernmental Panel on Climate Change (IPCC), which operates on the basis of consensus, with its reports requiring approval of all governments.

In reality, feedback mechanisms in the climate system are causing impacts to accelerate rapidly. This acceleration can be compounded by the breaching of tipping points, leading to a significant step change from one climate state to another that is far more onerous than the first. The combination of feedback mechanisms and tipping points can lead to runaway climate change over which we will have no control.

In commenting on a 2019 study on the feedback of thawing Siberian permafrostⁱ, respected climate change author Joe Romm wrote:^{31, 32}

"The only surprise is that the world continues to ignore this gravest of threats to humanity, even as it speeds up, triggers amplifying feedbacks, and rapidly approaches a climate death spiral."

We are facing a climate emergency that requires an emergency response. We will not overcome the emergency without implementing all available measures, including a general transition away from animals as a food source.

6.2 Animal agriculture's broad climate change impact

Animal agriculture's climate change impacts arise from many inter-related factors, some of which have already been referred to in this submission. They include:

- (a) its inherent inefficiency as a food source;
- (b) the massive scale of the industry;
- (c) resultant land clearing far beyond what would otherwise be required to satisfy our nutritional requirements;

¹ Permafrost is frozen soil, sediment or rock covering around twenty-four per cent of exposed land in the northern hemisphere and extends to offshore Arctic continental shelves. It ranges in thickness from less than one metre to more than a kilometre.

- (d) greenhouse gases such as carbon dioxide, methane and nitrous oxide; and
- (e) other warming agents such as tropospheric ozone (derived from precursors such as volatile organic compounds and carbon monoxide) and black carbon.

Items (b) and (c) are referred to in more detail below.

Official figures under-report animal agriculture's overall and proportional emissions because relevant factors are:

- (i) omitted entirely, e.g. tropospheric ozone;
- (ii) classified under different headings, e.g. livestock-related land clearing reported within the category "land use, land use change and forestry" (LULUCF); and
- (iii) considered but with conservative calculations, e.g. methane's impact using a 100-year, rather than 20-year, time horizon for determining its "global warming potential" (as referred to below).

As acknowledged by the IPCC, the choice of GWP time horizon is a value judgement. The shorter time horizon is critical in the context of climate change tipping points, beyond which we can lose any chance of influencing the climate system in a positive manner.

The land clearing is a double-edged sword, as it releases carbon in the form of CO2 from soil and vegetation, while reducing the biosphere's ability to draw existing CO2 from the atmosphere.

More details regarding the various warming agents can be seen in Appendix 3.

6.3 Land clearing's regional climate change impacts

The extent of land clearing in Victoria and elsewhere in Australia was highlighted in Section 5.

In 2007, a paper in Geophysical Research Letters reported on the impact of land cover change on Australia's regional climate.³³ In introducing their study, the authors cited results of a 2006 study which indicated that deforestation in the Sahel (with a fragile landscape like Australia's) had led to a 20-40 per cent reduction in rainfall.³⁴

Their own study found that "replacing the native woody vegetation with crops and grazing in southwest Western Australia and eastern Australia has resulted in significant changes in regional climate, with a shift to warmer and drier conditions, especially in southeast Australia".

They said the findings "highlight a strong feedback effect between land cover change and the severity of recent droughts impacting on Australia's already stressed natural resources and agriculture".

The reported changes in climate can be seen in Figures 8 and 9.

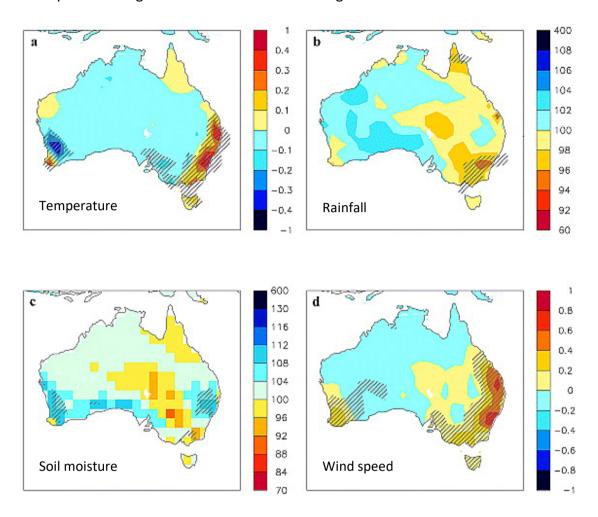


Figure 8: Differences in the ensemble climate averages (1951–2003) between pre-European and modern day conditions: (a) mean annual temperature (°C), (b) mean annual rainfall (% change), (c) mean annual soil moisture (% change), and (d) summer surface wind speed at 10 m (m sec-1). The hatched areas are statistically significant at the 95% confidence level.

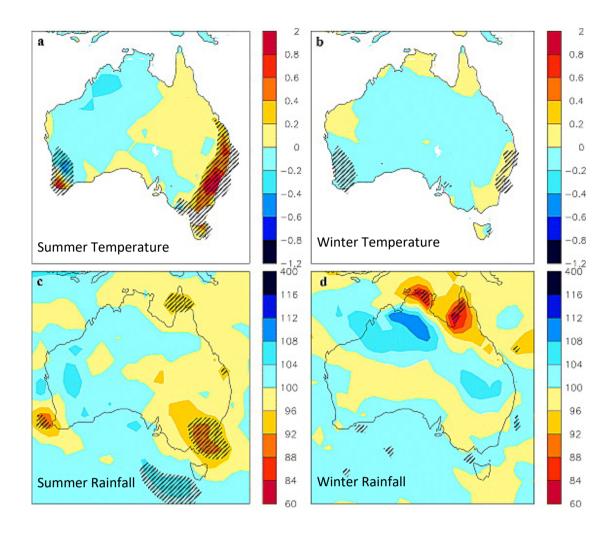


Figure 9: Difference in the ensemble seasonal climate averages (1951–2003) between pre-European and modern conditions: (a) summer surface temperature (°C), (b) winter surface temperature (°C), (c) summer mean rainfall (% change), and (d) winter mean rainfall (% change). The hatched areas are statistically significant at the 95% confidence level.

6.4 Climate change in Victoria

The state government's 2019 climate science report has indicated that the average temperature across the state has increased by just over 1.0°C since official Bureau of Meteorology records began in 1910.³⁵

With increased temperatures, reduced rainfall and increased wind speeds, it is no surprise that the intensity and frequency of bushfires have increased alarmingly.

