Cruise tourism in Aotearoa New Zealand:

Impacts and management with reference to Piopiotahi Milford Sound

June 2024

Contributing Authors

James Higham (Griffith University)
Ya-Yen Sun (University of Queensland)
Damien Mather (University of Otago)
Caroline Orchiston (University of Otago)
Hannah McKeeman (University of Otago)
Mehran Kamali (University of Otago)
Michelle Fitzgerald (University of Otago)

Acknowledgements

The research presented in this report has been informed by Statistics New Zealand Tatauranga Aotearoa technical expertise and advice received from Emeritus Professor Steve Dawson (University of Otago), Dr. William Carome (University of Otago), Rose Ursem (University of Otago). Brandon Southall (Southall Environmental Associates), Professor Lars Bejder (University of Hawaii), Professor Robert McLachlan (Massey University), Eke Eijgelaar (Breda University of Applied Sciences), Florence Reynolds (Dunedin City Council) and Jinty MacTavish (Dunedin City Council).

Table of contents

Executive Summary

This report addresses the cruise tourism component of the Milford Opportunities Project. It presents an analysis of the economic, environmental and social costs and benefits of cruise tourism in Aotearoa New Zealand with specific reference to Southland, Fiordland and Piopiotahi Milford Sound. The cultural costs and benefits of cruise tourism are addressed elsewhere and therefore lie outside the scope of this report.

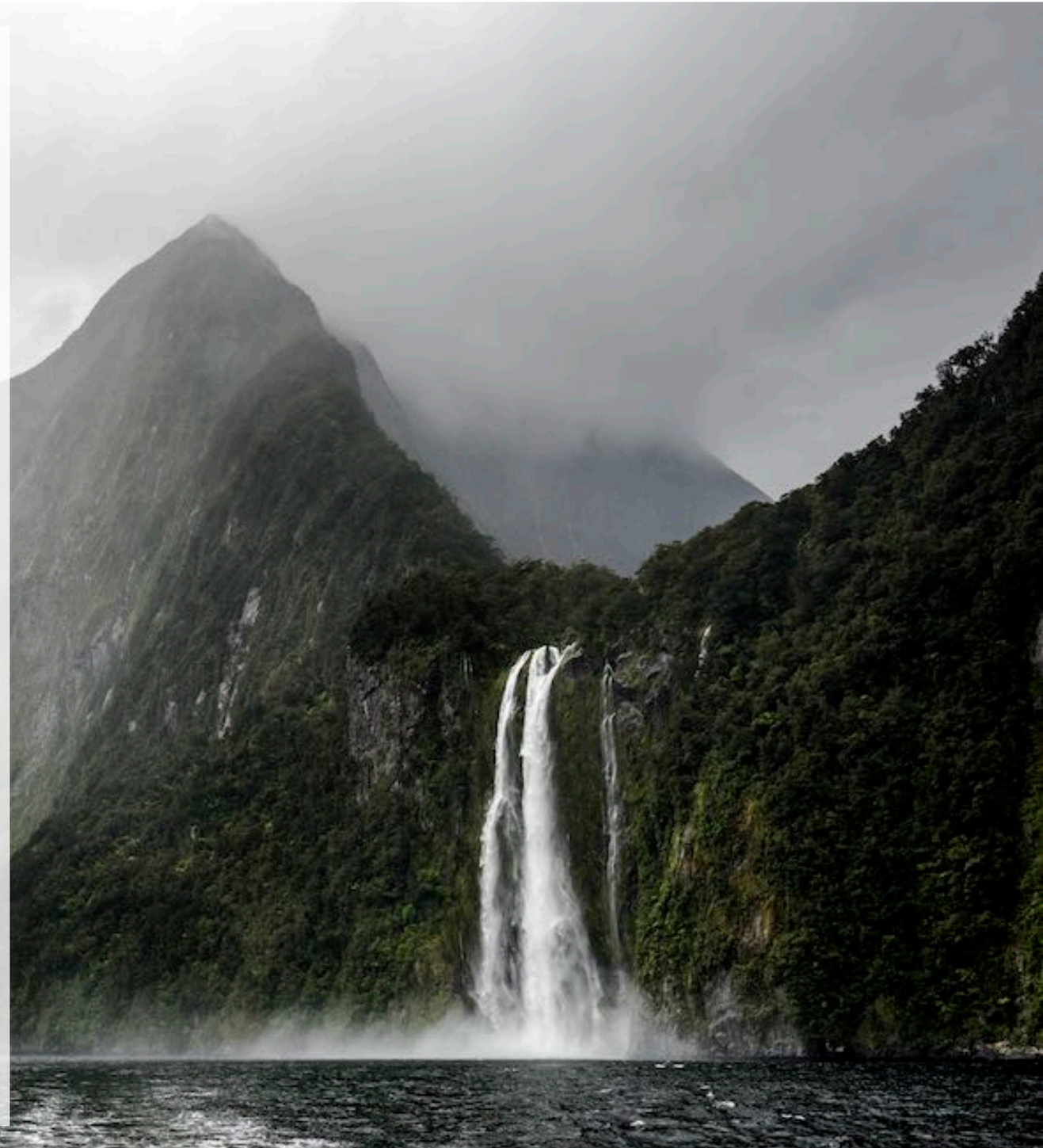
The first part of the report addresses the economic costs and benefits of cruise tourism, including national and regional estimations of the economic scale of cruise tourism in the post-COVID period in New Zealand, providing insights into expenditure, seasonality and employment. This analysis confirms that cruise is a niche tourism market in New Zealand, accounting for around 1% of total tourism expenditure. In the Southland region a significant disparity exists between cruise volume and spending although visitation fees are received by the Regional Council from cruise ships visiting Piopiotahi Milford Sound. Fiordland receives 69% of total unique cruise passenger visits in Aotearoa New Zealand and 0% of the total cruise passenger spending.

The second part examines the environmental costs and benefits of cruise tourism. It finds that cruise passenger experiences of Piopiotahi Milford Sound come with significant environmental impacts and costs. Cruise ships are one of the highest emitting forms of tourist transportation with potentially significant impacts on air quality, marine environments and marine mammals. Cruise ship visits to Piopiotahi Milford Sound also present significant potential environmental and economic risks associated with geohazards, particularly those arising from proximity to the Puysegur Subduction Zone.

The third part of the report focusses on the social costs and benefits of cruise tourism. It is informed by a review of existing studies, an analysis of social media discourses in three South Island destinations, and an analysis of reporting on cruise tourism in selected national and regional media, both before (2015-2019) and after (2020-2023) the outbreak of COVID-19. These insights indicate that cruise tourism is increasingly seen as a form of conspicuous and high carbon luxury consumption that is incompatible with sustainable communities and destinations. Cruise tourism is also associated with various negative social impacts in some communities. Negative social sentiments were less evident in Southland where little engagement between cruise passengers and local residents occurs. More broadly it is clear that community attitudes towards cruise tourism have hardened since the COVID-19 pandemic, now extending to organised public protests and political action.

Finally a summary is presented in the last part of the report with potential avenues of response for consideration by regulatory and management authorities. A set of nine recommendations are outlined which relate to considering the need for independent monitoring and reporting on the impacts of cruise, phasing out GHG emitting cruise ship visits, and stopping large cruise ships from visiting Piopiotahi Milford Sound. These recommendations align with recent evidence of strong support among the majority of New Zealanders and international visitors to phase out cruise ship visits to Piopiotahi Milford Sound.

More broadly the recommendations extend to consideration of opportunities to significantly lift the quality of cruise tourism in Southland (and more broadly). This will require a proactive, engaged and transparent approach on the part of cruise operators, and a willingness to collaborate to not only reduce the high environmental costs but actively advance the potential economic, social and cultural benefits of cruise tourism through engagement with the ambitions and aspirations outlined in regional Destination Management Plans.



Introduction: Managing tourism in Piopiotahi Milford Sound

Context: Protecting and enhancing environmental and culture values is critical to all aspects of tourism management, most notably in areas designated primarily for conservation and the protection of outstanding environmental and cultural values. The fundamental values and management outcomes of relevance to Fiordland and Piopiotahi Milford Sound are addressed across a range of scales of governance and in a number of key policy documents.

Global governance: Piopiotahi Milford Sound has long been recognised as Aotearoa New Zealand's most iconic visitor attraction. Situated in Fiordland National Park with Te Wāhipounamu UNESCO World Heritage status, it is recognised that management of access to, and the planning and management of recreation and tourism in Piopiotahi Milford Sound must protect and enhance its World Heritage Status and be aligned with cultural and conservation values. This is a multifaceted challenge that involves conservation management, safeguarding indigenous ecosystems, and protecting natural and cultural landscapes, while providing world class visitor experiences that are consistent with conservation.

The World Heritage status of Te Wāhipounamu is recognised in various pieces of legislation in Aotearoa New Zealand including the Conservation Act 1987 (Conservation General Policy 2005; Southland Murihiku Conservation Management Strategy 2016), the National Parks Act 1980 (General Policy for National Parks 2005; Fiordland National Park Management Plan 2007, Mount Aspiring NPMP 2011, Westland Tai Poutini NPMP 2001-2011); and the Resource Management Act 1991 (Southland Regional Plans, Southland District Plan).[1]

UNESCO Statement of Universal Value for Te Wāhipounamu: The UNESCO Statement of Universal Value (SOUV) outlines the values and attributes that underpin the World Heritage status of Te Wāhipounamu. They centre on 1. Ecological values including outstanding naturalness containing representations of Aotearoa's long evolutionary isolation and biological heritage (e.g., ancient southern beech and podocarp forest; largely unmodified ecologies including representations of the primitive species of Gondwanaland) and 2. Landscape values including scenic grandeur (e.g., landscapes carved by Ice-Age glaciers; primeval vistas). These values extend to perpetuating the limited evidence of human influence on Te Wāhipounamu while recognising the long association between Te Wāhipounamu and mana whenua.

Fiordland Marine Guardians: FMG is an advisory group that provides advice to a range of government agencies and their ministers on managing the Fiordland Marine Area (FMA). FMG advice focusses on 'ensuring the values of Fiordland are protected as the area faces increasing pressure from competing interests'.[2] A study of Fiordland marine area users conducted in 2010 found that the values held for the Fiordland Marine Area (FMA) have generally remained stable over time. They centre on natural scenic beauty and scenic grandeur. The essential qualities underpinning these values include the presence of unique wildlife, richness of marine species, absence of marine pests and weeds, high water quality, remote wilderness places and peace and quiet.[3]

Tourism Management in Piopiotahi Milford Sound: Protecting the landscape, biodiversity and scenic values of Piopiotahi Milford Sound and Te Wāhipounamu UNESCO World Heritage status must recognise and respond to various contemporary challenges. Foremost among them is sustained high growth in tourism in Aotearoa New Zealand and intensifying pressures of visitor access to Piopiotahi Milford Sound. Tourism, recreation and visitor management in Piopiotahi Milford Sound must be informed by ecological and landscape values and be consistent

with the UNESCO Statement of Universal Value (SOUV) for Te Wāhipounamu and the conservation values outlined in the Department of Conservation National Park Management Plan. World Heritage status comes with obligations under the World Heritage Convention. The principle management objectives of Te Wāhipounamu centre on conservation, and fostering nature-based recreation and tourism as long as it is consistent with conservation.

Intensifying pressures of sustained high growth tourism:
The pressures of sustained high growth tourism have come to the fore in Aotearoa New Zealand over the course of the last decade. The Parliamentary Commissioner for the Environment presents the most comprehensive analysis of the environmental, social and cultural impacts of high growth tourism,[4] and the policy measures required to begin to address the challenges of sustainable tourism.[5] These reports have contributed to discussion and debate that have informed sector-wide responses.

Those responses emerged immediately prior to COVID-19, in the form of such initiatives at the Tiaki Promise (November 2018), which was created by leading seven private and public sector tourism organisations as a call for collective action to care for environment and culture when visiting Aotearoa New Zealand. However, the urgency of moving tourism onto a sustainable trajectory become a point of unprecedented consensus among tourism agencies, organisations and communities during the COVID-19 disruption. Key actors that have led the systematic redirection of tourism included the Parliamentary Commissioner for the Environment (Dec 2019 and Feb 2021), Tourism Industry Aotearoa (Dec 2020), MBIE (Dec 2020, May 2023 and June 2023), and the full span of Destination Management Plans (DMPs) produced by all thirty-one Regional Tourism Organisations (RTOs) in Aotearoa New Zealand during the COVID-19 pause[6] (see Appendix A). The urgency with which the tourism industry must respond to the climate crisis was most comprehensively addressed in The Aotearoa Circle 'Tourism Adaptation Roadmap (May 2023).

Cruise tourism in Aotearoa New Zealand

It is within this context that the focus of this research falls upon cruise tourism within the general context of Aotearoa New Zealand, with reference to Southland, Fiordland and specifically Piopiotahi Milford Sound.

This report presents the findings of a wide-ranging analysis of the economic, environmental and social costs and benefits of cruise tourism in Aotearoa New Zealand. It draws on existing published articles and reports from different regions of the world, the limited body of rigorous existing knowledge in Aotearoa New Zealand and analysis of various primary and secondary data sources. This report is divided into three major parts:

Economic: This section presents three comprehensive sets of information to address the economic impact of cruise tourism in New Zealand and specifically in the Southland region, including Fiordland, including:

1. International cruise research: A review of current knowledge on all aspects of the economic impacts of cruise tourism internationally;
1. New Zealand cruise research: A review of existing knowledge on the economic impacts of cruise tourism in New Zealand;
2. Primary analysis of New Zealand cruise tourism (2022-23 and 2023-24): Estimations of the scale of cruise tourism in the post-COVID period in New Zealand, benchmarking cruise tourism against other main visitor segments, and analysis of regional volume and spending patterns across fifteen regions in New Zealand including Southland/Fiordland.

Environment: The environmental impacts of cruise draws on a comprehensive review of existing research, internationally and in New Zealand, noting that gaps exist in the body of published empirical research. This analysis is presented in six sub-sections: 1. Emissions, 2. Air pollution, 3. Ocean and marine environments, 4. Marine biosecurity, 5. Marine mammals, and 6. Environmental risks.

Social: The social impacts of cruise tourism are comprehensively addressed in sub-sections: 1. Review of empirical studies in the international context and reporting in New Zealand; 2. An analysis and interpretation of social media discourses in three cruise destination regions; Southland/Fiordland, Dunedin/Port Chalmers and Christchurch/Lyttleton and Akaroa; 3. A secondary analysis of media reporting on cruise tourism in Aotearoa New Zealand including 1. national media outlets (pre- and post-Covid) and 2. regional media outlets (pre- and post-Covid).

Culture: In recognising the critical importance of the cultural context of tourism in Aotearoa New Zealand it is important to note that the cultural impacts of cruise tourism in Piopiotahi Milford Sound fall outside the scope of this project and are addressed separately and are therefore not addressed in this report.

The report presents the first wide-ranging review of relevant international research and a comprehensive analysis of the costs and benefits of cruise tourism in Aotearoa New Zealand. Wherever possible specific insights are drawn in reference to Southland region and Fiordland to inform a set of recommendations relating to the future of cruise tourism in Piopiotahi Milford Sound and the wider Te Wāhipounamu UNESCO World Heritage Area.

References

1. Boffa Miskell Ltd (2024). World Heritage Impact Assessment of Milford Opportunities Project Proposals. Feasibility Stage Assessment. 26 March 2024.
2. Fiordland Marine Guardians (2024). https://www.fmg.org.nz
3. Booth, K. & Espiner, S. (2010). Fiordland (Te Moana o Atawhenua) Marine Area User Study 2010 Volume 1. Report prepared for Department of Conservation, Environmental Southland, Fiordland Marine Guardians, MAF Biosecurity New Zealand, Ministry for the Environment and Ministry of Fisheries. Lindis Consulting. 30 September 2010. https://www.fmg.org.nz/sites/default/files/2018-11/fma-user-study-2010.pdf
4. Parliamentary Commissioner for the Environment (2019). Pristine, popular... imperilled? The environmental consequences of projected tourism growth. 18 December 2019. https://pce.parliament.nz/publications/pristine-popular-imperilled-the-environmental-consequences-of-projected-tourism-growth/
5. Parliamentary Commissioner for the Environment (2021). Not 100% – but four steps closer to sustainable tourism. Parliamentary Commissioner for the Environment. 21 February 2021. https://pce.parliament.nz/publications/not-100-but-four-steps-closer-to-sustainable-tourism/
6. Regional Tourism New Zealand (2023). RTO Destination Management Plans. 16 November 2023. https://rtnz.org.nz/rto-destination-management-plans/

Chapter 1

Economic impacts

Economic impacts - introduction

This section presents three comprehensive sets of information to address the economic impact of cruise tourism in New Zealand and specifically in the Southland region, including Fiordland. The information provided covers the following areas:

1. **International Cruise Research:** A review of the current knowledge regarding the economic impact of cruise tourism development in other countries.
2. **New Zealand Cruise Research:** An overview of existing knowledge regarding cruise tourism development in New Zealand.
3. **Analysis of New Zealand Cruise Tourism:** Estimations of the scale of cruise tourism in the post-COVID period in New Zealand, benchmarking cruise tourism against other main visitor segments, and analysis of regional volume and spending patterns across fifteen regions in New Zealand.

Research context: It is important to note there are two schools of thought exist when debating cruise ship visitor expenditure and the wider economic impacts of the cruise industry. Cruise proponents tend to extol the economic virtues of cruise ship visits to port destinations and contributions to national economies. An opposing school of thought arises from research that draws most aspects of the economics of cruise into question.

To navigate the validity of information from both schools of thought, many studies have attempted to measure cruise passenger spending, revealing common disparities between industry commissioned studies and independent research. Failure to use appropriate methods of probability sampling and to fully disclose methods and data limitations are common.

1. International cruise research

Decisions about what to measure and how to measure it are critical. It is important to overcome broad generalisations. Estimates can not be accurately applied to all cruise ships and the total number of passengers on board.[7] Ships that remain unable to berth due to weather conditions and passengers who remain onboard rather than go ashore should be excluded. Economic modelling, accounting for leakage, shore excursions purchased on board, ship-sponsored onshore shopping programmes and calculations of multipliers can lead to overestimates. One study from Halifax, Nova Scotia that specifically addressed these potential discrepancies found a spending overstatement of 31.5%. It is thus important to treat cruise economic statistics with caution and examine its data source, methodology and assumptions in detail.

Visit Flanders (VF) provides the most comprehensive study of the costs and benefits of cruise in The Netherlands. It includes an in-depth and critical analysis of the economics of cruise visits to the five port destinations of Ostend, Ghent, Antwerp, Zeebrugge and Brussels. The findings are presented in three parts:[8]

1. **Expenditure by cruise lines in ports:** In 2019 ocean cruise lines collectively spent €3.53 million in all ports (average €27,911) for port services and port agents (with high variation between ports based on size of ships). Port costs per passenger vary with market segments with luxury being the highest (€37 per passenger) and mass market the lowest (€12 per passenger).
2. **Direct expenditure of cruise passengers:** A survey of cruise passengers was conducted between May-September 2022. It attempted to account for cruise passenger spending including shore excursions (differentiating between those purchased onboard and onshore), and accounting for cruise passengers who did not disembark. Average direct expenditure per ocean cruise passenger was €41 spent mostly on shopping, local transport, guided tours, food and drink (mainly chocolate and beer). A comparative analysis was performed against the direct spending of day visitors and overnight visitors drawing on data collected in 2017 with indexation to 2022. This comparison found that ocean and river cruise visitors spend less than a quarter of overnight tourists (average €176).
3. **Expenditure of crew members at destinations:** Extrapolating from existing studies, VF estimates that 50% of crew disembark at ports. Crew expenditure estimates were drawn from the number of crew on ships visiting Flanders in 2019, and estimates that crew spending is 40% that of passenger spending with on average 10% of crew spending nothing while ashore. VF reports that on average ocean cruise ship crew spent €17 while shore (total €1.12 million across the five port destinations).

Drawing together cruise lines (port services and port agents), passengers and crew VF estimated total ocean cruise expenditure in Flanders in 2019. Across the five port destinations in Flanders it found a total ocean cruise economic impact of €21 million (excluding €4.6 million from river cruises). Approximately 73% of this total was derived from cruise passenger spending, 22% from cruise lines themselves and 5% from crew.

Cruise economic impacts across the five port destinations of Antwerp, Bruges, Ghent, Ostend and Brussels was compared with total visitor spending in Flanders in 2019 (€5 billion). Cruise passenger spending in that year represented half a percent (0.5%) of total visitor spending.

Comparative studies: Few studies have compared cruise passenger spending with other spending in other visitor markets at the level of the destination. One exception is a comprehensive study of tourists visiting the western Norway port city of Bergen across three years (2010-2012).[9] In each year large samples of tourists were surveyed including large sub-samples of cruise passengers. Survey respondents were asked what they had purchased and estimated total spending on the day they were interviewed. This study found that cruise passengers spend significantly less at the destination than other tourists. They also spent the least of all other categories of visitors to the destination (e.g., backpackers, organised tour groups).

Victoria BC comparative analysis: One of the most recent and most comprehensive comparative studies of cruise spending addresses cruise ship visits to Victoria, BC in 2022.[10] This study reports that in 2022 a total of 330 cruise ships visited Victoria which represented a greater than 30% increase on the pre-Covid 2019 season. Using input-output analysis, it found cruise economic benefits to be overstated.

Drawing on 2019 data it found that cruise tourism constituted approximately 12% of total visitor numbers but that cruise passenger spending account for less than 2% of total visitor spending in Greater Victoria. Non-cruise tourism spending (CA$2.93 billion) was over 20 times more than cruise spending (CA$137.1 million) and created approximately 31 times more jobs (37,411) than cruise operations (1210). Non-cruise tourism was responsible for generating approximately 25 times more in government taxes than cruise tourism. This analysis excluded costs incurred through pollution, congestion, waste generation, noise, damage to infrastructure and public health costs.

Onboard revenue: Cruise lines are dependent upon onboard revenues to maintain profitable operations.[11] Various strategies can be used to maximise onboard spending such as offering half day rather than full day shore excursions. Staying in ports for relatively short periods of time may reduce port costs. Offering all-inclusive resort style entertainment options may encourage passengers to spend the majority of their time onboard. The consequence of such strategies is to limit opportunities for unstructured time (and therefore visitor spending) on shore.

Some studies have highlighted concerns about the marginal economic contribution of cruise visits to local tourism businesses and destination communities.[12] These concerns commonly re-occur at destinations where the claims of cruise proponents contradict those who maintain that local economic impacts of cruise visitors are negligible. It has been recognised that local policies that seek to maximise local spending conflict with the economic interests of cruise companies.[13]

Return visits: The cruise industry has made claims that a high proportion of cruise passengers make subsequent return visits to destinations that they previously experienced on cruise itineraries. Most recently in 2024 the New Zealand Cruise Association[14] claimed that ‘About 60% of cruise passengers return on a land-based holidays [sic], providing additional ongoing benefit to destinations’. This general claim has been empirically tested and found to be false in a Norwegian study.[15] It found that cruise tourists did not report additional spending when more opportunities arose and had lower inclinations to revisit a destination than other (land-based) tourists.

2. New Zealand cruise research

Statistics New Zealand (2015-2020): The most comprehensive analyses of cruise economic impacts in New Zealand is provided by Statistics New Zealand Tatauranga Aotearoa (Stats NZ).[16] Stats NZ started reporting cruise economic impacts in New Zealand nationally and regionally in 2015 (discontinued in 2020 due to COVID-19). This reporting has been detailed at both the national and regional scale, including Southland (Fiordland) and provides a detailed level of reporting on the volume and value of cruise.

Stats NZ data reporting includes unique passenger counts by port and citizenship, national and regional expenditure with fully disclosed methodology, methods, data sources, analysis and limitations.

Prior to the maritime border closure in March 2020 the New Zealand Cruise Association (NZCA) reported 169 ship voyages and 901 port calls. The corresponding figure for the 2019 season was 146 voyages and 823 port calls. At the time of the border closure a further 41 voyages and 139 port calls and an estimated 70,000 further passengers were expected prior to the end of the 2020 season.

The unique cruise passenger count for the disrupted 2020 season was 282,920. Assuming that an additional 70,000 passengers would have arrived if COVID-19 had not happened, this would have raised the cruise passenger number to 353,000, a 10% increase from the 2019 season. Without the impact of COVID-19, it is likely the cruise industry would have experienced a strong year in the 2020 season with an expected 10% growth rate compared to the previous year.

Cruise passenger origins: Australians typically represent approximately half of total cruise passengers. In the 2019 season 49% of cruise passengers were Australian citizens and 20% United States citizens. The remaining 31% of cruise passengers were citizens of the New Zealander (11%), United Kingdom (6%), Canada (4%), or other countries (10%). This passenger profile indicates high aviation emissions associated with travel to and from ports of embarkation. Stats NZ reports that in the 2019 season every 100 cruise passengers visiting New Zealand were accompanied by 41 onboard crew.

New Zealand cruise economic impacts: In the year to June 2020, cruise contributed $547 million of spending into the New Zealand economy. This represented a decline of 3.2% on the 2019 season caused by the curtailment of the season due to the New Zealand border closure in March 2020. It was nonetheless 85% higher than when reporting began in 2015, and 23% higher than 2018. Cruise expenditure is reported by Stats NZ in three categories (Figure 1); vessel (cruise line costs), visitor spending and GST.[17]

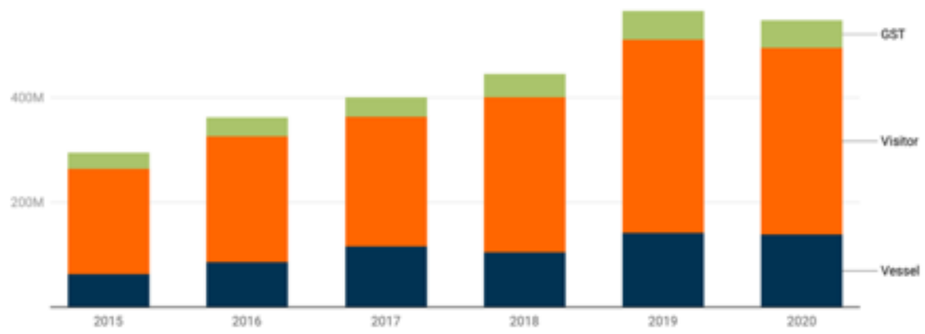


Figure 1. Cruise ship economic impacts in New Zealand ($NZ year to June).

Source: Stats NZ; Chart: Rob Heyes (2023).

The 2019 season provides a picture of the sector before it was impacted by the pandemic. Robust growth was reported in the 2019 season, with cruise visitor spending reaching $565.2 million (27.1% or $120.6 million). This includes vessel spending of $141.8 million (35.8% or $37.4 million), visitor spending of $369.5 million (24.5% or $72.6 million), and GST of $53.9 million (24.6% or $10.6 million).

Cruise visitor spending in the shortened 2020 season was $356.4 million (-3.5% or $13.1 million). Cruise visitor spending included shore excursions (predominantly pre-booked onboard), some overland tours (between ports), and spending ashore by passengers and crew. The costs met by cruise lines themselves totalled $138.7 million (-2.2% or $3.2 million). These costs include shipping agents (ship visit logistics), bunkering (marine refuelling), and providoring (produce and supplies). GST from cruise expenditure contributed $52.0 million (Figure 1).

Ship providores: All ships and vessels require provisions and supplies when visiting ports. These may include food and consumables, water, safety equipment, cleaning supplies, engineering and technical products. These provisions and supplies are called ship providores. Lack of disclosure for commercial reasons allows little insight into the economics of provision and supply for cruise ships.

Regional economic impacts: Cruise expenditure patterns and passenger spending varies significantly between regional port destinations. Key factors include the number of voyages, nature of port calls, passenger transit or exchange port status, ship capacity (boutique versus large cruise ships), cruise market segment (luxury, premier, mass market), bunkering, weather and other disruptions, and economic conditions (including exchange rates).

The ports of Auckland and Tauranga received the largest total spending in the year to June 2020. Auckland spend was $207.6 million (+9.5%). Spending in Tauranga was $74.3 million. This represented a decline of 16.8% on the 2019 season impacted by the Whakaari White Island tragedy in December 2019. While Dunedin received the most cruise passenger visits of any New Zealand port in 2020 cruise spending fell 17.3% ($10.4 million) to $49.8 million. Such a decline in spending is likely to have been common to most destinations due to COVID-19.

Regional tourism operators: In the context of consumer spending cruise passenger and crew spending is generally insignificant. One exception may be the case of tour operators that provide shore experiences for cruise passengers. These operators are particularly vulnerable to cruise disruptions particularly those that result in last minute cancellations (e.g., weather disruptions). These points are further explored in the following section.

Confidentiality: The limited number of shipping agents, providors and shore excursion operators used by cruise lines poses a challenge for transparent reporting. Confidentiality is problematic when the majority of cruise business is met by very few providers. In the reporting of cruise expenditure 2015-2020 Stats NZ withholds findings (marked C) in instances where confidentiality constraints dictate.

Direct and indirect costs: Concerns have been raised with the local councils in Dunedin and Christchurch in cases where the costs of cruise passenger transportation have been met directly or indirectly by local rate payers (e.g., public or chartered bus services from Port Chalmers to Dunedin, Lyttleton to Christchurch). The costs paid by local councils and levies or fees paid by cruise companies or passengers (if any) should be fully and publicly reported.

Use of public transport by cruise passengers has on occasions been the cause of inconvenience of local public transport users particularly the displacement of local commuters due to public transport services being flooded by cruise passengers seeking to avoid the high cost of shuttles provided by cruise companies.

Ratepayer subsidisation: Dunedin Railways provides a ratepayer subsidised train excursion for cruise passengers. On 12 March 2024 the DCC voted to commit $2 million to Dunedin Railways to cover anticipated trading losses by the company over the next 12 months.

Cruise disruptions: Between 2015-2018 the number of cruise passengers visiting New Zealand increased by 45% and total spending by 77%. This rapid growth in cruise passenger arrivals and spending was subsequently curtailed by a range of challenging circumstances most notably the loss of the 2021 and 2022 seasons due to COVID-19. In 2020, the Diamond Princess had a major COVID-19 outbreak onboard resulting in nine deaths. Biosecurity New Zealand requirements for cruise ships to meet standards of cleanliness before visiting special protected marine areas such as the Bay of Islands, Akaroa and Fiordland and weather disruptions have resulted in cancellations of some port visits. Cyclone Gabrielle (5-11 February 2023) severely disrupted the cruise season in 2023. Disruptions to cruise schedules are reported by Maritime New Zealand.

New Zealand Institute of Economic Research: NZIER (2020) provides insights into the economics of tourism in New Zealand. It challenges the popular stereotype that international tourists and particularly cruise passengers are lucrative visitor markets for regional economics, tourism businesses and retail. Stats NZ's Tourism Satellite Account (TSA)[18] shows that domestic visitors spend more per guest night on average than overseas tourists. They also have a far lower carbon footprint because of modest distances travelled by high carbon tourist transportation modes, particularly cruise, aviation and vehicles (e.g., campervans and rental vehicles).

NZIER reports that contrary to the popular perception of tourism, the majority of tourism spending comes from domestic (58%) rather than international visitors (42%) and that domestic visitor spending comes from both households (76%) and businesses and government (24%). Of international visitor spending 74% is generated by international business and leisure tourists and 23% international students studying in New Zealand.

This report places cruise in context relative to higher value domestic visitors and international students. Accoding to NZIER, despite its high visibility and image of luxury and consumption spending, cruise tourism in 2019 accounted for 9% of international visitors (approximately 350,000 passengers and crew) and only 3% of international tourist spending. This is because cruise companies are overseas owned and geared to maximise onboard (as opposed to port/destination) visitor spending. Passengers typically spend little time in ports of visit. Short duration half day shore excursions allow passengers to return onboard for mid-day meals rather than maximising opportunities to spend time onshore.

New Zealand Cruise Association (NZCA): NZCA has previously commissioned its own studies of the economic impacts of cruise in New Zealand. It has used Market Economics (ME Consulting) to report on the economic impacts of cruise and project forecast growth for the following season. These reports take a broad perspective on the cruise industry, reporting global growth in cruise passenger numbers, highest growth markets, regional economic contributions and employment.[20]

Unsurprisingly, NZCA reports present cruise as a 'good news story in New Zealand'. They celebrate sustained high growth and accelerating forecast future growth. The economic contribution reported for the 2017-2018 season was $491 million which was expected to increase to $695 million the following season. The level of employment supported by cruise tourism across these seasons was 9,100 in 2017 increasing to 12,800 in 2018[19]. Concerns arising from sustained high growth are typically framed in terms of New Zealand's (in)ability to capitalise on in this influx as there are emerging issues around capacity in essential services for the sector'[21]

These reports do not conveniently disclose methods and appear to use arbitrary approaches. They tend to report on measures of cruise activity, employing visitation levels to rate forwards to create expenditure estimates. It is probable (but uncertain) that estimates assume that all schedule cruise ships arrive at ports of visit and that all passengers go ashore at all ports of call. Detailed breakdowns of cruise and visitor expenditure, patterns of spending, definition of economic boundaries and leakage from local/national economies, and the parameters used to define cruise related employment are not specified. Displacement and diversion effects are general not acknowledged or accounted for.

ChristchurchNZ cruise database: Christchurch NZ, the economic development agency for the city of Christchurch, has established a dashboard to monitor tourism related employment, accommodation occupancy and visitor cardholder spending.[22] The Christchurch Tourism and Business Events Research website includes a dedicated cruise dashboard that draws upon the cruise schedule sourced from the New Zealand Cruise Association.

The Christchurch NZ dashboard uses Electronic Card Transactions (ECT) data which is sourced from Marketview. ECT data does not include cash spending or online pre-purchases but does account for the transactions of local people, domestic visitors (those who live outside Christchurch, Selwyn and Waimakariri) and international visitors (including international cruise passengers). This interactive dashboard allows for filters to be applied to break down ECT data for the local economies of Christchurch/Lyttleton and Akaroa based on month and year with results presented by arrival dates of cruise ships, ship name, passenger numbers onboard and visitor types.

This data offers broad insights into transactions on cruise days and non-cruise days concluding in general that electronic card transactions on cruise days are on average higher than non-cruise days. Interpretations of the data offered in reporting are not comprehensive and generally biased.

The key limitation of ECT data is that it can be treated as an indicator of spending without being able to determine the causes or sources of high or low local or visitor spending on a given day. These patterns vary significantly across the data set and between the local economies of Christchurch/Lyttleton and Akaroa. ChristchurchNZ notes that the dashboard can not be treated as a proxy for tourism spending or cruise passenger spending per se.

Summary points

The review of international research and New Zealand studies that addresses the economic impacts of cruise indicate that:

- Research that has been conducted in Europe and North America casts doubt on the economic impacts of cruise tourism, including patterns of levels of cruise expenditure, cruise spending relative to other tourism markets, and return visitation.
- Industry commissioned reports typically lack transparency of methods. They tend to celebrate historic growth and forecast future growth, calling for national and local authorities to invest in infrastructure and services to avoid missing future growth opportunities.
- Cruise expenditure estimates that are drawn from official statistics published by Stats NZ overcomes the possibility of uncertain methods leading to inflated positive impacts such as excluding ships that do not arrive in port due to weather and passengers who remain on board rather than engage in shore excursions.
- Stats NZ reports (2015-2020) suggest that cruise is very niche. While cruise provides a seasonal fillip for some local businesses it barely impacts in terms of retail spending across most regional economies.
- Little is known about the displacement and diversion effects caused by the social impacts that are associated with large cruise and multiple same day cruise ship visits. Cruise visits may displace other visitors and local residents with implications of diverted or deferred spending in local economies.
- Stats NZ reports (2015-2020) indicate that cruise involves very few suppliers. Providoring is a relatively minor part of the cruise industry in New Zealand. Modelling suggests that providoring makes up less than 1.3% of expenditure in the industry. There is limited value at ports because of bunkering. Cruise companies tend to use their own select providers so revenue is leaked offshore. Very few tour operators for shore excursions operate at New Zealand ports.
- Most cruise lines use bunkering services supplied offshore. Fuel is typically taken onboard in Australia and fuel services - mainly top ups - in New Zealand are few.
- Cruise line expenses contribute to the income of port companies through port services and port agents. Against this cruise lines require infrastructure investment for ships (e.g., renewable shore to ship power supply infrastructure) and passengers (e.g., passenger terminals and shore transport).
- The impacts of cruise visits on local public transport and the displacement of local commuters are documented in some port communities.

3. Analysis of the New Zealand cruise tourism

In addition to the baseline information on cruise development provided in the section above, we offer further analysis to profile the economic impact of cruise tourism on New Zealand's visitor economy. This analysis covers the following four elements:

1. The scale of the cruise economy: The first element presents a summary of the cruise economy before the COVID-19 pandemic using the Stats NZ 2015-2020 report and extends the cruise economic analysis to the post-COVID period for the 2023 and 2024 seasons. This establishes a six-year (2015-2020) trend pattern for the cruise sector in terms of volume and spending. In addition, it assesses how rapidly cruise tourism rebounded after the pandemic.

2. Comparison across tourism markets: The second element compares the performance of cruise tourism against two other visitor segments: overall international visitors and international students. The comparison is made based on four indicators: market shares in the New Zealand visitor economy, average spending per person-trip, seasonality of visits, and the geographic distribution of spending. Results establish the relative economic performance of cruise tourism by benchmarking its spending, seasonality, and spatial distribution against other non-cruise visitor segments.

3. The importance of cruise to the regional tourism economy: The third element examines the share of cruise tourism in the regional tourism profile, with a particular focus on Southland and Fiordland. Economic importance is discussed in terms of unique cruise passenger visits, cruise tourism spending, and the share of cruise tourism in the regional tourism economy. This analysis assesses the spatial distribution of cruise tourism across fifteen regions and the level of regional tourism dependence on cruise.

4. The nature of its supply chain and employment effect: The last component discusses the characteristics of the cruise line supply chain by examining the types of goods and services cruise lines purchase and the likely number of suppliers involved. For the employment effect, the number of local people employed by cruise lines is presented, which is then compared against the employment effect of the New Zealand visitor economy. We address the flow-on effects from cruise tourism by examining activities that benefit other businesses (suppliers) and local residents (employment).

Methods

Analysis is based on data provided by Statistics New Zealand (Stats NZ) and the Ministry of Business, Innovation & Employment (MBIE). Data is sourced from Cruise Ship Traveller and Expenditure statistics[16], Tourism Satellite Account[18], International Travel Statistics[23] and Regional Tourism Estimates.[24] These datasets are updated annually with fully disclosed methodology, methods, data sources, analysis and limitations. In addition, Stats NZ provided customized data support to identify the monthly share of cruise passenger arrivals and the number of crew members with New Zealand citizenship.

While most figures are available from the year 2015 and onward, they are measured in different season years. For example, Cruise Ship Traveller and Expenditure statistics are reported for the year ended June (referred to as June year), and Tourism Satellite Account is recorded for year ended March (referred to as March year). Season year is identified in each table and figure to facilitate reading.

Due to the COVID-19 pandemic, two statistics were discontinued in the year 2020, including Cruise Ship Traveller and Expenditure statistics and Regional Tourism Estimates. As a result, secondary data is not currently available to profile the scale of the cruise tourism economy in the post-COVID seasons.

We adopt assumptions and a set of analysis procedures to extrapolate the likely scale of cruise tourism for the 2023 (July 2022 to June 2023) and 2024 (July 2023 to April 2024) seasons. First, cruise ship schedules and guest numbers (lower berths) by regions and ports were obtained from itineraries reported to the New Zealand Cruise Association (NZCA).[25] Due to poor weather and biosecurity concerns, existing cruise itineraries and scheduled port visits can change at short notice. Data from CruiseMapper.com was used to verify whether a cruise ship actually visited ports as scheduled. Cases that were unsure or not docking were excluded.

The sum of guest numbers across regions represents ‘gross passenger numbers’ where one passenger can be counted multiple times, depending on the number of regions the vessel has visited. To estimate unique cruise passenger numbers, gross passenger numbers were divided by the average number of regions visited per trip during the 2015-2020 seasons. It is assumed that the itineraries in the 2023 and 2024 seasons are similar to those of the 2015-2020 seasons, and thus the average number of regions visited per trip would remain unchanged before and after the COVID pandemic.

Please note that gross passenger numbers for the 2024 season only cover the months from July 2023 to April 2024. Passenger numbers in May and June 2024 are not included because the project was completed before data for these two months became available. As a result, the estimation in this report for the 2024 season for the cruise tourism economy is underestimated.

Findings and interpretation

1.The scale of the cruise economy

The number of unique cruise passengers has increased from 194,000 in 2015 to 283,000 in 2020, corresponding to an 8% compound annual growth rate (Table 1). The demand for cruise travel rebounded rapidly after the COVID pandemic. We estimate it reached 242,000 unique cruise passengers in 2023 and 314,000 in 2024. The 2024 season figure equates to 99% of the peak level in 2019, implying that cruise tourism will likely have reached a new historical volume in 2024 if passengers from May and June 2024 are included.

Besides volume expansion, average spending per cruise passenger also performed strongly, increasing at a rate of 5% per annum during 2015-2020 (Table 1). Upon closer examination of cruise spending, vessel spending per passenger expanded at 8% per year, while visitor spending per passenger rose by 4% per annum. On average, each cruise passenger contributed $1,934 to the NZ economy in 2020, with 25% being vessel expenses, 65% being visitor spending (tours, food, souvenirs), and 10% being GST. Crew members may also disembark and spend money onshore, and their spending, while minimal, has been included in the visitor spending category.

To estimate the post-COVID pattern, we extrapolated the 2023 and 2024 average spending per passenger based on the trend observed in 2015-2020. With a 5% growth rate per annum, the average spending per passenger is estimated to increase to $2,033 and $2,138 in the 2023 and 2024 seasons, respectively.