Figure 10 shows the dramatic change in rainfall patterns over the past thirty years, with excessive rain in the north of the state during warmer months and major shortfalls at other times. Images for other climate change indicators can be found in Appendix 2.

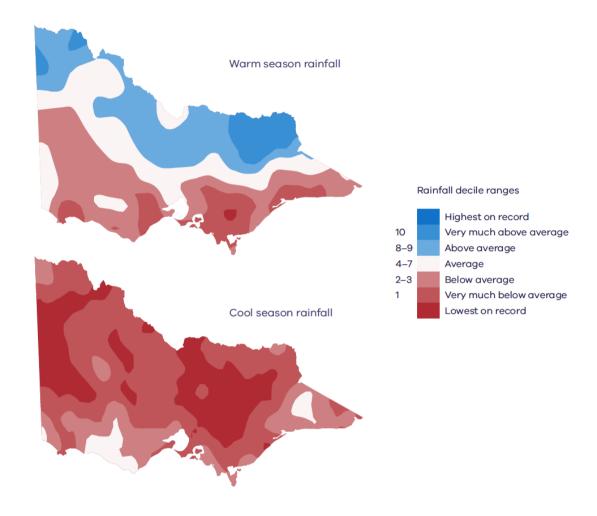


Figure 10: Observed rainfall changes in Victoria for the 30 years 1989-2019

6.5 The meat industry's questionable climate change claims

There are several concerns with the Australian red meat industry's position on climate change.

Methane

As mentioned earlier, Meat and Livestock Australia focuses strongly on marketing and PR. Its key marketing catch cry is currently the red meat industry's claimed goal of achieving a carbon neutral supply chain by 2030. The program has been branded "CN30" and appears to have been accepted largely without question by mainstream media outlets and political parties.

A central plank of the opposition Australian Labor Party's 2019 federal election campaign was its climate change policy. Less than four lines were devoted to the agriculture sector specifically, but they included reference to MLA and CN30.

There are many flaws in the industry participants' supposed efforts on this issue.

The first involves an outdated carbon neutral certification process, which is administered by the federal Department of the Environment and Energy. It should surprise no one that the Australian government is a laggard in terms of carbon neutral certification in the same way it is a laggard on the issue of climate change generally.

The methodology specifies that a global warming potential (GWP) of 25 be used for methane (CH4) emissions. ^{36,37,38} GWPs are expressed as multipliers representing the warming effect of a unit mass of a non-CO2 greenhouse gas relative to the same mass of CO2 over a specific period.

The approach enables the emissions of different greenhouse gases to be aggregated in order to determine the overall CO2-equivalent (CO2-e) figure.

The GWP of 25 for methane was specified by the Intergovernmental Panel on Climate Change (IPCC) in its 2007 Fourth Assessment Report (AR4), based on a 100-year time horizon. It was amended in its 2013 Fifth Assessment Report (AR5) to a figure of 34, allowing for climate-carbon feedbacks. Even without those feedbacks, it had been increased to 28.

Although the industry's Sustainability Steering Group has adopted the 34 multiplier, individual producers can and have utilised the lower figure. ^{39,40}

Another deficiency in the carbon neutral classification system is that it fails to consider the shorter-term impacts of methane emissions, which are a key feature of cattle and sheep farming's overall emissions profile.

Methane breaks down in the atmosphere to a significant extent within around 12 years from its release. Accordingly, the commonly used 100-year GWP (showing the average impact over a period of 100 years) greatly understates its shorter-term impact. The issue is critical when considering climate change feedback mechanisms and tipping points, with potentially catastrophic and irreversible consequences.

The Intergovernmental Panel on Climate Change (IPCC) has said:41

"There is no scientific argument for selecting 100 years compared with other choices. The choice of time horizon is a value judgement because it depends on the relative weight assigned to effects at different times."

Based on an alternative 20-year time horizon, the GWP multiplier for methane increases from 34 to 86.

The Red Meat Advisory Council (RMAC) favours an alternative form of GWP accounting which is referred to as GWP* (or GWP star) and has written to the Climate Change Authority encouraging it to adopt it.⁴²

The GWP* concept treats methane as a "flow" gas, arguing that it is relatively short-lived in the atmosphere and does not accumulate if emissions remain steady.

However, key problems include (but are not limited to): (a) the IPCC and the USA's National Oceanic and Atmospheric Administration (NOAA) do not consider methane to be short-lived; (b) methane has been accumulating rapidly; ⁴³ (c) methane has been described as "carbon on steroids" due to its potent impact during the time it exists; ⁴⁴ and (d) the UN Food and Agriculture Organization (FAO) is projecting global meat production to double by 2050.⁴⁵

Carbon offsets

Meat industry participants may also claim carbon offsets in order to claim carbon neutrality.

The overriding problem with carbon offsets, including those administered under the Kyoto Protocol's Clean Development Mechanism, is that they excuse an ongoing carbon emitting activity when that activity itself must be addressed. Related to that concern, the offsetting activity: (a) may have occurred independently of the emitting activity; (b) may contribute to activities that increase emissions in the longer term; and (c) to the extent it does provide longer-term benefits, should be undertaken in its own right as part of a global emergency response to the climate crisis.

In the words of Kevin Anderson of the Tyndall Centre for Climate Change Research at the University of Manchester:⁴⁶

"Offsetting is worse than doing nothing. It is without scientific legitimacy, is dangerously misleading and almost certainly contributes to a net increase in the absolute rate of global emissions growth."

Sharon Beder from the University of Wollongong has argued:⁴⁷

"Carbon offsets are a greenwashing mechanism that enables individuals to buy themselves green credentials without actually changing their consumption habits, and nations to avoid the more difficult structural and regulatory change necessary to prevent further global warming."

Reforestation projects fall into category (c) referred to above. In a landmark 2008 paper, leading climate scientist Dr James Hansen and co-authors argued that, in addition to dealing with fossil fuels, we would not achieve a critical threshold level of 350 ppm (parts per million) of CO2 in the atmosphere without massive reforestation.⁴⁸ The aim would be to reduce CO2 concentrations (at that time around 400 ppm) by drawing them from the atmosphere, while also reducing ongoing emissions.