With the rapid expansions of both cruise passengers and average spending per person, cruise tourism spending increased from $295 million to $565 million between 2015-2020, achieving a 13% annual growth rate. This robust growth rate is double that of total NZ tourism expenditure (6%) during the same period.

If the trend (13% growth) continues, total cruise tourism spending is estimated to reach $491 million and $672 million in the 2023 and 2024 seasons, respectively. While the demand for cruise tourism is strong, it remains a small niche market in the New Zealand visitor economy, contributing around 1% of the national tourism expenditure (domestic and inbound tourism).

	June year								
Cruise tourism	2015	2016	2017	2018	2019	2020	2023 (est.)	2024 (est.)	Annual change (2015-2020)
Demand									
Total unique passengers	194,451	237,383	221,536	259,489	321,841	282,920	241,718	314,389	8%
Total unique crew	26,885	32,641	34,675	33,915	37,194	36,344	NA	NA	6%
Total	221,336	270,024	256,211	293,404	359,035	319,264	NA	NA	8%
Average spending per passenger ($)									
Vessel	327	365	526	403	441	490	531	576	8%
Visitor	1,035	1,011	1,117	1,144	1,148	1,260	1,310	1,363	4%
GST	155	147	162	167	167	184	191	199	4%
Total	1,517	1,524	1,806	1,713	1,756	1,934	2,033	2,138	5%
Total spending ($ million)									
Vessel	63.6	86.6	116.6	104.5	141.8	138.7	128.4	181.1	17%
Visitor	201.2	240.1	247.5	296.8	369.5	356.4	316.7	428.5	12%
GST	30.1	35.0	36.0	43.3	53.9	52.0	46.2	62.5	12%
Total	294.9	361.7	400.1	444.5	565.2	547.1	491.3	672.1	13%
Total tourism expenditure in NZ ($ million) (March year)	31,608	35,157	36,208	39,084	40,866	41,521	37,693	NA	6%
Pct of cruise tourism expenditure	0.9%	1.0%	1.1%	1.1%	1.4%	1.3%	1.3%	NA	

Table 1. NZ cruise tourism visit and spending, 2015-2024

2.Comparisons across tourism segments

Table 2 provides a comparison across the international visitor, international student, and cruise tourism segments on three economic indicators: total spending, market shares, and average spending per person.

Before the COVID-19 pandemic, the inbound tourism market was an important component of the New Zealand visitor economy, with its contribution to total spending increasing from 39% in 2015 to 43% in 2020. Similarly, international students also gained momentum, with their expenditure shares increasing from 8% to 10% during the same period. In comparison, cruise tourism remained at a 1% market share.

In terms of average spending, international students (staying less than 12 months) contributed more than $45,000 per person to the economy due to their extended stays. Before the COVID pandemic, international visitors spent between $3,800 and $4,800 per person per trip. In contrast, cruise tourists had the lowest spending per person per trip, at $1,500 to $1,900, which is about 40% of the average spending of international tourists.

Another dimension to examine the economic contribution of individual segments is to focus on monthly arrival data. Less seasonal fluctuation by month is preferred as, in this case, it supports higher quality job conditions (longer working months and stable income), mitigates social and environmental pressure during the peak season, and enhances the well-being of residents to avoid overburden from tourism.[26]

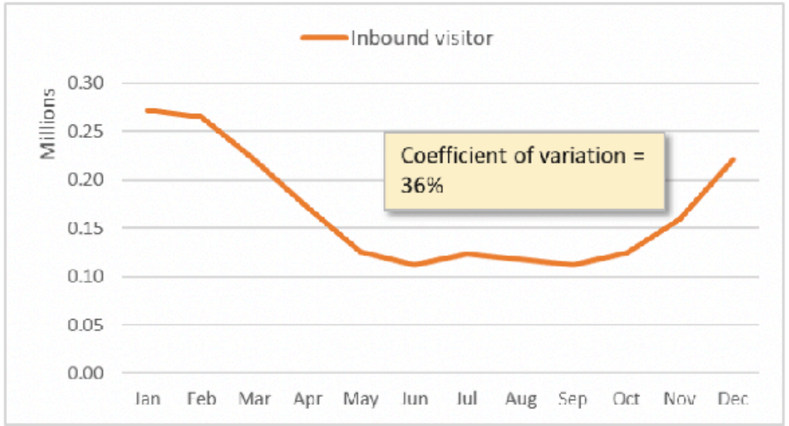
Across the three segments, international students report the least extent of seasonality, with around 13,000 to16,000 arrivals per month (coefficient of variation is 15%) during 2015-2020 (Table 2).

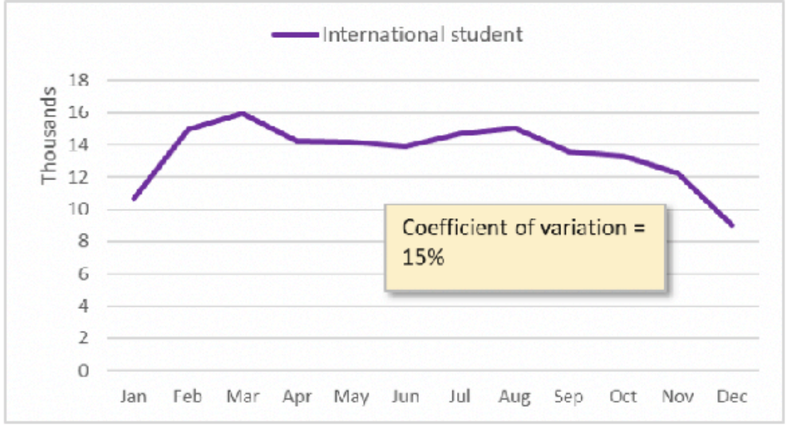
For international tourists, peak demand during the summer season, November to March, is identified, recording more than 220,000 arrivals per month. Arrivals between these five months cover 56% of the total annual visits. In contrast, the shoulder season sees international arrivals drop to around 120,000 per month (coefficient of variation is 36%).

Cruise tourism displays the largest seasonality pattern with significant high- and low-seasons. During the 2019 season, highly aggregated demand is seen from November to March, with 80% of its annual passenger visits occurring during these five months. From May to September, cruise activity stays in hibernation, accounting for less than 2% of annual visits. The coefficient of variation, a proxy for seasonality, is 84%, which is 2.3 times higher than the international visitor segment.

	June year								
Cruise tourism	2015	2016	2017	2018	2019	2020	2023 (est.)	2024 (est.)	Annual change (2015-2020)
Demand									
Total unique passengers	194,451	237,383	221,536	259,489	321,841	282,920	241,718	314,389	8%
Total unique crew	26,885	32,641	34,675	33,915	37,194	36,344	NA	NA	6%
Total	221,336	270,024	256,211	293,404	359,035	319,264	NA	NA	8%
Average spending per passenger ($)									
Vessel	327	365	526	403	441	490	531	576	8%
Visitor	1,035	1,011	1,117	1,144	1,148	1,260	1,310	1,363	4%
GST	155	147	162	167	167	184	191	199	4%
Total	1,517	1,524	1,806	1,713	1,756	1,934	2,033	2,138	5%
Total spending ($ million)									
Vessel	63.6	86.6	116.6	104.5	141.8	138.7	128.4	181.1	17%
Visitor	201.2	240.1	247.5	296.8	369.5	356.4	316.7	428.5	12%
GST	30.1	35.0	36.0	43.3	53.9	52.0	46.2	62.5	12%
Total	294.9	361.7	400.1	444.5	565.2	547.1	491.3	672.1	13%
Total tourism expenditure in NZ ($ million) (March year)	31,608	35,157	36,208	39,084	40,866	41,521	37,693	NA	6%
Pct of cruise tourism expenditure	0.9%	1.0%	1.1%	1.1%	1.4%	1.3%	1.3%	NA	

Table 2. Comparison of cruise tourism, inbound tourism and international students by visit and spending, 2015-2024





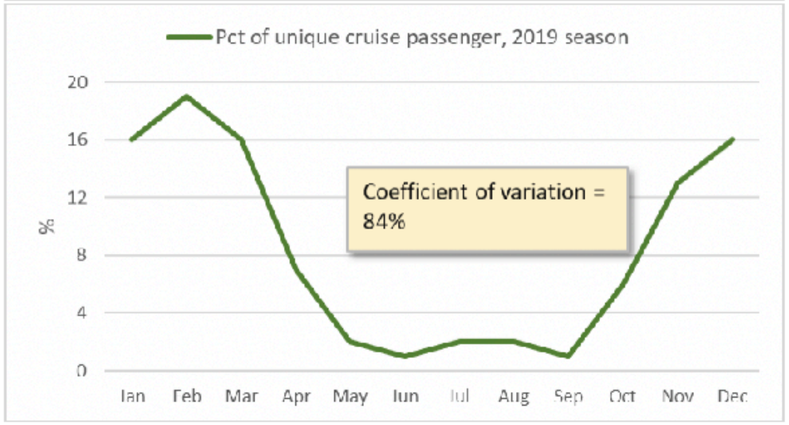
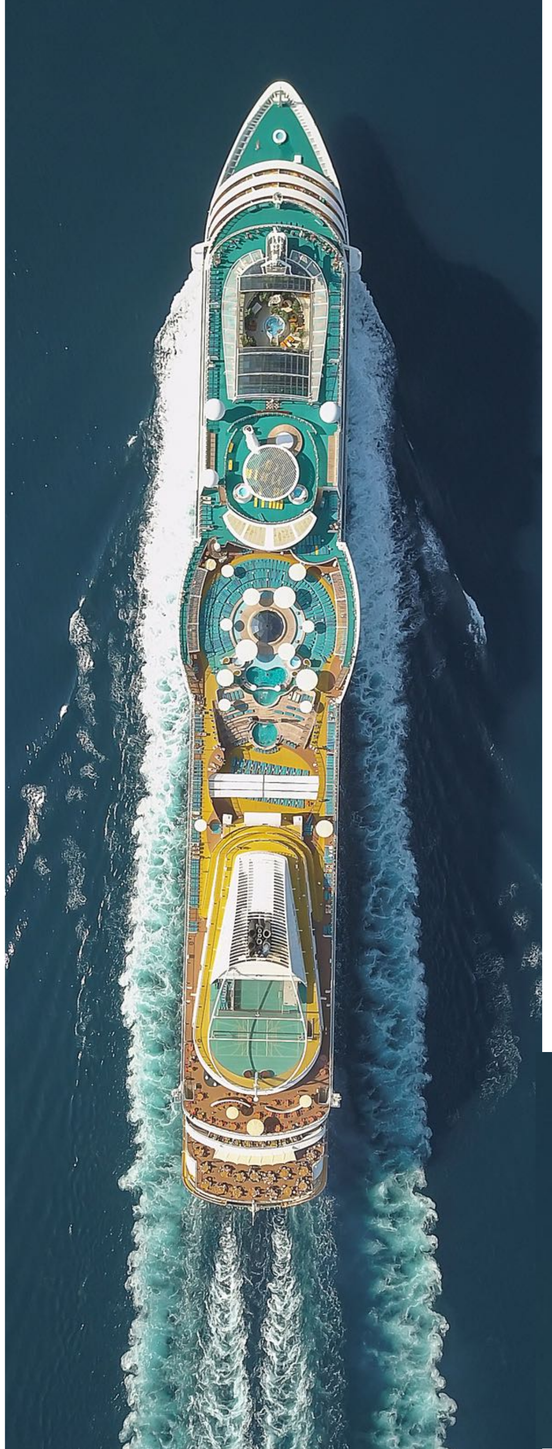


Figure 2. Monthly arrivals for international visitors (2015-2020), international students (2015-2020) and cruise tourism (2019)



Regarding the spatial distribution of spending, cruise tourism is compared against inbound tourism across fifteen regions (fourteen regions + other). No statistical difference is reported, indicating both segments have a similar distribution pattern across geographic areas.

Overall, more than one-third of expenditure occurs in Auckland across both segments. Bay of Plenty (16%) ranks second for cruise tourism expenditure, while Otago (18%) is the second region with the largest inbound tourism spending.

Figure 3 highlights four regions—Bay of Plenty, Wellington, Marlborough, and Hawke's Bay—that have benefited more from cruise tourism compared to inbound tourism, based on the proportion of spending in the local community. In particular, Bay of Plenty stands out, with a difference of more than 10% between the two shares, indicating that this region benefits significantly more from cruise tourism.

For the Southland area, there is no difference in the spending allocation from cruise tourism versus international tourism. The region receives around 2% of the total tourism spending in these two markets, respectively.

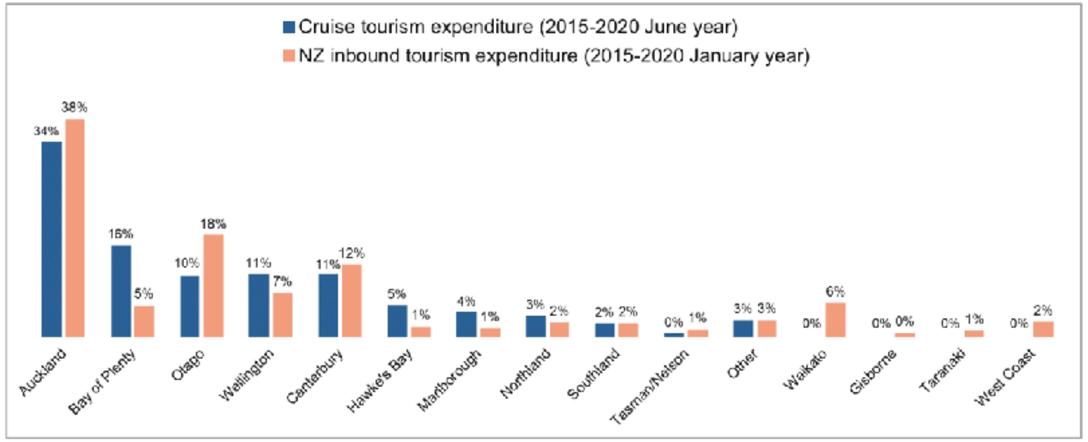


Figure 3. Spending distribution by regions for cruise tourism and inbound tourism, 2015-2020

3.The importance of cruise to the regional tourism economy

Contributions of cruise tourism to regional economies vary according to cruise port visit schedules and the scale of the regional tourism economy. Tables 3 and 4 detail the spatial distribution of unique cruise passenger numbers and spending across fifteen regions in New Zealand during 2015-2020.

In terms of visits, there are five ‘popular cruise spots’ in New Zealand, with each region receiving around 70% of total unique cruise passengers: Auckland, Bay of Plenty, Otago, Southland, and Wellington (Table 3). Seven out of every ten cruise passengers have visited these places.

In the Southland region, three ports are included in the statistics: Bluff, Fiordland, and Stewart Island. Fiordland is the primary attraction point in this region, recording more than 222,000 unique cruise passengers in 2019. Its importance can be seen by the fact that its cruise volume is higher than those recorded in Wellington, Canterbury, and Hawke’s Bay. The post-COVID rebound for Fiordland is likely to reach 204,000 passengers by April 2024 based on our estimation. In contrast, Stewart Island and Bluff received a marginal 7,000 and 3,000 passengers in 2024, respectively (Table 3).

Cruise tourism spending, however, does not follow the passenger distribution pattern. Spending is more concentrated in large cities. Eighty percent of cruise tourism spending occurred in five regions/ ports: Auckland, Bay of Plenty, Otago, Wellington, and Canterbury, while other regions received marginal shares (Table 4).

Cross-referencing Tables 3 and 4 reveals a significant disparity between the volume of visitors and spending in Southland. In 2019, Southland recorded a high percentage of unique cruise passenger visits (69%) but received only a small share of cruise tourism spending (3%) (Figure 4). In contrast, other ‘popular cruise spots’ such as Auckland, Bay of Plenty, Otago, and Wellington each received more than 10% of cruise tourism spending.

Examining the docking ports across the Southland area reveals that passengers are likely to disembark and spend money in Bluff and Stewart Island, while hardly any passengers disembark in Fiordland . In other words, Fiordland hosted 69% of the total unique cruise tourism passengers but received no tourism spending, as there are virtually no opportunities for passengers to spend money ashore.

Visits (000)		June year						Estimated number		
Region	**Port**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2023**	**2024**	**Pct in 2019***
Auckland	Auckland	179.4	217.2	193.2	211.4	239.0	183.2	165.6	246.0	74%
Bay of Plenty	Tauranga	147.5	164.4	153.7	152.5	227.4	183.2	153.3	199.2	71%
Otago	Port Chalmers	131.4	145.7	162.3	179.6	237.8	191.1	170.2	199.2	74%
Southland	Bluff, Fiordland, Stewart Island	134.4	150.1	164.6	170.6	222.9	181.4	164.3	213.9	69%
	Bluff	0.0	0.2	1.8	0.2	1.1	0.8	1.6	3.1	0%
	Fiordland	134.4	150.1	164.3	168.6	222.2	179.1	157.3	203.9	69%
	Stewart Island	3.1	3.4	4.7	8.3	6.7	7.9	5.5	6.9	2%
Wellington	Wellington	139.3	161.3	163.9	162.2	222.4	190.8	155.7	193.2	69%
Canterbury	Akaroa, Lyttleton, Timaru, Kaikoura	128.4	129.4	148.3	132.0	195.0	155.5	178.1	189.6	61%
Hawke's Bay	Napier	96.0	80.1	88.3	101.8	116.8	105.9	115.7	147.2	36%
Northland	Bay of Islands	59.1	111.1	88.8	103.5	123.0	107.4	68.4	146.5	38%
Marlborough	Picton	51.5	74.0	74.9	78.2	93.0	95.6	91.9	106.6	29%
Gisborne	Gisborne	0.0	28.3	30.0	7.1	22.1	9.5	13.4	11.7	7%
Taranaki	New Plymouth	0.0	0.1	1.2	0.1	0.8	3.6	1.0	7.8	0%
Tasman/Nelson	Golden Bay, Nelson	1.6	0.2	2.4	0.8	4.9	6.6	5.0	6.2	2%
Waikato	Mercury Bay	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0%
West Coast	Jackson Bay	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0%
Other		0.9	0.6	1.2	0.1	0.4	0.0	0.0	0.0	0%

Table 3. Unique cruise passenger numbers by region and port, 2015-2024

Spending ($ millions)		June year						
Region	Port	2015	2016	2017	2018	2019	2020	Pct in 2019
Auckland	Auckland	93.7	120.5	134.4	146.0	189.6	207.6	34%
Bay of Plenty	Tauranga	50.0	62.4	70.4	67.0	89.2	74.3	16%
Otago	Port Chalmers	31.7	37.7	43.3	48.0	60.2	49.8	11%
Wellington	Wellington	35.2	44.1	41.3	49.4	59.2	53.1	10%
Canterbury	Akaroa, Lyttleton, Timaru, Kaikoura	38.1	43.0	44.9	48.6	55.3	52.8	10%
Hawke's Bay	Napier	19.3	16.3	19.2	27.0	28.4	27.4	5%
Marlborough	Picton	8.5	10.2	13.4	20.0	23.5	29.1	4%
Northland	Bay of Islands	8.2	10.1	10.1	16.2	20.3	23.7	4%
Southland	Bluff, Fiordland, Stewart Island	4.6	6.3	8.3	8.0	14.6	10.8	2%
Tasman/Nelson	Golden Bay, Nelson	1.2	0.3	1.5	0.7	1.4	1.6	0%
Other		3.2	8.9	10.8	11.8	19.1	13.8	3%
Waikato	Mercury Bay	C	C	C	C	C	C	
Gisborne	Gisborne	C	C	C	C	C	C	
Taranaki	New Plymouth	C	C	C	C	C	C	
West Coast	Jackson Bay	C	C	C	C	C	C	
Total spend		294.9	361.7	400.1	444.5	565.2	547.1	100%

Table 4. Cruise tourism spending region and port, 2015-2020

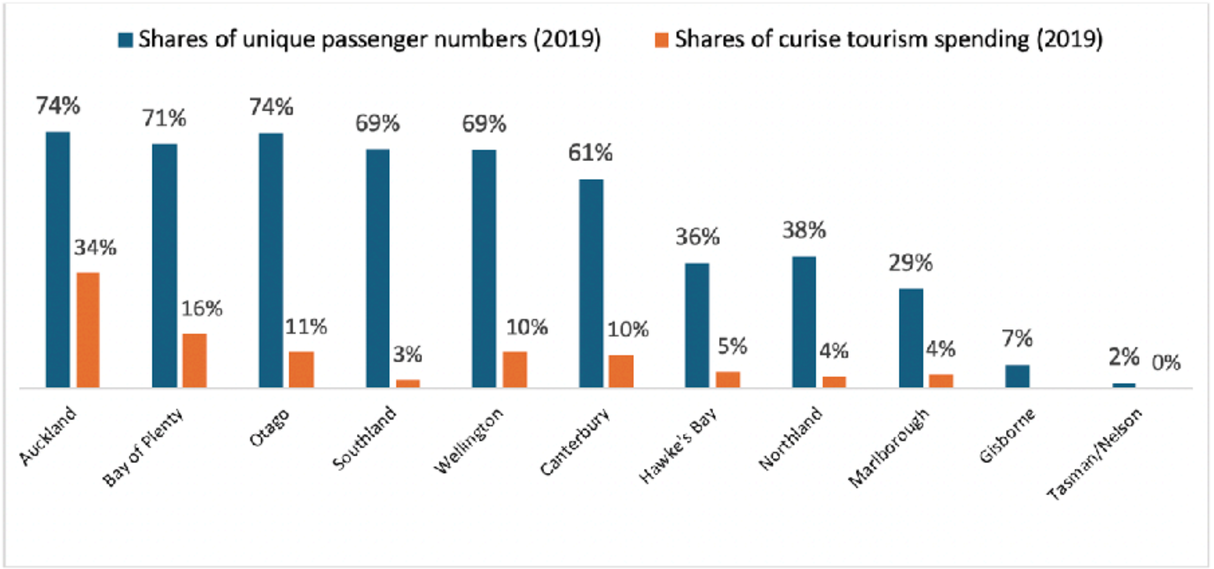


Figure 4. Cruise unique passenger numbers and cruise tourism spending by regions, 2019

4.The nature of its supply chain and the employment effect

Besides direct visitor spending and vessel spending, cruise tourism can benefit the New Zealand economy through its flow-on effects, including purchases of local goods and services (the supply chain effect) and support of local employment (the employment effect).

The supply chain effect comes from vessel expenditure, including payments to shipping agents (ship visit logistics), bunkering (providing marine fuels), and providoring (providing produce and other supplies). Vessel expenses increased by 17% per annum during 2015-2020, from $64 million to $139 million (Table 5).

Fees covered by shipping agents can include berth hire, cruise traffic and security charges, government marine safety levy, government services, government oil pollution levy, other port charges, passenger charges, waste oil removal, and wharfage. There is a very limited number of shipping agents in New Zealand and the major agent is based in Auckland.

For bunkering and providoring, the majority of these two activities are done outside of New Zealand, primarily in Australia. For those transactions that occur in New Zealand (mainly top-ups), businesses that directly assist cruises with these two items are very limited (<10 suppliers).

It is important to note that bunkering and providoring are crucial to triggering upstream supply chain effects. Supplying local wine to cruise ships, for example, benefits grape growers, seasonal labour, wine manufacturers, transporters, and wholesalers, among many others. Fees paid to the government do not create such supply chain effects. However, a breakdown of expenditure relating to shipping agents, bunkering, and providoring is not possible due to business confidentiality.

Overall, the supply chain impact of the cruise sector is concentrated among a few key providers, primarily located in Auckland. This is in contrast to the preferred tourism model, where small and medium-sized tourism enterprises support the local economy by engaging with a diverse range of local suppliers for locally-made goods and services. This preferred model minimizes revenue leakage and ensures a fair distribution of income among tourism stakeholders. Currently, there is no evidence to suggest that the cruise sector delivers similar benefits to the regional economies of New Zealand.

We also examined the employment effect by differentiating the number of unique crew members based on nationality . While crew numbers have grown from 27,000 people to 36,000 people (+6% per annum) between 2015-2020, crew members with New Zealand citizenship increased only marginally from 114 people in 2015 to 213 people in 2018, then decreased to 126 people in 2020 (+2% per annum) (Table 5).

Two-thirds of the crew onboard cruise ships visiting New Zealand are from three countries: the Philippines (36%), Indonesia (15%), and India (13%). In contrast, less than 0.5% of unique crew members are New Zealanders.

We further benchmarked the employment opportunities from cruise operation versus the New Zealand visitor economy by the number of people employed per million-dollars spending. We found that in 2019 every one million dollars spent on general tourism supported 5.4 people employed, whereas every one million dollars spent on cruise ship operation supported 1.3 people employed (Table 6). The opportunities to support employment in New Zealand via cruise ship operations is very limited, around 75% less than the overall tourism sector.

Unique crew numbers	2015	2016	2017	2018	2019	2020	Annual change (2015-2020)
New Zealand	114	139	138	213	184	126	2%
Other countries	26,771	32,502	34,537	33,702	37,010	36,218	6%
Total	26,885	32,641	34,675	33,915	37,194	36,344	6%
Pct of New Zealand employee	0.4%	0.4%	0.4%	0.6%	0.5%	0.3%	

Note. Two-thirds of the crew are from three countries: the Philippines (36%), Indonesia (15%), and India (13%).

Table 5. Unique crew numbers by nationality, 2015-2020

	Expenditure ($ million)	Number of people employed	Ratio (# people employed/ $ million)
New Zealand visitor economy	$40,891	220,656	5.4
Cruise tourism (vessel spending)	$139	184	1.3

Table 6. Expenditure, employment and employment ratio by New Zealand visitor economy and cruise tourism, 2019

Conclusions

Like all other economic sectors, cruise tourism generates both positive and negative impacts on the New Zealand economy, with varying degrees of volume and spending across fifteen geographic regions. We summarized these economic attributes of cruise tourism as follows.

Positive Impacts

- Cruise tourism is a small niche market in the New Zealand tourism industry, accounting for around 1% of total tourism expenditure. This niche market experienced strong growth before the COVID-19 pandemic (2015-2020), with its passengers (+8% per annum) and average expenditure per passenger (+5% per annum) reporting robust growth from a very small base.
- The cruise sector expenditure growth rate (+13% per annum) was double the overall New Zealand visitor economy (+6% per annum) between 2015-2020.
- Cruise tourism has rebounded rapidly during the 2023 and 2024 seasons, likely exceeding pre-COVID peak passenger volumes by the of the 2024 season.

Negative Impacts

- Benchmarking shows that (1) cruise tourism is 2.3 times more seasonal than international tourism; (2) cruise passengers spend 60% less than international visitors per trip; (3) cruise operation provides fewer local employment opportunities with 1.3 people employed per million dollars of vessel spending in contrast to 5.4 people employed per million dollars of general tourism spending; (4) the cruise sector works with very limited suppliers, which are mainly based in Auckland.
- While cruise tourism has grown rapidly in recent years, its spending is concentrated in the five peak months from November to March, with minimal activity during the rest of the year. This highly seasonal pattern increases environmental pressure on the local marine environment and provides limited income for businesses that depend on cruise tourism during the off-season.
- Additionally, cruise operations experience significant revenue leakage, with major bunkering and provisioning done offshore. Since vessel operations do not benefit a large number of suppliers across individual regions in New Zealand and fail to create sufficient local employment opportunities, the broader economic impacts of cruise operations remain limited.

The Southland Region and Fiordland

- Cruise tourism is a small niche market in the New Zealand tourism industry, accounting for around 1% of total tourism expenditure. Despite high growth in recent years cruise tourism remains at 1% market share.
- The Southland region experienced a significant disparity between cruise volume and spending (69% of total unique cruise passengers vs 3% spending). Due to limited opportunities to get ashore, cruise tourism contributed a marginal 2% to the local tourism economy in the Southland region, through limited spending in Bluff and Stewart Island.
- Fiordland, while shouldering the bulk of cruise visits (69% of total unique cruise passengers), received 0% of the total cruise passenger spending. Cruise passengers are generally unlikely to disembark and spend money in Fiordland. As a result, they do not contribute to the local tourism economy.

References

7. Kayahan, B., Vanblarcom, B., & Klein, R. A. (2018). Overstating cruise passenger spending: Sources of error in cruise industry studies of economic impact. *Tourism in Marine Environments*, *13*(4), 193-203.
8. Visit Flanders (2023). Study into the characteristics and impacts of cruise tourism in Flanders. https://publicaties.vlaanderen.be/view-file/56812
9. Larsen, S., Wolff, K., Marnburg, E., & Øgaard, T. (2013). Belly full, purse closed: Cruise line passengers' expenditures. *Tourism Management Perspectives*, *6*, 142-148.
10. Stand Earth (2022). Missing the boat: Comparative economic impacts of cruise and non-cruise tourism in Greater Victoria, BC. February 2022 https://static1.squarespace.com/static/60ac1901834afd53d9ab2496/t/62aa1ceae902da5fc47087a0/1655315693081/victoria_report.stand.earthfinal06042022.pdf
11. Vogel, M. P. (2011). Monopolies at sea: the role of onboard sales for the cruise industry's growth and profitability. In *Tourism economics: Impact analysis* (pp. 211-229). Heidelberg: Physica-Verlag HD.
12. Seidl, A., Guiliano, F., & Pratt, L. (2007). Cruising for colonies: cruise tourism economics in Costa Rica. *Tourism Economics*, *13*(1), 67-85.
13. Torbianelli, V. (2012). The local economic impact of cruises: From figures to the active policies of the European harbour cities. *Pomorstvo*, *26*(1), 139-150.
14. New Zealand Cruise Association (2024). Navigating the tides of truth: Myths and facts about cruising. April 2024. https://newzealandcruiseassociation.com/cruise-facts/
15. Larsen, S., & Wolff, K. (2016). Exploring assumptions about cruise tourists' visits to ports. *Tourism Management Perspectives*, *17*, 44-49.
16. Statistics New Zealand (2020). Cruise ship traveller and expenditure statistics: Year ended June 2020. 8 October 2020. https://www.stats.govt.nz/information-releases/tourism-satellite-account-year-ended-march-2023/
17. Heyes, R. (2023). How important are cruise ships to local tourism? Infometrics 28 February 2023. https://www.infometrics.co.nz/article/2023-02-how-important-are-cruise-ships-to-local-tourism#
18. Statistics New Zealand (2024). Tourism satellite account: Year ended March 2023. https://www.stats.govt.nz/information-releases/tourism-satellite-account-year-ended-march-2023/
19. Clough, P. (2020). Tourism beyond COVID-19 – is the future sustainable, local and green? NZIER Insight 87. New Zealand Institute of Economic Research (NZIER) 9 June 2020. https://www.nzier.org.nz/publications/tourism-beyond-covid-19-is-the-future-sustainable-local-and-green
20. ME Consulting (2018). Cruise tourism's contribution to the New Zealand economy 2018. Prepared for the New Zealand Cruise Association (NZCA) 31 October 2018. https://newzealandcruiseassociation.com/wp-content/uploads/2018/12/Cruise-Tourisms-Contribution-to-the-New-Zealand-Economy-2018-FINAL.pdf
21. Market Economics Limited and Cruise New Zealand (2010). New Zealand cruise industry study. Report prepared for the Ministry of Economic Development, Cruise New Zealand and Tourism New Zealand. September 2010. https://img.scoop.co.nz/media/pdfs/1009/CNZ_Economic_Impact_Report_2009101112.pdfNew
22. Christchurch NZ (2024). ChristchurchNZ destination insights dashboard. https://www.christchurchnz.com/about-us/economic-insights/christchurchnz-tourism-research
23. Statistics New Zealand (2024). International travel: December 2023. https://www.stats.govt.nz/information-releases/international-travel-december-2023/
24. Ministry of Business, Innovation & Employment (2024). Regional Tourism Estimates (RTEs). https://www.mbie.govt.nz/immigration-and-tourism/tourism-research-and-data/tourism-data-releases/monthly-regional-tourism-estimates/regional-tourism-estimates
25. New Zealand Cruise Association (2024). 2023-2024 Cruise Ship Schedule. https://newzealandcruiseassociation.com/2023-2024-cruise-ship-schedule/
26. Duro, J. A., & Turrion-Prats, J. (2019). Tourism seasonality worldwide. Tourism Management Perspectives, 31, 38-53.

Chapter 2.1

Environmental: Cruise emissions

Research overview: The cruise sector is a fast growing and carbon-intensive form of tourism.[27] Some of the most current analyses of cruise sector emissions are presented by the International Council on Clean Transportation (ICCT) and Transport and Environment (T&E). The current science confirms the high energy use and GHG emissions of cruise.

Global cruise emissions: The global cruise industry is dominated by three major players, Carnival, Royal Caribbean and Norwegian.[27] Data from their annual reports has been used to estimate the sector's carbon emissions and carbon intensity.[27] This research found that in 2019 those three cruise companies served 22 million passengers (80% of total global passenger volume) and emitted 18Mt CO_2-e (Scope 1-2). They also calculate that in 2019 cruise emissions across the average trip length of 7.2 days was 114.9kg CO_2-e per passenger per day (Scope 1-2).

Transport and Environment[29] reports that cruise carbon emissions in Europe increased by 17% between 2019 (173 ships) and 2022 (218 ships) to reach 8.1Mt CO_2 -equivalent to 50,000 flights between Paris and New York.

Full carbon accounting: At COP27 the United Nations High Level Expert Group (HLEG)[30] delivered its 'Integrity Matters' report on the net zero commitments of non-state actors. This report was commissioned by the Secretary General of the United Nations in an attempt to counter greenwashing and outlines what companies, investors and regional authorities should consider when implementing net zero targets. The United Nations outlines the need for all non-state actors to create credible carbon mitigation targets if they have not done so already, and advise that they must include:

1. Emissions reductions from an entity's full value chain and activities (Scope 1-3);
2. All greenhouse gas emissions including targets for material non-CO_2 emissions; and
3. Absolute emissions reduction targets consistent with the IPCC's 1.5C pathway.

While the direct carbon emissions caused by cruise ships are relatively well studied, less attention has been paid to Scope 2 and 3 cruise sector emissions. Full carbon accounting requires the inclusion of purchased goods (e.g., supply chain, importation of food) and services (e.g., shore excursions), waste, and employee commuting (e.g., crew air travel to and from cruise ports).

Cruise tourism often involves significant air travel of passengers and crew to ports of departure and/or from ports of final disembarkation. While it may be argued that the air travel of passengers to ports of departure is the responsibility of the air transport sector, full cruise emissions accounting should include air travel where it forms an unavoidable part of the cruise itinerary. Flights to and from port destinations for passengers and crew are likely to incur approximately 300kg CO_2/1000km of air travel.[31]

Humpe et al.[27] extrapolate CO_2-e (Scope 1-2) for the three largest cruise companies and include Scope 3 emissions drawing upon 2019 data provided by Carnival and Royal Caribbean, finding that those companies emitted more than 45 Mt CO_2-e in that year. They estimate 60 Mt CO_2-e total global Scope 1-3 cruise emissions in 2019. They also calculate 230kg CO_2-e emissions per passenger per day (Scope 1-3). On this basis the global average cruise duration of 7.2 days would emit 1.65 t CO_2-e per passenger.[27]

Humpe et al.[27] conclude that despite the forecast 2% per annum efficiency improvement, if the global cruise industry continues its 1990-2019 historical growth of 6.6% per annum it will:

1. Carry 40 million passengers and emit 30 Mt CO_2-e (Scope 1-2) or 59 Mt CO_2-e (Scope 1-3) in the year 2030 despite the IPCC warning that gross global carbon emissions must be halved by that year;
2. Carry 145 million passengers and emit 71 Mt CO_2-e (Scope 1-2) or more than 195Mt CO_2-e (Scope 1-3) emissions in 2050.

Assuming the proportional development of Scope 3 emissions the estimated accumulated emissions of the cruise industry for the years 2024-2050 is 2.3 Gt CO_2.

Global fleet of cruise ships: The International Maritime Organisation (IMO) distinguishes the global cruise ship fleet on the basis of gross tonnage:[32]

1. Small cruise ships: Those less than or equal to 10,000 gross tonnes (GT) which represent 45% of the global cruise ship fleet and emit approximately 10% of the total gross cruise sector GHG emissions.
2. Large cruise ships: Those greater than 10,000 GT represent the remaining 55% of the cruise fleet and emit approximately 90% of sector emissions.[33]

Smaller cruise ships produce significantly lower emissions per passenger than large cruise ships. They also offer greater scope to transition to new technologies that use alternative fuels.[33] Greater accountability and transparency in emissions reporting for individual cruise ships (and different cruise segments, including private super yachts) is urgently required.

National research: The failure of international efforts to mitigate the cruise industry's environmental impacts had heightened the need for national, regional and port-specific measurements and interventions. Various national studies have now measured cruise greenhouse gas emissions, air pollutants and particulate matter.

Norway: Simonsen et al.[33] model carbon dioxide (CO_2), nitrous oxide (NOx) and particulate matter ($PM_{2.5}$) emitted at sea and in port in Norwegian waters. They report that 81 cruise ships of various sizes operated in Norwegian waters in 2017 consuming 129,798 t of fuel and emitting 0.4 Mt of CO_2. In response regulations have been developed in Norway to ban conventional fossil fuel cruise ships from Norway's world heritage fjords from 2026.

Pacific North-West: Thirteen cruise ships serving 559,414 serving passengers departed the Port of Seattle to Alaska in the 2019 cruise season. Those vessels emitted a total of 1,120,324 mtCO_2-e (1.12 million tons).[34]

New Zealand: Despite calls for accurate and current accounting of cruise emissions,[35] the most comprehensive analysis of New Zealand cruise emissions was conducted by Howitt et al. in 2010.[36] They calculated cruise ship emissions in New Zealand using an 'activity based' or 'bottom-up' approach informed by 2007 data.

They found that emissions varied between vessels from 250-2200 gCO_2 per passenger-kilometre (gCO_2/pax-km). At the time the equivalent economy class flight emissions were in the range of 98-130gCO_2/pax-km. Current data indicates that the average marine-fuel powered cruise ship continues to equate to approximately four times more CO_2 than economy class flying.[37]

Howitt et al.[37] compared the accommodation functions of cruise ship and land-based hotels. They report that the average energy consumption per visitor night in a New Zealand hotel is 155 MJ (global average 130 MJ; New Zealand luxury hotels 322 MJ). By comparison the mean energy use per passenger night for the hotel equivalent accommodation function of cruise ships visiting New Zealand was 1600 MJ per visitor night . This figure is 12 times greater than the average energy demands of a land-based hotel.[37]

The total energy costs of cruise ships should include the energy used by crew which is a significant part of cruise ship operating costs. Crew represent 30-50% of people on board a cruise ship. The equivalent figure for Air New Zealand's fleet of aircraft at the time was approximately 4-5%.[37] Inclusion of crew energy both onboard and in travelling to and from cruise ports significantly further increases per passenger carbon emissions.

Cruise emissions per passenger kilometre could be significantly reduced by sacrificing the luxury amenities that have become synonymous with large cruise ships and reducing accommodation space per passenger.[37] Growth in cruise tourism and emissions also indicates the urgency of energy transition.

Energy transition: Heavy fuel oil (HFO) is the traditional energy source used to power cruise ship engines. Growing climate, environment and health concerns and social pressure have triggered an energy transition. Liquefied natural gas (LNG) has been put forward as the best energy alternative. LNG contains less carbon and relatively little sulphur than HFO and can therefore lower CO_2 and sulphur oxides (SOx) emissions. LNG also offers the possibility of reduced nitrogen oxides (NOx) emissions.

Methane (CH4) accounts for 87-96% of the energy contained in LNG. Methane is a long-lived greenhouse gas that has 36 times more global warming power than CO_2 over a 100-year period. Methane leaks occur when gas is transformed into LNG and when LNG is being stored and transported representing significant sources of upstream methane emissions.

The ICCT[38] reports that methane slip from ship engines powered by LNG is also a cause of significant releases of unburned methane into the atmosphere. This builds on an earlier report that using LNG could actually *worsen* the climate impacts of shipping. It concludes that LNG could double the climate impact of conventional shipping fuels, while 'continuing to invest in LNG infrastructure on ships and on shore might make it harder to transition to low-carbon and zero-carbon fuels in the future'.[39]

It is expected that small cruise ships will create a transition pathway that may ultimately be possible for the large higher emissions cruise fleet.[28] It remains unclear how the profitability of the cruise industry would be impacted by the adoption of bunkered low-carbon biofuels.[27] Questions also remain as to whether low carbon, low emission fuels can be made available at scale.[29]

Shore energy supply: Cruise ship port visits typically involve the use of high emissions onboard energy systems despite long standing concerns for the high environmental impacts of berthed vessels. High emissions, particulate pollution, noise and visual pollution are an increasing cause of social resistance to cruise ship visits in port communities. This remains a significant challenge facing ports worldwide.

The Council of the European Union adopted the FuelEU Maritime regulation in July 2023. This requires that from 1 January 2030 vessels of 5,000 gross tonnage (GT) including cruise ships connect to shore power in main EU ports. Ships using alternative zero-emission technologies including batteries and fuel cells are exempt. The stated aim of this regulation is to begin to reduce greenhouse gas emissions and curb air pollution in ports.[29]

ICCT[29] estimates that 15,700 ships spent more than 2 hours at the 489 major EU ports in 2019. They demanded nearly 5.9 terawatt-hours of energy. Over two-thirds (67%) of that energy demand came from tankers, passenger and cruise ships, which also produce the majority of in-port CO_2 emissions.

This report highlights the limitations of existing regulations in terms of cruise emissions and air pollution mitigation. Only 51 of the major EU ports (10.4%) have shore power infrastructure. They supply 309 MW of power to ships in port of which only 283 MW are intended for container, passenger and cruise ships. The EU will need to triple or quadruple its shore power capacity by 2030 to meet the current ambitions of the FuelEU Maritime regulation.[29]

Policy interventions and management of cruise emissions: Reducing emissions from cruise ships is a critical challenge for the cruise industry and for tourism destinations. Global, national, regional and municipal policies and management interventions are required to rein in high cruise emissions. The following examples indicate that decisive action is now being taken in some regions of the world.