The Australian animal agriculture sector may seek to claim credit for forest regeneration activities on their own properties or elsewhere in Australia when it has been responsible for most of the nation's land clearing. ⁴⁹ The ongoing loss of carbon sequestration resulting from that clearing is not accounted for in official greenhouse gas emissions reporting.

Soil carbon

Many in the sector globally claim that certain grazing practices help to store carbon in soil. In a critical assessment of such claims, the Food Climate Research Network at the University of Oxford has stated:

"The potential contribution of grazing ruminants to soil carbon sequestration is small, time-limited, reversible and substantially outweighed by the greenhouse gas emissions they generate. The ambitious claims made by advocates of grass-fed livestock about grazing as a significant mitigation opportunity are thus unfounded." ⁵⁰

"... there is no room, environmentally speaking, for more animals." 51

A prominent proponent of animal agriculture is sheep farmer and author Charles Massy. In a book of over 500 pages in which he praised the environmental efforts of fellow animal farmers, he did not use the word "methane" or its chemical symbol, CH4.

That is despite the gas conservatively representing around 44 per cent of the livestock sector's greenhouse gas emissions globally (expressed as CO2-equivalent emissions).⁵²

When a 20-year time horizon (rather than standard 100-year period) is used for converting methane to a CO2-equivalent, its share increases to around 70 per cent.

Also of note is that methane emissions are far more significant in grass-fed animals than in grain-fed. 53,54

In discussing one of his favourite birds, the yellow-faced honeyeater, Massy blamed the loss of habitat, including the "brigalow lands of south and central Queensland", on "the giant machines of modern cropping agriculture". He erroneously failed to mention that clearing for cattle grazing has been the main cause of forest loss in the Brigalow Belt, which runs from Townsville in northern Queensland to Dubbo in New South Wales. Approximately ninety per cent has disappeared in around sixty years. 55, 56

Supplements

Although additives such as seaweed appear promising for feedlots⁵⁷, their broader application may be questionable. The bulk of Australian enteric (digestive) methane emissions come from grazed cattle and sheep. In large areas of northern Australia, accounting for a significant portion of national production, graziers may only handle their cattle once or twice a year. Achieving the industry's emission reduction target would require new technologies and delivery methods in such settings.⁵⁸

CSIRO Partnership

The red meat industry has partnered with the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in relation to its climate change activities. Although CSIRO has achieved much, it has also been criticised for various collaborations and connections, including research funded by MLA that was used in the best-selling publication "The CSIRO Total Wellbeing Diet".

The many critics have included: Clive Hamilton, a prominent author and currently Professor of Public Ethics at Charles Sturt University; Rosemary Stanton OAM, a nutritionist, lecturer and author; and Gyorgy Scrinis, formerly from RMIT University and now with the University of Melbourne.

Here's what Hamilton said about the CSIRO's involvement with the coal industry:59

"Since when did it become normal for publicly-employed scientists to spruik for the coal industry? The Australian Coal Association's slick new website aimed at promoting 'clean coal' features video grabs of CSIRO experts mixed in with industry spokespeople."

"Participating directly in coal industry propaganda is the culmination of an increasingly intimate relationship between the industry and Australia's peak scientific research body."

And on tobacco:60

"Concerns about CSIRO management's commitment to independent science go back at least to 1994 with the appointment of Donna Staunton as director of communications. Staunton was the chief executive of the Tobacco Institute of Australia where she had rejected the science linking smoking and cancer, telling a Senate committee: 'I do not believe that cigarette smoking is an addiction, based on any reasonable definition'."

Stanton and Scrinis have commented as follows regarding the Total Wellbeing Diet:61

"The CSIRO's research was partly funded by the Meat and Livestock Industry and Dairy Australia. So it is no surprise the sponsors' products figure so highly in the recommended meals and weekly meal plans: beef, lamb and dairy products.

The CSIRO's endorsement of a high-meat diet is perhaps an indication of the extent to which our scientists have taken on the role of consultants to industry in their bid to raise funds, and their willingness to deliver research findings that industry finds agreeable."

7. INTRODUCED ANIMALS AND PLANTS

Animal species that are currently widely regarded as pests in Australia, such as rabbits and foxes, were introduced in order to enable hunting. Although most people may regard such measures as mind numbingly foolish, they tend to turn a blind eye to, or may be unaware of, the destruction caused by other introduced animal species, such as cattle, sheep and brown trout and plant species such as buffel grass and gamba grass.

The impact of cattle and sheep is referred to elsewhere in this submission, while the other examples are referred to in this section.

7.1 Brown trout

Brown trout were introduced to Australia in 1864 at great cost to native fish and frogs. Despite it being well established that they are causing the extinction of native species, their continued existence in the Australian environment is supported by government agencies that release millions of young bred trout every year to support recreational fishing.

Affected fish species include the tiny Shaw galaxias and other galaxiids found in Victoria. Many are considered to have a greater than seventy per cent chance of extinction within the next twenty years.⁶²

Although Victorian Fisheries only releases trout into lakes or impoundments, Susan Lawler of La Trobe University contends that the movement of these populations into nearby rivers is virtually guaranteed.⁶³

Relocating trout and constructing barriers to protect native species has occurred and may assist but such measures may be too little too late and should never have been necessary.

7.2 Pasture grasses

Many of the grasses planted for farmed animals are introduced varieties that wreak havoc on native plants and animals. Buffel grass and gamba grass are two examples.

Both have the capacity to spread and dominate landscapes. This is achieved partly through their deep root systems (which enable them to monopolise available water) and intense fire load.

In vast areas of Australia, native grass fires are slow moving and of low intensity. Buffel and gamba fires are fast moving and extremely intense, destroying trees and other forms of life that would easily survive native grass fires.

Buffel grass has invaded extensive areas of the Northern Territory, Queensland, Western Australia and South Australia and is spreading into New South Wales and Victoria. 64

The government of South Australia has declared the grass a weed and banned it, stating:⁶⁵

"Buffel grass is arguably the single greatest invasive species threat to biodiversity across the entire Australian arid zone . . . The potential value of buffel grass for livestock production is offset by its serious conservation and social impacts. It has been identified as a 'transformer weed' of the Australian rangelands . . . due to its ability to transform the basic attributes of habitats. Modelling suggests buffel grass could establish in over 60% of mainland Australia . . . "

Ecologist John Read says buffel grass in the Northern Territory is moving like "a cancer across the countryside", taking out trees and all the other grasses. It is also adversely affecting the ability of indigenous communities to utilise native food resources and access cultural sites. 66

Grazier Steven Cadzow of Mt Riddock Station, located north of Alice Springs, seems unaffected by such concerns, saying: ii

"We're in a business. I mean, our business is growing kilos of beef per square kilometre and that's what we do and if this grass is going to help us do that and stay viable, we'll keep it."