Global action: The United Nations HLEG and IMO's GHG reduction strategy signals imminent change for the cruise sector. In 2024 the EU will begin charging ships for their carbon pollution through the EU Emissions Trading Scheme. The EU has also implemented regulations that require the lifecycle GHG intensity of marine fuels to move onto a declining trajectory from 2025.[31] The new European Union FuelEU Maritime regulations makes the use of onshore shore power mandatory for cruise ships operating in EU ports from 2030.[32]

Transport and Environment[33] (Norway) makes the case that cruise ships should be required to meet 'first-mover' regulations to decarbonise because of its status as a 'public-facing luxury segment'. This would require zero-emission berth standards for cruise ships and requirements to switch to zero emission propulsion in EU territorial waters.

National government policy: Responses include monitoring and tracking cruise sector GHG emissions (Scope 1–3), requiring the public disclosure of per passenger emissions from cruise ships, and capping the size and volume of cruise ship visits to align the sector with national climate commitments. National legislation has been advanced in Norway where from 2026 GHG emitting cruise ships will be banned from entering Norway's world heritage fjords. This ban is inspired in part by the need to drive technological development and cruise sector action towards a lower emissions future.[34]

New Zealand's 2050 emissions reduction targets include domestic aviation and shipping. The Climate Change Commission is currently developing advice for government as to whether international aviation and shipping should be included in the targets, and if so how. A discussion document for this review has been open for public consultation in the second quarter of 2024 (8 April – 31 May 2024).[35]

Concerns have been raised that as other international jurisdictions move to reduce international shipping emissions, New Zealand risks being served by old and more polluting ships, raising the need to advance a trans-Tasman green shipping corridor.

Local authorities: The actions of territorial local authorities have the greatest direct influence on cruise emissions mitigation.[28] In 2019 the Christchurch City Council (CCC) adopted targets to reduce GHG from all sources.[47] The CCC emissions inventory for the 2022/23 financial year included cruise ship emissions estimates based on fuel use measures. Previously cruise emissions had been excluded due to lack of data and estimation uncertainties. The CCC has committed to improving measurement of cruise emissions for inclusion in future emissions inventories.

The Dunedin City Council tabled its draft Zero Carbon Plan 2030 on 29 August 2023 which charts Dunedin's pathway to becoming a zero carbon city by 2030. It notes that cruise emissions are not currently included in the city's emissions reporting due to data limitations but that the volume of cruise arrivals indicates that it is a significant source of unmeasured emissions. Similarly, Dunedin's Destination Management Plan *Destination Ōtepoti* states the need to address the "perceived imbalance between the benefits and burdens of the cruise industry" (p.15).[49]

The DCC Zero Carbon Plan 2030 outlines that, when quantified, cruise emissions will need to be reduced by a minimum of 40% by 2030. This plan requires the development of a Cruise Action Plan which should include an "exploration of the consequences of capping cruise ship visits to the city" (p.29).[49] The Cruise Action Plan 2023 was made public in June 2024. It makes little reference and makes no concrete commitments to cruise ship emissions mitigation.[50]

Port authorities: Ports of Auckland Ltd commissioned a report in 2017 that recommended upgrading local fuel storage to advance fuel switching, noting that relatively few vessels had the capacity to connect to shore power supply.[51] That report recommended the development of a grid supply shore power system in the next 5 years (2017-2022), in anticipation of increasing shore power enabled vessels visiting the port in future. At the time it was estimated that shore power supply could reduce sulphur dioxide emissions by 33% and greenhouse gas emissions by 31%. The estimated cost of developing shore power infrastructure at Ports of Auckland in 2017 was $18.3 million (±30%).

In 2024 no New Zealand ports have infrastructure to provide shore power to cruise ships.
The first shore power supply in the southern hemisphere is due to be completed in Sydney in 2024 at the costs of $A 60 million ($NZ 66 million). [51]

Cruise companies: The cruise industry should make transparent its emissions reduction pathway and demonstrate its commitment to decarbonizing global shipping. It should discontinue the use of scrubbers and commit to fuels that have low or zero life-cycle emissions. It should invest in and commit to using zero-emission technologies. The ICCT[32] states that this should include shore power, batteries, fuel cells, and wind-assisted propulsion.

The need for coordinated collective action

The Clydebank Declaration and Green Corridors
The Clydebank Declaration was signed at COP26 by twenty-four nations in a commitment to establish zero-emission maritime routes between ports. So called 'Green corridors' are intended to accelerate the adoption of zero-emission fuels and technologies in shipping. The Green Corridors concept recognises the urgent need to bring together key players within the industry to advance a coordinated collective approach which includes policymakers, port authorities, cruise/shipping companies, and fuel producers. This urgency will require the development of partnerships across the supply chain to 'allow each entity to coordinate their timelines and investments to ensure the production of new maritime fuels can be met with demand from ships equipped to use those fuels and infrastructure to deliver those fuels to maritime customers'. While possible zero-emission fuels are emerging and being tested in ships, a coordinated approach is required to overcome technical, regulatory, and financial hurdles.[52]

The Pacific Northwest to Alaska is the first of six proposed green corridors. It represents a collaborative partnership between major cruise lines and port authorities serving the Alaska cruise market. This is a 'First Mover' partnership commitment to exploring low and zero GHG emissions cruising between Washington, BC and Alaska. [53] The partnership was launched at the World Ports Conference in Vancouver BC in 2022 (International Association of Ports and Harbours). In March 2023 Port of Seattle published online the Project Charter and First Mover Commitment. Current priorities to advance this project in 2024 include launching a green methanol feasibility study, exploring a framework for measuring and tracking shipping GHG emissions, and coordination across partners to advance policy engagement, funding and early action opportunities. [54]

Summary

- Cruise tourism produces high growth emissions both in New Zealand and internationally.
- On average the global cruise fleet emits 230kg CO_2-e per passenger per day (Scope 1-3). On this basis the average cruise duration of 7.2 days will emit 1.65 t CO_2-e per passenger.[27]
- A typical one-week New Zealand cruise from Sydney is likely to equate to 2-3t CO_2-e per passenger, exhausting an individual's safe carbon budget for the year. New Zealand cruises originating from the US and those that form part of round-the-world itineraries would have significantly higher per passenger emissions.
- Cruise passenger emissions (250-2200g CO_2 per pax-km) compare unfavourably to air travel emissions (98-130g CO_2 per pax-km) typically ranging from double to quadruple, but up to 18 times equivalent economy class air travel emissions. The accommodation energy demands of cruise passengers are 12 times higher than tourists using land-based hotel accommodation.
- Limiting global temperature rise to between 1.5-2.0°C requires urgent reduction of carbon emissions. Global maritime transport and sustainable fuel budgets should be committed to essential activities such as providing food, sustainable energy, medicines, and the transportation of essential goods and services. Luxury leisure activities such a cruise tourism must become carbon neutral to justify their continued existence.[27]
- As a response some major cruise companies have committed to the goal of reducing their carbon intensity of their products by 2% per annum, and the longer-term goal of zero emission ships and net zero carbon emissions by 2050.[55]
- The remains a lack of near-term absolute emissions reductions targets for the cruise industry. Science-based targets (SBTi) for marine emissions is -36% by 2030, -96% by 2040. Cruise companies have only adopted voluntary intensity targets without verification or enforcement. The Glasgow Declaration states the urgent need to halve gross global emissions by 2030 to remain within the 1.5-2.0C pathway.
- An architecture for regulating cruise emissions remains absent. Cruise emissions are unmeasured, untaxed and unlimited. Tightening regulations in the EU including charging ships for their carbon pollution through the EU Emissions Trading Scheme.
- Cruise emissions nationally and locally remain largely or entirely unaccounted. There are increasing calls for full transparency of emissions accounting for all cruise ships berthing in ports of call. This should include emissions for individual cruise ship visits, and per passenger per day.
- Full Scope 1-3 emissions accounting is also required. Scope 1-3 accounting would include ship building emissions, supply chain emissions, shore excursions, and passenger and crew air travel.
- While transition from heavy fuel oil (HFO) to liquefied natural gas (LNG) offer potential reduction of carbon emissions (and reduced sulphur and nitrogen oxides emissions), the climate benefits are offset by increased methane emissions across the supply chain. Given continuing uncertainty regarding zero-carbon fuels and their availability the cruise sector's pathway to net-zero 2050 remains unclear and uncertain.[15]

- Emissions mitigation through use of shore energy supply is dependent on vessel capacity to connect to shore energy systems at ports, and the availability of shore energy infrastructure. Currently no New Zealand ports are capable of providing shore energy supply to cruise ships that are berthed.

- Shore energy supply also depends on whether the local electricity grid is served by renewable energy sources which remains a scarce resource both globally and regionally. Given the issues of supply, the share of renewables in the electricity grid used that might be committed to cruise ship power supply should be a point of public transparency.[39]

- National regulation has been advanced in Norway where greenhouse gas emitting cruise ships have been banned from entering Norway's world heritage fjords effective from 2026. This ban reflects the need to reduce emissions in accordance with national climate commitments, move to a sustainable tourism model, and drive technological development and cruise sector action towards a lower emissions future.[55]

- The Christchurch[48] and Dunedin City Councils[49] are acting to measure unaccounted cruise emissions and bring those emissions into city emissions accounts. Port Authorities are being required to respond to the high environmental costs of cruise ships visits.

- These recent actions are a response to growing community concerns for lack of transparency of and accountability for cruise emissions, and an inability to stabilise or reduce high growth gross cruise emissions.

- Coordinated action requires a broad, cross sector commitment to action as the basis of a collective approach to address high cruise GHG emissions. The Clydebank Declaration[52] and the Pacific Northwest to Alaska Green Corridor[54] represent such an approach to climate action and potential 'first mover' opportunities. It also presents the risk of old cruise stock being diverted to cruise routes that lack environmental protection regulations.

- Cruise emissions are incompatible with the outstanding universal values of Piopiptahi Milford Sound. This is a particularly acute problem for large cruise ships which contribute disproportionately to the both high cruise emissions and the problem of cruise emissions mitigation.

Key terms:

Scope 1 emissions	Direct emissions that are owned and controlled by the entity.
Scope 2 emissions	Indirect emissions that are attributable to a company's activities but occur from sources that are not owned or controlled by it.
Scope 3 emissions	All emissions created by an entities value chain that are not covered by Scopes 1-2.

References

27. Humpe, A., Sun, Y. Y., & Gössling, S. (2023). Cruise emissions and economic feasibility of biofuels. *Annals of Tourism Research*, *103*(C).
28. Chang, Y. T., Lee, S., & Park, H. K. (2017). Efficiency analysis of major cruise lines. *Tourism Management*, *58*, 78-88.
29. Transport and Environment (2023). The return of the cruise: How luxury cruises are polluting Europe's cities. June 2023. https://www.transportenvironment.org/wp-content/uploads/2023/06/The-return-of-the-cruise-June-2023.pdf
30. United Nations (2023). Integrity Matters: Net-Zero emissions commitments of non-state actors. https://www.un.org/en/climatechange/high-level-expert-group#:~:text=The%20United%20Nations%20Secretary%2DGeneral,businesses%2C%20investors%2C%20cities%2C%20and
31. Lee, D. S., Fahey, D. W., Skowron, A., Allen, M. R., Burkhardt, U., Chen, Q., ... & Wilcox, L. J. (2021). The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018. *Atmospheric Environment*, *244*, 117834.
32. Faber, J., S. Hanayama, S. Zhang, P. Pereda, B. Comer, E. Hauerhof, W. Schim van der Loeff, et al. (2021). *Fourth IMO Greenhouse Gas Study 2020.* London: International Maritime Organization. https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Fourth%20IMO%20GHG%20Study%202020%20-%20Full%20report%20and%20annexes.pdf
33. Simonsen, M., Gössling, S., Walnum, H.J. 2019. Cruise ship emissions in Norwegian waters and implications for maritime governance. Journal of Transport Geography, 78: 87-97, https://doi.org/10.1016/j.jtrangeo.2019.05.014
34. Friends of the Earth (2023). Cruising Versus Land Vacationing: An Analysis of Vacation Carbon Footprints in Seattle. https://foe.org/wp-content/uploads/2023/04/Comparison_of_CO2_Emissions_v2.pdf
35. Parliamentary Commissioner for the Environment (2021). Not 100% – but four steps closer to sustainable tourism. Parliamentary Commissioner for the Environment. 21 February 2021. https://pce.parliament.nz/publications/not-100-but-four-steps-closer-to-sustainable-tourism/
36. Howitt, O. J., Revol, V. G., Smith, I. J., & Rodger, C. J. (2010). Carbon emissions from international cruise ship passengers' travel to and from New Zealand. *Energy Policy*, *38*(5), 2552-2560.
37. The Guardian (2024). How cruise ships became a catastrophe for the planet: It's complicated. https://www.youtube.com/watch?app=desktop&v=EZlgM_u4Ghg
38. International Council on Clean Transportation (2024). Fugitive and unburned methane emissions from ships (FUMES): Characterizing methane emissions from LNG-fueled ships using drones, helicopters, and onboard measurements. The International Council on Clean Transportation (ICCT). January 2024. https://theicct.org/publication/fumes-characterizing-methane-emissions-from-lng-fueled-ships-using-drones-helicopters-and-on-board-measurements-jan24/
39. International Council on Clean Transportation (2020). The climate implications of using LNG as a marine fuel. Swedish Environmental Protection Agency: Stockholm, Sweden. The International Council on Clean Transportation (ICCT). January 2020. http://theicct.org/sites/default/files/publications/Climate_implications_LNG_marinefuel_01282020.pdf
40. Tourism Panel on Climate Change (2023). Tourism and Climate Change Stocktake 2023. Tourism Panel on Climate Change. https://tpcc.info/stocktake-report/
41. International Council on Clean Transportation (2022). What if I told you that cruising is worse for the climate than flying? The International Council on Clean Transportation (ICCT). 16 May 2021. https://theicct.org/marine-cruising-flying-may22/
42. European Council (2023). FuelEU maritime initiative: Council adopts new law to decarbonise the maritime sector (25 July 2023). https://www.consilium.europa.eu/en/press/press-releases/2023/07/25/fueleu-maritime-initiative-council-adopts-new-law-to-decarbonise-the-maritime-sector/
43. Transport and Environment (2019). One Corporation to Pollute Them All: Luxury cruise air emissions in Europe. June 2019. https://www.transportenvironment.org/wp-content/uploads/2021/07/One-Corporation-to-Pollute-Them-All_English.pdf
44. New Zealand Ministry of Foreign Affairs and Trade (2024). Decarbonisation of Norway's cruise industry. Market Intelligence Report. New Zealand Ministry of Foreign Affairs and Trade. March 2024. https://www.mfat.govt.nz/en/trade/mfat-market-reports/decarbonisation-of-norways-cruise-industry-march-2024/
45. Climate Change Commission He Pou a Rangi (2024). Review on whether emissions from international shipping and aviation should be included in the 2050 target. https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/review-on-whether-emissions-from-international-aviation-and-shipping-should-be-included-in-the-2050-target/
46. Gibson, E (2024). Old, more polluting ships serving NZ could be a barrier to climate goals. Radio New Zealand (RNZ) 7 May 2024. https://www.rnz.co.nz/news/environment/516056/old-more-polluting-ships-serving-nz-could-be-a-barrier-to-climate-goals
47. Christchurch City Council (2024). Ōtautahi Christchurch Greenhouse Gas Emissions Inventory, FY23 (1 July 2022-30 June 2023). Christchurch City Council (CCC). 1 February 2024. https://ccc.govt.nz/assets/Documents/Environment/Climate-Change/Christchurch-Greenhouse-Gas-Emissions-Inventory-Financial-Year-2023.pdf
48. Dunedin City Council (2023). Zero Carbon Plan 2030. https://www.dunedin.govt.nz/__data/assets/pdf_file/0011/992873/zero-carbon-plan-2030.pdf
49. Dunedin City Council (2023). *Destination Ōtepoti*. Dunedin City Council Destination Management Plan. August 2023. https://www.dunedin.govt.nz/__data/assets/pdf_file/0007/994111/Destination-Otepoti-Oct-2023.pdf
50. Cruise Action Group (2023). Ōtepoti Dunedin Cruise Action Plan 2023-2025. Port Otago. October 2023. https://www.dunedin.govt.nz/__data/assets/pdf_file/0005/1049567/Otepoti-Dunedin-Cruise-Action-Plan-2023-2025.pdf
51. Ports of Auckland Ltd (POAL) (2017). Cruise vessel emission reducing technologies: Feasibility study. 3 August 2017. https://www.poal.co.nz/sustain/Documents/Cruise%20Vessel%20Emission%20Reduction%20Technologies.pdf
52. United Nations Climate Change Conference (2021). Clydebank Declaration for Green Shipping Corridors. COP26 10 November 2021. https://webarchive.nationalarchives.gov.uk/ukgwa/20230313124737/https://ukcop26.org/cop-26-clydebank-declaration-for-green-shipping-corridors/
53. Port of Seattle (2023). Project Charter and First Mover Commitment. March 2023 https://www.portseattle.org/sites/default/files/2023-03/Charter_PNW2AK_Final-ForWeb.pdf
54. Port of Seattle (2024). Exploring the world's first Green Corridor for cruise. https://www.portseattle.org/projects/exploring-green-corridor-cruise-pacific-northwest-alaska
55. Hoegh-Guldberg, O., Northrop, E. et al. (2023). The ocean as a solution to climate change: Updated opportunities for action. Special Report. Washington, DC: World Resources Institute (WRI). Available online at https://oceanpanel.org/publication/ocean-solutions-to-climate-change
56. International Energy Agency (2021) Net Zero by 2050: A Roadmap for the Global Energy Sector. International Energy Agency. https://www.iea.org/reports/net-zero-by-2050

Chapter 2.2

Environmental: Air Pollution

Cruise air pollution: Cruise ships produce harmful emissions that impact climate, air quality and human health. Over time cruise ships have become larger to cater for mass markets. Large cruise ships require a lot of power and produce many pollutants.

Emissions at sea and at port: Cruise ships have contrasting energy demands at sea and in port. Propulsion for manoeuvring and transport represents approximately 60% of total cruise ship power demand.[57] In addition the luxury and mass market cruise segments require extensive hotel accommodation, food and beverage and entertainment facilities, all of which have constant high energy demands whether at sea or at port.

Air pollution: Cruise ships emit significant amounts of air pollutants such as sulphur oxides (SO_X), nitrogen oxides (NO_X) and particulate matter (PM). Extrapolation of sustainability report data provided by Carnival and Royal Caribbean suggests that the global sector contributed to emissions of 544,600 t SO_X, 383,500 t NO_X and 32,200 t PM in 2019.[58] Cruise ships often operate along coastlines and in coastal waterways and have port calls often in populated areas.[59] [60]

The 203 cruise ships operating in Europe in 2017 emitted approximately 155 kt of NO_X, 62 kt of SO_X, 10 kt of PM and more than 10 Mt of CO_2.[61] Most of these emissions were produced in the Mediterranean Sea, along coastlines and at major port destinations. Transport and Environment[62] report that levels of toxic air pollution from cruise ships visiting European ports now exceed pre-pandemic levels.

Antarctica: Over 50 cruise ships have visited the Antarctic Peninsula since cruise tourism resumed after the pandemic. The environmental impacts of those cruise visits include emissions of black carbon (smoke and soot) from cruise ship funnels. The snow in areas most visited by cruise ships has higher concentrations of black carbon which absorbs heat and contributes to snow melt.[63] A paper published in 2022 in *Nature Communications* reports that each visitor between 2016-2020 was effectively melting 83 tonnes of snow due to their individual contributions to total cruise ship emissions.[64]

Nitrogen oxide (NO_X) pollution: Simonsen et al.[60] report that 7184 t of NO_X and 132 t of PM were emitted by cruise ships in Norwegian waters in 2017, approximately 14.6% of which was emitted in the port destinations of Bergen, Oslo and Stavanger.

Sulphur oxide (SO_X) pollution: Transport and Environment (2023)[62] reports that in 2022 the 218 cruise ships operating in Europe emitted sulphur oxides (SO_X) equivalent to 1 billion cars. This equates to four times more sulphur dioxide than all of Europe's 253 million cars combined.

Particulate matter (PM): Cruise ships can burn up to 150 tonnes of low-grade heavy fuel oil (HFO) each day. Fuel combustion produces particulate matter (PM) pollution which if inhaled can lodge in lung tissue or carried in the bloodstream.[65] The average marine-fuel powered cruise ship emits particulate matter (PM) equivalent to one million cars per day.

Manoeuvring and berthing: Complex manoeuvring procedures and the availability of berth space (which dictates the need for manoeuvring procedures and/or the use of the anchorages) are linked to port emissions.[59] Ship operations in locations that required complex manoeuvring procedures, such as Piopiotahi Milford Sound, are likely to produce increased emissions and higher air pollution.

Figure 5 Cruise ship nitrogen oxides (NO_X) heatmap in 2017. (Source: Transport and Environment, 2019).

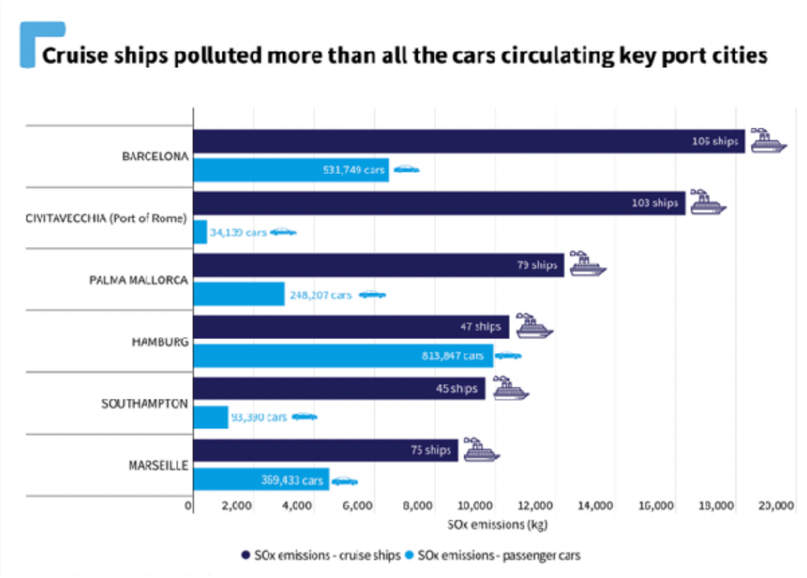


Figure 6 Sulphur emissions from cruise ships and vehicle traffic at major European ports (Source: Transport and Environment, 2023).

Damage costs: Air pollution has material public health costs. Dragović et al.[59] present a study of cruise emission externalities in the Adriatic ports of Kotor (Montenegro) and Dubrovnik (Croatia). Their study extends to an analysis of damage cost estimates using methods that has been previously applied in studies of air pollution in the ports of Pireaus (Greece), Kaohsiung (Taiwan), Bergen (Norway) and selected Spanish ports.

These studies use damage cost estimates that vary between rural (less than 150 residents /km^2), sub-urban (150-900/km^2) and urban (over 900/km^2) areas. Air pollution damage costs for the urban port of Dubrovnik (Croatia) were €15,149/tonne nitrogen oxide (NO_X), €12,317/tonne sulphur oxide (SO_X) and €208,779/tonne particulate matter (PM) (damage cost estimates vary between countries).

They applied these damage cost estimates to cruise ship visits to Dubrovnik in 2014 when 73 ships made 442 calls. Accounting for port time spent manoeuvring, berthed or at anchor, they estimated 414.7 tons total emissions including 355.6 tonnes NO_X, 46.9 tonnes SO_X and 12.2 tonnes PM. The total air pollution damage cost arising from cruise ship visits to Dubrovnik in 2014 was €8.5million. This equated to €19,282 per cruise ship visit.[59]

Scrubbers: Cruise ships that continue to use HFO (rather than transition to LNG) are increasingly using scrubbers to reduce emissions into the air. Scrubbers are exhaust gas cleaning systems that can be fitted to remove sulphur oxides, typically by spraying water into exhaust pipes.[66] Scrubbers allow the continued use of cheaper high-sulphur heavy fuel oil rather than more expensive low-sulphur fuels to comply with International Maritime Organization (IMO) fuel sulphur regulations.

The most common open-loop scrubbers use saltwater that is contaminated when clearing exhaust gases, diluted and then discharged into the sea. The use of scrubbers does limit sulphur emissions into the air but comes with other environmental costs because they:

1. Result in higher direct and life-cycle carbon emissions than using marine gas oil, and higher PM emissions, including black carbon.
2. Re-route pollution from the air into the water. Scrubber discharge water is contaminated with polycyclic aromatic hydrocarbons and heavy metals.

These contaminants have been linked to cancers and reproductive dysfunction in marine mammals.[67]

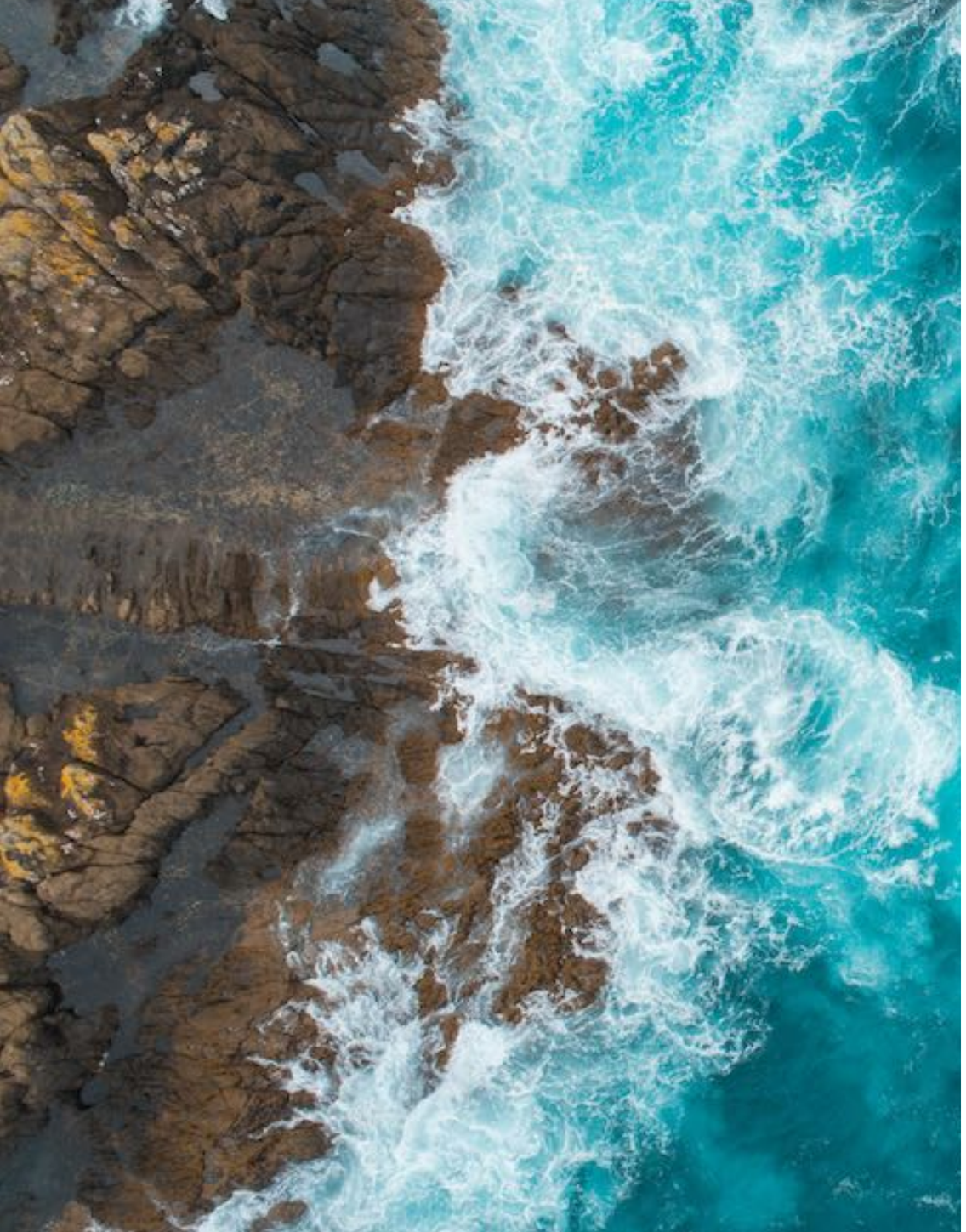
Air pollution in New Zealand: Kuschel et al.[68] identify that most of the health effects of air pollution in New Zealand arise from particulate matter less than 2.5 µm ($PM_{2.5}$) and nitrogen dioxide (NO_2). They report that exposure to $PM_{2.5}$ and NO_2 contributed to over 3,300 premature adult deaths, 13,100 hospital admissions for respiratory and cardiac illnesses (including 845 asthma hospitalisations for children), 13,200 cases of childhood asthma and approximately 1.745 million restricted activity day in New Zealand in 2016.

The social cost of $PM_{2.5}$ in urban areas is $622,786/tonne and NOx $499,526/tonne. In rural areas the equivalent costs are $24,473 and $11,296 respectively. The total social cost of the national air pollution health burden from anthropogenic sources is estimated to be $10.5 billion/year.

The EU received 7.7 million cruise passengers in 2019 producing 383,500 t NO_X and 32,200 t PM. New Zealand received 0.283m cruise passengers in 2019. Assuming proportionality and 10% of cruise emissions being emitted in urban areas the social cost of cruise emissions in New Zealand would be NOx $850 million and $PM_{2.5}$ $100 million. It is likely that the health costs of cruise air pollution would be concentrated among the residents of port communities.

A study prepared by Visitor Solutions and Fresh Info (2021) reported that Piopiotahi Milford Sound residents and boat crews periodically expressed concerns about cruise ship air pollution. They indicated that an inversion layer can arise from cruise ships emissions which may remain throughout the day, long after cruise ships have departed from the fiord.[69]

The Celebrity Solstice prepares to anchor in Akaroa Harbour on 02/11/19. Photograph: Steve Dawson



Policy and management interventions

Gössling et al.[58] review global, national, regional and port-level legislative approaches that have been implemented to reduce cruise emissions. They conclude that many policies are voluntary or incentive-based with regulatory approaches generally limited to Emission Control Areas. They also found that existing policies tend to focus on efficiencies rather than reductions in absolute pollutant and greenhouse gas emissions. They identified no policies at that time that created incentives or requirements to transition to zero-carbon fuels.

Community resistance: Social sentiments towards the cruise industry are hardening. Local pressures to reduce the sector's carbon footprint and wider environmental impacts continue to build. The banning of cruise ships and closure of cruise terminals in some European port cities has been in response to a combination of emissions and pollution mitigation commitments, and the loss of social license to operate due to widespread host community opposition. Organised public protests against cruise ship visits to Wellington, Christchurch and Dunedin took place in the 2023-2024 cruise season.

Global: While ships can use heavy fuel oil (HFO) in international waters more strict rules apply in some coastal and inshore areas. Emission Control Areas (ECAs) have been designated by the IMO with some ECAs specific to sulphur (SECA) and nitrogen (NECA) oxides. These include the Baltic and North Seas, the coasts of the USA and Canada, the US Caribbean, some areas in China and EU ports.

Transport and Environment[61] recommend zero-emission berth standards for all European ports. This report also highlights the need for particularly stringent air pollution standards for cruise ships, which disproportionately impact air quality because of significant time spent close to coastlines and in ports. It recommends extending existing ECAs in the North and Baltic Seas to the rest of the EU and to further tighten SECAs. It recommended the extension of emission control areas in the North and Baltic Seas to the rest of the EU seas and the tightening of marine SECA standard.

MARPOL. The International Convention for the Prevention of Pollution from Ships (1973). New Zealand signed the MARPOL maritime environmental convention in 1998 and five of the six subsequent annexes. Annex VI was developed in 2005 and has been through multiple amendments to expand its parameters. Most recently an expansion to Annex VI from 1 January 2020 required the sulphur content of shipping fuels to be reduced from 3.5% to 0.5%.[70]

Annex VI was supported by New Zealand's International Maritime Organization (IMO) membership to advance a real reduction in global emissions from international shipping. New Zealand acceded to MARPOL Annex VI in 2022, coming into effect in New Zealand on 26 August 2022. This has required many New Zealand flagged ships to meet Annex VI requirements.[71]

Use of scrubbers: Tightening shipping regulations to reduce sulphur emissions has resulted in the increasing installation and use of scrubbers on cruise ships. This has led to increasing concerns of the transfer of pollutants from air to water. Several jurisdictions have implemented regulations to restrict the use of scrubbers in order to (a) reduce the potential marine environments to be polluted with contaminated water and (b) ensure that cruise ships move to the use of fuels with lower sulphur content.

Portugal has banned the use of open-loop scrubbers in all of its ports, as have some Spanish ports. Belgium has banned the use of scrubbers within three nautical miles of its coast. The states of California and Connecticut have implanted bans in ports and territorial waters. Transport and Environment[62] has recommended that the use of scrubbers be banned in all European waters.

Requiring the use of shore power in ports: The State of California's *Ocean-Going Vessels at Berth Regulation (2020)* now requires cruise ships in all Californian ports to use shore energy supply to reduce diesel particulate matter (PM) and oxides of nitrogen (NOx) from auxiliary engines. This authorisation was granted by the United States Environmental Protection Agency (US EPA) in 2020 with a transition period that ended on 19 November 2023.[72]

This measure has successfully reduced pollution and emissions in the European ports of Hamburg, Rostock and Kiel. By contrast The Guardian reports that on 300 days between April 2022 and July 2023 at least one cruise ship docked in Southampton which is one of Europe's most polluted ports. However, shore power facilities were used only 71 times during the same timeframe. It reports that cost is a barrier with most cruise companies opting to burn cheaper marine fuel while in port rather than pay for clean shore power.

The Guardian[71] concludes that regulation is necessary that requires disclosure when using onboard on onshore energy supply, and the use of onshore power when it is available. The high costs of developing shore energy infrastructure remains a barrier as does limited renewable energy supply in many port communities.[72] Currently no New Zealand ports have the infrastructure required to provide shore power supply.

Municipal authorities: Municipalities are considered to have the greatest influence on the future course of the cruise industry.[73] In Europe cruise companies increasingly face the need to operate within defined pollution levels in order to enter specific jurisdictions.[58] This measure prevents ships that exceed pollution thresholds from entering ports. Some are imposing port fees that vary based on levels of efficiency to encourage and accelerate the transition to alternative fuels.

In its meeting on Wednesday 17 April 2024 the CCC voted in support of two amendments to the Christchurch Holding Ltd (CCHL) Statement of Intention 2024-2025 for Lyttleton Port Company. It requested that (a) Greater reference is given to how Lyttleton Port Company is monitoring, mitigating and reducing the impact of cruise ships and their emissions when they visit port and (b) Lyttleton Port Company consider what additional fees and charges it would introduce to help mitigate and offset the environmental impact of cruise ships that visit the port.

Incorporate damage costs: The study of cruise air pollution damage costs published by Dragović at al.[59] recommended the internalisation of damage costs associated with in-port emissions. In accordance with the polluter pays principle they propose that cruise port services should incorporate air pollution damage costs from individual ships.

Cruise companies: Energy transition to fuel cells, renewable hydrogen and renewable methanol emit fewer GHGs. Some have opted for Liquid Natural Gas (LNG) which cuts CO_2 emissions but emits more GHG overall because LNG engines leak methane which traps 80 times more heat in the atmosphere than CO_2 over the twenty years after it is released into the atmosphere (see Emissions).

European port cities banning cruise ships: Bans have had a significant positive impact on reducing cruise ship pollution in ports. An increasing number are restricting access or banning cruise ships from their ports altogether. Venice was Europe's third most polluted cruise port in 2019 leading to the implementation of a ban on all large cruise ships in 2021. This resulted in an immediate 80% reduction in sulphur emissions.[62]

Barcelona and Amsterdam are recent examples that have followed the Venice precedent. Local politicians in Amsterdam have stated that cruise ships fail to align with the city's sustainability ambitions.[76]

Cruise ship in Otago Harbour at Port Chalmers (Dunedin)

Summary

- Over time cruise ships have become larger to reduce cost and cater for a mass market. Simultaneously, cruise ships have come to consume more energy and produce more material waste. Global emissions from shipping are expected to more than triple between 2020 and 2050.
- Cruise ships emit significant amounts of air pollutants such as sulphur oxide (SO_X), nitrogen oxide (NO_X) and particulate matter (PM).
- Cruise ships often operate along coastlines and in coastal waterways and have long port calls often in populated areas. Ship operations in locations such as Piopiotahi Milford Sound that required complex manoeuvring procedures are likely to produce increased emissions and higher air pollution.
- New Zealand cruise operators are yet to make a commitment to measure and report all forms of emissions, and to absolute short-term emissions reductions.
- Calls have been made to regulate for disclosure when using onboard on onshore energy supply and the use of onshore power when it is available. Where available cruise companies may opt to burn cheaper marine fuel in port rather than pay for clean shore power.
- The use of shore energy supply has been made mandatory in some northern hemisphere ports. The high costs of developing shore energy infrastructure - and who meets the costs of that investment - remains barriers in New Zealand, as does limited renewable energy supply. Currently no New Zealand ports provide shore power supply.
- Cruise ship air pollution has material environmental impacts and public health costs. Damage cost estimates have been produced for some cruise ports. Costs vary with fuel type, navigational and manoeuvring requirements, types of berthing (e.g., dockside, anchorage) and energy use while berthed. Studies generally recommend that port service charges should include air pollution damage costs.
- The International Maritime Organisation (IMO) has established and extended Emission Control Areas (ECAs). These include the Baltic and North Seas, the coasts of the USA and Canada, the US Caribbean, some areas in China and EU ports. New Zealand signed MARPOL Annex VI which came into effect in 2022, requiring the sulphur content of shipping fuels to be reduced from 3.5% to 0.5%.[69]
- In response to tightening regulation of sulphur emissions, some have continued to use high sulphur HFO while adopting the use of scrubbers. The use of scrubbers has been banned in a number of jurisdictions due to concerns for wastewater discharge contamination.
- Others have opted for Liquid Natural Gas (LNG) which cuts sulphur and CO_2 emissions but emits more GHG overall because LNG engines leak methane which traps 80 times more heat in the atmosphere than CO_2 over the twenty years after it is released into the atmosphere (see Emissions).
- A commitment to an energy transition to fuel cells, renewable hydrogen and renewable methanol emit fewer GHGs is required. Increasing regulation is necessary to accelerate the transition to low emissions or zero emission fuels.
- Bans on cruise ship visits to some ports in Europe are now in place, resulting in dramatically reduced levels of air pollution in the case of Venice. These bans have been the result of loss of social license and the political realization that cruise ships are not aligned with city environmental and social sustainability ambitions.
- Inversion layers of air pollution from cruise ships emissions which may remain long after cruise ships have departed from the fiord has been the cause of local concern in Piopiotahi Milford Sound. Cruise air pollution is generally considered incompatible with the outstanding universal values of Piopiptahi Milford Sound both in terms of impacts on air quality and visual pollution.

References

57. Faber, J., D. Lee, S. Becken, J.J. Corbett, N. Cumpsty, G. Fleming, T. Longva, M. Tronstad Lund, and T. Smith. 2020. “Bridging the Gap: The Role of International Shipping and Aviation.” In *Emissions Gap Report 2020*, by United Nations Environment Programme (UNEP) and UNEP Copenhagen Climate Centre (CCC), 11. Nairobi: UNEP; Copenhagen: UNEP-CCC. https://wedocs.unep. org/xmlui/bitstream/handle/20.500.11822/34431/EGR20ch5.pdf?sequence=3.
58. Gössling, S., Meyer-Habighorst, C. & Humpe, A. (2021). A global review of marine air pollution policies, their scope and effectiveness. Ocean and Coastal Management, https://doi.org/10.1016/j.ocecoaman.2021.105824
59. Dragović, B., Tzannatos, E., Tselentis, V., Meštrović, R., & Škurić, M. (2018). Ship emissions and their externalities in cruise ports. *Transportation Research Part D: Transport and Environment*, *61*, 289-300.
60. Simonsen, M., Gössling, S., Walnum, H.J. 2019. Cruise ship emissions in Norwegian waters and implications for maritime governance. Journal of Transport Geography, 78: 87-97, https://doi.org/10.1016/j.jtrangeo.2019.05.014
61. Transport and Environment (2019). One Corporation to Pollute Them All: Luxury cruise air emissions in Europe. June 2019. https://www.transportenvironment.org/wp-content/uploads/2021/07/One-Corporation-to-Pollute-Them-All_English.pdf
62. Transport and Environment (2023). The return of cruise: how luxury cruises are polluting Europe’s cities. June 2023. https://www.transportenvironment.org/wp-content/uploads/2023/06/2023-Cruise-ship-study.pdf
63. Harris, M, (2022). Each Antarctic tourist effectively melts 83 tonnes of snow: new research. 23 February 2022. The Conversation. https://theconversation.com/each-antarctic-tourist-effectively-melts-83-tonnes-of-snow-new-research-177597
64. Cordero, R. R., Sepúlveda, E., Feron, S., Damiani, A., Fernandoy, F., Neshyba, S., ... & Casassa, G. (2022). Black carbon footprint of human presence in Antarctica. *Nature communications*, *13*(1), 984.
65. Welch, T. (2022). Cruise ships are coming back to New Zealand waters – should we really be welcoming them? 23 August 2022. The Conversation. https://theconversation.com/cruise-ships-are-coming-back-to-nz-waters-should-we-really-be-welcoming-them-188974
66. International Council on Clean Transportation (2020). Air emissions and water pollution discharges from ships with scrubbers. International Council on Clean Transportation November 2020.https://theicct.org/sites/default/files/publications/Air-water-pollution-scrubbers-nov2020.pdf
67. International Council on Clean Transportation (2021). Global scrubber washwater discharges under IMO’s fuel sulphur limit. International Council on Clean Transportation April 2021. https://theicct.org/wp-content/uploads/2021/06/scrubber-discharges-Apr2021.pdf
68. Kuschel et al. (2022). Health and air pollution in New Zealand 2026 (MAPINZ 3.0): Volume 1- Findings and implications. Report prepared by G. Kuschel, J. Metcalfe, S. Sridhar, P. Davy, K. Hastings, K. Mason, T. Denne, J. Berentson-Shaw, S. Bell, S. Hales, J. Atkinson and A. Woodward for Ministry for the Environment, Ministry of Health, Te Manatū Waka, Ministry of Transport and Waka Kotahi NZ Transport Agency. March 2022.
69. Visitor Solutions and Fresh Info (2021). Tourism Report. 10 March 2021. https://www.milfordopportunities.nz/assets/Projects/210331-Tourism-Report.pdf
70. Ministry of Transport (2022). MARPOL Annex VI Treaty. https/www.transport.govt.nz/assets/Uploads/MARPOL-VI-factsheet-and-FAQs-July-2022.pdf
71. Ministry of Transport (2023). MARPOL Annex VI Treaty. Reducing harmful ship emissions that affect climate and human health. https://www.transport.govt.nz/area-of-interest/maritime-transport/marpol
72. California Air Resources Board (2024). Ocean going vessels at birth regulation. California Air Resources Board (CARB). https://ww2.arb.ca.gov/our-work/programs/ocean-going-vessels-berth-regulation
73. The Guardian (2023). Cruise ships polluting UK ports as they ignore greener power options. 4 November 2023. https://www.theguardian.com/environment/2023/nov/04/cruise-ships-polluting-uk-coast-as-they-ignore-greener-power-options
74. International Council on Clean Transportation (2023). Shore power needs and CO_2 emissions reductions of ships in European Union ports: Meeting the ambitions of the FuelEU Maritime and AFIR. International Council on Clean Transportation (ICCT). October 2023. https://theicct.org/publication/shore-power-eu-oct23/
75. Hoegh-Guldberg, O., Northrop, E. et al. (2023). The ocean as a solution to climate change: Updated opportunities for action. Special Report. Washington, DC: World Resources Institute (WRI). Available online at https://oceanpanel.org/publication/ocean-solutions-to-climate-change
76. BBC (2023). Amsterdam bans cruise ships to limit visitors and curb pollution 21 July 2023. https://www.bbc.com/news/world-europe-66264226.amp

Chapter 2.3

Environmental: Oceans and marine impacts

Impacts of cruise ships on oceans and marine environments: The cruise industry contributes to a range of negative environmental impacts on ocean and marine environments through its contribution to marine pollution.

The international context

Marine pollution: Cruise ships create significant volumes of waste which may be sources of marine pollution. Where limited or inadequate onboard waste managed processes exist, and in regions with inadequate regulations for the treatment and discharging of waste, cruise ships may dump or discharge harmful pollutants into marine environments. Estimates suggest that one large cruise ship creates 1 million litres of black water, 8.8 million litres of grey water, 95,000 litres of bilge water and 200 million litres of wash water in a one-week return trip to from Seattle to Alaska.[77]

Solid waste: One cruise ship carrying 3000 passengers can create an estimated 50-70 tonnes of solid waste in a week.[78] Much of the solid waste (marine litter, plastics, and organic/inorganic materials)[79] has historically been discarded into the ocean.[80] The discarding of food waste into the sea has been linked to algae growth that can be toxic to marine life.[81]

Wastewaters: Wastewater is contaminated water from toilets, bathing and washing on cruise ships.[79] Luxury amenities and consumption on board cruise ships results in high water consumption and creates large volumes of wastewater.[83] Wastewater is categorized into two main types: black and grey water.[77] Black water (or sewage) is human waste from toilets, and can contain fecal coliform, ammonia, chlorine, and several other toxic pollutants. Grey water comes from showers, kitchens, and laundries and can contain cleaning and personal care products, solids, oil and grease, and other hazardous pollutants.[82]

When discharged into the sea, micropollutants present in wastewater can be transferred to other organisms.[83] In most jurisdictions, wastewater can be discharged three and a half miles away from land.[84]

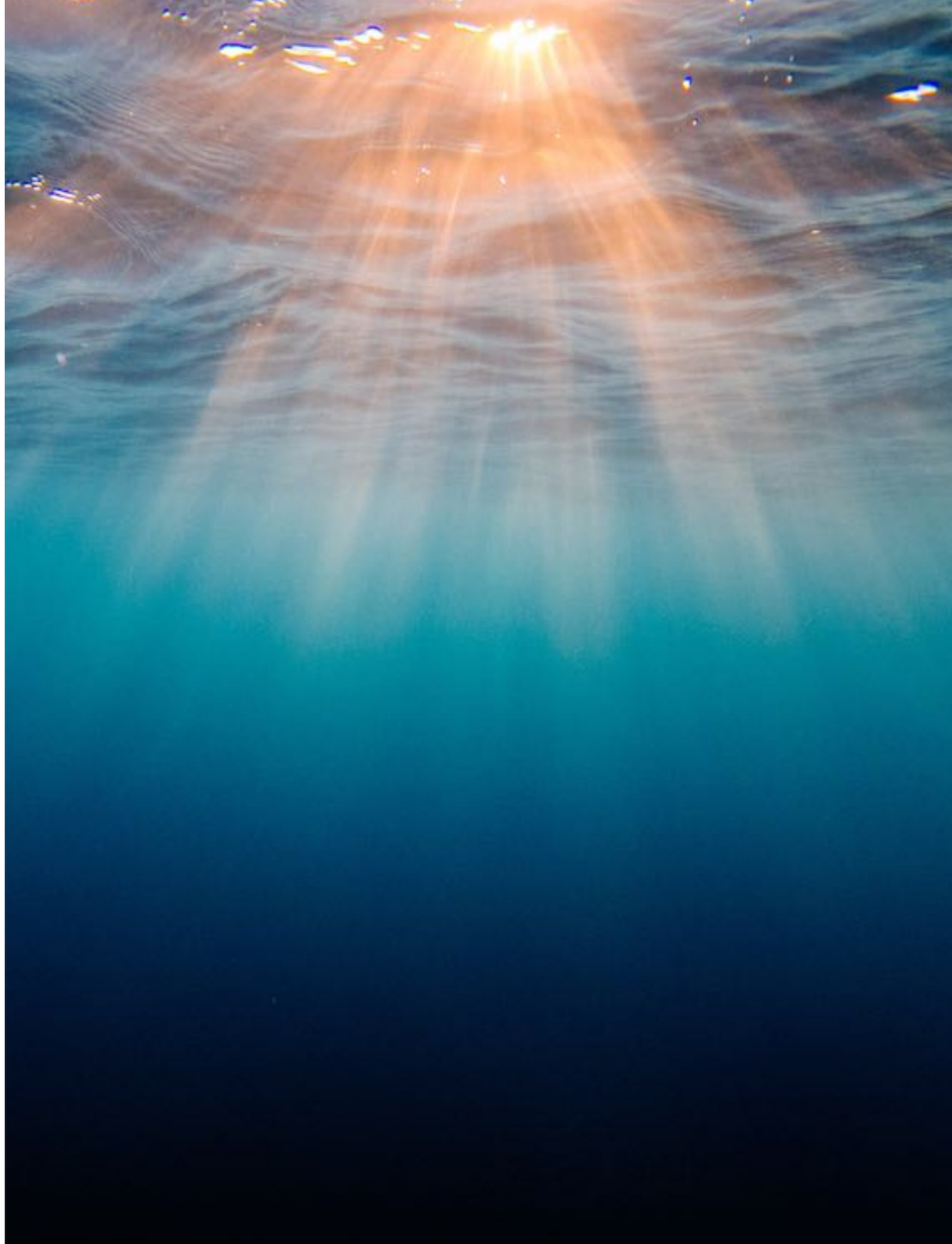
Bilge water: Bilge water is excess water that gathers in the bilge of a ship from spills and leakages and can contain harmful contaminants. When discharged, bilge water can be a source of hydrocarbon discharge and marine pollution.[79]

Ballast water: Ballast water is stored in tanks used to stabilise ships, often containing wastewaters, hydrocarbons and bacteria.[85] Discharging ballast water can cause biological invasions[86] and globally distribute pathogens and waterborne diseases.[87] This process can have consequences for marine ecosystems by introducing non-native species and diseases.[85]

Scrubbers: In 2008, the IMO committed to reduce the maximum allowable sulphur content in marine fuels to 0.5%.[77] Instead of transitioning to cleaner fuels, the cruise industry has predominantly moved to install scrubbers (exhaust gas cleaning systems) to continue using heavy fuel oil (HFO).[88] Open-loop scrubbers, which make up of 80% of the market, use seawater to dissolve sulphur oxide. The treated exhaust is then discharged into the ocean.[89]

Water pollution from the use of scrubbers has not been well regulated and can have serious negative consequences for marine ecosystems.[90] Wash water from scrubbers may contain heavy metals, polycyclic aromatic hydrocarbons, nitrates, sulphates and particulate matter.[88] Cruise ships have been found to account for 96% of scrubber discharge in seven out of 10 ports with the highest amount of wash water discharge.[90]

Exposure to scrubber wash water has been found to increase mortality and reduced feeding for marine zooplankton.[91] Similarly, Magnussen et al.,[92] found that the toxicity of seawater with estimated levels of scrubber wash water exceeded safe levels for marine life, particularly for zooplankton which can have harmful consequences for the marine ecosystem.[92]



Canada: World Wildlife Fund Canada's assessment on waste produced by different ships found that cruise ships, despite making up only 2% of the ships analysed, were the primary producers of multiple waste streams nationally (see Figure 1). Stand.earth reports that approximately 31 billion litres of cruise ship waste are annually dumped into the British Columbia Coast due to insufficient marine pollution regulations.[93] Because Canada's regulations are weaker than the US, cruise lines have been described as effectively treating Canadian coastal waters like a toilet bowl.[94]

Antifouling: Antifouling is the process of treating the hull of a ship with a biocide coating to prevent marine organisms (such as fungi, algae, or snails) from attaching to the hull. According to Caric et al.,[95] antifouling contamination poses a threat to marine ecosystems, when antifouling coatings dissolve into the ocean. These coatings contain active ingredients that are toxic to marine organisms.[95]

Ship dismantling: The ship dismantling industry converts end-of-life ships into recyclable materials. However, a significant portion of ship dismantling takes place in developing countries where there are minimal environmental protections or management. Toxic substances and hazardous materials are often exposed during the dismantling process. [96]

Accidents: Cruise ship collisions and accidents can cause a series of environmental consequences, such as oil spills and damage to fragile marine ecosystems. Little research has been conducted to analyse cruise ship accidents and their environmental effects.[3] In the event of an oil spill, cruise ships that use HFO present a high risk to marine environments. HFO emulsifies in the water and can be ingested by aquatic wildlife.[88]

Light pollution: Organisms that require darkness can be negatively impacted by light pollution created by cruise ships with bright lights.[98] Migratory birds and sea turtles are some of the most well-known wildlife species negatively affected by artificial marine light sources at night.[97]

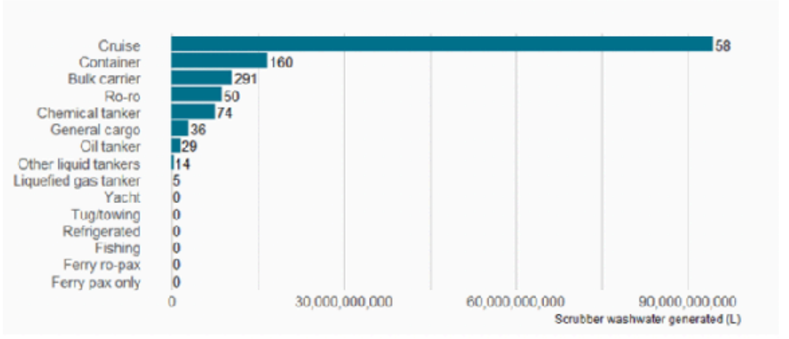
Wakes in shallow waterbodies: Wakes generated by cruise ships can have an impact on shallow bodies of water. Wakes can create disturbances (e.g., abnormal wakes or depressions areas) of the foreshore and seabed.[79]

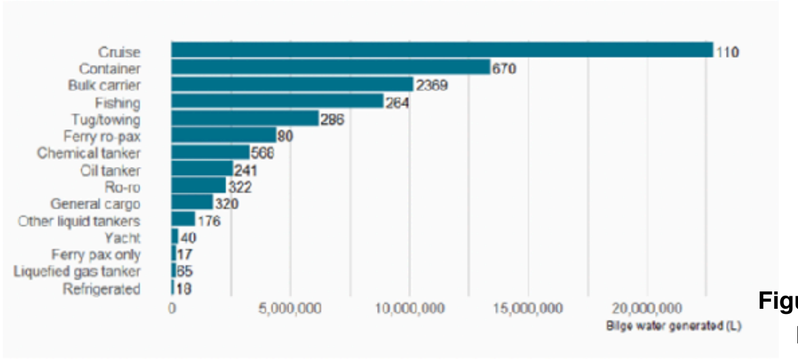
Sediment resuspension in shallow waterbodies: Cruise ship propulsions systems resuspend sediment in shallow waterbodies which can be dispersed and drift into fragile habitats.[79] For example a study that investigated sediment resuspension in Bermuda found that sediment from cruise ships negatively impacted nearby coral reefs. [98]

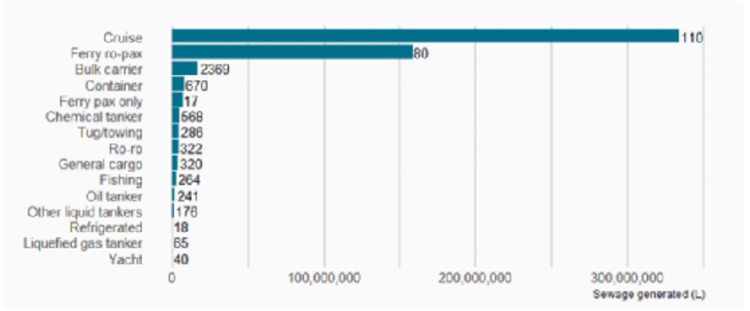
Cruise infrastructure: The construction and expansion of cruise infrastructure can imnpact marine environments, such as seagrass meadows and coral reefs.[79] In particular, dredging of the sea beds can suspend sediments and increase water turbidity.[85]

Cruise infrastructure in the Cayman Islands: Prior to the pandemic, Carnival and Royal Caribbean Cruise Lines announced plans to build a new docking facility in the Cayman Islands.[99] This project would have destroyed an estimated 15 acres of coral reef, negatively affect 15-20 acres of adjacent reef, and put 26 coral species at risk. The coral reefs, which hold historical and cultural significance to the people of the Cayman Islands, are already under pressure from disease and bleaching. The cruise industry proposed a solution to the destruction of coral reefs, which involved relocating or replanting lab-grown corals.[100] Citizens of the Cayman Islands started a movement opposing the project.

Anchoring: Cruise ship anchors can damage sensitive marine environments. A 2020 study in Barbados found that when 28 cruise ships were allowed to anchor along the coast during the COVID-19 pandemic, anchors caused extensive structural damage to the coral reefs.[100]







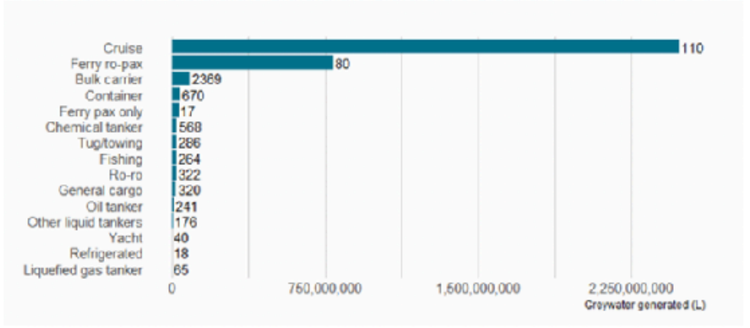


Figure 7: Assessment of waste produced by category of shipping in Canada. Source: World Wildlife Fund (WWF) Canada (2022).

New Zealand: Much of the current discussion on the impacts of cruise ships on oceans and marine environments in New Zealand is focused on biosecurity.

In a 2003 report by the Parliamentary Commissioner for the Environment (PCE), the main concerns about cruises impact on marine environments were waste discharged to water, the spread of marine pests and maritime accidents.[101] Due to the low number of cruise ship visits at the time, the impacts were deemed insignificant. However, with the increasing number of cruise ships, in 2019 the PCE reported growing concerns about their impacts on marine environments.[102]

Marine accidents: Marine accidents in New Zealand presents multiple environmental risks. In 1986, cruise ship Mikhail Lermontov struck rocks in the Marlborough Sounds because of an operating error.[103] The incident caused the ship to sink below the surface. No oil was spilt during the incident. More recent incidents include the cruise ship L'Austral, which struck a bank in Piopiotahi Milford Sound in 2017 after deviating from its planned course.[104] An investigation revealed the incident could have been avoided, and a $100,000 fine was issued for entering a prohibited UNESCO World Heritage Site.[104]

In 2024, a cruise ship ran aground in Doubtful Sound, causing the vessel to become stranded on rocks.[105] According to Environment Southland, there were no environmental impacts from the accident. However, the potential risk of an oil spill remains significant in areas such as Fiordland, where the logistics of response are likely to be challenging.

Scrubbers: A 2022 Stuff article revealed that most cruise ships visiting New Zealand are fitted with scrubbers.[106] The article references a study funded by Cruise Lines International Association (CLIA), which concludes open-loop scrubbers have minimal impact on marine environments. However, it also presents an opposing view from Friends of the Earth and the ICCT, arguing that while scrubbers reduce sulphur emissions in the air, they transfer pollution to the water.[105]

Research by the National Institute of Water and Atmospheric Research (NIWA), looking at the environmental risks of scrubber discharge from ships in New Zealand, found that open-loop scrubber wash water discharge poses a threat to New Zealand marine environments.[107] NIWA predicts that concentrations of copper and chromium would exceed guidelines in Lyttelton, Tauranga, Auckland Ports and in the cruise ship area of Akaroa. Closed-looped scrubber discharge was not predicted to exceed water quality guidelines.

NIWA also reviewed 11 Iwi Environmental Management Plans (IEMP), which revealed some of the key areas scrubber wash water discharge could negatively impact. While the IEMPs did not specifically reference scrubbers, some areas of potential concern to iwi and hapū included kaitiakitanga, mātauranga, water, air, kaimoana/fisheries, climate change and taniwha.[106]

Fiordland: Environment Southland has highlighted the potential negative marine impacts of cruise ships in Fiordland's internal waters in the Regional Coastal Plan for Southland (2013).[108] The impacts included noise, wakes, discharges to water (from waste and ballast), the possible grounding of ships and resultant oil spills, disturbances of wildlife, adverse effect on indigenous flora and fauna, and the introduction of unwanted pests or organisms.

As highlighted by the Fiordland Maritime Guardians in their 2021 annual report,[109] a HFO oil spill would present a major risk to Fiordland's marine environment. Further challenges would be presented for authorities by the remote nature and weather/sea conditions of Fiordland.

Policy and management interventions

International Maritime Organization Convention Prevention of Pollution from Ships (MARPOL): In the 1970s, the IMO developed an international treaty aimed to address and regulate pollution from ships. MARPOL is made up of six annexes focusing on different areas of maritime pollution.

MARPOL Annex IV (Prevention of pollution by sewage from ships): While MARPOL Annex IV does not prohibit the discharging of sewage, it imposes regulations to minimize the impacts. Sewage discharge is generally prohibited, except:

1. When comminuted (pulverised/reduced to minute particles) and disinfected sewage (using an IMO approved system) is discharged more than 3 nautical miles from lands, or non-comminuted/disinfected sewage is discharged more than 12 nautical miles away from lands, with gradual discharge while ships are moving; or
2. When the ship has an approved sewage treatment plant certified by IMO.[110]

However, MARPOL Annex IV does not require compliance monitoring, enforcement protocols, or treatment plants to meet concentrations limits.[111]

Wastewater treatment: Most cruise ships use wastewater treatment systems to treat waste on board.[3] The two most common systems are Marine Sanitations Devices (MSD) and Advance Wastewater Treatment Systems (AWTS). However, the Alaska Department of Environmental Conservation found that MSD systems do not adequately treat wastewater, and while AWTS systems are more effective, they were found to not remove all nutrients and dissolved metals. [112]

A study conducted between 2012-2016 in the Netherlands found that because of a lack of maintenance and testing 97% of ships sewage treatment systems did not meet discharge standards and were discharging 'virtually raw sewage'.[110 113] This highlights the need for strict pollution standards and mandated maintenance and testing.[79]

MARPOL Annex V: Annex V regulates solid waste disposal into oceans by prohibiting disposal of certain materials (e.g., plastic) and in specific areas. The majority of solid waste is treated on board cruise ships, and is either incinerated, pulped, or ground to be discharged.[114] Solid waste is not allowed to be disposed in 'special areas', which include the Mediterranean Sea, Baltic Sea, Black Sea, Red Sea, Gulfs area, North Sea, Antarctic, and Wider Caribbean Region.[6] Despite restrictions, some cruise lines have been found to be illegally dumping plastic into oceans.[82] In 2019, Carnival Cruise Lines was fined $20 million for dumping food waste mixed with plastic in the Bahamas.[81]

Venice: In 2021 Italian authorities approved a ban on large cruise ships entering the centre of Venice, requiring them to dock at the city's industrial port instead. This decision, driven by concerns over pollution and the erosion of the city's foundations, seeks to protect Venice's lagoon. The lack of cruise ships during the COVID-19 pandemic resulted in improved water quality in the lagoon.

Alaska: The Commercial Passenger Vessel Environmental Compliance (CPVEC) program in Alaska sets effluent limits and requires sampling of cruise ship wastewater discharges.[115] Cruise ships must obtain a permit to discharge treated wastewater within Alaskan state waters. The permit outlines the requirements for discharge which includes the use of an AWTS and compliance with effluent limits.[114] In 2018 a Holland America Line cruise ship was charged $17,000 for leaking greywater into Glacier Bay, Alaska.[116]

Scrubber regulations recommendations: The ICCT provides the following recommendations for policymakers that are concerned about the impact of scrubber wash water discharges:[90]

Global level: International Maritime Organisation (IMO):

- Pass a resolution to stop dumping scrubber discharge is areas that should be protected.
- Prohibit scrubbers as a fuel sulphur compliance option for new ships under MARPOL and phase out scrubbers on existing ships.

Regional/national level: National governments

- Prohibit all scrubber discharges in national waters; use closed-loop scrubbers in zero-discharge mode.
- Harmonize scrubber discharge restrictions across neighbouring countries to avoid displacing scrubber discharges over political borders.
- Prominent flag states should phase out scrubbers on ships flying their flags.

Local level: Local and regional councils

- Ban scrubber discharges in port waters; require ships to use onshore power or marine gas oil.
- Conduct ongoing monitoring of water and sediment for pollutants.

Scrubber bans and restrictions: The ICCT found that in 2023 there were 93 bans and restrictions against scrubbers around the world at national, sub-national and port levels (Figure 8). The majority of bans relate to the use of open-loop scrubbers.

New Zealand: New Zealand is currently a signatory to all MARPOL Annexes apart from Annex IV. Sewage cannot be discharged near marine farms, mataitai reserves and marine reserves. Untreated sewage cannot be discharged less than 500 metres away from land and must be in water that is more than 5 metres deep.[115] Grade A treated sewage cannot be discharged within 100 metres of a marine farm or within the internal waters of Fiordland. Grade B treated sewage cannot be discharged within 500 metres of a marine farm or a mataitai reserve or within areas prohibited under rules in a Regional Coastal Plan.[116]

New Zealand scrubber guidelines: In 2021, the Ministry for the Environment released guidelines for the use of scrubbers.[116] Ships were encouraged to use close-looped scrubbers in zero discharge mode and to avoid discharging scrubber wash water near coastal marine environments. These guidelines are non-statutory and not a legal requirement.

Fiordland: The Fiordland Marine Guardians are a group dedicated to managing and protecting Fiordland's marine environment, representing various stakeholders including recreational fishers, tourism, marine science, conservation, and local communities. They provide advice to the government, recommend management measures, and promote environmental stewardship.[117]

The Regional Coastal Plan for Southland recognises that the increasing number and size of cruise ships may diminish the values that attract people to Fiordland.[107] The objectives of the plan are to preserve the remoteness and wilderness values of the internal waters of Fiordland and ensure cruise ships do not negatively affect the intrinsic values of the coastal environment. The following actions are outlined to achieve these:

1. Avoid, remedy, or mitigate the negative impacts of cruise ships.
2. Advocate for mandatory pilotage areas for ships over 100 gross tons in Fiordland.
3. Offset negative impacts through financial contributions.
4. Encourage cruise ship operators to enter a formal agreement with council to manage activities.[31]

To maintain environmental standards Environment Southland restricts ships to Piopiotahi Milford Sound, Poison Bay, Thompson Sound, the outer part of Doubtful Sound, Breaksea Sound west of the Acheron Passage, the Acheron Passage, and Dusky Sound west of Cooper Island.[120] Requirements for cruise ships entering Fiordland are covered by the Cruise Ship Deed of Agreement and Harbourmasters Directions. Mitigations include passage plans, restricted speeds, compulsory pilotage, and vessel number limitations.[108]

Figure 8: Bans and restrictions on scrubbers by countries and ports (Source: ICCT, 2023).

Summary

- Cruise ships generate large volumes of solid waste, black water (sewage), grey water, bilge water, and scrubber wash water. These waste streams contain harmful pollutants that negatively impact marine ecosystems discharged into oceans, whether legally or illegally.

- The use of scrubbers to reduce sulphur emissions shifts pollution from the air to the water. Scrubber wash water, which may contain heavy metals, polycyclic aromatic hydrocarbons, nitrates, sulphates and particulate matter, is known to negatively impact marine life such as zooplankton.

- Antifouling coatings and ship dismantling processes pose a serious threat to marine ecosystems due to the release of toxic substances into the ocean. Similarly, cruise ship collisions and accidents can lead to significant environmental consequences, with HFO posing a high risk due to its potential to emulsify in water and harm aquatic life.

- The generation of wakes, sediment resuspension, anchoring and the construction of cruise infrastructure can impact shallow waterbodies and sensitive marine environments. These activities disturb the seabed, resuspend sediments and cause extensive structural damage to coral reefs, as evidenced by studies in Bermuda and Barbados. As evidenced by the example in the Cayman Islands, the cruise industry has minimal concern for or understanding of its impacts.

- With the increasing number of cruise ships visiting New Zealand, there is a growing concern about their impacts on marine environments, focusing particularly on biosecurity, accidents, the use of scrubbers and anchor damage.

- The identified marine impacts of cruise ships on the internal waters of Fiordland include noise, wakes, discharges to water (from waste and ballast), the possible grounding of ships and resultant oil spills, disturbances of wildlife, adverse effect on indigenous flora and fauna, and the introduction of unwanted pests or organisms.

- The IMO’s MARPOL treaty regulates maritime pollution but lacks compliance monitoring, enforcement protocols, and concentration limit testing for waste treatment plants. New Zealand is currently a signatory to all MARPOL Annexes apart from Annex IV.

- Most cruise ships use MSD or AWTS systems for onboard wastewater treatment. However, MSD systems are often inadequate and AWTS systems do not remove all nutrients and dissolved metals.

- To protect marine environments various regions have implemented strict regulations: Venice banned large cruise ships from its centre to protect the lagoon, Alaska enforces strict wastewater discharge permits and penalties, and Canada recommends removing waste dumping loopholes, banning HFO, and mandating advanced wastewater treatment systems/maintenance.

- The ICCT recommends banning scrubber discharges in protected areas, national and port waters, phasing out scrubbers on new and existing ships, harmonizing discharge restrictions, and conducting ongoing pollutant monitoring to mitigate the environmental impact of scrubber wash water discharges.

- New Zealand has specific regulations on sewage discharge to protect marine environments and guidelines encouraging the use of closed-loop scrubbers and the discharge of scrubber wash water away from coastal marine environments. However, these guidelines are not legally enforced.

- Environment Southland restricts cruise ship access to specific areas in Fiordland and enforces measures such as passage plans, restricted speeds, compulsory pilotage, and vessel number limitations to mitigate the impact of cruise ships on Fiordland’s marine environment.

- Cruise ship impacts on oceans and marine environments are incompatible with the outstanding universal values of Piopiptahi Milford Sound.

References

77. Stand.earth. (2021). *Regulating the West Coast Cruise Industry: Canada at the low water mark.* Stand.earth. https://old.stand.earth/sites/stand/files/regulating_the_west_coast_cruise_industry_final3.pdf
78. Butt, N. (2007). The impact of cruise ship generated waste on home ports and ports of call: A study of Southampton. *Marine Policy*, *31*(5), 591-598.
79. Lloret, J., Carreño, A., Carić, H., San, J., & Fleming, L. E. (2021). Environmental and human health impacts of cruise tourism: A review. Marine pollution bulletin, 173, 112979.
80. Herz, M., Davis, J., (2002). Cruise Control: A Report on How Cruise Ships Affect the Marine Environment.
81. Friends of the Earth. (2022). Can Cruise Ships Dump Garbage in the Ocean? Friends of the Earth. 18 May 2022. https://foe.org/blog/can-cruise-ships-dump-garbage-in-the-ocean/#:~:text=Carnival%20Cruise%20Lines%20was%20found
82. United States Environmental Protection Agency, Oceans and Coastal Protection Division (2008). *Cruise Ship Discharge Assessment Report.* 29 December 2008. https://archive.epa.gov/water/test/web/pdf/2009_01_28_oceans_cruise_ships_front_matter.pdf
83. Westhof, L., Köster, S., & Reich, M. (2016). Occurrence of micropollutants in the wastewater streams of cruise ships. *Emerging Contaminants*, *2*(4), 178-184. https://doi.org/10.1016/j.emcon.2016.10.001
84. Friends of the Earth. (2022). *Cruise Ship Water Pollution*. Friends of the Earth. 13 May 2022. https://foe.org/blog/cruise-ship-water-pollution/
85. Petit, S., Caric, H., Jaki, Z., & Laurent, C. (2019). Safeguarding Marine Protected Areas in the Growing Mediterranean Blue Economy: Recommendations for the Cruise Sector.
86. Mouchtouri, V. A., Nichols, G., Rachiotis, G., Kremastinou, J., Arvanitoyannis, I. S., Riemer, T., Jaremin, B., & Hadjichristodoulou, C. (2010). State of the art: public health and passenger ships. *International maritime health*, *61*(2), 49-98.
87. Ruiz, G. M., Rawlings, T. K., Dobbs, F. C., Drake, L. A., Mullady, T., Huq, A., & Colwell, R. R. (2000). Global spread of microorganisms by ships. *Nature (London)*, *408*(6808), 49-50. https://doi.org/10.1038/35040695
88. Georgeff, E., Mao, X., & Comer, B. (2019) *A whale of a problem? Heavy fuel oil, exhaust gas cleaning systems, and British Columbia's resident killer whales.* International Council on Clean Transportation. 10 December 2019. https://theicct.org/publication/a-whale-of-a-problem-heavy-fuel-oil-exhaust-gas-cleaning-systems-and-british-columbias-resident-killer-whales/
89. DNV-GL. (2019). *Alternative Fuels Insight Platform*. https://www.dnvgl. com/services/alternative-fuels-insight-128171
90. Osipova, L., Georgeff, E., & Comer, B. (2021). *Global scrubber washwater discharges under IMO's 2020 fuel sulfur limit*. April 2021. International Council on Clean Transportation https://theicct.org/wp-content/uploads/2021/06/scrubber-discharges-Apr2021.pdf
91. Koski, M., Stedmon, C., & Trapp, S. (2017). Ecological effects of scrubber water discharge on coastal plankton: Potential synergistic effects of contaminants reduce survival and feeding of the copepod *Acartia tonsa. Marine Environmental Research*, 129, 374-385. https://doi.org/10.1016/j.marenvres.2017.06.011
92. Magnusson, K., Thor, P., & Granberg, M. (2018). *Scrubbers: Closing the loop Activity 3: Task 2. Risk assessment of marine exhaust gas scrubber water*. IVL Swedish Environmental Research Institute. https://www.ivl.se/download/18.694ca0617a1de98f4739e2/1628417415931/FULLTEXT01.pdf
93. Stand.earth. (2020). *COVID Pandemic Results in a Cleaner Coast: An Investigation into Unregulated Cruise Ship Pollution in Canada's West Coast Waters.* Stand.earth. https://stand.earth/wp-content/uploads/2022/10/stand-report-cleaner-coast-canada-shipping.pdf
94. Syal, R. (2022). *US cruise ships using Canada as a "toilet bowl" for polluted waste*. 9 July 2022. The Guardian. https://www.theguardian.com/environment/2022/jul/09/us-cruise-ships-using-canada-as-toilet-bowl-for-polluted-waste-alaska-british-columbia
95. Caric, H., Klobucarb, G., & Stambukb, A. (2016). Ecotoxicological risk assessment of antifouling emissions in a cruise ship port. *Journal of Cleaner Production*, *121*, 159-168. https://doi.org/10.1016/j.jclepro.2014.08.072
96. Muhibbullah, M. (2013). Health hazards and risks vulnerability of ship breaking workers: A case study on Sitakunda ship breaking industrial area of Bangladesh. *Journal of Geography and Regional Planning*, *2*(8), 172-184.
97. Longcore, T., & Rich, C. (2004). Ecological Light Pollution. *Frontiers in ecology and the environment*, *2*(4), 191-198. https://doi.org/10.1890/1540-9295(2004)002[0191:ELP]2.0.CO;2
98. Jones, R. J. (2011). Environmental Effects of the Cruise Tourism Boom: Sediment Resuspension from Cruise Ships and the Possible Effects of Increased Turbidity and Sediment Deposition on Corals (Bermuda). *Bulletin of marine science*, *87*(3), 659-679. https://doi.org/10.5343/bms.2011.1007
99. Dunning, H, K. (2021). *As Tourism Returns, We Can't Allow Cruise Companies to Destroy Coral Reefs for Profit.* 28 May 2021. The Revelator. https://therevelator.org/cruise-companies-coral-reefs/
100. Small, M., & Oxenford, H. A. (2022). Impacts of cruise ship anchoring during COVID-19: Management failures and lessons learnt. *Ocean & coastal management*, *229*, 106332-106332. https://doi.org/10.1016/j.ocecoaman.2022.106332
101. Parliamentary Commissioner for the Environment. (2003). *Just cruising? Environmental effects of cruise ships*. Wellington: PCE. https://pce.parliament.nz/media/a3ejfvlx/just_cruising.pdf

102.Parliamentary Commissioner for the Environment. (2019) *Pristine, popular... imperilled? The environmental consequences of projected tourism growth.* December 2019. Wellington: PCE. https://pce.parliament.nz/media/mvud3vpb/report-pristine-popular-imperilled.pdf
103.Ministry for Culture and Heritage. (2023). *Sinking of the Mikhail Lermontov.* 16 February 2023. https://nzhistory.govt.nz/page/sinking-mikhail-lermontov
104.Stuff. (2018). *Commission finds cruise ship crash in Milford Sound was avoidable*. 31 July 2018. https://www.stuff.co.nz/southland-times/news/105776729/
105.Quill, A., & Steyl, L., (2024). Cruise ship runs aground in Doubtful Sound, 67 people evacuated. 25 January 2024. https://www.stuff.co.nz/travel/350157669/cruise-ship-runs-aground-doubtful-sound-67-people-evacuated
106.Cropp, A. (2022). *Cruise ships say they are getting greener, but critics want faster change*. 20 August 2022. Stuff. https://www.stuff.co.nz/business/green-business/129581715/cruise-ships-say-they-are-getting-greener-but-critics-want-faster-change
107.Gadd, J., Arnold, J., Taylor, R., Te Puni, K., Mayall Nahi, M., Williams, E., Currie, K., & Seaward, K. (2021). *Environmental Risks from Discharges from Exhaust Gas Cleaning Systems on Ships in Aotearoa New Zealand*. March 2021. National Institute of Water and Atmospheric Research. https://environment.govt.nz/assets/Publications/April-June-2021/NIWA-scrubber-environmental-risk-assessment.pdf
108.Environment Southland. (2013). *Regional Coastal Plan for Southland.* 13 March 2013. Environment Southland. https://www.es.govt.nz/repository/libraries/id:26gi9ayo517q9stt81sd/hierarchy/about-us/plans-and-strategies/regional-plans/coastal-plan/documents/coastal_plan_december_2013.pdf
109.Fiordland Marine Guardians (2021). *Fiordland Marine Guardians Annual Report 2020/21.* Fiordland Marine Guardians. https://www.fmg.org.nz/sites/default/files/2021-12/fiordland-marine-guardians-annual-report-2021.pdf
110.International Maritime Organization. (2019). *Prevention of Pollution by Sewage from Ships.* International Maritime Organization. https://www.imo.org/en/OurWork/Environment/Pages/Sewage-Default.aspx#:~:text=Annex%20IV%20of%20MARPOL&text=Governments%20are%20required%20to%20ensure,force%20on%2027%20September%202003.
111.The Maritime Executive. (2018). *Sewage from Ships – Rules and Realities.* 3 November 2018. The Maritime Executive. https://maritime-executive.com/editorials/sewage-from-ships-rules-and-realities-1#:~:text=It%20contains%20a%20set%20of,not%20less%20than%20four%20knots
*112.*Alaska Department of Environmental Conservation. (2012). *Cruise ship wastewater 2009-12 science advisory panel preliminary report*. Prepared by OASIS Environmental Inc.
113.Jeuthe, B. (2023). *MARPOL ANNEX IV REVISION PART 1*. 23 June 2023. Hamanag. https://www.hamannag.com/marpol-annex-iv-revision-part-1/
*114.*Congressional Research Service (CRS). (2007). *Cruise ship pollution: Background, laws and regulations, and key issues*. Washington, DC. www.ncseonline.org/NLE/CRSreports/07Jul/RL32450.pdf
115.White, E. (2021). *Grey Water from Passenger Vessels in Alaska 2000-2019.* March 2021. Oceans Conservancy. https://oceanconservancy.org/wp-content/uploads/2021/03/Grey-water-from-passenger-vessels-in-AK.pdf
116.Heacox, K. (2021). *Cruise ships are back. And it's a catastrophe for the environment.* 8 July 2021. The Guardian. https://www.theguardian.com/commentisfree/2021/jul/08/massive-tax-exempt-cruise-ships-damage-environment
117.Maritime New Zealand. (n.d.) *Sewage discharge*. Maritime New Zealand. https://www.maritimenz.govt.nz/commercial/environmental-requirements/sewage-discharge/#treatment_standards
118.Ministry for the Environment. (2023). *Guidance on the use of exhaust gas cleaning systems (scrubbers) for ports, regional authorities and ships in New Zealand waters.* 8 March. Ministry for the Environment. https://environment.govt.nz/guides/guidance-on-the-use-of-exhaust-gas-cleaning-systems-scrubbers-for-ports-regional-authorities-and-ships/
119.Fiordland Marine Guardians. (2018). *Fiordland Marine Guardians.* https://www.fmg.org.nz/guardians
120.Fiordland Marine Guardians. (2018). *Protect Fiordland.* https://www.fmg.org.nz/protect-fiordland

Chapter 2.4

Environmental: Marine biosecurity

Cruise ships present a significant global threat for marine biosecurity through the transfer of invasive and non-native species via biofouling, ballast water discharge and human activities. **The first known marine biological invasion was the introduction of the Asian phytoplankton algae Ondontella to the North Sea in 1903.[121] In the 1970s, scientists began to review the problem. Countries such as Canada and Australia, which were experiencing issues with non-native species invasions, brought the issue to the attention of the IMO in the 1980s.**[121]

Biofouling: Biofouling is the accumulation of plants, animals and other aquatic micro-organisms on surfaces submerged in marine environments. In the case of cruise ships, biofouling occurs predominantly on the hulls of ships.[2] Biofouling found on a ship can be influenced by a multitude of factors including design and construction, operating profiles, places visited, and maintenance history.[122]

In the early stages of biofouling, micro-organisms such as bacteria, fungi, microalgae, and protozoans attach to the hull of the ship creating a biofilm (slime layer) in a process known as microfouling.[122] Subsequently, macrofouling occurs when larger and more visible plants and animals attach to the biofilm. Common organisms include barnacles, tubeworms, mussels, algae, bryozoans, or sea squirts.[122]

Ballast water: Ballast water discharge can be a contributor to biological invasions. Ballast water may contain bacteria, microbes, small invertebrates, eggs, cysts, and larvae of organisms.[121]

Biological invasions: A biological invasion occurs when a non-native species is introduced into a marine ecosystem, with potentially serious implications for global biodiversity.[124] Through biofouling and the discharging of ballast water, species are transferred from different global marine environments to areas where they may be considered marine pests. If introduced species are able to reproduce in new marine environments, they may become invasive[125] and potentially out-compete native species.[122] (Table 5)

Name	Native to	Introduced to	Impact
Cholera *Vibrio cholerae* (various strains)	Various strains with broad ranges	South America, Gulf of Mexico and other areas	Some cholera epidemics are reported to have been associated with ballast water.
Cladoceran water flea *Cercopagis pengoi*	Black and Caspian Seas	Baltic Sea	Reproduces to form very large populations that dominate the zooplankton community and clog fishing nets and trawls, with associated economic impacts.
Chinese mitten crab *Eriocheir sinensis*	Northern Asia	Western Europe, Baltic Sea and west coast North America	Undergoes mass migrations for reproductive purposes. Burrows into riverbanks and dykes causing erosion and siltation. Preys on native fish and invertebrate species, causing local extinctions during population outbreaks. Interferes with fishing activities.
Round goby *Neogobius melanostomus*	Black, Azov and Caspian Seas	Baltic Sea and North America	Highly adaptable and invasive. Increases in numbers and spreads quickly. Competes for food and habitat with native fishes including commercially important species, and preys on their eggs and young. Spawns multiple times per season and survives in poor water quality.
Asian kelp *Undaria pinnatifida*	Northern Asia	Southern Australia, New Zealand, west coast of the United States, Europe and Argentina	Grows and spreads rapidly, both vegetatively and through dispersal of spores. Displaces native algae and marine life. Alters habitat, ecosystem, and food web. May affect commercial shellfish stocks through space competition and alteration of habitat.