26

ii At the time of preparing this submission, the transcript of ABC's Landline program had mistakenly attributed Steven Cadzow's comment to Stewart Taylor of North Australian Pastoral Company (NAPCO). Cadzow's Mt Riddock Station is not a NAPCO property. The author has notified the ABC.

8. MARINE ECOSYSTEMS

"Seagrasses sit at that interface between land and sea, in that coastal area, and they occur on every continent except Antarctica. They look a lot like land grasses but they are very different in terms of their productivity. They are extremely efficient at sequestering carbon, they act as a nursery ground for juvenile fish and support fisheries in that way. They cycle nutrients and they stabilise our coastlines and prevent erosion."

"... in terms of all those ecosystem services ... they are worth about four times more, it is estimated, than coral reefs globally."⁶⁷

Dr Peter Macreadie Associate Professor of Marine Science Deakin University

A 2015 paper in Nature Climate Change highlighted critical impacts of excessive fishing and harvesting on vegetated coastal habitats, comprising seagrass meadows, mangroves and salt marshes.⁶⁸

Excessive fishing and harvesting disturbs food webs, changing the way ecosystems function and altering the ecological balance of the oceans in dangerous ways. The paper focused on the phenomenon of "trophic downgrading", the disproportionate loss of species high in the food web.

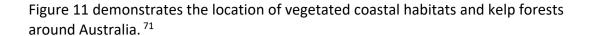
The process involves the loss of ocean predators, such as large carnivorous fish, sharks, crabs, lobsters, seals and sea lions. The removal of predators affects the number and behaviour of bioturbators, which disturb ocean sediment, and herbivores, which in turn adversely affects carbon rich vegetation and sediment on the ocean floor. The paper's authors cited earlier research indicating that the overall predator population had reduced by up to 90 per cent from natural levels.⁶⁹

Victoria's Commissioner for Environmental Sustainability has also recognised the impact on vegetated coastal habitats from terrestrial activities. In addition to population pressures and poor management, they have cited land clearing and animal grazing as causes of degradation and loss of vegetated coastal habitats.⁷⁰

Trophic downgrading also adversely affects kelp forests, which are an essential element of healthy seas.

In Victoria, the problem is demonstrated by the dramatic loss of sea grass and kelp forests due to a proliferation of the sea urchin species Heliocidaris erythrogramma (also known as the red, purple or white sea urchin) and Centrostephanus rodgersii (also known as the black sea urchin).

In this section, we look firstly at the importance of seagrass meadows and kelp forests to marine biodiversity, then the devastating impact of sea urchins, and finally at how the thriving market for rock lobster has allowed sea urchins to flourish, with devastating consequences.



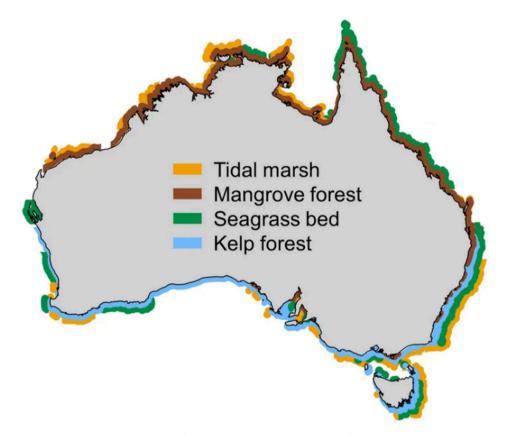


Figure 11: Spatial distribution of tidal marshes, mangrove forests, seagrass beds, and kelp forests.

Seagrasses

Victoria's Commissioner for Environmental Sustainability has stated:⁷²

"Seagrasses dramatically influencing [sic] biodiversity and ecosystem function. Seagrass meadows provide the majority of important habitat within the bays because their three-dimensional structure protects juvenile fish from predators and seagrass plants support algae and invertebrates that are an important food source."

They noted that seagrasses in Victoria's bays act as key ecosystem "engineers" that: (a) stabilise sediments and improve water quality; (b) reduce coastal erosion; (c) provide nursery habitats and refuge for key fish species; and (d) support algae and invertebrates that provide food for other species.

They stated: "When the stabilising roots of seagrass are lost, the result is increased turbidity and reduced water clarity. Increased turbidity then kills more seagrass and this process continues in a vicious cycle."

Kelp forests

The Victorian Environmental Assessment Council has highlighted the importance of kelp forests, noting that giant kelp (Macrocystis pyrifera) is the world's largest benthic (bottom dwelling) organism, growing on rocky reefs up to 35 metres deep. ⁷³

"Giant kelp acts as a habitat-forming species, supporting high levels of biodiversity through settlement of larvae, food and shelter for adults living among the fronds, organisms living directly on the kelp plant itself, and for organisms living on the seafloor in the low-light sheltered environment created beneath the canopy of the kelp."

The council has noted that giant kelp forests are listed as an endangered community under the EPBC Act.

"In line with patterns seen in other states, particularly Tasmania, the Victorian distribution of giant kelp has substantially decreased. At many locations where it was plentiful it is now either absent or represented by only a few plants."



Figure 12: Kelp forest

The devastating impact of sea urchins

According to the Victorian Environmental Assessment Council:

"The main threats to giant kelp forests are climate change-induced sea surface temperature increases associated with the southward extension of the East Australian Current and a corresponding range expansion of kelp-grazing sea urchins."

The black sea urchin (Centrostephanus rodgersii) has expanded its range from central and southern New South Wales to eastern Victoria and Tasmania. The Victorian species of white sea urchin (Heliocidaris erythrogramma) has also been increasing in abundance and forming barrens, especially in the northern parts of Port Phillip Bay.

Since the 1960s, around 90 per cent of kelp forests around Williamstown, Point Cook and Beaumaris in Port Phillip Bay have disappeared.⁷⁴

The initial loss of kelp in Port Phillip Bay may have resulted largely from increases in temperature and declines in rainfall, which influences salinity, nutrient inputs and algal productivity. In the period from 1997 to 2009 there was a one degree increase in average daily maximum temperature and 137mm less rainfall than the long-term average.⁷⁵

However, those changes influenced the behaviour of sea urchins, with devastating impacts.