Table 5: Examples of invasive aquatic species (Source: International Maritime Organization, 2019)

Biofouling prevention: Preventing biofilm on the hulls of ship entirely is not possible,[126] even with the use of best practice preventative measures.[127] Common measures to prevent or remove biofouling include antifouling and in-water cleaning.

Antifouling: To minimise biofouling, the underwater surfaces of ships are treated with an antifouling paint during dry docking.[128] Biocides in the antifouling coating make the surface toxic to organisms, preventing them from attaching to submerged surfaces.[129] Antifouling can minimise the global spread of invasive species.[128] However, antifouling is not effective in preventing biofouling entirely.[130]

In-water cleaning: During in-service periods, proactive or reactive in-water cleaning can be used to remove or prevent biofouling.[129] Proactive in-water cleaning can reduce biofilm (microfouling), while reactive in-water cleaning can remove macrofouling.[131] However, in-water cleaning can discharge antifouling biocides into the water, increase biosecurity risks, and diminish antifouling coatings.[132] In-water cleaning is also dependent on favourable weather conditions.

Non-indigenous species detections: To inform conservation and policy management, Bailey et al.[133] examined non-indigenous species detections in 49 aquatic ecosystems from 1965 to 2015. An average of 43 species a year were detected. Although, these findings are likely underestimated due to global underreporting and monitoring of non-indigenous species. While direct evidence was not always available, it was concluded that most non-indigenous species were introduced through ballast water or biofouling. The authors call for standardized, targeted, and repeated global reporting methods on the transfer of non-indigenous species to enhance global comparisons and sustain long-term measures.[133]

Global biosecurity and ship lay-ups: According to Ruiz et al.,[134] the COVID-19 pandemic altered the global movement patterns of vessels, causing extended lay-ups. Such disruptions may have resulted in increased worldwide invasions of marine pests. When vessels remain stationary for long periods, as was the case during the pandemic, the likelihood of biofouling increases. They called for accelerated efforts from the IMO to update their biofouling guidelines to address lay-up events that are likely to occur again in the future.[134]

New Zealand

Marine pests: Non-native marine species can become marine pests upon introduction into New Zealand's marine environments. While not all species are harmful, hundreds of non-native species have been introduced to New Zealand marine environments through biofouling and the discharging of ballast water.[135]

A study from 2004 to 2007 found that all international vessel types that entered New Zealand were likely to have some degree of biofouling, with 60% of vessels sampled having non-native species.[136] The most common species found were barnacles, tubeworms, bryozoans, bivalves, and macroalgae.[136]

New Zealand actively works to prevent the introduction of several highly damaging marine pests that are not yet present in New Zealand waters. These include the Northern Pacific seastar, European shore crab, Chinese mitten crab, Asian clam, and aquarium Caulerpa.[135] Some areas around New Zealand already face challenges from existing marine pests such as the Mediterranean fanworm, droplet tunicate (sea squirt), clubbed tunicate (sea squirt), Asian date mussel, Asian paddle crab, and undaria.[135]

Biofouling incidents: During the 2023/2024 cruise season, five out of 54 cruise ships that visited New Zealand faced issues with biofouling non-compliance.[137] Non-compliance resulted in denied entry or restricted access to certain ports.[138] While cruise ship arrivals have increased by 25%, biofouling non-compliance decreased from 11 instances in the 2022/2023 season.[137]

The Queen Elizabeth was turned away from Dunedin, Fiordland, and the Bay of Islands in January of 2023 due to failure to meet biosecurity requirements.[139] The hull of the ship reportedly needed additional underwater cleaning to meet the requirements to enter these ports.[139] In November of 2023, the Pacific Adventure was turned away from entering New Zealand due to concerning levels of biofouling.[132] The hull of the ship reportedly had high-risk mussel and oyster growth.[140] Attempts were made to clean the ship to meet biosecurity requirements, however, bad weather resulted in the voyage being cancelled.[140]

A spokesperson from the CLIA told The New Zealand Herald that the lack of suitable hull-cleaning facilities was a barrier for cruise ships attempting to meet New Zealand biosecurity requirements.[141] The CLIA chief executive also suggested that issues with biosecurity compliance were likely attributed to an increase in biosecurity inspections.[138]

Fiordland: Fiordland is home to various native marine species and has exceptional marine diversity.[142] A 2006 baseline survey for non-indigenous marine species in the Piopiotahi Milford Sound, reported that many of the non-indigenous species recorded were likely to have been introduced from hull fouling or ballast water discharge.[143]

Undaria: The only known marine pest currently in Fiordland is Undaria, an invasive Asian seaweed.[144] Undaria originates from Japan and is primarily spread through biofouling. It can be found in almost all New Zealand ports, growing on various hard surfaces and forming dense populations in sheltered reef areas.[135] The dense underwater stands can lead to competition for light and space, potentially displacing native species.[135]

Policy and management interventions

IMO biofouling guidelines: In 2011, the IMO released guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species.[145] In 2023, the IMO released an updated version to provide a consistent approach to the global management of biofouling.[122] The IMO recognizes that managing biofouling and the transfer of invasive species requires a global collaborative approach across nations and relevant stakeholders.[122]

The 2023 guidelines cover ship design and construction, anti-fouling system installation and maintenance, contingency action plans, inspections, cleaning and maintenance, biofouling management plans, biofouling record books, documentation and dissemination of information, and training and education.[122] While the guidelines are not mandatory, the IMO encourages port, flag and coastal states to implement the guidelines.[122]

This approach is similar to that of the treatment of ballast water which began with voluntary guidelines and transitioned to mandatory treatment.[149] However, according to Ruiz et al., the mandating of biofouling regulations is likely years away from implementation.[134] They argue that there is an urgent need for further international and national biosecurity policy interventions to limit the risk of biological invasions.[134]

IMO ballast water convention: In 1991, the IMO adopted international guidelines for preventing the introduction of unwanted aquatic organisms and pathogens from ships' ballast water and sediment discharges.[121] The release of the guidelines recognized the introduction of non-native species via ballast water as a major global concern. A revised version of the voluntary guidelines was also adopted in 1997.[121] In 2004, the International Convention for the Control and Management of Ship's Ballast Water and Sediments was adopted to establish standards and procedures for ballast water management. The convention entered into force in 2017 with standards phased in overtime.[121]

Under the convention ships must manage ballast water to a specific standard, develop and follow a ship-specific management plan, carry a ballast water record book, and obtain an international ballast water management certificate.[146] As an interim solution, ships are encouraged to exchange ballast water mid-ocean. Ships will eventually be required to have an onboard ballast water treatment system.[146]

New Zealand: New Zealand is globally recognized for its proactive and preventative biosecurity measures and was the first country to mandate national biofouling management for international vessels.[134] [147] Ruiz et al., argue that if more countries implemented similar requirements, it could significantly reduce biofouling transfers worldwide.[134]

Ministry for Primary Industries (MPI): MPI is the lead government agency which manages biosecurity in New Zealand. [147] MPI administers the Biosecurity Act 1993, advises the Minister for Biosecurity, provides border inspections, and maintains a system for responses to marine pests and diseases.[148] Other agencies responsible for managing biosecurity include the Department of Conservation, Maritime New Zealand, Environmental Protection Agency, and regional councils.[147] [148]

Biosecurity Act 1993: This act provides MPI with a legal framework to manage and prevent marine pests from entering New Zealand's marine environments.[147] [148] The act covers pre-border management and standard setting, border management, readiness and response and long-term pest management.[148]

Ballast water management: In 1992, New Zealand adopted voluntary ballast water guidelines. The MPI introduced mandatory ballast water management measures in 1998.[147] The measures require that ballast water must not be discharged in New Zealand waters without permission from an inspector.[150]

Biofouling management: In 2014, the Craft Risk Management Standard for Biofouling on Vessels Arriving in New Zealand (CRMS-BIOFOUL) was approved, with a four-year voluntary compliance implementation period (MPI, 2014).[147] The CRMS-BIOFOUL takes a preventative approach, requiring all vessels to have a clean hull (no visible aquatic organisms) before entering New Zealand. [151]

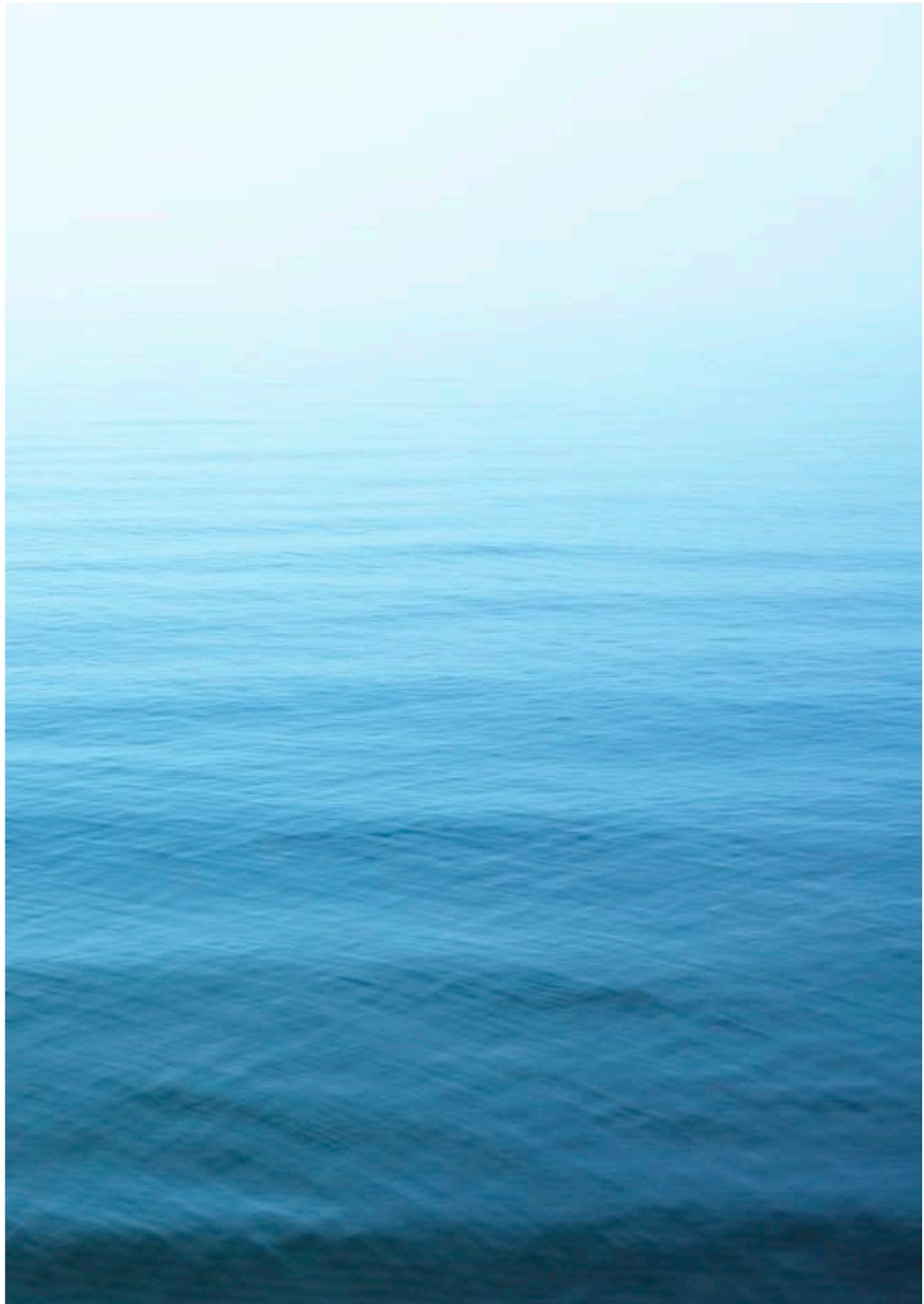
Documentation is required to provide evidence of best practice measures. Vessels must either demonstrate continual best practice maintenance, have been cleaned within 30 days, or have an appointment booked with an approved provider to be cleaned or treated within 24 hours of arriving in New Zealand.[151] In 2018, CRMS-BIOFOUL became mandatory. Should a vessel not meet CRMS-BIOFOUL requirements, actions taken can include restricting the vessel to a single port, directing the vessel to be cleaned, or refused entry.[151]

2023 Biofouling requirements: In 2023, MPI updated the biosecurity requirements and released the Craft Risk Management Standards (CRMS) for Vessels. The updated CRMS combines requirements from CRMS-BIOFOUL and CRMS Vessels.[152] Some of the changes include additional information requirements, new schedules for minimum evidence for biofouling inspections, clarification on acceptable measures for clean hull requirements, and a clause for managing cruise vessels. [153]

Cruise vessels: The CRMS (2023) mandates that cruise vessels must comply with long-stay requirements or operate under an MPI approved system approved by a chief technical officer to manage biofouling risks.[154] Long-stay vessels may only have biofilm or gooseneck barnacles.[154]

Fiordland: The Fiordland Marine Conservation Strategy (2003), produced by the Fiordland Marine Guardians (the Guardians), urges government agencies to monitor and enforce biosecurity programmes in Fiordland.[155] Under The Fiordland Marine Management Act (2005), government agencies must consider the recommendations from the Guardians.[156] The Fiordland Marine Biosecurity Programme provides marine biosecurity protection for Fiordland and is based on the Fiordland Biosecurity Plan (2015/16-2020/21).[157] MPI is the key agency responsible for developing and implementing the Fiordland Biosecurity Plan.[142]

The Deed of Agreement between Environment Southland and the New Zealand Cruise Industry has direct and indirect biosecurity requirements that cruise ships must follow in Fiordland to reduce the potential introduction of non-native organisms.[142] Cruise ships must operate under zero discharge of ballast water, hulls must be cleaned, painted or scraped outside of internal waters, the use of smaller support vessels must be kept to a minimum, and anchoring and mooring must take place in agreed anchorages.[142]



Summary

- Cruise ships present a significant global threat to marine biosecurity by transferring invasive and non-native species via biofouling, ballast water discharge and human activities. Marine biological invasions can occur when non-native species are introduced into aquatic ecosystems.
- Common measures to prevent or remove biofouling include antifouling paints containing biocides and in-water cleaning, though both methods have limitations and potential environmental impacts.
- In 2023, the IMO released an updated version of the Guidelines for controlling and managing ships' biofouling to minimize the transfer of invasive aquatic species.
- Non-native species can become marine pests when introduced to New Zealand marine environments, often introduced through biofouling and ballast water discharge. A 2004-2007 study found that 60% of sampled international vessels carried non-native species.
- New Zealand is globally recognized for its proactive and preventative biosecurity measures. If more countries implement similar mandates, biofouling transfers could be reduced worldwide.
- A 2006 baseline survey of non-indigenous marine species in Piopiotahi Milford Sound reported that the species recorded were likely to have been introduced from hull fouling or ballast water discharge.
- To minimize biosecurity risks in Fiordland, cruise ships must operate under zero discharge of ballast water, hulls must be cleaned, painted, or scraped outside of internal waters, the use of smaller support vessels must be kept to a minimum, and anchoring and mooring must take place in agreed anchorages.
- The marine biosecurity challenges associated with cruise ship visits present an ongoing risk to the marine environment of Piopiotahi Milford Sound and the wider Te Wāhipounamu World Heritage Area.

References

121.International Maritime Organization. (2019). Ballast Water Management. International Maritime Organization. https://www.imo.org/en/OurWork/Environment/Pages/BallastWaterManagement.aspx

122.International Maritime Organization. (2023) Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species. International Maritime Organization. 7 July 2023. https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.378%2880%29.pdf

123.Wang, Z., Saebi, M., Grey, E. K., Corbett, J. J., Chen, D., Yang, D., & Wan, Z. (2022). Ballast water-mediated species spread risk dynamics and policy implications to reduce the invasion risk to the Mediterranean Sea. *Marine Pollution Bulletin*, *174*, 113285. https://doi.org/https://doi.org/10.1016/j.marpolbul.2021.113285

124.Anil, A. (2006). *A perspective of marine bioinvasion*. TERI Press. https://drs.nio.res.in/drs/bitstream/handle/2264/200/MD_GEChange_2006_203.pdf?sequence=1&isAllowed=y

125.International Maritime Organization. (2019). Invasive Aquatic Species (IAS). International Maritime Organization. https://www.imo.org/en/OurWork/Environment/Pages/AquaticInvasiveSpecies(AIS).aspx

126.Tuck, B., Watkin, E., Somers, A., & Machuca, L. L. (2022). A critical review of marine biofilms on metallic materials. *Npj Materials degradation*, *6*(1), 1-12. https://doi.org/10.1038/s41529-022-00234-4

127.Georgiades, E., & Kluza, D. (2020). *Technical advice: Conduct of in-water biofouling surveys for domestic vessels.* Biosecurity New Zealand Technical Paper No: 2020/04. Ministry for Primary Industries.

128.International Maritime Organization. (2019). Anti-fouling systems. International Maritime Organization. https://www.imo.org/en/OurWork/Environment/Pages/Anti-fouling.aspx

129.Tamburri, M. N., Davidson, I. C., First, M. R., Scianni, C., Newcomer, K., Inglis, G. J., Georgiades, E. T., Barnes, J. M., & Ruiz, G. M. (2020). In-Water Cleaning and Capture to Remove Ship Biofouling: An Initial Evaluation of Efficacy and Environmental Safety. *Frontiers in Marine Science*, *7*. https://doi.org/10.3389/fmars.2020.00437

130.Georgiades, E., & Kluza, D. (2017). Evidence-based decision making to underpin the thresholds in New Zealand's CRMS: biofouling on vessels arriving to New Zealand. *J. Mar. Sci. Technol*, *51*, 76-88.

131.Georgiades, E., Scianni, C., & Tamburri, M. N. (2023). Biofilms associated with ship submerged surfaces: implications for ship biofouling management and the environment. *Frontiers in Marine Science*, *10*, 1197366.

132.Scianni, C., & Georgiades, E. (2019). Vessel In-Water Cleaning or Treatment: Identification of Environmental Risks and Science Needs for Evidence-Based Decision Making. *Frontiers in Marine Science*, *6*. https://doi.org/10.3389/fmars.2019.00467

133.Bailey, S. A., Brown, L., Campbell, M. L., Canning-Clode, J., Carlton, J. T., Castro, N., Chainho, P., Chan, F. T., Creed, J. C., Curd, A., Darling, J., Fofonoff, P., Galil, B. S., Hewitt, C. L., Inglis, G. J., Keith, I., Mandrak, N. E., Marchini, A., McKenzie, C. H., . . . Zhan, A. (2020). Trends in the detection of aquatic non-indigenous species across global marine, estuarine and freshwater ecosystems: A 50-year perspective. *Diversity & distributions*, *26*(12), 1780-1797. https://doi.org/10.1111/ddi.13167

134.Ruiz, G. M., Galil, B. S., Davidson, I. C., Donelan, S. C., Miller, A. W., Minton, M. S., Muirhead, J. R., Ojaveer, H., Tamburri, M. N., & Carlton, J. T. (2022). Global marine biosecurity and ship lay-ups: intensifying effects of trade disruptions. *Biological invasions*, *24*(11), 3441-3446. https://doi.org/10.1007/s10530-022-02870-y

135.Marine Biosecurity Porthole (n.d.) What are marine pests?. Marine Biosecurity Porthole. https://marinebiosecurity.org.nz/what-are-marine-pests/

136.Inglis, G., Floerl, O., Ahyong, S., Cox, S., Unwin, M., Ponder-Sutton, A., Seaward, K., Kospartov, M., Read, G., & Gordon, D. (2010). The biosecurity risks associated with biofouling on international vessels arriving in New Zealand: summary of the patterns and predictors of fouling. In *Biosecurity New Zealand Technical Paper* (Vol. 2008).

137.Ministry for Primary Industries. (2024). *Vessel Biosecurity Quarterly.* Ministry for Primary Industries. March 2024. https://www.mpi.govt.nz/dmsdocument/61486-Vessel-Biosecurity-quarterly-March-2024-Issue-9

138.Chittock, N. (2023). Bodies meet to address biosecurity concerns over cruise ship cleaning. RNZ. 9 January 2023. https://www.rnz.co.nz/news/national/482146/bodies-meet-to-address-biosecurity-concerns-over-cruise-ship-cleaning

139.Williams, C. (2023). Cruise ship passengers miss out on Bay of Islands due to biosecurity issues. Stuff. 23 January 2023. https://www.stuff.co.nz/travel/travel-troubles/300788784/cruise-ship-passengers-miss-out-on-bay-of-islands-due-to-biosecurity-issues

140.RNZ. (2023). Cruise ship turned away from New Zealand over failed biosecurity standards. RNZ. 25 November. https://www.rnz.co.nz/news/national/503227/cruise-ship-turned-away-from-new-zealand-over-failed-biosecurity-standards#:~:text=In%20a%20statement%2C%20Biosecurity%20New,a%20risk%20to%20New%20Zealand

141.Bywater, T. (2024). Cruise biofoul improving says MPI as four ships fall foul this summer. The New Zealand Herald. 5 February 2024. https://www.nzherald.co.nz/travel/cruise-biofoul-improving-says-mpi-as-four-ships-fall-foul-this-summer/HJRWQYJGQVDOLOWVDDUVMPS6NQ/

142.Ministry for Primary Industries. (2016). *Fiordland Marine Biosecurity Plan 2015/16-2020/21.* Ministry for Primary Industries. https://www.mpi.govt.nz/dmsdocument/13849-Fiordland-Marine-Biosecurity-Plan-201516-202021

143.Inglis, G. (2008). Milford Sound: First baseline survey for non-indigenous marine species (research project ZBS2005/19). Wellington, NZ: MAF Biosecurity New Zealand.

144.Fiordland Marine Guardians. (2018). Protect Fiordland. Fiordland Marine Guardians. https://www.fmg.org.nz/protect-fiordland

145.International Maritime Organization. (2011). *Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species.* International Maritime Organization. 15 July 2011. https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.207(62).pdf

146.International Maritime Organization. (2004). *International Convention for the Control and Management of Ships' Ballast Water and Sediments.* International Maritime Organization. 13 February 2004. https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships%27-Ballast-Water-and-Sediments-%28BWM%29.aspx

147.Georgiades, E., Kluza, D., Bates, T., Lubarsky, K., Brunton, J., Growcott, A., Smith, T., McDonald, S., Gould, B., Parker, N., & Bell, A. (2020). Regulating Vessel Biofouling to Support New Zealand's Marine Biosecurity System – A Blue Print for Evidence-Based Decision Making. *Frontiers in Marine Science*, *7*. https://doi.org/10.3389/fmars.2020.00390

148.Ministry for Primary Industries. (2020). Introduction to biosecurity legislation. Ministry for Primary Industries. 16 November 2020. https://www.mpi.govt.nz/legal/legislation-standards-and-reviews/biosecurity-legislation/introduction-to-biosecurity-legislation/

149.Scianni, C., Lubarsky, K., Ceballos-Osuna, L., & Bates, T. (2021). Yes, we CANZ: initial compliance and lessons learned from regulating vessel biofouling management in California and New Zealand. *Management of biological invasions*, *12*(3), 727-746. https://doi.org/10.3391/mbi.2021.12.3.14

150.Ministry for Primary Industries. (2005). *Import health standards for ships' ballast water from all countries.* Ministry for Primary Industries. 13 June 2005. https://www.epa.govt.nz/assets/FileAPI/proposal/EEZ000004/Evidence/28f8aa484e/EEZ000004-23A-Ray-Barlow-Navigation.PDF

151.Ministry for Primary Industries. (2014). *Craft Risk Management Standard for Vessel Biofouling.* Ministry for Primary Industries. https://www.epa.govt.nz/assets/FileAPI/proposal/EEZ000004/Evidence/60119acc29/EEZ000004-23B-Ray-Barlow-Navigation.PDF

152.Ministry for Primary Industries. (2023). Cruise ships and passengers. Ministry for Primary Industries. 20 October 2023. https://www.mpi.govt.nz/import/border-clearance/ships-and-boats-border-clearance/cruise-ships-and-passengers/

153.Ministry for Primary Industries. (2023). *The Craft Risk Management Standard for vessels: frequently asked questions.* Ministry for Primary Industries. https://www.mpi.govt.nz/dmsdocument/27444-Craft-Risk-Management-Standard-FAQs

154.Ministry for Primary Industries. (2023). *Vessels: CRMS Vessels.* Ministry for Primary Industries. 13 October 2023. https://www.mpi.govt.nz/dmsdocument/19757-Vessels-Craft-risk-management-standard

155.Guardians of Fiordland's Fisheries & Marine Environment Inc. (2003). *Fiordland Marine Conservation Strategy.* Guardians of Fiordland's Fisheries & Marine Environment Inc. June 2003. https://environment.govt.nz/assets/Publications/Files/fiordlandmarineconservationstrategy2003final.pdf

156.Ministry for the Environment. (2021). Fiordland (Te Moana o Atawhenua) Marine Management Act 2005. Ministry for the Environment. 31 March 2021. https://environment.govt.nz/acts-and-regulations/acts/fiordland-marine-management-act/

157.Ministry for Primary Industries. (2023). Fiordland Marine Biosecurity Programme. Ministry for Primary Industries. 10 March 2023. https://www.mpi.govt.nz/biosecurity/exotic-pests-and-diseases-in-new-zealand/long-term-biosecurity-management-programmes/fiordland-marine-biosecurity-programme/

Chapter 2.5

Environmental:
Impact on marine mammals

Research overview

Much empirical research in the field of marine science informs our understanding of the impacts of human activities on marine mammals (whales, dolphins and porpoises). The majority of research relating to tourism activities has centred on commercial whale and dolphin watching. Less research attention has been paid to the impacts of cruise ships on marine mammals. That is now changing with growth in the number and size of cruise ships and the increasing range of cruise destinations.

Limitations: This section draws on existing research on the impact of tourism on marine mammals from both the international and New Zealand contexts. Much of the existing research addresses the impacts of relatively small vessels that offer tourists interactions with populations of marine mammals in the wild. Research addressing the impacts of cruise ships on marine mammals is limited. The exception in New Zealand is research conducted in recent years on the cruise impacts in Akaroa Harbour. While these studies are of relevance to the potential impacts of cruise ship visits to Piopiotahi Milford Sound, there remains a lack of direct evidence relating to vessel size, speed and marine noise specifically in the context of Piopiotahi Milford Sound.

Photo: Mature female Hector's Dophin, Akaroa Harbour. Steve Dawson, New Zealand Whale and Dolphin Trust.

The impacts of marine tourism

The impacts of marine tourism including cruise tourism and whale watching on marine mammals are wide ranging. They include marine pollution, noise, vessel strikes and physical effects on marine mammals which can have implications for the energy budgets of individuals and populations, and reproductive success. Impacts can be broadly classified as fatal and non-fatal.

Injuries from vessel strikes that are sometimes fatal have become more common where the volume and/or speed of marine traffic has increased. The first comprehensive study of the impacts of vessels strikes was on North Atlantic right whales. While not specifically focussed on cruise ships, it showed the injuries and the lingering effects of vessel strikes linked to increasing vessel traffic.[158] In the tourism context research in Hawaii shows that vessel strikes often involve younger animals and calves and increase during the breeding season. Increasing traffic, particularly marine vessels between 7.9 and 19.8m in length, are linked to increases in vessel strikes.[159]

Harris et al.[160] document crusie ship strikes causing fatal injuries to humpback whales in Alaska recommending reduced speed as a management response. Research in New Zealand has examined the risk of vessel strikes with Bryde's whales in the Hauraki Gulf.[161] It found that cruise ships pose a relatively high risk of lethal vessel strike and that voluntary speed restrictions were unlikely to occur due to scheduling difficulties.

Non-fatal impacts include all causes of non-lethal anthropogenic stress (NLAS).[162] Physical disturbance, compromised energetic budgets and displacement may occur due to tourist interactions with dolphin populations in the wild. Other broader causes of anthropogenic stress include marine pollution (causing immune deficiencies), disturbance of sediment and seafloor, and depletion of prey species.[163] [164]

Noise in the marine environment has been shown to cause displacement of marine species and disruption of predator-prey relationships. Marine mammals are particularly susceptible to noise due to the importance of echolocation in locating prey and hunting.[165]

It has been reported that marine noise has reached epidemic proportions in areas that are receiving increasing maritime traffic. Much of the research on cruise ship noise has been conducted in the Arctic and Antarctica.[166] [167] For example high exposure of humpback whales to acoustic noise from cruise ships in Glacier Bay National park (Alaska) indicated that protected area managers should reduce the number of cruise ships and/or their speed to reduce marine noise.[168]

These causes of NLAS may contribute to tipping points being reached when the cumulative effects of human disturbances exceed critical thresholds for individuals or populations.[169]

Bejder et al.[170] offer one of the most comprehensive studies of the effects of human activity on bottlenose dolphins (Tursiops sp.). Their research examined both short-term behavioural responses and the biological significance of the long-term impacts of vessel activity. They studied dolphin abundance at Shark Bay, Australia comparing a study site population where tourism levels were increasing (i.e., the number of dolphin-watching operators) to a control site (no tourism) population. They found a significant average decline in dolphin abundance at the study site as tourism activity increased over time. They concluded that (a) this trend was unlikely to jeopardize the large, genetically diverse dolphin population of Shark Bay but that (b) a similar decline would be devastating for small, closed, resident, or endangered cetacean populations.

Fiordland Bottlenose dolphin populations

The Bottlenose Dolphin (*Tursiops truncates*) populations of Fiordland are iconic, recognised for their social and cultural values, and of economic importance to local dolphin watching tourism businesses.

The range of bottlenose dolphin distribution worldwide is temperature-related and occurs poleward north and south to 45° latitude. New Zealand is at the southern-most point of their range. Earlier research has confirmed three small, resident and genetically distinct populations of Bottlenose dolphins in Fiordland. The three groups have distinct ranges in Dusky Sound/Breaksea Sound, Doubtful Sound (the most well studied) and the sounds north of Charles Sound including Milford Sound and the lower Hollyford River Whakatipu Kā Tuka and Lake McKerrow Whakatipu Waitai.[169]

Research has shown that the Doubtful Sound population decreased by at least a third from 1994 when 81 individuals were recorded. Since that time the population has been recorded at 63 individuals in 1998 and 56 in 2008. The causes behind the decline include human-related effects such as vessel activity and habitat modification in the form of increasing freshwater discharge from the Manapouri hydroelectric power station.[171]

Human impacts on Fiordland Bottlenose dolphin populations

The Department of Conservation[172] notes that 'Bottlenose dolphins are particularly susceptible to human impacts due to their coastal nature. In New Zealand, the main threat to this species is likely to be the adverse effects of tourism'.

Research in Fiordland has shown that the presence of boats can lead to changes in normal dolphin behaviours.[173] [174] Dolphins in Doubtful Sound react to vessels within 400m of proximity.[175] Unpublished evidence suggests that dolphins in the fiords may react to vessels at greater than 400m distance when louder vessels are present. At least 68 min is recommended between two vessel-dolphin interactions. The residency patterns of dolphins in Piopiotahi Milford Sound are impacted by maritime traffic with dolphins more frequently absent from Piopiotahi Milford Sound during months of intense vessel traffic.[163]

Tourist interactions with Bottlenose Dolphins

The resident dolphin population living in Doubtful Sound/Patea has been the subject of a decades-long and ongoing research programme on population dynamics and the impacts of human interactions. [176] [169] [177]

Vessel interactions with dolphins in Doubtful Sound have been shown to affect the behavioural budget of the dolphin population, and that dolphins are more sensitive to interactions with boats when engaged in two critical behaviour states; resting and to a lesser extent socialising.[163] Studies of spatial ecology have revealed that these critical behaviours take place predominantly in particular areas within the population range. Mothers with calves were found to be least likely to be spatially displaced by marine vessels resulting in heightened risk of impacts (including vessel strikes) with consequences for breeding success. [170] [178]

Increasing vessel traffic has been shown to have a range of detrimental effects on the acoustic behaviour of whales and dolphins. Studies of the acoustic environment in Doubtful Sound have found that elevated boat noise affects communication, and that groups with calves are particularly sensitive to boat presence and noise. This point has important implications for the management of impacts due to the endangered status of the population and history of low calf survival.[173] While there is some evidence that a voluntary code of management has improved tour skippers behaviour and reduced disturbance of dolphins,[179] reduced vessel traffic and boat-dolphin interactions has been the consistent recommendation arising from dolphin research in Fiordland.[180]

Bottlenose dolphin, Dusky Sound, Fiordland, New Zealand.
Photo by: Steve Dawson

Cruise ships and marine mammals

While relatively little research has directly addressed the impacts of cruise ships on dolphins a notable exception has been the study of increasing cruise ship visits to Akaroa Harbour in the decade following the Christchurch earthquakes (2010-2019).[181] This research offers the first long-term analysis of Hector's dolphin (*Cephalorhynchus hectori*) distribution in Akaroa Harbour based on data collected from passive acoustic monitoring combined with autonomous visual and satellite tracking methods for monitoring vessel traffic. Short-term relationships between dolphins and cruise ship presence were also observed.[164]

This research found changes in dolphin habitat use within Akaroa Harbour coinciding with an increase in cruise ship visits. This was manifest in a southward shift and contraction in the relative distribution of Hector's dolphins in Akaroa harbour. Follow-up work has more closely investigated the probable causes of changes in distribution. This has included measurements of acoustic impacts, habitat change arising from damage to the seafloor caused by anchoring, and water turbidity (Figure 9) caused by cruise ship propulsion systems (Ursem, University of Otago, in progress).

An environmental impact assessment prepared by Olivia Johnston (Cawthron Institute)[182] for Environment Canterbury in 2019 outlined the potential impacts of cruise ships in Akaroa Harbour. It found that likely direct impacts included increased noise and risk of vessel strike (including from tender vessels). It also investigated the potential indirect impacts of increased turbidity, resuspension of contaminants, and localised habitat destruction. This research found that cruise ships would typically have 80-100m of anchor chain, creating an extensive radius of potential seabed damage.

Internationally, seafloor and reef impacts caused by cruise ship anchors has been shown to cause lasting damage.[183] Johnston's[181] risk assessment suggested that major long-term impacts from cruise ships also arise in Akaroa Harbour where anchoring or maintaining position occurs. These impacts include damage to the seafloor from anchor chain scour and thruster propulsion turbulence. Anchor and anchor chain scour has been shown to have significant impacts on benthic environments.[184] Such damage is likely to have impacts that cascade up trophic levels to dolphins.[185]

Figure 9: Cruise ship propulsion impacts on water quality and turbidity, Akaroa Harbour. Source: Dale Flewellen

Management interventions

Human interactions with marine mammals in New Zealand, including marine tourism, are managed under the Marine Mammal Protection Regulations (1992). Lusseau[163] recommended the delineation of a multi-levelled marine sanctuary in Doubtful Sound as an effective approach to managing vessel activity and the impacts of vessels on dolphins.

This research led to the creation of Dolphin Protection Zones (DPZ) in Doubtful Sound as a level of protection in addition to the Marine Mammal Protection Regulations (1992). This measure which was introduced in 2008 has seen a reversal of the trend of dolphin population decline in Doubtful Sound.[186] [187] In 2014 the Doubtful Sound population had recovered to 63 individuals.[173]

Environment Southland is currently advancing work to place hydrophones in Piopiotahi Milford Sound to measure the marine soundscape with the intention to be able to eventually compare the marine soundscape of Piopiotahi Milford Sound with other locations in Fiordland.

On 1 July 2020 Environment Canterbury issued new regulations for cruise ships seeking to anchor in Akaroa Harbour in response to longstanding community concerns. These regulations were developed in consultation with rūnanga, local community groups and the cruise industry and came into effect on 1 November 2021.[188]

The guidelines defined maximum seabed disturbance parameters requiring cruise companies to provide scientific evidence of no adverse effects. They also established guidelines to manage the number of cruise ships in the harbour at any time, banned vessels of greater than 50,000 tonnes displacement from anchoring without consent, and limited the number of visits of cruise ships over a 12-month period on the basis of size. The regulations also prohibited the use of thrusters and propulsion machinery when anchored without the permission of the Harbourmaster.

Summary

- Three small, resident and genetically distinct populations of Bottlenose dolphins (*Tursiops truncates*) have distinct ranges in Dusky Sound/Breaksea Sound, Doubtful Sound, and from Charles Sound north including Piopiotahi Milford Sound and the lower Hollyford River.[169] These iconic dolphin populations have strong social and cultural values and are of economic importance to local dolphin watching tourism businesses.

- These small populations are vulnerable to a range of anthropogenic impacts. The Department of Conservation[171] recognises that the main threats are likely to be the adverse effects of tourism, including increasing maritime traffic and marine noise causing altered energy budgets with implications for reproductive success. At least 68 minutes is recommended between two vessel-dolphin interactions. Behaviour change was observed when vessels were within 400m of proximity to dolphins.

- The residency patterns of dolphins are impacted by maritime traffic with dolphins more frequently absent from Piopiotahi Milford Sound during months of intense vessel traffic.

- Researchers who have specifically investigated the impacts of increasing cruise ship visits to Akaroa Harbour from 2011 have identified changes in Hector's dolphin (*Cephalorhynchus hectori*) habitat use. The changing distribution and displacement of dolphins is likely to have been caused by a combination of acoustic impacts and habitat change in the forms of damage to the seafloor and water turbidity caused by cruise ship anchor and propulsion systems.

- Management interventions are required to protect marine mammals from the impacts of tourism. Successful interventions include limiting the volume of marine traffic, mitigating vessel speed and acoustic noise, and actively managing vessel activity within the range of resident dolphins, particularly in locations where critical resting and socialising behaviours predominantly take place.

- The designation of dolphin protection zones (DPZ) in Doubtful Sound in 2008 provides evidence of the significance of these impacts, and the importance of active management interventions to reverse population decline. Such interventions have included actively managing levels of dolphin exposure to vessel traffic by minimising or excluding marine vessels from sensitive areas within the range of dolphins where critical behaviour occur.

- Management interventions should consider the risk of spatial displacement which risks the impacts associated with high marine vessel activity being transferred to other fiords and other vulnerable bottlenose dolphin populations.

Key terms

Behavioural budget
Individual and group dolphin behaviours include travelling, resting, milling, diving and socialising. Behavioural states are collectively used to study time-activity budgets and activity-specific energetic costs and are essential for determining behavioural responses to anthropogenic and ecological variables.

Energy budget
The energetic budget associated with individual and population behaviours and cumulative behavioural states.

Multi-level marine sanctuary
The designation of a hierarchy of protection measures, such as Dolphin Protection Zones, that may include a combination of open access, restricted access (e.g., permitted access only), restrictions on activities (e.g., speed, direction or duration) or complete closure to marine vessels.

Resuspension of contaminants
Occurs when sediment contaminants are resuspended in the water which may be caused by natural or anthropogenic erosive forces and can increase exposure to contaminant in the water column and redistribution of large quantities of sediment contaminants.

Anchor and chain scour
Reef and seabed damage and disturbance caused by anchors and anchor chains.

Benthic environment
The benthic zone is the lowest ecological zone in a water body and usually includes seafloor sediments.

Trophic levels
The position an organise occupies in the food web.