According to Dr Paul Carnell of Deakin University:

"With the changes in the environment we started to see a decline in kelp, but when kelp started declining the bay's urchins ran out of food and had to change how they ate. So they couldn't just sit there anymore, they had to move around to find their dinner and that really drove the final loss of kelp."

"Now the northern part of the bay where kelp forests once predominated, are mostly covered by what we term 'urchin barrens'. While there have been areas of urchin barren in the bay in the 70s and 80s, they rapidly expanded towards the end of the drought.

"While the numbers of urchins have dropped back after that spike, they can subsist on some small weedy species and the small amounts of kelp that return, but they eat it straight away before it gets a chance to grow back properly."

Removing rock lobsters enables sea urchins to proliferate

The Victorian Environmental Assessment Council has noted that "evidence from Tasmanian marine protected areas indicates that large rock lobsters (Jasus edwardsii) can effectively control C. rodgersii populations through predation and allow the reemergence of kelp and abalone."

According to Professor Craig Johnson of the University of Tasmania:77

"You can only get a long-spine sea urchin barren in Tasmania through an interaction between climate change and ecological overfishing of large lobsters.

"The lobster populations are not overfished in that there is going to be a total collapse of the fisheries, but they are overfished in the sense that we've lost ecosystem function."

"If we just had the climate change but there was no overfishing of lobsters, we wouldn't have a problem because the sea urchin would be here but it would be controlled by big lobsters. If we just had the fishing but not the climate change it wouldn't be a problem because the urchin would still be in New South Wales. It's only when you get those two things together that we've got a problem."

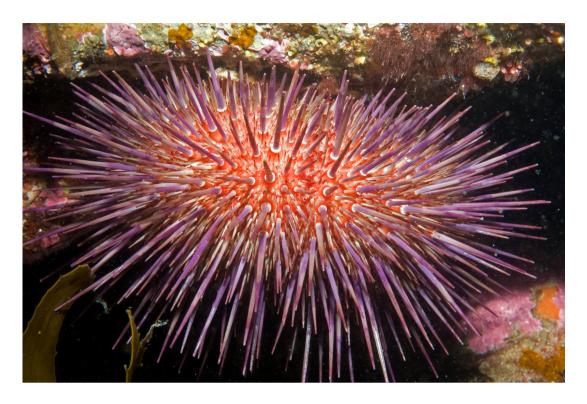


Figure 13: Red-spined Sea Urchin, Heliocidaris erythrogramma (Julian Finn, Museums Victoria, CC BY 4.0). The spines can be mauve, green or white.

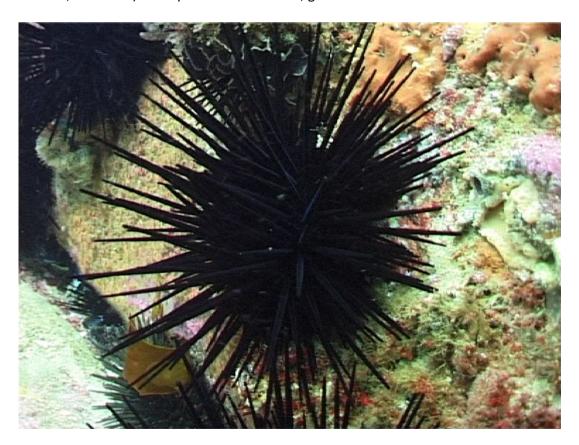


Figure 14: Black Sea Urchin, Centrostephanus rodgersii, (Julian Finn, Museums Victoria, CC BY 4.0). The spines are dark purple in colour, almost black, but may show a luminous green tinge in the presence of strong sunlight



Figure 15: Sea urchins and lobster in crevice © State of New South Wales through NSW Department of Industry

Other sea urchin predators

Snapper are another sea urchin predator.⁷⁸ They may target juveniles rather than adults but any predation of that type would assist in keeping sea urchin population numbers to a more natural level, with snapper fishing therefore contributing to the problem.

The Victorian government's response to sea urchins

The Victorian government has introduced quotas on the harvesting of rock lobsters, a sea urchin fishery and sea urchin culling programs in an effort to control sea urchin populations.^{79, 80, 81} The last two measures simply represent new forms of ecosystem intervention with uncertain outcomes aimed at overcoming problems caused by another, namely the over-harvesting of rock lobsters.

Rather than relying on those measures or rock lobster quotas, a preferable approach would be to cease harvesting rock lobsters altogether and allow natural ecosystems to regenerate to the maximum extent possible and function as they once did.

Like crown-of-thorn starfish on the Great Barrier Reef and elsewhere, sea urchins are a natural feature of the environment whose population numbers have increased to unnatural levels due to the actions of humankind.

Climate change impacts

Vegetated coastal habitats, including seagrass meadows, are the most carbon-rich ecosystems in the world, capturing carbon 35-57 times faster than tropical rainforests. Most of the carbon stored is in the form of organic matter trapped in the underlying sediment. The sediment contains little or no oxygen, allowing the organic material to last for millennia, as opposed to forests, where the time scale is often less than a century.⁸²

Despite their relatively small overall area, they represent fifty per cent of the carbon buried in ocean sediments.

Vegetated coastal habitats are estimated to store up to 25 billion tonnes of carbon globally. If it was released in the form of CO2, it would equate to 2.5 times the emissions from fossil fuels globally in 2018 (92 vs 37 billion tonnes).⁸³

Estimates of the areas affected are unavailable, but if only 1 per cent of vegetated coastal habitats were affected to a depth of 1 metre in a year, around 460 million tonnes of CO2 could be released. That is around the same level of emissions from all motor vehicles in Britain, France and Spain combined in 2010, and not far below Australia's annual CO2-equivalent greenhouse gas emissions.⁸⁴

Unlike vegetated coastal habitats, macroalgae such as kelp usually grow near the shore in rocky and eroding conditions where plant materials cannot be buried. Instead, segments of macroalgae are exported to the deep sea, where the carbon is sequestered and unlikely to be disturbed, potentially for millions of years.⁸⁵

A 2016 paper in Nature Geosciences indicated that macroalgae sequester around 200 million tons of carbon every year, which is around the annual emissions of the state of New York.⁸⁶

Loss of vegetated coastal habitats and kelp forests prevents them from sequestering further carbon and causes sequestered carbon to be released from unstable or disturbed sediment.

If sequestration capability were reduced by 20 per cent in only 10 per cent of vegetated coastal habitats globally, it would equate to a loss of forested area the size of Belgium.

Even with significant gaps in data, particularly from northern Australia where extensive vegetated coastal habitats exist, a 2019 paper in Nature Communications indicated that Australia contributes 5–11 per cent of the carbon stored in vegetated coastal habitats globally. Potential carbon dioxide emissions from current vegetated coastal habitat losses are estimated to increase emissions from land use change in Australia by 12–21 per cent.⁸⁷

9. OTHER IMPACTS ON ECOSYSTEMS

Human impacts on native ecosystems are many and varied. This section focuses on logging of native forests and duck shooting but other concerns include the use of "1080" and other poisons and ongoing kangaroo shooting.

9.1 Logging

Logging is a form of animal exploitation in that it utilises animal habitat for financial gain. In Victoria, it has adversely affected the habitat of the critically endangered Leadbeater's Possum, the vulnerable Greater Glider, and others.



Figure 16: Greater Glider (Petauroides volans)

In a paper published in 2018, the late David Blair and fellow ecologists David Lindenmayer and Lachlan McBurney argued that, despite a legislative obligation to protect Leadbeater's Possum and some limited recent improvements in management, conservation efforts for the species had gone backwards over the previous decade.⁸⁸

They contended that the Victorian Government had: (a) maintained levels of wood production that were too high given the amount of the forest estate that was burned in 2009; (b) failed to substitute clear-fell logging practices with more ecologically-sensitive Variable Retention Harvesting Systems; (c) ignored the science (including by its own researchers) on the need for a large protected area for Leadbeater's Possum; (d) altered key definitions such as those for mature trees and old growth that have substantially weakened the ability to protect Leadbeater's Possum; and (e)

overlooked the array of forest values beyond timber production (such as water and tourism), which make a greater contribution to the economy.

The authors' analyses indicated that populations of Leadbeater's Possum were declining substantially, as were those of the Greater Glider and other hollow-dependent species. They argued that Victoria needs to substantially change native forest timber harvesting practices as well as improve its efforts to conserve Leadbeater's Possum and the Mountain Ash forests in which they live.

Since that time, the Victorian government has announced that logging of native trees would be phased out by 2030 and that logging in old growth forest would cease immediately.⁸⁹

However, six environment groups, including The Wilderness Society, Friends of the Earth and Environment Victoria, subsequently wrote to the government expressing concern that it may open up some areas currently designated as old growth to logging. They called on the government to clarify how it plans to implement its promises.⁹⁰

Ed Hill from Friends of the Earth said: "They've told Victorians that 90,000 hectares of old growth will be protected and they can't tell Victorians how that's going to happen. They announced an immediate ban on old growth logging and in East Gippsland we're seeing old growth logging occurring right now in areas mapped as old growth that should be protected."

In a landmark decision, the Federal Court ruled in May 2020 that the Victorian government's logging agency VicForests had breached federal laws relating to threatened species. 91

The court found that VicForests had breached provisions relating to environmental conservation in the logging code of conduct and could not rely on forestry exemptions contained in federal laws. It stated that past and proposed logging would have a significant impact on the Greater Glider and Leadbeater's Possum.

Loss and fragmentation of habitat are almost impossible to reverse in a time frame that is meaningful to the survival of threatened species. It is critically important to retain what remains of Victoria's native forests.

9.2 Duck Shooting

In December 2017, the Victorian government released its Animal Welfare Action Plan.

In her foreword to the plan, former agriculture minister Jaala Pulford stated that we all have a role to play in ensuring the welfare of pets, farm animals and wild animals.⁹²

Similarly, the minister's ambassador for animal welfare, Lizzie Blandthorn, stated that we must protect animals from cruelty and support their quality of life, including on farms and in their natural environment.

The stated vision of the plan was "a Victoria that fosters the caring and respectful treatment of animals".

In its 2017 biodiversity plan, "Protecting Victoria's Environment – Biodiversity 2037", the state's Department of Environment, Land, Water and Planning expressed the view that "native plants and animals have an intrinsic right to exist, thrive and flourish". 93

In its 2018 "Living with Wildlife Action Plan", the department stated: "Victoria's native wildlife species are a unique and important part of the landscape. The Victorian Government is committed to the conservation of Victoria's wildlife and has developed this Action Plan to address some key areas that require improvement."

Despite those statements and vision, the government permits the shooting of ducks and other wild animals as "recreation".

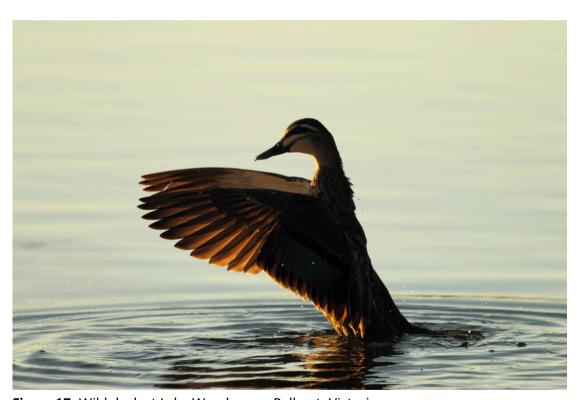


Figure 17: Wild duck at Lake Wendouree, Ballarat, Victoria

Allowing people to shoot animals "in their natural environment" is inconsistent with the notions of "caring and respectful treatment" and protecting animals from cruelty.

Duck shooting highlights the double standards that exist in our treatment of animals. How often have we seen media reports of a mother duck and her ducklings assisted in crossing a busy road? A duck who has been blasted from the sky may have had

ducklings awaiting food, warmth and comfort that will never come. They will almost certainly perish in horrendous circumstances.

Many victims are members of species that are supposed to be protected. Many suffer horribly before dying.

All this is happening as the ducks' habitat is being ravaged by climate change.

The 2018 Aerial Survey of Wetland Birds in Eastern Australia, with funding support from the Victorian government, reported continued long-term declines in total abundance, wetland area and breeding species richness.⁹⁵

The government must act in accordance with its professed beliefs concerning native animals and ban duck shooting.

10. CONCLUSION

We face dire circumstances in the natural environment that must be recognised as such.