References

158. Laist, D. W., Knowlton, A. R., Mead, J. G., Collet, A.S., & Podesta, M. (2001). Collisions between ships and whales. *Marine Mammal Science*. 17, 35–75
159. Lammers, M. O., Pack, A. A., Lyman, E. G., & Espiritu, L. (2013). Trends in collisions between vessels and North Pacific humpback whales (Megaptera novaeangliae) in Hawaiian waters (1975–2011). *Journal of Cetacean Resource Management. 13*(1), 73-80.
160. Harris, K., Gende, S. M., Logsdon, M. G., & Klinger, T. (2012). Spatial pattern analysis of cruise ship–humpback whale interactions in and near Glacier Bay National Park, Alaska. *Environmental management*, *49*, 44-54.
161. Ebdon, P., Riekkola, L., & Constantine, R. (2020). Testing the efficacy of ship strike mitigation for whales in the Hauraki Gulf, New Zealand. *Ocean & coastal management*, *184*, 105034.
162. Higham, J. E., Bejder, L., Allen, S. J., Corkeron, P. J., & Lusseau, D. (2016). Managing whale-watching as a non-lethal consumptive activity. *Journal of sustainable tourism*, *24*(1), 73-90.
163. Lusseau, D. (2005). Residency pattern of bottlenose dolphins *Tursiops* spp. *in Milford Sound, New Zealand, is related to boat traffic. Marine Ecology Progress Series.* 295, 265–272.
164. Carome, W., Rayment, W., Slooten, E., Bowman, M. H., & Dawson, S. M. (2023). Vessel traffic influences distribution of Aotearoa New Zealand's endemic dolphin (Cephalorhynchus hectori). *Marine Mammal Science*, *39*(2), 626-647.
165. The Guardian (2024). How cruise ships became a catastrophe for the planet: It's complicated. https://www.youtube.com/watch?app=desktop&v=EZlgM_u4Ghg
166. McKenna, M. F., Gabriele, C., & Kipple, B. (2017). Effects of marine vessel management on the underwater acoustic environment of Glacier Bay National Park, AK. *Ocean & coastal management*, *139*, 102-112.
167. Gabriele, C. M., Ponirakis, D. W., & Klinck, H. (2021). Underwater sound levels in Glacier Bay during reduced vessel traffic due to the COVID-19 pandemic. *Frontiers in Marine Science*, *8*, 674787.
168. Frankel, A. S., & Gabriele, C. M. (2017). Predicting the acoustic exposure of humpback whales from cruise and tour vessel noise in Glacier Bay, Alaska, under different management strategies. *Endangered Species Research*, *34*, 397-415.
169. Currey, R. J., Dawson, S. M., Slooten, E., Schneider, K., Lusseau, D., Boisseau, O. J., ... & Williams, J. A. (2009). Survival rates for a declining population of bottlenose dolphins in Doubtful Sound, New Zealand: an information theoretic approach to assessing the role of human impacts. *Aquatic conservation: marine and freshwater ecosystems*, *19*(6), 658-670.
170. Bejder, L., Samuels, A. M. Y., Whitehead, H. A. L., Gales, N., Mann, J., Connor, R., ... & Krützen, M. (2006). Decline in relative abundance of bottlenose dolphins exposed to long-term disturbance. *Conservation Biology*, *20*(6), 1791-1798.
171. Currey, R. J., Dawson, S. M., & Slooten, E. (2007). New abundance estimates suggest Doubtful Sound bottlenose dolphins are declining. *Pacific Conservation Biology*, *13*(4), 274-282.
172. Department of Conservation (2024). Bottlenose Dolphins https://www.doc.govt.nz/nature/native-animals/marine-mammals/dolphins/bottlenose-dolphin/
173. Pirotta, E., New, L., Harwood, J., & Lusseau, D. (2014). Activities, motivations and disturbance: An agent-based model of bottlenose dolphin behavioral dynamics and interactions with tourism in Doubtful Sound, New Zealand. *Ecological Modelling*, *282*, 44-58.
174. Guerra, M., Dawson, S. M., Brough, T. E., & Rayment, W. J. (2014). Effects of boats on the surface and acoustic behaviour of an endangered population of bottlenose dolphins. *Endangered Species Research*, *24*(3), 221-236.
175. Lusseau, D. (2006). The short-term behavioral reactions of bottlenose dolphins to interactions with boats in Doubtful Sound, New Zealand. *Marine Mammal Science*, *22*(4), 802-818.
176. Lusseau, D., & Higham, J. E. S. (2004). Managing the impacts of dolphin-based tourism through the definition of critical habitats: the case of bottlenose dolphins (Tursiops spp.) in Doubtful Sound, New Zealand. *Tourism Management*, *25*(6), 657-667.
177. Bennington, S., Rayment, W.J., Currey, R.J.C., Oldridge, L., Henderson, S.D., Guerra, M., Brough, T.E., Johnston, D.W., Corne, C., Johnson, D., Slooten, E., & Dawson, S. (2020). Long-term stability in core habitat of an endangered population of bottlenose dolphins (Tursiops truncatus): Implications for spatial management. *Aquatic Conservation*. 31:1–12.
178. Lusseau, D. (2003). Male and female bottlenose dolphins Tursiops spp. have different strategies to avoid interactions with tour boats in Doubtful Sound, New Zealand. *Marine Ecology Progress Series*, *257*, 267-274.
179. Guerra, M., & Dawson, S. M. (2016). Boat-based tourism and bottlenose dolphins in Doubtful Sound, New Zealand: The role of management in decreasing dolphin-boat interactions. *Tourism management*, *57*, 3-9.
180. Fumagalli, M., Guerra, M., Brough, T., Carome, W., Constantine, R., Higham, J., ... & Dawson, S. (2021). Looking back to move forward: Lessons from three decades of research and management of cetacean tourism in New Zealand. *Frontiers in Marine Science*, 8: https://doi.org/10.3389/fmars.2021.624448
181. Carome, W., Slooten, E., Rayment, W., Webster, T., Wickman, L., Brough, T., & Dawson, S. M. (2022). A long-term shift in the summer distribution of Hector's dolphins is correlated with an increase in cruise ship tourism. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *32*(10), 1660-1674.
182. Johnston, O. (2019). Akaroa Harbour cruise ship visits: Preliminary ecological risk assessment. Cawthron Report No. 3387. 11 October 2019.
183. Rogers, C. S., & Garrison, V. H. (2001). Ten years after the crime: lasting effects of damage from a cruise ship anchor on a coral reef in St. John, US Virgin Islands. *Bulletin of Marine Science*, *69*(2), 793-803.
184. Broad, A., Rees, M. J., & Davis, A. R. (2020). Anchor and chain scour as disturbance agents in benthic environments: trends in the literature and charting a course to more sustainable boating and shipping. *Marine Pollution Bulletin*, *161*, 111683.
185. Lloret, J., Carreño, A., Carić, H., San, J., & Fleming, L. E. (2021). Environmental and human health impacts of cruise tourism: A review. *Marine pollution bulletin*, *173*, 112979.
186. Department of Conservation (2008). Dolphin Protection Zones
187. https://www.doc.govt.nz/about-us/science-publications/conservation-publications/native-animals/marine-mammals/doubtful-sound-marine-mammal-and-other-wildlife-code-of-management/
188. Department of Conservation (2008). Dolphin Protection Zones map.
189. https://www.doc.govt.nz/globalassets/documents/conservation/native-animals/marine-mammals/dolphin-protection-zone-map.pdf
190. Environment Canterbury Regional Council Kaunihera Taiao ki Waitaha (2020). Guidance for cruise ships anchoring in Akaroa Harbour. https://www.ecan.govt.nz/get-involved/news-and-events/2020/guidance-for-cruise-ships-anchoring-at-akaroa-harbour/
191. Guidelines available: https://www.ecan.govt.nz/document/download?uri=3897180

Chapter 2.6

Environmental: Geohazards

Environmental geohazards in Piopiorhi Milford Sound

New Zealand is a geologically active country due to its position straddling the Pacific and Australian tectonic plates. The plate boundary is complex, involving two major subduction zones – Hikurangi and Puysegur – in the northeast and southwest of the country respectively. These zones involve one plate diving beneath the other, and are places of significant seismic hazards. Linking them is a transform fault, the Alpine Fault,[192] which transects the western side of the Southern Alps in Te Waipounamu, the South Island (Figure 10).

Te Rua-o-te-moko Fiordland is a large area of more than 12,000 km^2. It is a mountainous region, with elevations up to 2730 m, interspersed with a system of deep fjords, steep slopes (~35°–65°)[193], and high rainfall. Due to its topography, it is a region exposed to a range of significant geophysical and climatic hazards. Fiordland is considered one of the most seismically active areas in New Zealand.

Earthquakes

: The Fiordland region has experienced a number of significant earthquakes in the historical period, including 18 $M_w > 6.0$ in the last 85 years.[194] These earthquakes were generated by active faults in proximity to the Puysegur subduction zone and the southern extent of the Alpine Fault.

Examples of large Fiordland earthquakes in the last 30 years include:

- 2009 M_w 7.8 Dusky Sound earthquake.[195]
- 2007 M_w 6.7 George Sound earthquake.[196]
- 2003 M_w 7.2 Fiordland earthquake.[193] [197]
- 1993 M_w 7.0 Fiordland earthquake.[198]
- 1993 M_w 6.8 Secretary Island earthquake.[199]

Alpine Fault: The Alpine Fault is a 450 km long plate boundary transform fault,[199] with the southern extent tracking off the coast at Piopiotahi Milford Sound, linking into the offshore Puysegur Subduction Zone.[200] The last recorded rupture of the Alpine Fault was in 1717AD. Evidence of past earthquakes suggests the Alpine Fault has a long history of producing large magnitude earthquakes, with 27 events recorded over the last 8000 years.[201] Based on this evidence, the Alpine Fault has a calculated recurrence interval of ca. 280-300 years.[202]

More recently, emerging science has increased the probability of a large-magnitude Alpine Fault earthquake from 29% to 75% probability in the next 50 years.[204] [205] There is an 82% likelihood that the next event will be > M_w 8.2.[205] An event of this magnitude would cause widespread damage and disruption across the South Island, and would trigger a range of secondary hazards, including landslides, rockfall, liquefaction and local tsunamis.[203] This makes the Alpine Fault the most significant geohazard in Fiordland and the South Island.[194]

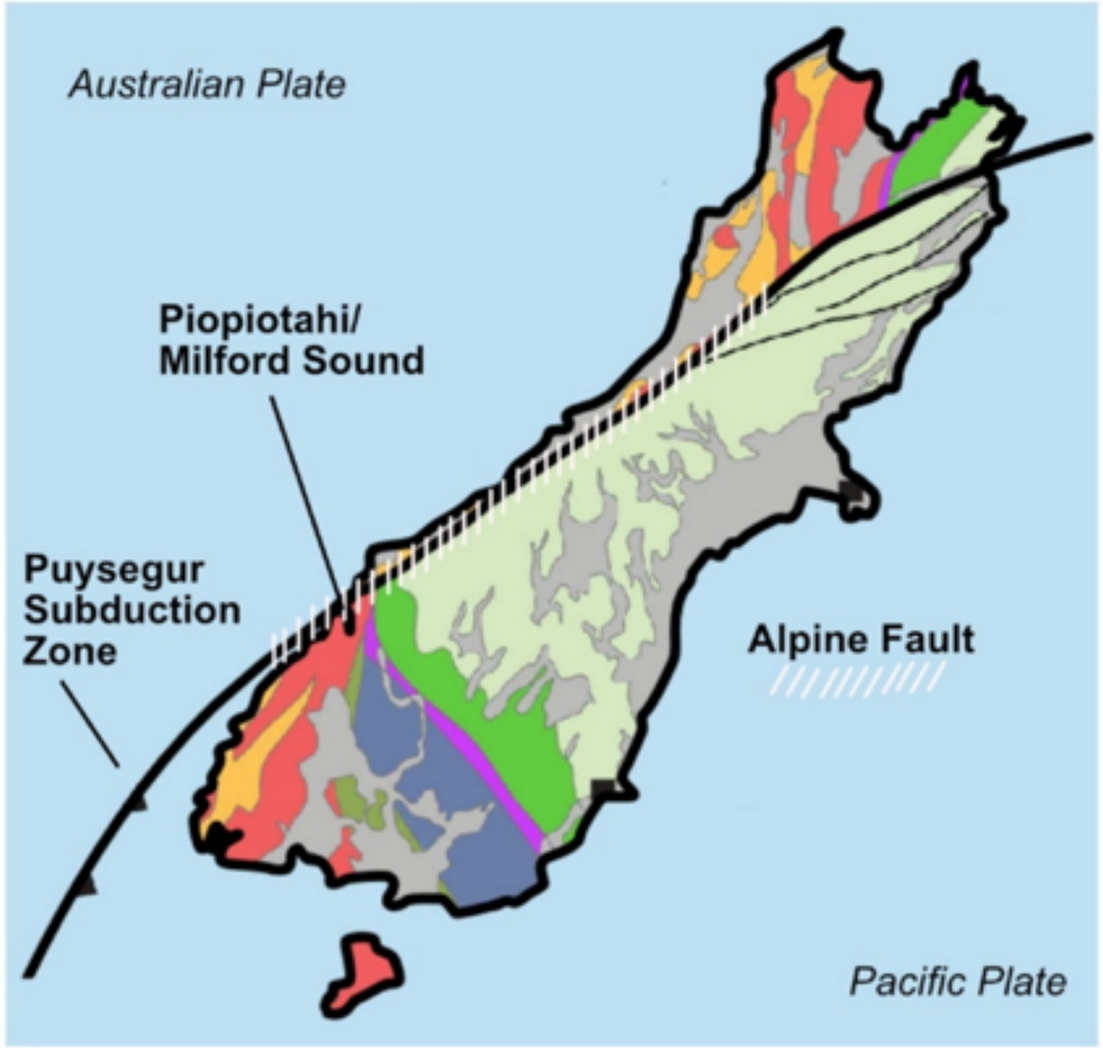


Figure 10. Geological map of New Zealand's South Island, showing the location of Piopiotahi Milford Sound relative to the Alpine Fault and the plate boundary (dark line bisecting the South Island).

Landslides

Large magnitude earthquakes in mountainous regions commonly trigger slope failure and landslides.[194] Estimates of earthquake-induced landslides for a future Alpine Fault earthquake scenario suggest that up to 70,000 landslides will be triggered across the Southern Alps,[204] affecting an area over 30,000 km^2 (larger than the province of Otago), and moving >1 billion m^3 of material.[205] Landslides can disrupt critical infrastructure, including roads, bridges and trains, as observed during the Kaikōura earthquake in 2016.[206] Where landslides or rockfall enter bodies of water, such as rivers, lakes or fiords, localised tsunamis can occur.

Landslides in Fiordland: Landslides are a significant hazard in Fiordland due to the steep nature of its topography combined with very high annual rainfall, exceeding 12 m/year,[207] and local seismic hazards.[202] During a period of extended rainfall, the landslide severity increases due to saturated ground conditions.[208]

The 2003 M_w 7.2 Fiordland earthquake triggered over 400 landslides, including large debris flows falling 1000 m downslope, moving up to 700,000 m^3 of material. Landsliding events such as this are likely to occur on average every 50 years.[193] Another example is the AD1826 M_w 7.6–7.8 Fiordland earthquake, which caused landslides widely across >200 km of the Fiordland coast.[209]

Landslide-induced tsunamis: In Fiordland, the presence of deep fjords and high elevation produces significant landslide-induced tsunami hazard risks. At Piopiotahi Milford Sound, landslides can fall up to 1650 m down near-vertical slopes, resulting in high impact velocities of material hitting the water.[210] Piopiotahi Milford Sound contains evidence of at least 17 rock avalanches of high volume (3 x 10^6 m^3) triggered by past Alpine Fault ruptures.[213] The waves generated by these rockfalls have been estimated to reach up to 47 m in height and can travel the length of Piopiotahi Milford Sound in as little as 2 to 5 minutes,[213] with little to no warning.[211] The next Alpine Fault earthquake has an estimated 44% probability of generating a landslide-induced tsunami in Piopiotahi Milford Sound.[212]

Landslide-induced tsunamis in Piopiotahi Milford Sound can be triggered by a number of different local earthquake sources, including the Alpine Fault and Puysegur Subduction zone. For example, the 2003 M_w 7.2 Fiordland earthquake caused a large rockslide into Gold Arm of Charles Sound that generated a 2 m tsunami. Tsunami waves propagated 800 m across the water, damaging a helipad wharf, and vegetation up to 4 m above the shoreline [193] [213] (Figure 11).

A previous risk assessment of landslide-induced tsunami at Piopiotahi Milford Sound carried out in 2015 [215] indicated that 'the societal risk (the risk of multiple deaths in one event) from a landslide-generated tsunami at Piopiotahi Milford Sound is significant but not exceptional.[215] This analysis was based on a 25% probability of an Alpine Fault earthquake within 50 years and annual Piopiotahi Milford Sound visitor numbers of 640,000. Since then, the exposure of Piopiotahi Milford Sound has increased in light of the updated Alpine Fault probability (75% in the next 50 years)[205] and an increase in visitor numbers to more than 850,000.[195]

Tsunami evacuation modelling results for Piopiotahi Milford Sound [214] indicate that in the event of landslide-induced tsunami, safe evacuation of people from tourist facilities (including the marina) will be extremely difficult due to the short wave arrival time.[214] A recent University of Canterbury study reports that a tsunami in Piopiotahi Milford Sound triggered by a landslide could result in no survivors among visitors on land and a best case scenario of 5% survival.[214]

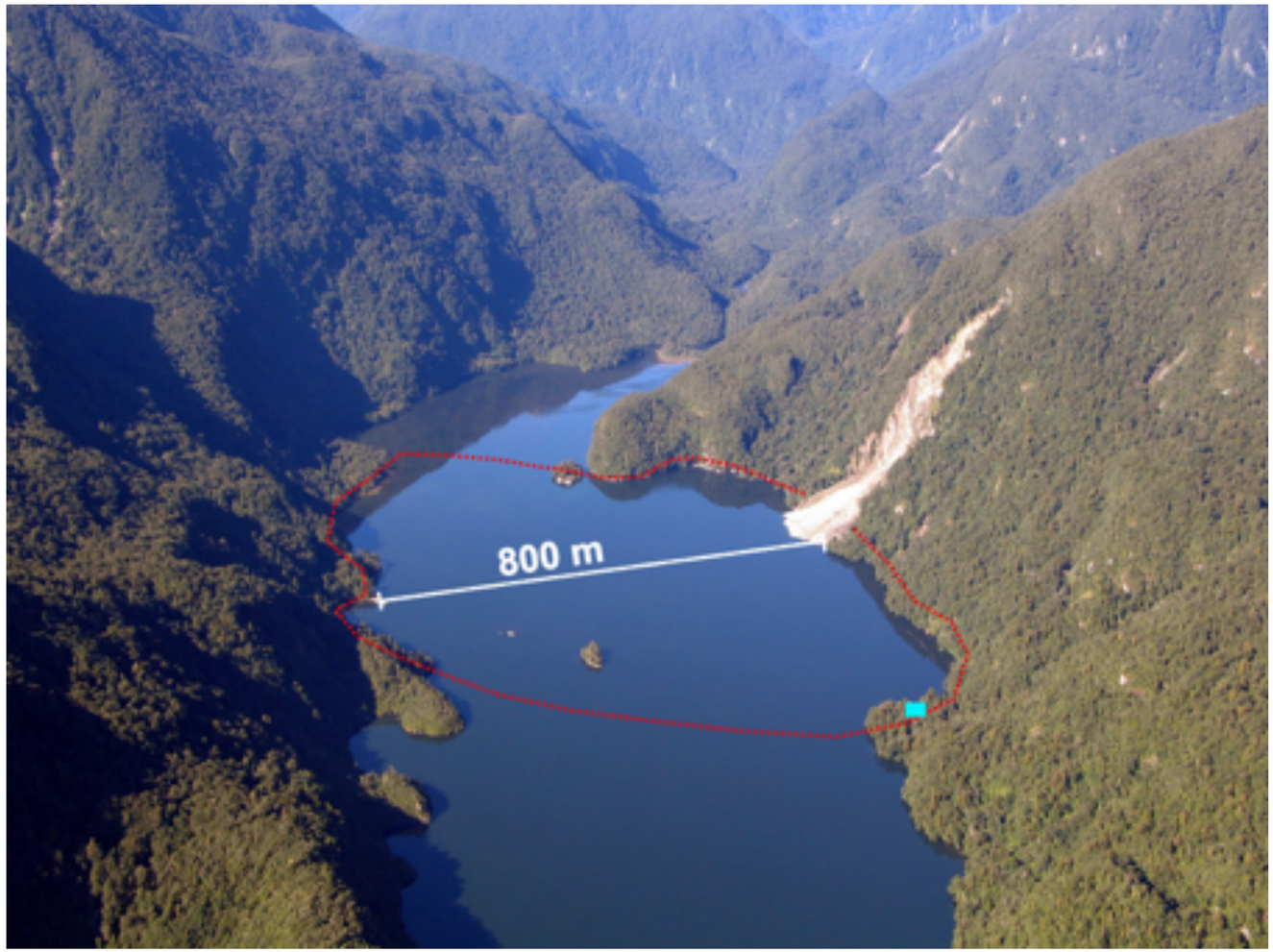


Figure 11. Aerial photo of the Gold Arm rockslide in Charles Sound that produced a tsunami. Tsunami extent is represented by red dotted line, and location of damaged helipad is represented by a blue square. (Photograph: Graham Hancox. Permission: GNS Science).

Global examples of landslide-induced tsunami

In other parts of the world, smaller-magnitude earthquakes have been known to generate landslide tsunamis. A 2007 M_w 6.2 earthquake near Aysen Fjord, Chile, triggered two rock avalanches 8–12 x 10^6 m^3 in volume that caused a tsunami in the fjord, killing 10 people.[215]

Norway: The three most significant natural hazard events disasters in Norway since 1900 have all been landslide-induced tsunamis.[216] As a result, landslide-induced hazard management takes high priority in Norway. In contrast to Fiordland, most landslides in the Norwegian fjords are caused by slow-moving failures on the surrounding hillsides. These high-risk areas are continuously monitored, providing early warning to vulnerable communities.

Tajford, Norway: In 1934, a rock landslide 3 x 10^6 m^3 in volume occurred from a height of 700 m created a fjord tsunami that reached a height of 62 m killing 41 people. The narrow and winding shape of the fjord trapped the energy of the waves, amplifying the effects of the initial wave.[217] The bathymetry (water depth) and topography of Piopiotahi Milford Sound are comparable to the Norwegian setting, as well as the potential height and volume of rockfalls that could occur.[213]

Loen, Norway: In 1936 a similar volume rockfall fell 400–800 m into Loenvann Lake, generating a 74 m high wave that travelled across the lake and into the village of Loen, causing 73 deaths (more than one-third of the population) up to 15 km away from the impact.[218] A similar tsunami in the same location in 1905 had killed 61 people. Modelling indicates that a scenario like this could occur in Deepwater Basin, which is the deepest part of Piopiotahi Milford Sound.[213]

Lituya Bay, Alaska: One of the largest mega-tsunamis on record was generated by a rockfall at the fjord of Lituya Bay, Alaska, in 1958. A M_w 7.7–8.3 earthquake on the nearby Fairweather Fault caused a landslide of 30 x 10^6 m^3 that fell 915 m into Lituya Bay. The resulting 150 m high mega-tsunami travelled 11 km through the bay, reaching speeds of 200 km/h, with a runup height opposite the landslide of 524 m.[219] This wave destroyed over 10 km^2 of forest on the shoreline, sunk boats, and killed 2 people.[30] The death toll was relatively low due to Lituya Bay's extreme isolation.

The close proximity of Lituya Bay to the Fairweather Fault is similar to the proximity of Piopiotahi Milford Sound's to the Alpine Fault.[208] Piopiotahi Milford Sound is also similar to Lituya Bay in terms of observed rockfall heights, fjord depths (200–300 m), and fjord length and width. Moreover the geometry of Piopiotahi Milford Sound is more complex, which could amplify tsunami waves more than the relatively simple shape of Lituya Bay. Population exposure is larger in Piopiotahi Milford Sound compared to the isolation of Lituya Bayl due to the level of tourism development.

Ocean-generated tsunamis

Ocean-generated tsunamis also pose a threat to Piopiotahi Milford Sound. The 2021 NZ National Tsunami Hazard Model[220] provides maximum probabilistic tsunami runup height estimates of 10–12 m at the Piopiotahi Milford Sound coast (Figure 3). This model combines tsunami scenarios from both distant and local sources, with the most significant local risk derived from the Puysegur Subduction Zone off the Fiordland coast.

Modelling of a M_w 7.3 Puysegur Subduction Zone earthquake indicates a fast-moving ocean tsunami would arrive on land within minutes.[221] Such a tsunami could be expected to bring approximately 4 m high waves,[222] [223] with wave amplification occurring as the tsunami moved into the confined area of the fjord.

Historical reports of ocean-generated tsunami in Fiordland include the following:

- 1826 Fiordland earthquake tsunami, which inundated Doubtful Sound and as far north as Okarito Lagoon, near Hokitika.[206]
- 2003 Fiordland M_w 7.2 earthquake generated a tsunami, which raised the seabed by up to 45 cm.[216]
- 2009 Dusky Sound M_w 7.8 earthquake generated a tsunami, which arrived within 15 minutes of the earthquake with a wave height of 2 m at Dusky Sound and waves continuing for up to 2 hours.[224]

Cruise ships in Piopiotahi Milford Sound during an emergency

Earthquakes, landslides, landslide-induced tsunamis, and ocean-generated tsunamis all pose significant risks to cruise ships and passengers in Piopiotahi Milford Sound. The shortest estimated wave arrival time for tsunamis is 2 minutes. Such limited timeframes negate immediate warning communications and attempts to evacuate tourists and staff from Piopiotahi Milford Sound.[214] It is currently unclear how cruise ships should respond to a landslide-induced tsunami due to limited warning and reaction times.

International recommendations for ships in the event of an earthquake are as follows:[225]

1. Ships in port: Abandon vessels. Once the shaking stops, persons should immediately evacuate on foot to the safest place on land.
This recommendation is not feasible because large cruise ships do not dock in Piopiotahi Milford Sound. Regardless tsunami evacuation modelling[214] shows that even the best-case scenario tsunami evacuation plan would be insufficient due to lack of time. The disembarking time for 145 passengers on a ship under normal conditions is approximately 5 minutes. The numbers of passengers on large cruise ship would be impossible to disembark before the arrival of the first wave.[214]

2. Ships at sea: Vessels should stay offshore in at least 100 m in depth (recommended by UNESCO, 2008).
Piopiotahi Milford Sound is a fiord arm and landslide-induced and ocean tsunamis would arrive within a short timeframe giving no opportunity to move to offshore waters at short notice. Due to the specific context of Piopiotahi Milford Sound, neither of these two recommended emergency responses are feasible.

Diesel spill: Landslide-induced tsunami waves have the potential to affect large cruise ships. In the worst case tsunami waves may lead to capsize of vessels. Tsunami waves may also trigger a cascade of secondary hazards that present additional risks to people and the environment. An example is the 1964 Good Friday earthquake and tsunami in Prince William Sound in Alaska. The earthquake triggered a 9 m high landslide-induced tsunami and multiple ocean-generated tsunamis up to 12 m high, with subsequent waves arriving at the coast for hours afterwards; one of the most destructive waves arrived 5 hours after the earthquake.[226] A tanker docked in the area rolled sharply in the waves, causing diesel fuel to spill into the water. The fuel caught fire, and burning fuel was carried to the shore by the tsunami waves, resulting in the ignition of the petroleum tanks of an onshore train, with 40 tanks exploding in succession. Residents attempted to evacuate but were trapped in the area for three days as the causeway to exit the area had been washed away.[228]

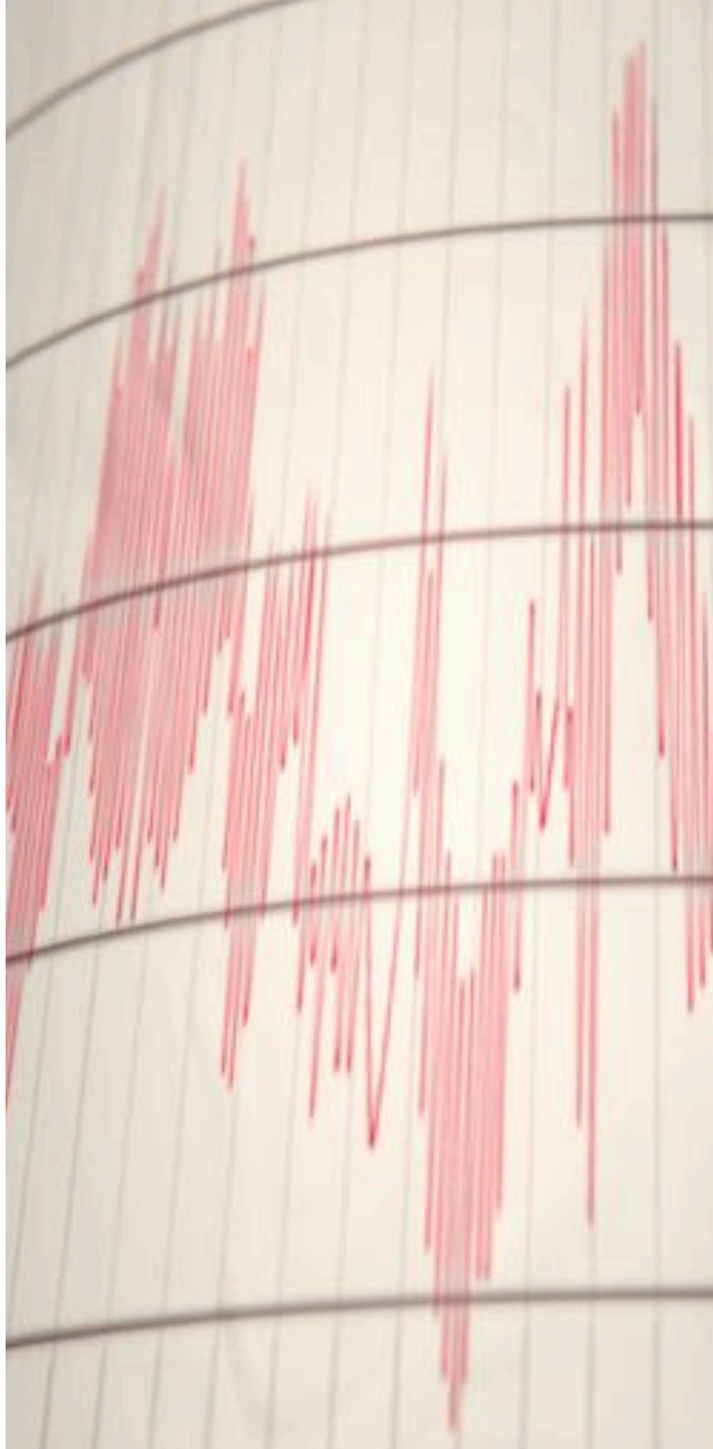
Oil spill: A cruise ship being damaged, running aground, or capsizing as a result of an earthquake or tsunami brings the risk of oil spill. In the event of an oil spill, cruise ships that use HFO present a particularly high risk to marine environments. HFO emulsifies in the water and can be ingested by aquatic wildlife.[203]

New Zealand's worst marine disaster was the MV Rena, which struck the Astrolabe Reef off the coast of Tauranga in 2011.[227] It released approximately 350 tonnes of heavy fuel into the marine environment, resulting in significant environmental damage to wildlife and biodiversity, and $47M in clean-up costs funded by the taxpayer.[227]

Egan[2278]presents estimates of the direct costs associated with oil spills in populated (Bay of Plenty) and remote (Piopiotahi Milford Sound) marine locations. She compares the logistics of oil spill response in different locations based on remoteness, which has implications of speed and duration of response. Her research also examines the potential environmental impacts and probable direct costs for the tourism and fishing industries. This is one of few pieces of research that that address the direct economic consequences of oil spills globally. [228]

The direct costs of the *MV Rena* oil spill were estimated to fall between $NZ 99.06 and $NZ 115.38 million (2021). By comparison the potential minimum direct cost of an oil spill in Piopiotahi Milford Sound was estimated to be in the range of $NZ 140.235 and $NZ 770.177 million (2021). These Piopiotahi Milford Sound estimates use pre-COVID visitor numbers.[228]

Egan argues that such estimates are important for planning in New Zealand due to its relatively small economy, the economic value of the coastal and marine environment, and the importance of the marine environment to the people of New Zealand. She also argues that such estimates should inform New Zealand coastal and marine policies to ensure that key agencies are suitably and adequately prepared in order to mitigate human and environmental risks and minimise the potential environmental damage and economic costs in the event of an oil spill. [228]



Summary

- The Fiordland region is one of the most seismically active areas in New Zealand. The Alpine Fault and the Puysegur Subduction Zone, coupled with Fiordland's high average rainfall and steep mountainous terrain, result in the potential for a range of natural hazards including earthquakes, landslides, and tsunamis.
- The cruise sector in Piopiotahi Milford Sound is exposed to many of these risks, particularly the potential for rockfall or landslide-induced tsunami in the fiord, which can generate large destructive waves. The potential risks to life and the environment in such an event are high.
- Ocean-generated tsunami, particularly from earthquakes on the Puysegur Subduction Zone, present an additional significant risk.
- Future targeted risk assessment is required to understand the implications of environmental hazards for the cruise sector, including an urgent need to consider how to mitigate risks to life, develop evacuation plans and manage the potential environmental impacts.
- The economic costs associated with significant natural hazard events in future should be accommodated in environmental risk management planning.

Key Terms

Subduction zone
A tectonic plate boundary where one plate sinks down into the mantle beneath the other.

Liquefaction
A process that causes soil to behave like a liquid during strong ground shaking.

Landslide
The movement of a mass of rock, soil, or debris down a slope.

Rockfall
The movement of a mass of rock down a steep slope. Rockfalls are the fastest type of landslide and occur most frequently in mountains.

Debris flow
A distinct type of rapid mass movement commonly triggered by intense rainfall and/or melting snow on steep hill slopes. It differs from landslide in its "flowing" nature.

Recurrence interval
The average time between earthquakes on a fault or fault system.

Tsunami
A series of waves in a water body caused by the displacement of a large volume of water.

Runup
A measurement of a tsunami wave height as it arrives onshore, observed above a reference sea level.

Wave refraction
The process by which the direction of waves approaching a shoreline is altered by interaction with the sea floor.

Wave reflection
Occurs when a wave bounces off of a hard surface, such as a seawall or a rocky coast, changing the direction of the wave.

Wave amplitude
The height of the wave above the still water line.

References

192. Norris, R. J., & Cooper, A. F. (2001). Late Quaternary slip rates and slip partitioning on the Alpine Fault, New Zealand. *Journal of Structural Geology*, *23*(2-3), 507-520.
193. Hancox, G. T., Cox, S. C., Turnbull, I. M., & Crozier, M. J. (2003). Reconnaissance studies of landslides and other ground damage caused by the M_w7.2 Fiordland earthquake of 22 August 2003. *Institute of Geological and Nuclear Sciences science report*, *30*, 2003.
194. U.S. Geological Survey, Earthquake Hazards Program, 2017, Advanced National Seismic System (ANSS) Comprehensive Catalog of Earthquake Events and Products: Various, https://doi.org/10.5066/F7MS3QZH (accessed 19 April 2024)
195. Beavan, J., Samsonov, S., Denys, P., Sutherland, R., Palmer, N., & Denham, M. (2010). Oblique slip on the Puysegur subduction interface in the 2009 July M_w 7.8 Dusky Sound earthquake from GPS and InSAR observations: implications for the tectonics of southwestern New Zealand. *Geophysical Journal International*, *183*(3), 1265-1286.
196. Petersen, T., Ristau, J., Beavan, J., Denys, P., Denham, M., Field, B., ... & Samsonov, S. (2009). The M_w 6.7 George Sound earthquake of October 15, 2007: response and preliminary results. *Bulletin of the New Zealand Society for Earthquake Engineering*, *42*(2), 129-141.
197. Robinson, R., Webb, T., McGinty, P., Cousins, J., & Eberhart-Phillips, D. (2003). The 2000 Thompson Sound earthquake, New Zealand. *New Zealand journal of geology and geophysics*, *46*(3), 331-341.
198. Van Dissen R, Cousins J, Robinson R, Reyners M (1994) The Fiordland earthquake of 10 August, 1993: A reconnaissance report covering tectonic setting, peak ground acceleration, and landslide damage. *Bulletin of the New Zealand Society for Earthquake Engineering 27*:147–154. https://doi.org/10.5459/bnzsee.27.2.147-154
199. Norris, R. J., Koons, P. O., & Cooper, A. F. (1990). The obliquely-convergent plate boundary in the South Island of New Zealand: implications for ancient collision zones. *Journal of structural geology*, *12*(5-6), 715-725.
200. Fry, B., Bannister, S., Beavan, J., Bland, L., Bradley, B., Cox, S., ... & Wilson, K. (2010). The M_w 7.6 Dusky sound earthquake of 2009: Preliminary report.
201. Berryman, K., Cooper, A., Norris, R., Villamor, P., Sutherland, R., Wright, T., ... & Biasi, G. (2012). Late Holocene rupture history of the Alpine fault in south Westland, New Zealand. *Bulletin of the Seismological Society of America*, *102*(2), 620-638.
202. Howarth, J. D., Barth, N. C., Fitzsimons, S. J., Richards-Dinger, K., Clark, K. J., Biasi, G. P., ... & Sutherland, R. (2021). Spatiotemporal clustering of great earthquakes on a transform fault controlled by geometry. *Nature Geoscience*, *14*(5), 314-320.

204. Wells, J. R. G. A., Chagué-Goff, C., Nichol, S. L., & Devoy, R. J. (2004). The elusive AD 1826 tsunami, South Westland, New Zealand. *New Zealand Geographer*, *60*(2), 28-39.
205. Robinson, T. R., Davies, T. R., Wilson, T. M., Orchiston, C., & Barth, N. (2016). Evaluation of coseismic landslide hazard on the proposed haast-hollyford highway, south island, new zealand. *Georisk: Assessment and Management of Risk for Engineered Systems and Geohazards*, *10*(2), 146-163.
206. Robinson, T. R., & Davies, T. R. H. (2013). Potential geomorphic consequences of a future great (M w= 8.0+) Alpine Fault earthquake, South Island, New Zealand. *Natural Hazards and Earth System Sciences*, *13*(9), 2279-2299.
207. Cubrinovski, M., Bradley, B. A., Elwood, K. J., Johnston, D., Orchiston, C., Sullivan, T., & Wotherspoon, L. M. (2020). Wellington's earthquake resilience: Lessons from the 2016 Kaikōura earthquake. *Earthquake Spectra*, *36*(3), 1448-1484.
208. Ministry for the Environment. (2023). *Annual and seasonal rainfall at 30 sites, state, 1960 - 2022* [Data set]. https://data.mfe.govt.nz/layer/115364-annual-and-seasonal-rainfall-at-30-sites-state-1960-2022/ (accessed 28 May 2024).
209. Hancox, G. T., Perrin, N. D., & Dellow, G. D. (2002). Recent studies of historical earthquake-induced landsliding, ground damage, and MM intensity in New Zealand. *Bulletin of the New Zealand Society for Earthquake Engineering*, *35*(2), 59-95.
210. Wells JRGA, Chagué-Goff C, Nichol SL, Devoy RJN (2004) The Elusive AD 1826 Tsunami, South Westland, New Zealand. New Zealand Geographer 60:28–39. https://doi.org/10.1111/j.1745-7939.2004.tb01710.x
211. Dykstra, J. L. (2012). *The Post-LGM Evolution of Milford Sound, Fiordland, New Zealand: Timing of Ice Retreat, the Role of Mass Wasting & Implications for Hazards* [Master's thesis, University of Canterbury].
212. Harris, O. L. (2023). *Agent-based modelling of evacuation scenarios for a landslide-generated tsunami in Milford Sound* [Master's thesis, University of Canterbury].
213. Taig, T., McSaveney, M. J. (2015). Milford Sound risk from landslide-generated tsunami, Report 2014/224 by GNS Science for Environment Southland.
214. Power, W., Downes, G., McSaveney, M., Beavan, J., & Hancox, G. (2005). The Fiordland earthquake and tsunami, New Zealand, 21 August 2003. *Tsunamis: Case Studies and Recent Developments*, 31-42.
215. Radio New Zealand (2024). Best-case scenario: 5% survive Milford Sound tsunami. 13 June 2024. https://www.rnz.co.nz/news/national/519488/best-case-scenario-5-percent-survive-milford-sound-tsunami
216. Sepúlveda, S. A., Serey, A., Lara, M., Pavez, A., & Rebolledo, S. (2010). Landslides induced by the April 2007 Aysén fjord earthquake, Chilean Patagonia. *Landslides*, *7*, 483-492.
217. Eidsvig, U. M., Medina-Cetina, Z., Kveldsvik, V., Glimsdal, S., Harbitz, C. B., & Sandersen, F. (2011). Risk assessment of a tsunamigenic rockslide at Åknes. *Natural hazards*, *56*, 529-545.
218. Harbitz, C. B., Løvholt, F., Pedersen, G., & Masson, D. G. (2006). Mechanisms of tsunami generation by submarine landslides: a short review. *Norwegian Journal of Geology/Norsk Geologisk Forening*, *86*(3).
219. Jorstad, F. A. (1968). Waves generated by landslides in Norwegian fjords and lakes. *Norwegian Geotechnical Institute Publ*.
220. Miller, D. J. (1960). The Alaska earthquake of July 10, 1958: giant wave in Lituya Bay. *Bulletin of the Seismological Society of America*, *50*(2), 253-266.
221. GNS Science. (2021). *National Tsunami Hazard Model - 2021*. [Data set]. https://doi.org/10.21420/C3CK-FB93 (accessed 27 April 2024).
222. Hayes, G. P., & Furlong, K. P. (2010). Quantifying potential tsunami hazard in the Puysegur subduction zone, south of New Zealand. *Geophysical Journal International*, *183*(3), 1512-1524.
223. Downes, G., Cochran, U., Wallace, L., Reyners, M., Berryman, K., Walters, R., ... & Bell, R. (2005). Understanding local source tsunami: 1820s Southland tsunami. *Earthquake Commission of NZ Res. Rep*, *3*(490), 92.
224. Barnes, P. M., Bostock, H. C., Neil, H. L., Strachan, L. J., & Gosling, M. (2013). A 2300-year Paleoearthquake record of the southern Alpine Fault and Fiordland Subduction zone, New Zealand, based on stacked Turbidites. *Bulletin of the Seismological Society of America*, *103*(4), 2424-2446.
225. Uslu, B., Power, W., Greenslade, D., Eblé, M., & Titov, V. (2011). The July 15, 2009 Fiordland, New Zealand tsunami: Real-time assessment. *Pure and applied geophysics*, *168*, 1963-1972.
226. NSF/PRSN/NOAA-NWS. (2011). Tsunami Guideline Plan for Operators of Caribbean Ports.
227. Wood, N. J., Schmidtlein, M. C., & Peters, J. (2014). Changes in population evacuation potential for tsunami hazards in Seward, Alaska, since the 1964 Good Friday earthquake. *Natural Hazards*, *70*, 1031-1053.
228. Egan, A. L. (2023). *Direct economic losses of oil spills in populated and remote locations within New Zealand.* A thesis presented in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Veterinary Science at Massey University, Palmerston North, Manawatu, New Zealand [Doctoral thesis].