Only then will we be in a position to take the steps required to overcome the biodiversity and climate change emergencies we face.

It is hoped this submission will assist the process in a meaningful way.

Appendix 1: Inquiry's terms of reference

The inquiry's terms of reference are as outlined below.

On 30 October 2019 the Legislative Council agreed to the following motion:

That this House requires the Environment and Planning Committee to inquire into, consider and report, within 12 months, on the decline of Victoria's ecosystems and measures to restore habitats and populations of threatened and endangered species, including but not limited to:

- a) the extent of the decline of Victoria's biodiversity and the likely impact on people, particularly First Peoples, and ecosystems, if more is not done to address this, including consideration of climate change impacts;
- b) the adequacy of the legislative framework protecting Victoria's environment, including grasslands, forests and the marine and coastal environment, and native species;
- the adequacy and effectiveness of government programs and funding protecting and restoring Victoria's ecosystems;
- legislative, policy, program, governance and funding solutions to facilitate ecosystem and species protection, restoration and recovery in Victoria, in the context of climate change impacts;
- e) opportunities to restore Victoria's environment while upholding First Peoples' connection to country, and increasing and diversifying employment opportunities in Victoria; and
- f) any other related matters.

Appendix 2: Charts depicting climate change in Victoria

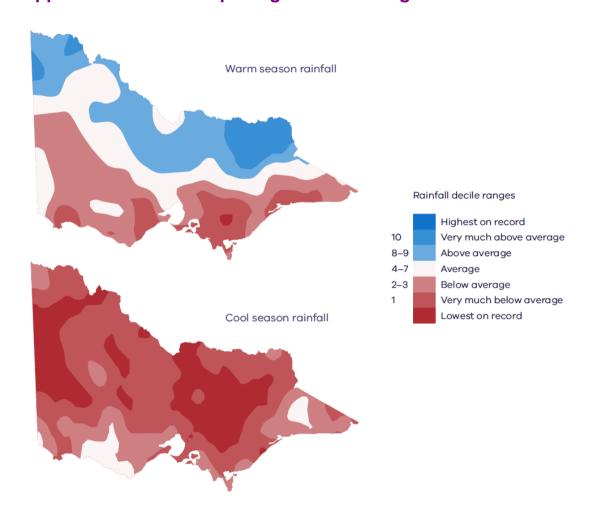


Figure A2-1: Observed rainfall changes in Victoria for the 30 years 1989-2019 (repeated from Section 6.4)

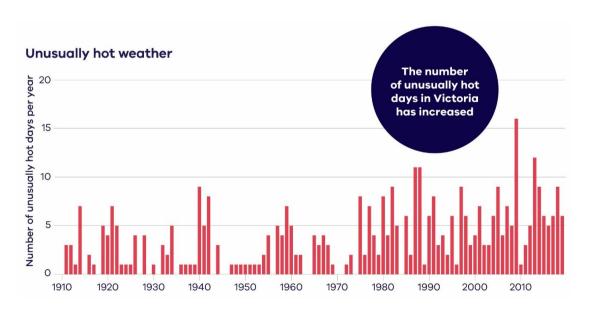


Figure A2-2: The number of unusually hot days in Victoria

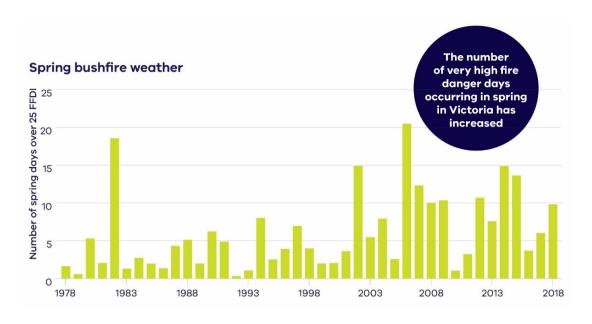


Figure A2-3: Spring bushfire weather

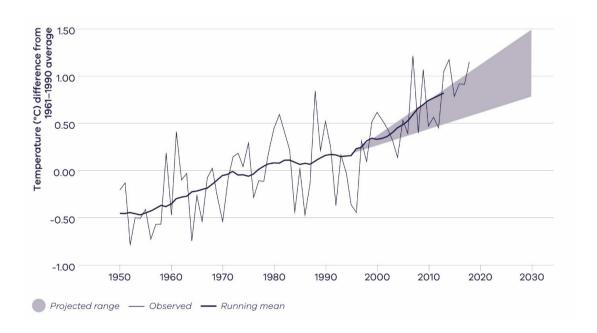


Figure A2-4: Observed temperature in Victoria is tracking toward the upper limit of projections

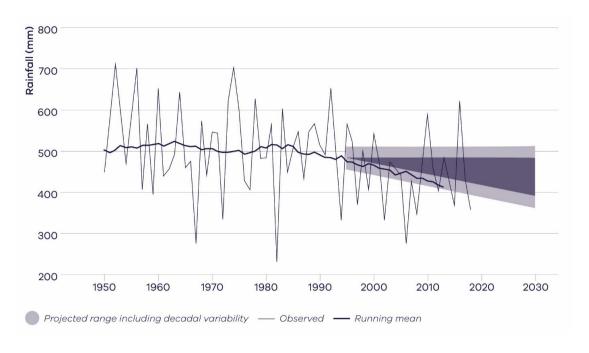


Figure A2-5: Observed winter rainfall in Victoria is tracking towards the drier end of projections

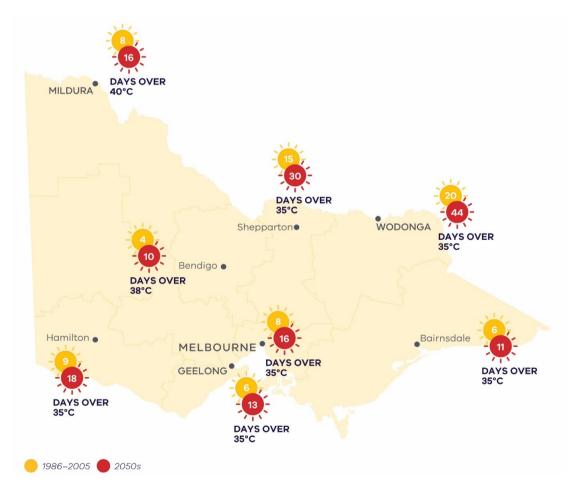


Figure A2-6: Hot days may double by the 2050s

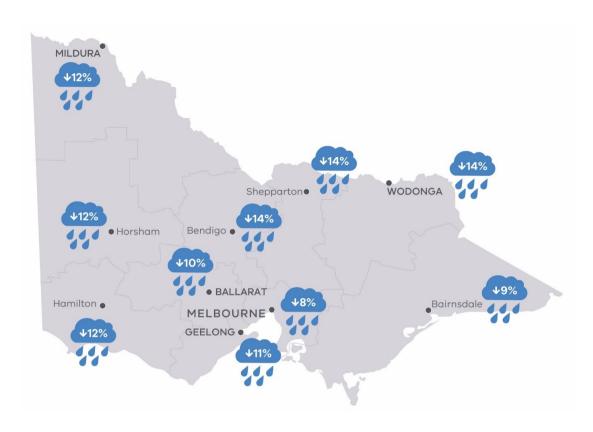


Figure A2-7: Projected annual rainfall decline by the 2050s



Figure A2-8: Projected sea level rise



Figure A2-9: 2050s climate impacts under high emissions compared to 1986–2005⁹⁶

Appendix 3: Methane and other warming agents

In national greenhouse gas inventories, the only greenhouse gases generally attributed to livestock are methane (CH_4) and nitrous oxide (N_2O). Other relevant warming agents are either excluded altogether or reported in different categories. An example is carbon dioxide emissions from livestock-related deforestation, which are attributed to the category "land use, land use change and forestry".

Two of the warming agents generally omitted are tropospheric ozone and black carbon, as referred to below. They are referred to as short-lived climate forcers, as their impact on climate primarily occurs within a decade from the time they are emitted, and generally within days or weeks for these particular warming agents. Those timeframes are critical, as meaningful action in reducing emissions of such warming agents provides rapid benefits and can contribute to us avoiding tipping points and runaway climate change as our energy infrastructure is transformed.

National inventories also exclude estimates of foregone sequestration, which is the loss of carbon absorption arising from the loss of forest and other vegetative matter through land clearing. Allowing for that factor would help identify significant mitigation measures, such as reforestation, afforestation and rewilding, along with other measures to reinstate biomass and soil carbon.

Global Warming Potential

An issue particularly relevant to methane is the concept of "global warming potential" or "GWP". The emissions of different gases can be aggregated by converting them to carbon dioxide equivalents (CO_2 -e). It is analogous to converting different currencies to a common denomination. The greenhouse gases are converted by multiplying the mass of emissions by the appropriate GWP, representing the relative warming effect of a unit mass of the gas when compared with the same mass of CO_2 over a specific period. The choice of time horizon is critical in relation to methane's emissions, as referred to below.

Carbon Dioxide (CO₂)

The main CO₂-related emissions from livestock arise from land clearing and loss of soil carbon in relation to grazing and feed crop production. Energy used in preparing livestock feed is also a factor. Loss of soil carbon can be in the form of oxidation and combustion of deforested and drained tropical peat lands or overgrazing of land, with resultant loss of topsoil and release of carbon.

Nitrous Oxide (N₂O)

Nitrous oxide is emitted through the use of fertiliser for feed production and from depositing manure on pasture or during the management and application of manure on crop fields.

Methane (CH₄)

The Intergovernmental Panel on Climate Change (IPCC) has reported that the livestock sector is responsible for around 44 per cent of anthropogenic methane emissions.⁹⁷

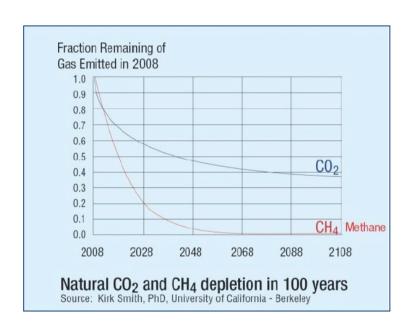
The main livestock source of methane is the process of enteric fermentation, which occurs in the digestive system of ruminant animals, such as cattle, sheep and goats. In their rumen (stomach), food is broken down into simple molecules that can be more easily digested. Methane is a by-product and is mainly emitted through belching and breathing.

Manure management is another source of methane.

A key factor in relation to methane is the choice of time horizon for calculating CO₂-e emissions figures.

By using a 100-year timeframe, traditional reporting methods have understated its shorter-term impact. The reason is that it breaks down in the atmosphere much faster than carbon dioxide and is almost non-existent for much of the 100-year reporting period. Its rapid breakdown is demonstrated in Figure A.3.1.

Figure A.3.1: Natural carbon dioxide and methane depletion over 100-year timeframe 98



The IPCC's 100-year GWP for methane was 25 in 2007 but was increased to 34 (with climate carbon feedbacks) in 2013.⁹⁹

The figures for a 20-year timeframe were 72 in 2007 and 86 in 2013.

NASA has reported figures of 33 for 100 years and 105 for 20 years. 100

In its Fifth Assessment Report, released in 2013, the IPCC stated: 101

"There is no scientific argument for selecting 100 years compared with other choices.
... The choice of time horizon is a value judgement since it depends on the relative weight assigned to effects at different times."

Tropospheric Ozone¹⁰²

Tropospheric ozone is formed through a series of chemical reactions involving nitrogen oxide, methane, carbon monoxide and other non-methane volatile organic compounds. It is the third most prevalent greenhouse gas after carbon dioxide and methane (not allowing for water vapour). Major sources of carbon monoxide are agricultural waste burning, savanna burning and deforestation. Livestock grazing is one of the main drivers of deforestation and savanna burning.

In its fifth assessment report, the IPCC stated, "there is robust evidence that tropospheric ozone also has a detrimental impact on vegetation physiology, and therefore on its CO₂ uptake".¹⁰³

Black Carbon¹⁰⁴

Black carbon is a microscopic particulate that is formed through the incomplete combustion of fossil fuels, biofuels and biomass. The greatest single sources of black carbon are savanna and forest fires, with livestock production playing a key role in northern Australia and elsewhere but not in Victoria.

Black carbon contributes to global warming in two ways. Firstly, the particulates create heat by absorbing the sun's radiation while airborne. Secondly, they can blow thousands of kilometres to land on glaciers and polar ice caps, where they cause solar radiation to be absorbed, rather than reflected, thereby contributing to planetary warming generally and speeding the melting process where they land.

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