Chapter 3.1

Media Analysis: New Zealand

Methodology

A qualitative media analysis was conducted to provide structured insights into New Zealand media reporting on the impacts of cruise in New Zealand. The periods 2016-2019 (pre-COVID) and 2020-2023 (post-COVID) were addressed separately to capture reporting arising from changes to cruise in New Zealand following the COVID-19 disruption. National and regional media reporting during these time periods were analysed separately to investigate variance in media reporting across regions and news outlets. The scope of the analysis was contained by selected news media outlets, correctness checking, and selection of the most relevant items. The data was organised and analysed in relation to three major impact categories; economic, environmental and social. References to cultural costs and benefits were also recorded but not included in the analysis.

Four national and three regional New Zealand news outlets were selected for analysis:

National:

- The New Zealand Herald
- The Press (Christchurch)
- Otago Daily Times
- Sunday Star Times

Regional:

- Bay of Plenty Times
- Hawke's Bay Today
- The Southland Times

Data collection used the Factiva media database because of its coverage and data export functionality. Factiva is one of the leading global providers of economic and financial information and offers access to a wide variety of global newspaper publications, going back to 1980. Using Factiva, two methods were trialled for data collection to optimize dataset manageability and ensure comprehensive, unbiased coverage. Both approaches used search settings to limit results to selected news outlets and were set from January 1st to December 31st of the two specified periods. The first approach involved searching "cruise" and "ship" along with pre-determined keywords, such as community, residents, emissions, pollution, management, or cost, aiming to find news articles relevant to the impacts of cruise. However, challenges emerged in tracking collected articles and there was risk of negative bias through the selection of search terms. The second approach involved searching "cruise" and "ship", without the addition of pre-determined keywords, to search for all articles in the specified periods that mentioned cruise ships. While this resulted in a much larger number of results, it allowed the researchers to achieve unbiased, comprehensive coverage, and provided a clear scope of the dataset from the outset. After trialling both approaches, the second approach was selected for data collection.

By limiting searches to the selected news outlets and time periods, a total of 18 searches were made (see Table 1 and 2 for search outputs). Each search result underwent a relevance selection process, wherein articles were read to determine relevance to the objectives of the analysis. Articles that only briefly mentioned cruise and/or were not relevant to the research were not selected for analysis. For example, articles that detailed cruise ship amenities or recounted historical cruise voyages were deemed to be irrelevant to the project. Articles that were deemed relevant were selected in Factiva and exported into a PDF file (see Table 1 and 2 for number of articles selected for analysis).

All articles in the exported PDFs were thoroughly read and analysed. The reported impacts were systematically coded and documented as either social, economic, or environmental impacts in an excel spreadsheet. Multiple impacts could be collected from one news article. Where articles were found to not provide relevant information no data record was taken (e.g., descriptive articles that did not report or discuss any specific impacts of cruise). Data was organized in groupings of national news outlets pre-COVID, national news outlets post-COVID, regional news outlets pre-COVID and regional news outlets post-COVID, each in a separate excel database (see Supplementary Materials). Recorded information included article titles, dates, and news outlet sources, relevant codes, and illustrative verbatim extracts. Each impact was recorded as either a positive (benefit) or negative (cost) impact of cruise. This process allowed the development of a comprehensive database of New Zealand media reporting on the impacts of cruise.

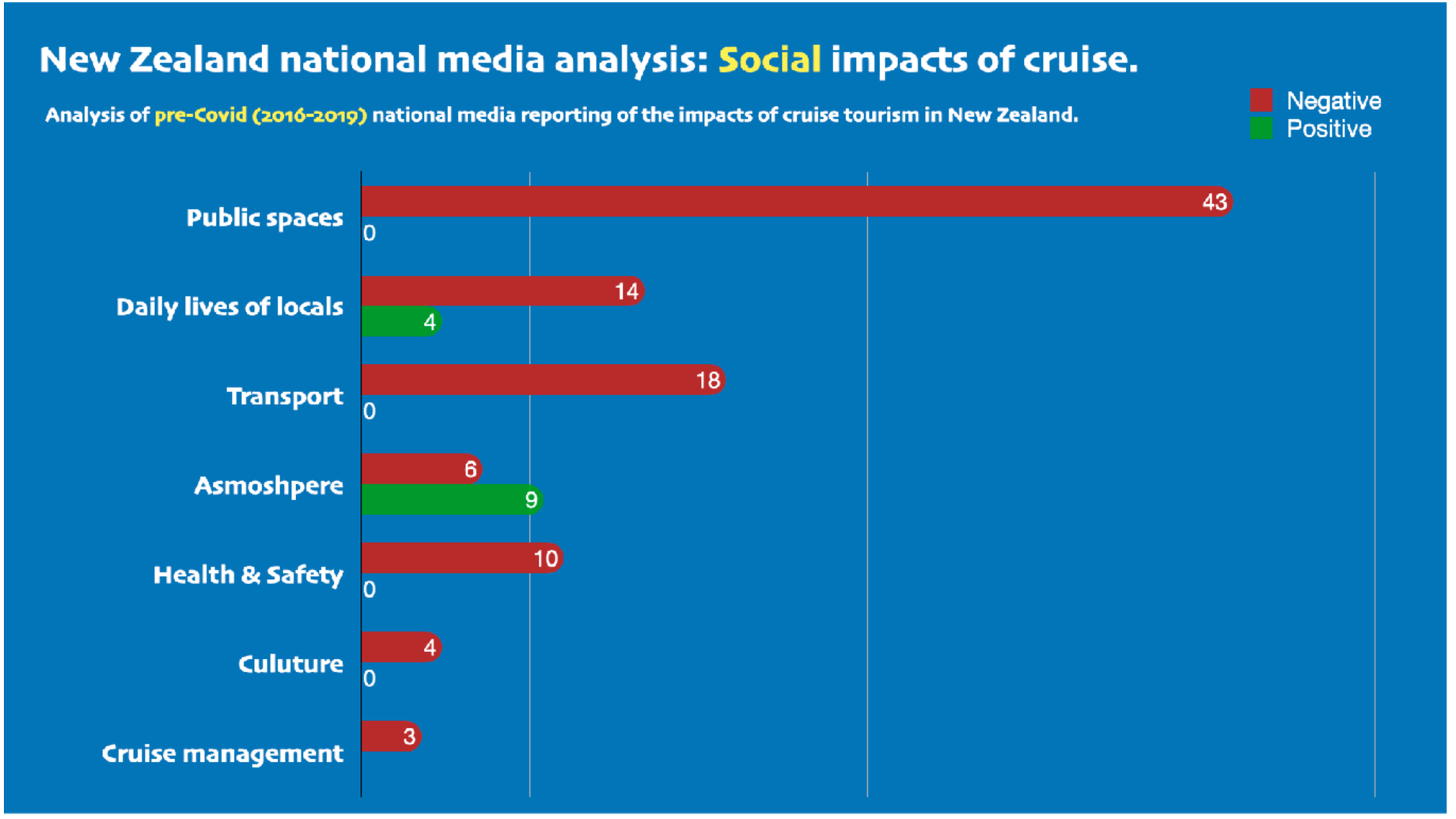
Following the initial analysis, the databases underwent a secondary analysis phase, during which codes were refined and categorized into thematic groupings with subcodes. This process allowed for the determination of the specific social, economic, and environmental impacts of cruise that were reported in different regions and/or time periods, which impacts received the most attention and how they were framed by different news outlets. The analysis extended to recording the stakeholders who were given a voice in media reporting.

The results below are presented in summary form. Full reporting of the national and regional media analyses (pre- and post-COVID) including extensive verbatim extracts from media reports are available in the Appendices.

National News Outlets pre-Covid (2016-2019)

Social impacts

Between 2016 and 2019, national New Zealand news outlets documented a total of 111 social impacts, 13 of which were positive, and 98 were negative. The key themes that emerged from the data were cruises impact on public spaces, the daily lives of locals, transportation, city atmosphere, health and safety, the influence of cruise management on locals, and cultural aspects. Notably, much of the discussion centred around the impact of cruise in Akaroa. The Press documented the most social impacts, with 42, in comparison to other national outlets that documented between 8 and 30 social impacts during this period. The three most cited, and only cited positive social impacts of cruise, were cruise passengers creating a sense of vibrancy in towns, cruise providing a sense of connection to the world and locals feeling a sense of city pride. The most reported negative social impacts during this period related to cruises' impact on public spaces, and included overwhelmed infrastructure, overcrowding when cruises were in port, and cruise infrastructure dominating public spaces.

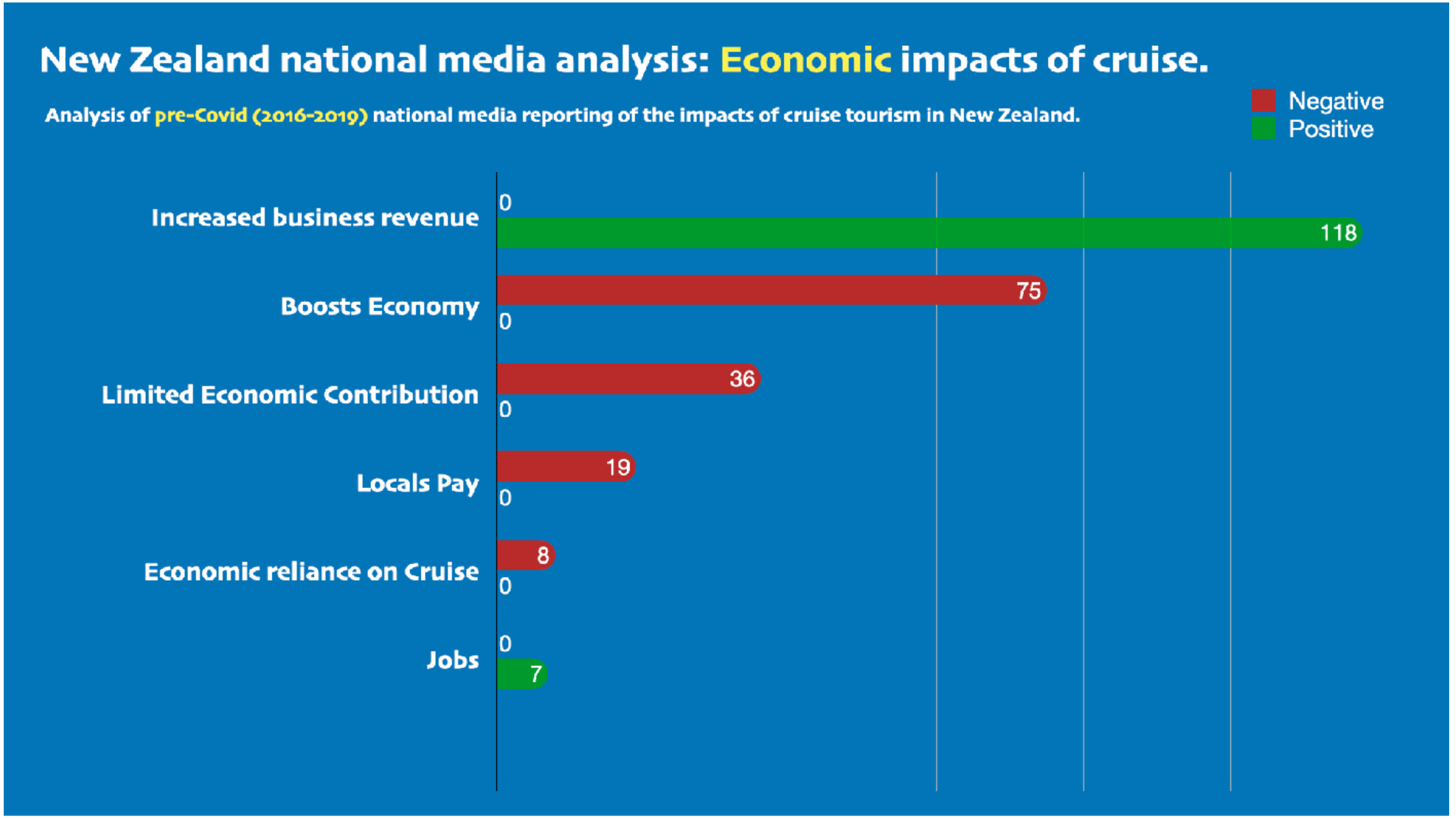


National News Outlets pre-Covid (2016-2019)

Economic impacts

Between 2016 and 2019, national New Zealand news outlets documented a total of 262 economic impacts, 62 of which were negative, and 200 were positive. The economic impacts of cruise were documented more than the total number of social and environmental impacts of cruise in the pre-COVID period. The key themes that emerged from the data were increased business revenue, boost to the economy, limited economic contribution, locals paying for cruise, economic reliance on cruise, and jobs provided by the cruise industry. The Otago Daily Times covered the economic impacts of cruise more than other news outlets with 90 mentions, compared to other news outlets that reported between 12 and 67 impacts.

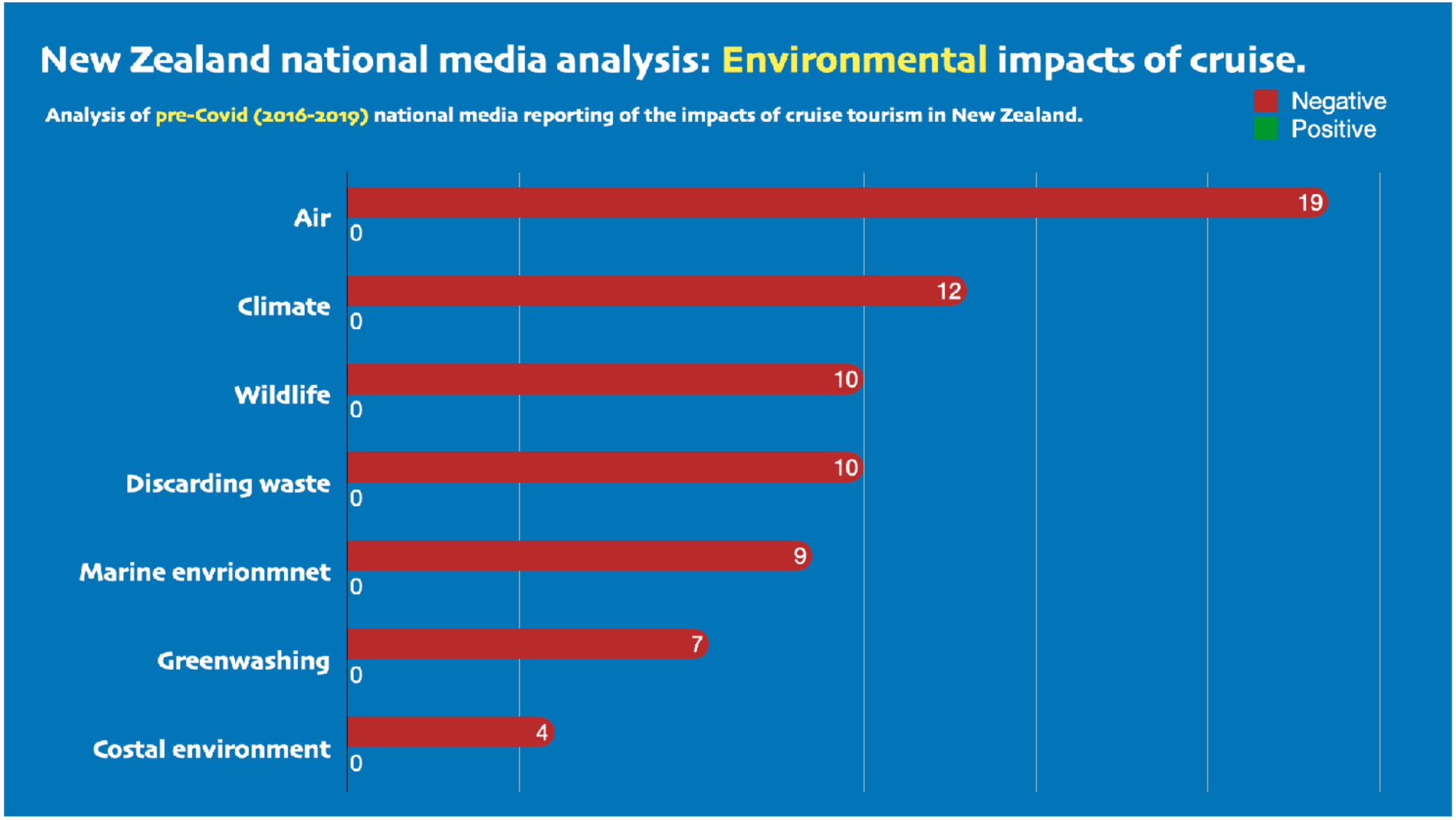
The primary positive outcomes frequently highlighted were the increased revenue for businesses when a cruise was in port, and the impact of the cruise industry on local economies. The most commonly cited negative economic impacts of cruise were ratepayers having to subsidize cruise infrastructure, and the economic benefits of cruise not contributing to port towns.



National News Outlets pre-Covid (2016-2019)

Environmental impacts

Between 2016 and 2019, national news outlets documented the environmental impacts of cruise, with 71 negative impacts and no positive impacts reported. The environmental impacts of cruise received the least coverage of the three dimensions of impact. The highlighted themes revolved around concerns regarding cruise ships' adverse effects on air quality, climate, marine environments, coastal environments, and wildlife, as well as cruise waste disposal practices and potential industry greenwashing. While all major news outlets covered these environmental impacts, the Dominion Post stood out during this period, leading the coverage with 22 mentions, compared to other news outlets, which made between 8 and 16 mentions. The most reported negative impacts were air pollution created by cruise ships, carbon emissions and wastewater polluting marine environments.



Summary of findings

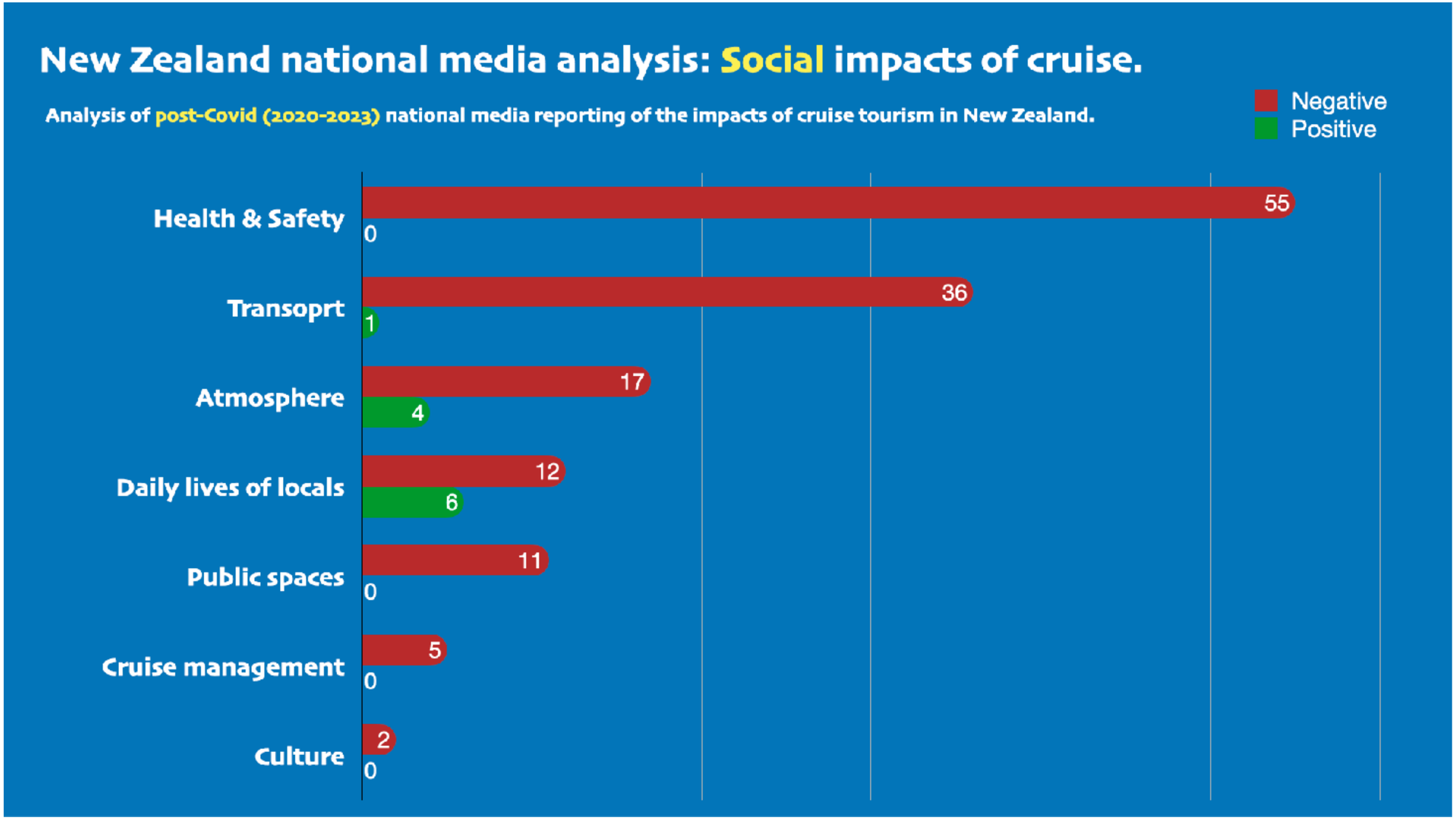
- Consistent with post-COVID reporting, the economic impacts received the most attention overall from national news outlets (n=262), while the environmental impacts received the least attention (n=71).
- The Otago Daily Times had a predominantly positive outlook on the cruise industry, with 83 positive and 45 negative impacts reported. While all other news outlets reported more negative than positive impacts of cruise, the Press delivered the most critical media coverage no doubt because of strong resident opposition to cruise in Akaroa during this time (n=72).
- While there was a higher number of positive economic impacts reported, 10 different negative economic impacts of cruises emerged. The most documented including ratepayers subsidizing cruise infrastructure (n=18), the economic benefits of cruise not contributing to port towns (n=12), and low-spending cruise passengers (n=10).
- The most documented social impacts were all negative, and included overwhelmed infrastructure (n=17), overcrowding (n=13), and cruise infrastructure dominating public spaces (n=13). The Press led the coverage of social impacts, with 36 negative and 4 positive social impacts documented.
- Notably, much of the media reporting on the negative social and environmental impacts of cruise pre-COVID was focused on Akaroa.
- Only negative environmental impacts were reported pre-COVID. The most frequently documented included air pollution created by cruise (n=13), cruises negative impact on air quality (n=6), and wastewater polluting marine environments (n=5).
- The Dominion Post led the coverage of environmental impacts, with 22 mentions, compared to other news outlets, which reported between 8 and 16 environmental impacts.

News Outlets	Positive	Negative	Grand Total
Otago Daily Times	**83**	**45**	**128**
Social	5	21	26
Economic	78	12	90
Environmental		12	12
Sunday Star Times	**8**	**26**	**34**
Social		7	7
Economic	8	5	13
Environmental		14	14
The Dominion Post	**28**	**33**	**61**
Social	2	7	9
Economic	26	5	31
Environmental		21	21
The New Zealand Herald	**49**	**55**	**104**
Social	2	27	29
Economic	47	20	67
Environmental		8	8
The Press (CHCH)	**45**	**72**	**117**
Social	4	36	40
Economic	41	20	61
Environmental		16	16
Grand Total	**213**	**231**	**444**

National News Outlets post-Covid (2020-2023)

Social impacts

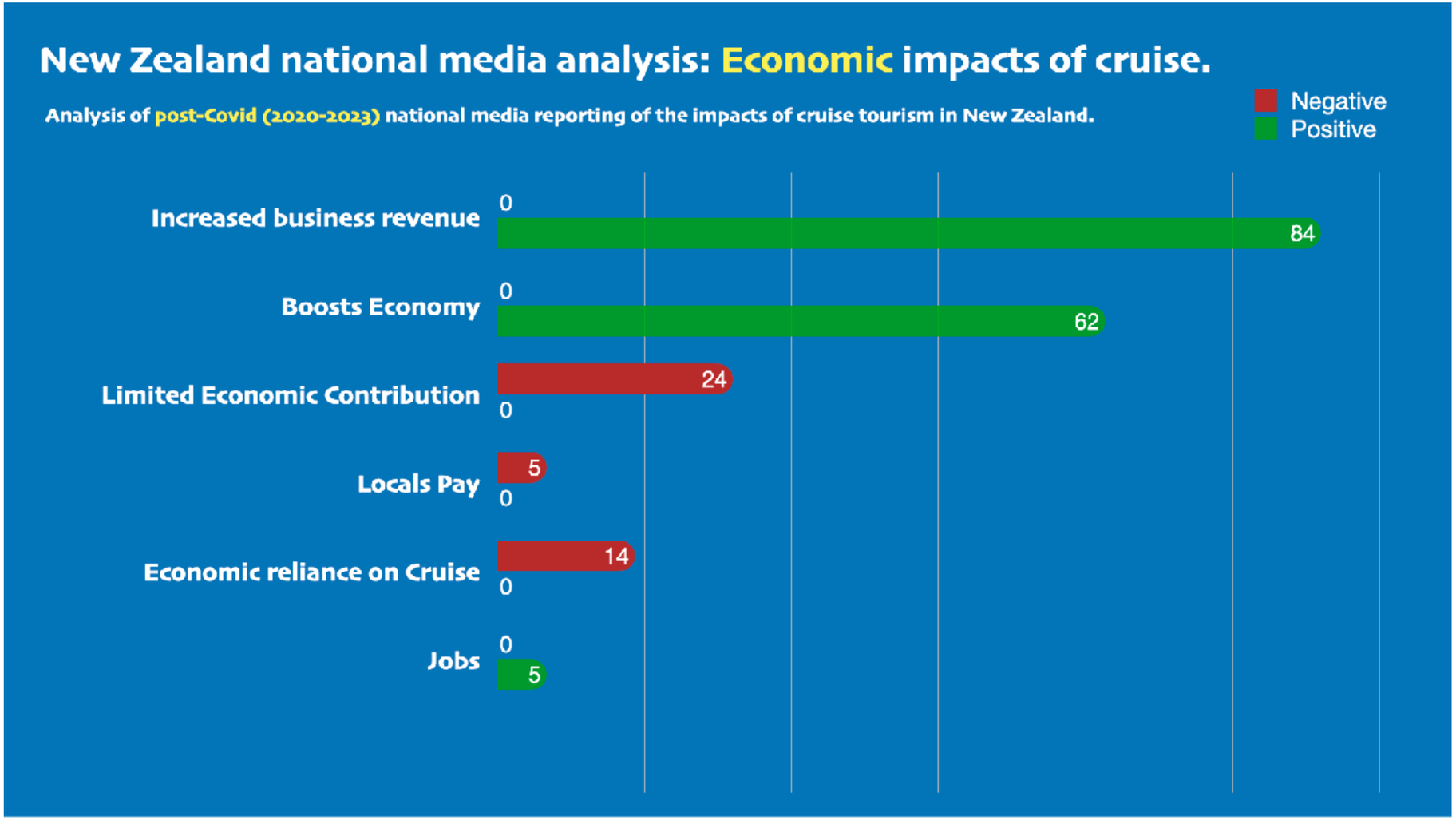
Between 2020 and 2023, national New Zealand news outlets documented 19 positive impacts and 130 negative social impacts of cruise. The key themes that emerged from the data were health and safety, transportation, city atmosphere, the daily lives of locals, public spaces, the influence of cruise management on locals, and cultural aspects. In total, the Press explored the social impact of cruises with a total of 66 recorded instances, a notably higher count compared to other news sources which reported between 8 and 30 social impacts. Among the positive effects, the most frequently cited was the role of cruises in creating a sense of vibrancy and a positive atmosphere in towns. However, notably, the most reported negative impacts during this period were the spread of COVID-19 from cruise passengers and the strain on local transportation systems, particularly due to overwhelmed buses caused by cruise activities.



National News Outlets post-Covid (2020-2023)

Economics impacts

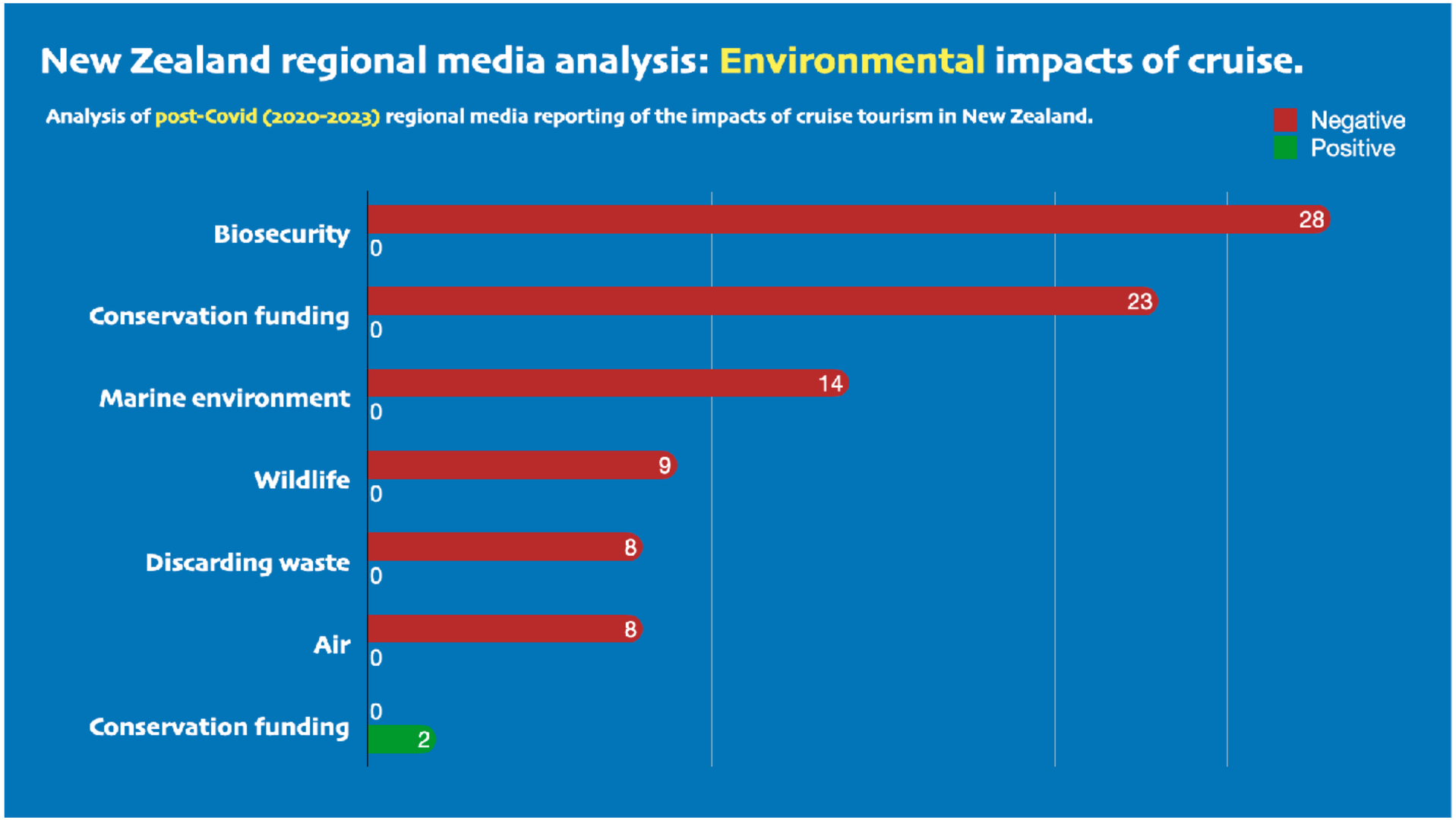
Between 2020 and 2023, national New Zealand news outlets documented 150 positive and 43 negative economic impacts of cruise. Overall, with 194 mentions, the economic impacts of cruise were documented more than the social and environmental impacts of cruise. The key themes that emerged from the data were increased business revenue, boost to the economy, limited economic contribution, economic reliance on cruise, locals paying for cruise and jobs provided by the cruise industry. The Press and the Otago Daily Times covered the economic impacts of cruise more than other news outlets, both with 61 recorded impacts compared to other news outlets who reported between 4 and 40 economic impacts of cruise. The most reported positive impacts were increased business revenue, and the boost cruise ships provide to local economies. However, a note of caution emerged in the reporting, highlighting the limited economic contribution of cruise passengers and the potential negative consequences of heavy economic reliance on the cruise industry for local and regional economies.



National News Outlets pre-Covid (2016-2019)

Environmental impacts

Between 2020 and 2023, national New Zealand news outlets documented 2 positive and 96 negative environmental impacts of cruise. The environmental impacts of cruise received the least coverage, with 98 impacts reported in total. The key themes that emerged were concerns about climate effects, biosecurity risks, marine environment, impacts on wildlife, the discarding of waste, air quality, alignment with government messaging, coastal environments, and conservation funding. The Press discussed the environmental impacts of cruise significantly more than other news outlets, with 40 impacts documented, compared to other news outlets that reported between 7 and 26 environmental impacts. During this period, the most frequently reported negative environmental impacts of cruises were the carbon emissions from cruise ships, the introduction of non-native organisms into New Zealand waters, and the detrimental effects of water pollution produced by cruise. Conversely, the sole positive impact highlighted was the revenue generated from the cruise industry that funds conservation projects.



Summary of findings

- Consistent with pre-COVID reporting, the economic impacts received the most attention overall from national news outlets (n=193), while the environmental impacts received the least attention (n=98).
- During the height of the pandemic (2020-2021), the environmental impacts of cruise received minimal attention, with much of the media reporting focusing on the potential spread of COVID from cruise passengers and the negative economic impact attributed to the loss of cruise.
- The most documented impacts across all three dimensions included cruise providing increased revenue for businesses (n=50), the potential spread of COVID (n=48), and cruises positive impact on local economies (n=38).
- The Press had a predominantly negative outlook on the cruise industry, with 125 negative and 42 positive impacts reported, giving the most attention to the negative social impacts of cruise (n=61).
- The most documented economic impacts were all positive and included cruise providing increased revenue for businesses (n=50), cruises positive impact on local economies (n=38), and an increase in retail spending (n=24).
- While there was a higher number of positive economic impacts reported, 9 different negative economic impacts of cruises emerged. The most documented including low-spending cruise passengers (n=14), cancellation uncertainty (n=6), and over reliance on cruise passengers (n=6).
- The most documented social impacts were the potential spread of COVID (n=48), overwhelmed buses (n=27), and cruises creating a sense of vibrancy (n=8).
- In the media reporting of the impacts of cruise on atmosphere, direct quotes indicating the positive effect of cruise came exclusively from business owners and managers, or the representatives and spokespeople of tourism organisations, port companies or cruise organisations.
- The most documented environmental impacts were all negative and included carbon emissions (n=15), the introduction of non-native organisms (n=10), and water pollution produced by cruise (n=10).
- The Press and The Dominion Post lead the coverage of environmental impacts, with The Press documenting 39 and The Dominion Post documenting 26 negative environmental impacts post-COVID. In contrast, The New Zealand Herald (n=9) and the Sunday Star Times (n=7) showed considerably less coverage of the environmental impacts of cruise.

News Outlets	**Positive**	**Negative**	**Grand Total**
Otago Daily Times	**61**	**46**	**107**
Social	9	21	30
Economic	51	10	61
Environmental	1	15	16
Sunday Star Times	**4**	**15**	**19**
Social		8	8
Economic	4		4
Environmental		7	7
The Dominion Post	**26**	**50**	**76**
Social	3	20	23
Economic	23	4	27
Environmental		26	26
The New Zealand Herald	**39**	**32**	**70**
Social	3	19	22
Economic	36	4	40
Environmental		9	8
The Press (CHCH)	**42**	**125**	**167**
Social	5	61	66
Economic	36	25	61
Environmental	1	39	40
Grand Total	**172**	**268**	**440**

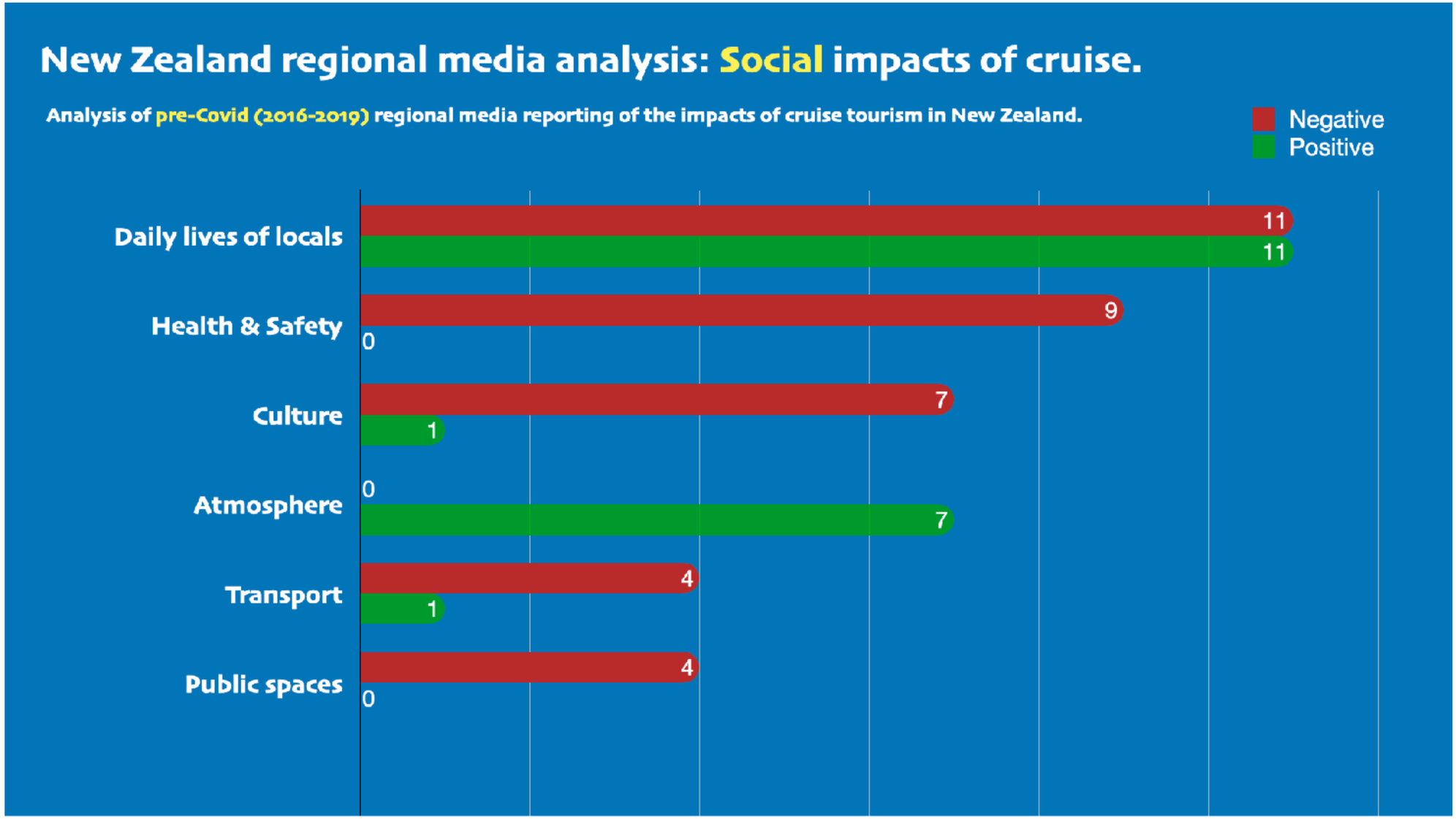
Chapter 3.2

Media Analysis: New Zealand regional

Regional media pre-Covid (2016-2019)

Social impacts

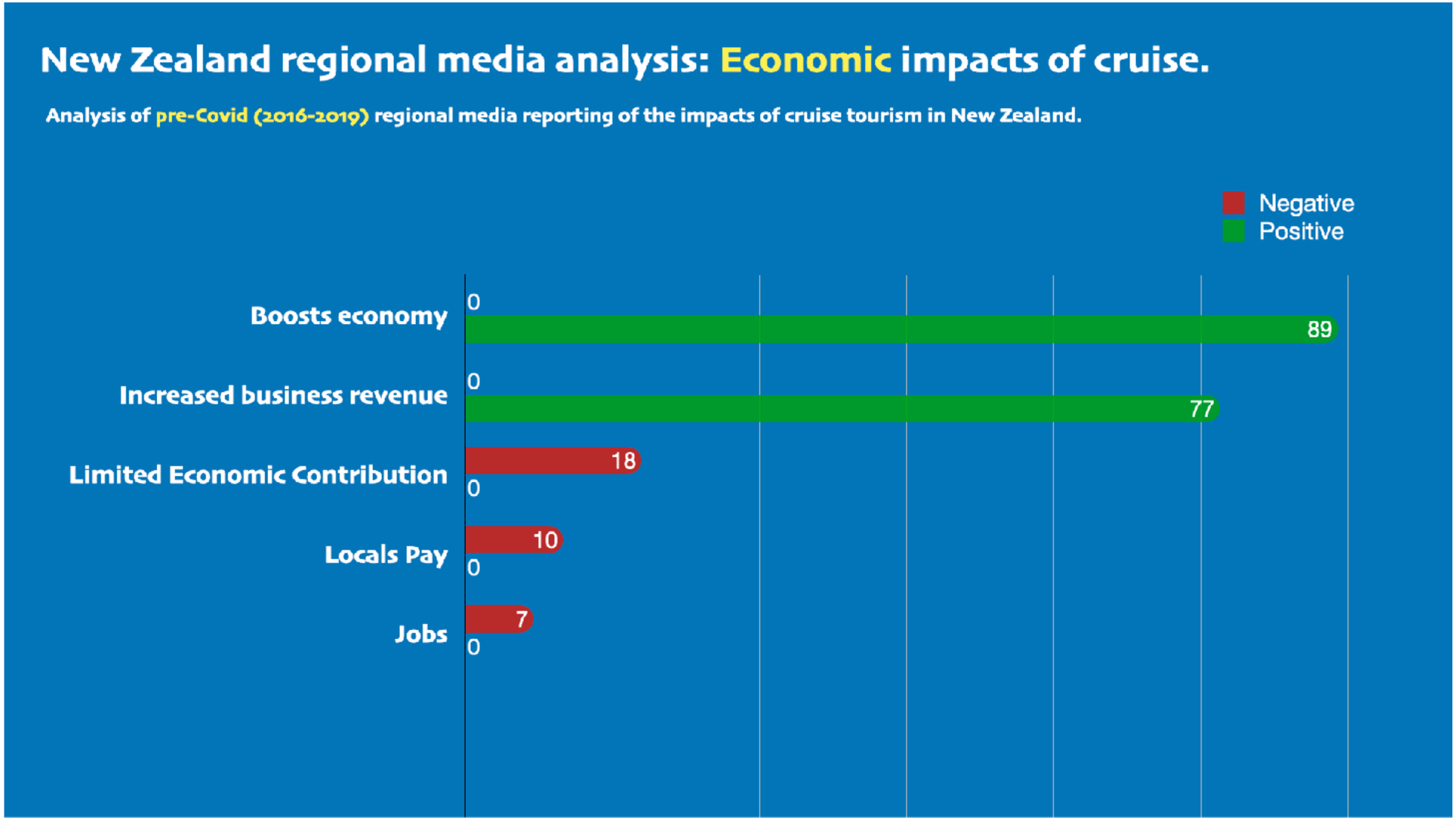
Between 2016 and 2019, regional news outlets documented 34 negative and 21 positive social impacts of cruise. The key themes that emerged were cruises impact on the daily lives of locals, health and safety, culture, town/city atmosphere, local transport, and the use of public spaces. The most reported negative social impacts of cruise were overcrowding when cruise ships were in port, and potential accident risks. The most reported positive impacts were cruise ships providing locals with a sense of connection to the world, fostering city pride, and creating a sense of vibrancy. The Bay of Plenty Times led the coverage, with 32 social impacts reported, in comparison to other regional news outlets that reported between 11 and 13 social impacts.



Regional media pre-Covid (2016-2019)

Economic impacts

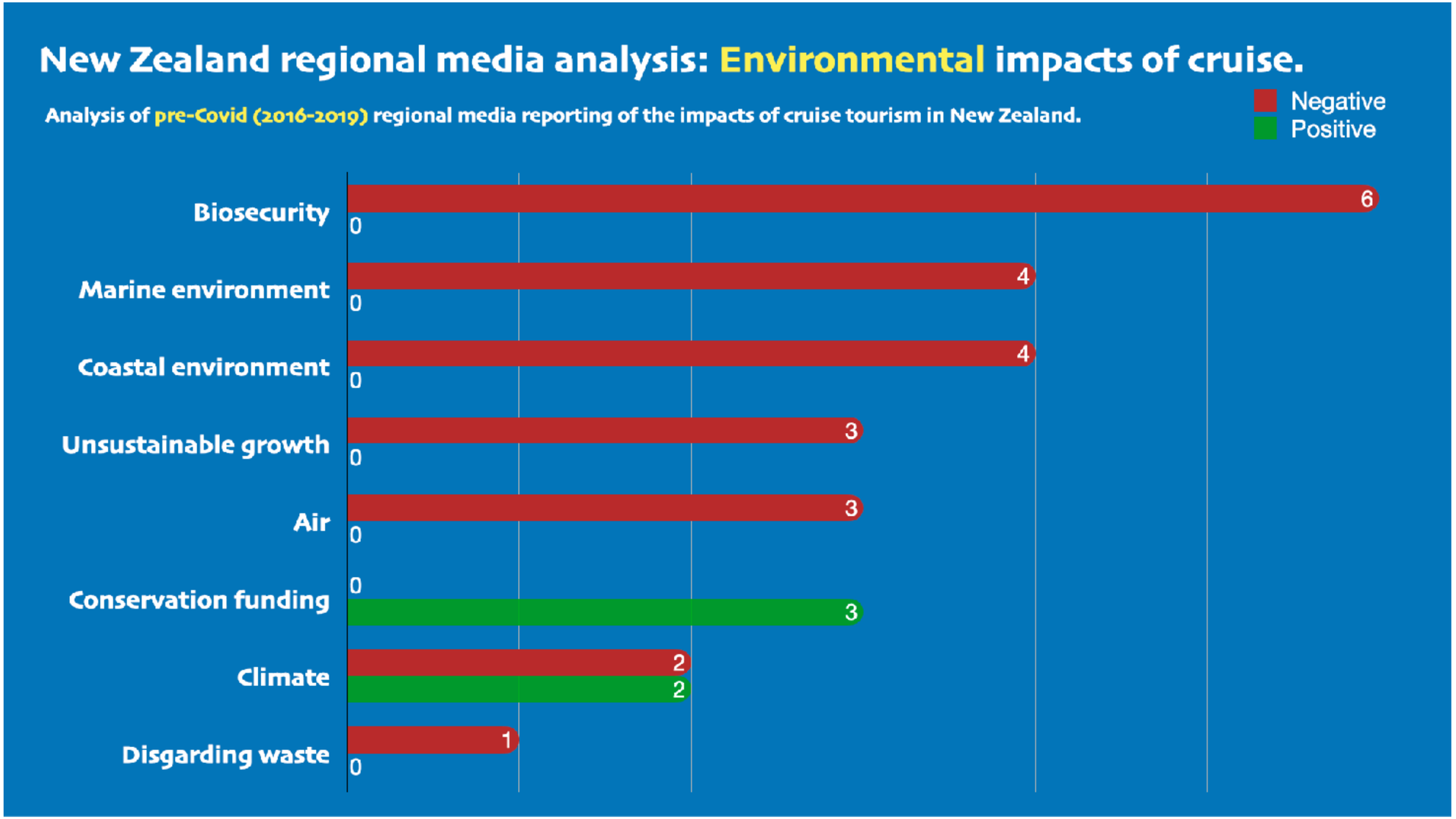
Between 2016 and 2019, regional news outlets documented 173 positive and 28 negative economic impacts of cruise. The Bay of Plenty Times led the coverage of economic impacts with 95, compared to Hawke's Bay Today, which reported 74 and the Southland Times, which reported 32. The key themes that emerged from the data included cruises' positive impact on the economy, the increase in business revenue, the cruise industry's limited economic contribution, locals paying for cruise-related costs, and jobs created by the cruise industry. The most reported positive economic impacts were the cruise industry's impact on local economies, increased revenue for businesses, and increased retail spending. The most reported negative economic impacts of cruise were low-spending passengers and ratepayers subsidizing cruise infrastructure.



Regional media pre-Covid (2016-2019)

Environmental impacts

Between 2016 and 2019, regional news outlets documented 23 negative and 3 positive environmental impacts of cruise. The media paid the least attention to cruises' environmental impacts compared to the social and economic effects. The key themes included cruises' impact on biosecurity, air quality and pollution, marine and coastal environments, unsustainable tourism growth, funding for conservation, climate impact, and waste disposal practices. The most frequently reported negative impacts were coastal damage, biosecurity risks from cruise passengers, and the introduction of non-native organisms into pristine environments. The only reported positive impact of cruise was the economic gains contributing to conservation funding. The Southland Times led the coverage of environmental impacts, with 12 reported, compared to other regional news outlets that both reported 7 environmental impacts.



Summary of findings

- The Bay of Plenty Times and Hawke's Bay Today had a predominantly positive outlook on the cruise industry. Much of their reporting focusing on the positive economic impacts of cruise, while The Southland Times provided a more balanced coverage of the positive and negative impacts.
- Consistent with post-COVID reporting, the economic impacts received the most attention from all regional news outlets (n=201), while the environmental impacts received the least attention (n=27).
- The most documented impacts across all three dimensions were cruises positive impact on local economies (n=69), cruise providing increased revenue for businesses (n=29), and an increase in retail spending (n=23).
- While most articles highlighted the positive economic impacts, some negative economic impacts of cruise emerged, most notably, low-spending cruise passengers (n=10), and ratepayers subsidizing cruise infrastructure (n=9).
- The most documented social impacts were overcrowding when cruise ships were in port (n=8), potential accident risks (n=6), and cruise ships providing locals with a sense of connection to the world (n=6).
- The most documented environmental impacts were coastal damage (n=4), biosecurity risks from cruise passengers (n=3), the introduction of non-native organisms (n=3), and the economic gains contributing to conservation funding (n=3).
- Articles addressing social impacts frequently incorporated direct quotes from community members, economic impacts typically quoted business owners and representatives from regional tourism organisations and the cruise industry. By contrast environmental impacts were usually supported by evidence from research studies.

News Outlets	Positive	Negative	Grand Total
Bay of Plenty Times	**94**	**40**	**134**
Social	15	17	32
Economic	79	16	95
Environmental		7	7
Hawke's Bay Today	**75**	**19**	**94**
Social	4	9	13
Economic	69	5	74
Environmental	2	5	7
The Southland Times	**27**	**27**	**55**
Social	2	8	10
Economic	25	7	32
Environmental	1	12	13
Grand Total	**196**	**86**	**283**

Summary of Southland Times regional reporting on cruise (2016-2019)

The Southland Times provided a balanced coverage of the impacts of cruise in the pre-COVID period, with 28 positive and 27 negative documented impacts. The Southland Times did not report to any length on social impacts specifically in Southland. This is unsurprising given that cruise ships are unable to dock and mostly unable to put passengers ashore in Milford Sound, and cruise ships visits to other harbours in Southland are less frequent.

The potential health and safety risks from navigation errors resulting in vessel collisions were reported with specific reference to a 2017 incident in Milford Sound. The Southland Times did also report some of the negative social impacts in other ports around New Zealand including Akaroa, Marlborough, and Wellington. The Southland Times was the sole regional news outlets to report on the impact of pollution on human health, documenting the implementation of air quality monitoring in Picton, following concerns raised by Picton residents about the effect of shipping fumes on human health.

The Southland Times reported 25 positive and 7 negative economic impacts of cruise. Notably, most mentions of the positive economic impacts for Southland were from articles discussing cruise ships docking in Stewart Island and Bluff. It is highlighted that because passengers are rarely able to come ashore in Milford Sound, there is minimal opportunity for passengers to contribute to the Southland economy.

One article quoting Tim Holland, Milford Sound Tourism general manager, highlighted that the positive economic impacts of cruise for Milford were more indirect, when cruise passengers returned to Milford Sound or told others about it. No evidence is provided in the article to support this claim.

The Southland Times gave more attention to the environmental impacts of cruise than all other regional news outlets pre-COVID. The environmental impacts reported included marine pollution, air pollution, and coastal damage. Specific mention of a cruise ship grounding in Milford sound was documented, emphasizing the potential negative consequences of oil spills.

One article questioned if Bonamia oastreae, an oyster-killing parasite found in Marlborough and Southland, could have been spread via cruise ship movements. Another reported cruise ships being a major source of water pollution cruise due to waste management practices and dumping waste into the ocean.

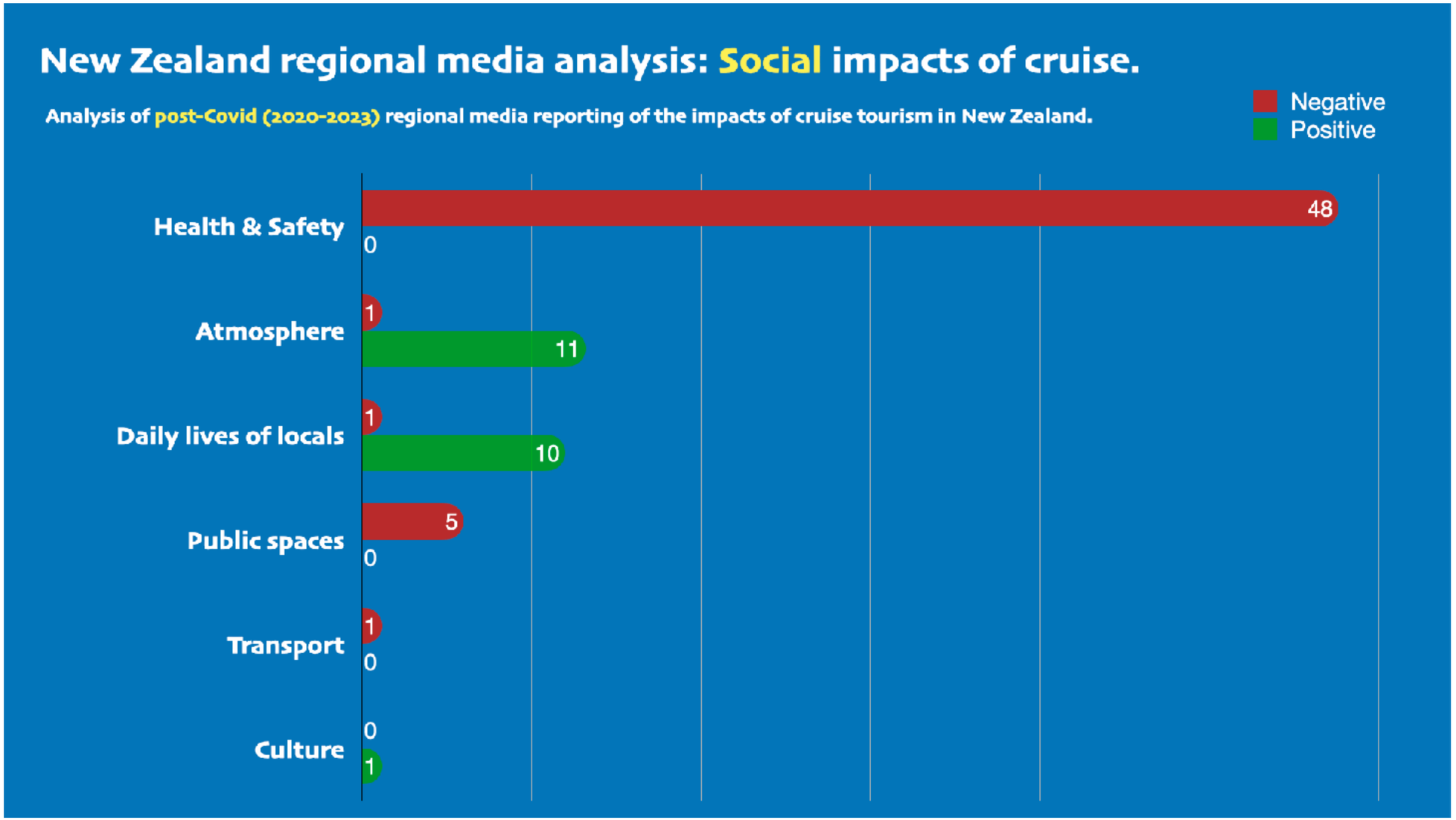
The Southland Times was the only regional news outlet to report on the impact of cruise ships on air quality and pollution, highlighting issues in Milford Sound and Picton. Following complaints from the public regarding cruise ship emissions, Southland harbourmaster, Lyndon Cleaver, was cited to be ‘cracking down’ on air pollution. He noted that New Zealand regulations do not require cruise ships to use scrubbers that reduce sulphur emissions, and that they might become mandatory in Fiordland.

On a similar note, one article criticized the lack of action from the New Zealand government in reducing sulphur emissions, highlighting that New Zealand had not yet signed up to Annex VI of the International Convention on the Prevention of Pollution from Ships, an international agreement to regulate shipping emissions.

Regional media post-Covid (2020-2023)

Social impacts

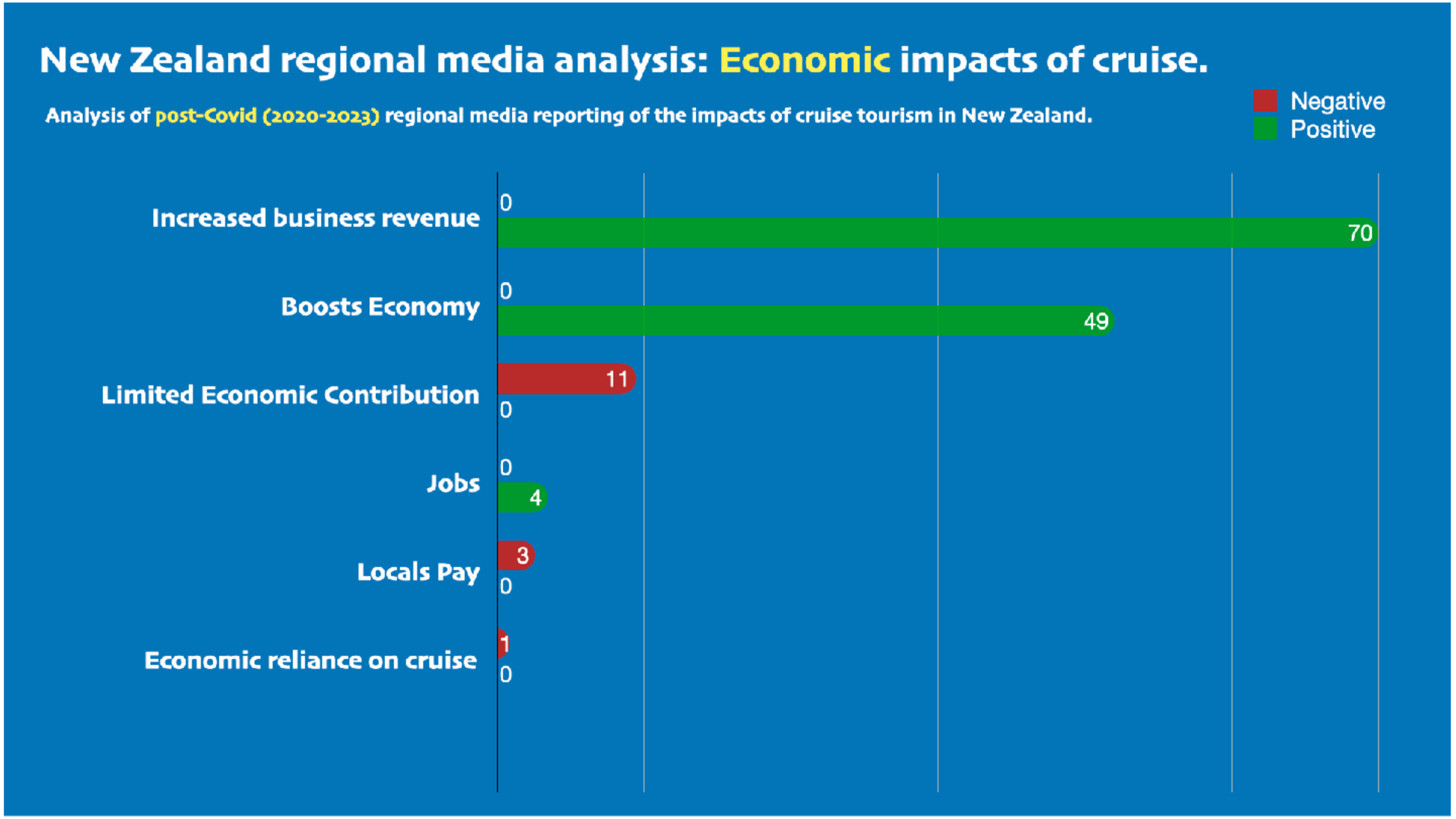
Between 2020 and 2023, regional news outlets documented 56 negative and 21 positive social impacts of cruise. The key themes that emerged from the data included cruises' impact on health and safety, town/city atmosphere, the daily lives of locals, use of public spaces, local transport, and culture. The most reported negative impact was the potential spread of COVID-19 from cruise passengers, with 46 mentions. Cruise ships' most reported positive social impacts were creating a sense of vibrancy, fostering city pride, and providing locals with a sense of connection to the world.



Regional media post-Covid (2020-2023)

Economic impacts

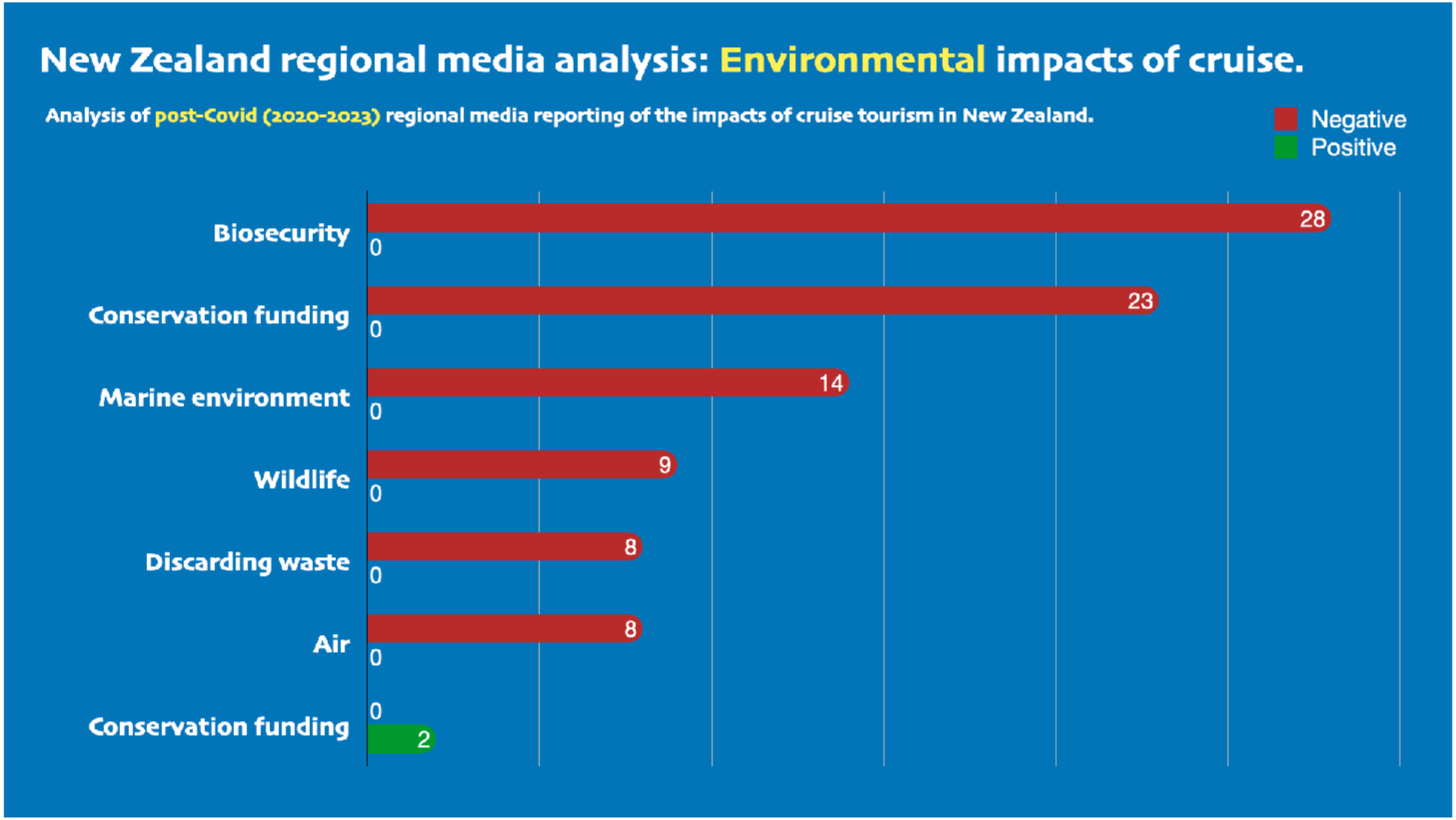
Between 2020 and 2023, regional news outlets reported 123 positive and 15 negative economic impacts. The economic impacts of cruise were reported on the most by regional news outlets, compared to the social and environmental impacts of cruise. The key themes that emerged from the data were increased business revenue when cruises visited, a boost to the economy, cruise having a limited economic contribution, the cruise industry providing jobs, locals paying for cruise, and economic reliance on cruise. The most reported economic impacts were increased revenue for businesses and cruises boosting local economies. The most frequently reported negative economic impacts included low-spending cruise passengers and ratepayers taking on the costs associated with the loss of cruise following the COVID-19 pandemic.



Regional media post-Covid (2020-2023)

Environmental impacts

Between 2020 and 2023, regional news outlets documented 12 negative and 4 positive environmental impacts of cruise. This was the lowest amount of reporting on any dimension of impact across regional and national news outlets, with much of the media reporting focusing on the economic impacts of cruise post-COVID. The Bay of Plenty Times reported on just one environmental impact, while Hawke's Bay Today reported on two environmental impacts. The key themes that emerged from the data included cruises' impact on biosecurity, conservation funding, wildlife, marine environments, waste disposal practices, and air pollution. The most reported environmental impact of cruise during this period was positive and involved the cruise industry funding conservation projects. While minimally reported, the most documented negative impacts were water pollution, the discarding of wastewater, and snails and algae found in ships entering New Zealand.



Summary of findings

- Post-COVID regional media reporting was dominated by discussions regarding the closure and reopening of New Zealand's borders to cruise ships, and the economic consequences of the closure of the maritime border.
- The Bay of Plenty Times had a predominantly positive outlook on the cruise industry. Much of their reporting focussed on the positive economic impacts of cruise. The Southland Times and Hawke's Bay Today provided much more balanced coverage of the positive and negative impacts.
- The economic impacts received the most attention from all regional news outlets (n=138), while the environmental impacts received the least attention (n=16). This was consistent with pre-COVID regional media reporting.
- The most documented impacts across all three dimensions were the potential spread of COVID from cruise passengers (n=46), cruise providing increased revenue for businesses (n=42), and the positive impact of cruise visits on local economies (n=35).
- The most documented social impacts were the potential spread of COVID from cruise passengers (n=46), cruise ships creating a sense of vibrancy (n=10), and cruise fostering a sense of city pride (n=6).
- The most documented economic impacts were cruise providing increased revenue for businesses (n=42), positive impact on local economies (n=35), and cruises positive impact on the national economy.
- The most documented environmental impact was positive and involved cruise providing funding for conservation, however, there is a lack of transparency around these claims (n=4).

News Outlets	Positive	Negative	Grand Total
Bay of Plenty Times	**80**	**25**	**105**
Social	10	20	30
Economic	70	4	74
Environmental		1	1
Hawke's Bay Today	**43**	**34**	**77**
Social	8	27	35
Economic	35	5	40
Environmental		2	2
The Southland Times	**25**	**24**	**49**
Social	3	9	12
Economic	18	6	24
Environmental	4	9	13
Grand Total	**148**	**83**	**231**

Summary of Southland Times regional reporting on cruise (2020-2023)

The Southland Times provided a balanced coverage of the impacts of cruise post-COVID, with 25 positive and 24 negative documented impacts. Consistent with regional and national news outlets, the potential spread of COVID-19 was The Southland Times most documented social impact.

The Southland Times did not report any negative social impacts in the Southland region specifically. One article highlighted Invercargill residents feeling a sense of city pride in being able to showcase the new Invercargill city centre to cruise passengers.

Like other regional media The Southland Times gave most attention to the economic impacts of cruise, with 18 positive and 6 negative economic impacts documented post-COVID. Unlike the Bay of Plenty Times and Hawke's Bay Today which frequently referenced cruises positive impact on local economies, The Southland times did not report on cruises positive impact on the Southland local economy during this period.

Some mentions were made of increased business revenue in Bluff, Gore, and Invercargill. No positive economic impacts for Fiordland specifically were reported by The Southland Times. One article did note that due to cruises all-inclusive packages, international cruise companies benefited more than local economies.

The Southland Times was the only regional news outlet to report on the increase in revenue for councils attributed to cruise, with 6 mentions post-COVID. Several articles documented that Environment Southland had lost $2.8m in marine fees due to cruise cancellations during the COVID period, highlighting cruises positive impact for councils.

It was reported in 2021 that Environment Southland had not adequately planned for the absence of cruises, resulting in local ratepayers supplementing the loss of cruise marine fees. One article also pointed out that due to unforeseeable cruise cancellations, revenue from cruise could never be guaranteed and should not be relied on by councils.

The Southland Times documented 13 of the total 16 environmental impacts reported by regional news outlets post-COVID. Several articles detailed reports of cruise ships being prevented from entering Fiordland due to 'strict biosecurity rules'. The cancellations caused by biosecurity risks were framed as a negative economic impact with council missing out on marine fees, and disappointment from passengers missing out on the iconic destination were highlighted.

The Southland Times also reported that revenue from cruise marine fees would contribute to conservation funding. Council profits are specifically mentioned to be spent on coastal activities, including flood protection measures. However, the media provided no detail to support claims of conservation funding.

The Southland Times reposted an article originally published on Stuff in 2023, detailing the impacts of cruise on Lyttleton. The article delves into the impact of cruise more broadly, citing a global review of the impacts of cruise. This piece highlighted the negative impacts of cruise on marine environments, air quality/pollution, and wildlife. The article also reports concerns about the cruise industry's harmful waste management practices, including the dumping of wastewater into oceans and harm caused to natural ecosystems.

Chapter 4

Conclusions and Recommendations

A lack of comprehensive research, systematic analysis and transparency has been a hallmark of cruise tourism to date, both internationally and in Aotearoa New Zealand. This report presents an in-depth analysis of cruise tourism across three broad impact categories, based on both primary analysis and secondary information sources. It does so with specific reference to the Aotearoa New Zealand, the Southland region and Fiordland to inform the regulation and management of cruise tourism in Piopiotahi Milford Sound.

Economic impacts

International research casts considerable doubt upon the economic impacts of cruise tourism and its wider contributions to national and local economies.

Primary analysis of New Zealand cruise tourism (2022-23 and 2023-24) confirms that cruise tourism is a small niche tourism market in New Zealand, accounting for around 1% of total tourism expenditure. Despite high growth in recent years cruise tourism remains only 1% of market share. Cruise passengers spend 60% less than other international visitors per trip. Cruise tourism is also 2.3 times more seasonal than international tourism, providing limited income or wider opportunities to tourism business development.

Regionally, cruise tourism offers little benefit to regional economies. It represents a tiny proportion of total tourism spending, albeit with some variation between regions. Bay of Plenty and Hawke's Bay benefit more economically in relative terms, a fact reflected in generally positive media coverage of the economic benefits of cruise in those regions. Cruise tourism is generally characterised by limited spending relative to other discrete markets, high seasonality, and low return visitation.

Employment of New Zealanders generated by cruise tourism is negligible. Cruise tourism in New Zealand involves very few local suppliers which limits local employment opportunities. Providoring is a minor part of the cruise industry in New Zealand. There is limited value at ports because most cruise lines use offshore bunkering and provisioning services.

The Southland region experiences a significant disparity between cruise volume and spending (69% of total unique cruise passengers vs 3% spending). Fiordland receives 69% of total unique cruise passengers and 0% of the total cruise passenger spending. Piopiotahi Milford Sound therefore serves as a location with cruise passenger experiences are produced and consumed, and where significant environmental impacts, costs and risks occur, with no direct local tourist spending contribution. This is reflected in the Southland media which tends to report on the environmental rather than economic impacts of cruise tourism in the region.

Some value from cruise visits to Piopiotahi Milford Sound is received by the Regional Council by way of visitation fees (approximately $2.9 million during the 2018/2019 season). [1] Any decisions to restrict or phase out cruise ship visits to Piopiotahi Milford Sound will require the Regional Council to become less reliant on or replace cruise tourism revenue over time.

The cruise economic model

The economic value of cruise tourism in New Zealand is largely extracted by the international cruise companies that operate New Zealand cruise schedules. The mass market cruise economic model is geared to onboard experiences and onboard (as opposed to onshore) spending. Further research is required to examine the ratio between onboard and onshore passenger spending, and whether the ratio of onshore spending is increasing or decreasing over time.

By contrast smaller expedition cruise ships generally have the capacity to offer passengers shore visits to locations and communities where limited or no port facilities exist (e.g., by zodiac). International research indicates that passengers on small cruise ships are likely to spend more unstructured time ashore, visit a more diverse range of locations and engage with local culture.

Environmental impacts

On a per passenger per kilometre basis cruise ships are one of the highest emitting forms of international transport. Cruise companies, like airlines, face the challenge of mitigating ‘difficult to abate’ emissions. Cruise sustainability commitments have been advanced through incremental efficiency gains that are embedded within existing business models that centre on sustained growth.

Local impacts are wide ranging with direct implications for air quality, marine pollution, marine biosecurity and marine mammals. These impacts require targeted local/regional regulation and management with such interventions are becoming increasingly evident in both the New Zealand and the international context.

Environmental costs

Cruise tourism incurs high costs in terms of CO_2 and other greenhouse gas emissions. The Climate Change Commission is currently engaged in a public submissions process relating to inclusion of international aviation and maritime transport emissions in national carbon accounting and how these emissions will be managed. It is likely that accounting for the carbon emissions of cruise ships will be allocated between the locations that ships visit. Several councils are now responding to this environmental cost by measuring and including cruise emissions in local carbon accounts.

Environmental risks

Cruise ship visits to Piopiotahi Milford Sound pose a range of unique environmental risks. These include marine biodiversity risks including biological invasions from biofouling. Cruise ships also present significant potential environmental and economic risks associated with geohazards, particularly seismic risks arising from proximity to the Puysegur Subduction Zone.

Targeted risk assessment is required to understand the implications of environmental hazards for the cruise ships in Piopiotahi Milford Sound, including how to mitigate risks to life and manage the potential environmental impacts and probable economic costs of significant natural hazard risks with documented future probabilities. The costs of an oil spill in Piopiotahi Milford Sound are likely to most directly impact the local marine economy (e.g., fisheries, fishing charters and local marine tourism operators).

Conservation values

The environmental impacts of cruise are largely or entirely incompatible with UNESCO World Heritage status, national park status and the conservation management goals of the Fiordland Marine Guardians. Mass tourism, high emissions, air pollution, noise and visual impacts are incompatible with the tourism and recreational values of Te Wāhipounamu and Fiordland National Park.

The cruise sustainability model

Increasing public scrutiny has occurred with continuing growth in cruise tourism, the increasing size of the cruise fleet and cruise ships, and the range and magnitude of their environmental and social impacts. The cruise sustainability model has been described as ‘reactive’ and secondary to perpetuating future growth, leading to concerns about neglect of environmental responsibility and greenwashing.

A ‘proactive’ approach is required to shift the cruise model onto a sustainable trajectory. This will require a commitment to collaboration and transparency which is unlikely to occur in the absence of regulatory intervention.

Social analysis

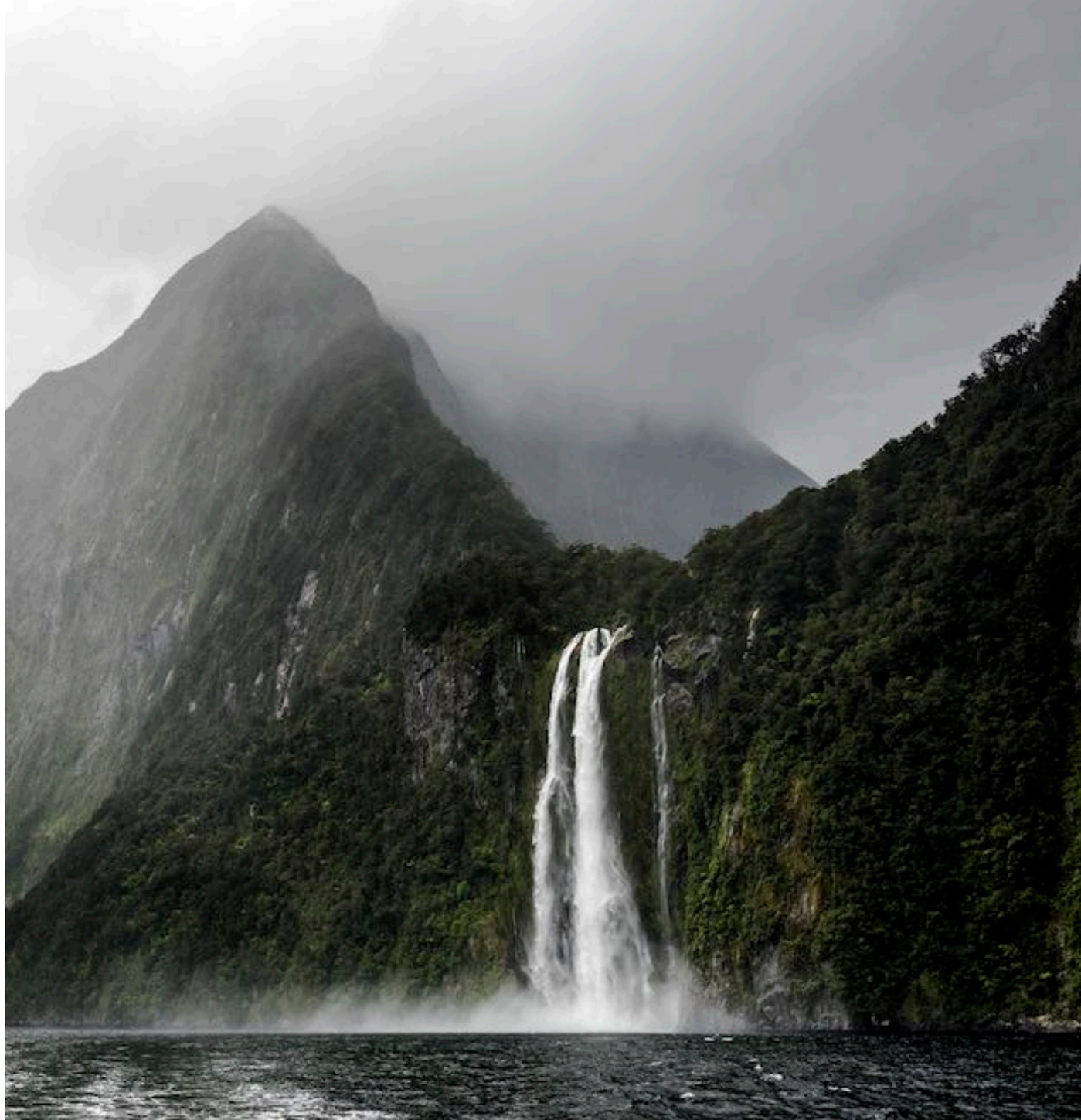
Growing concern for unsustainable tourism in New Zealand pre-dates COVID-19. Much of this concern centred on environmental impacts including climate change and loss of social licence. Cruise tourism is a form of conspicuous and high carbon luxury consumption that has now become a point of widespread community opposition. Community attitudes towards cruise tourism have hardened since the COVID-19 pandemic, now extending to organised public protests and political action.

Port community opposition: This research identified growing resistance to cruise tourism in port communities. Opposition to cruise tourism is evident in the port destinations of Dunedin (Port Chalmers) and Christchurch (Lyttleton and Akaroa) where submissions to councils, public protest and increasing media reporting reflect growing local opposition. Local opposition extends beyond climate concerns to a range of local issues including air pollution and public health, crowding and disruption and council funding (e.g., public transport funding).

Southland and Fiordland: Negative social sentiments were less apparent in Southland due to the fact that cruise tourism in Southland involves very little engagement between cruise passengers and local residents. Further research is required to investigate public opinion on the principle of cruise ships visiting Piopiotahi Milford Sound, including whether mass tourism and unconstrainted luxury consumption is consistent with managing the outstanding universal values of the Te Wāhipounamu World Heritage Area in perpetuity.

New Zealanders and international visitors: Kantar Insights report strong support among the majority of New Zealanders to phase out cruise ship visits to Piopiotahi Milford Sound due primarily to concerns about overcommercialisation. The banning of cruise ships has also received strong support across all international markets. Large cruise ships are considered fundamentally incompatible with experiencing the natural beauty of Piopiotahi Milford Sound.

Kantar Insights did find limited support for continued cruise ship access based on the assumption that cruise tourism provides benefits to Te Anau. This assumption is likely to arise from the misperception that cruise passengers come ashore in Piopiotahi Milford Sound and travel to Te Anau. This research confirms that cruise tourism makes little or no direct economic contribution to Te Anau or Fiordland.



Recommendations

The research presented in this report informs the following recommendations:

Managing the impacts of cruise tourism: Managing the impacts of cruise tourism can not rely on voluntary commitments and self-reporting. Third party independent reporting is required to ensure that measurement and mitigation is transparent and publicly reported.

Recommendation 1: All policies relating to cruise ship access to Piopiotahi Milford Sound should be reviewed.

Recommendation 2: Consider requiring that all cruise ships visiting Pioptiohahi Milford Sound are subject to independent environmental monitoring and reporting.

Regulating cruise ship emissions: Science-based targets (SBTi) for the maritime sector require absolute emissions reductions of 36% by 2030 and 96% by 2040. Cruise lines however remain focussed on intensity as opposed to absolute emissions targets, claiming that the technology is not yet ready for absolute reductions. Global agreements and regulations including air and water pollution standards go some way towards addressing the high environmental impacts of cruise. International research indicates that national and regional regulation is also required to shift the cruise sustainability model to a proactive approach.

The need to address mass tourism and high growth emissions in Piopiotahi Milford Sound is usefully informed by the Norwegian government which recognises that high emissions luxury cruise tourism is incompatible with UNESCO World Heritage status. A proposed package of measures formulated by the Norwegian government in 2019 includes limiting the number of ships and/or number of passengers in a port and permitting only emissions-free and therefore newer ships in Norwegian ports as soon as possible but no later than 2026. All ports must report emissions via a joint Environmental Port Index (EPI). The Norwegian government has also implemented a ban on all carbon/GHG emitting cruise ships from entering Norway's World Heritage fjords from 2026.

The ban is intended in part to drive technological development and to accelerate progress towards a lower emissions future. This will require the cruise sector to move to a proactive and collaborative approach to address challenges such as energy infrastructure and supply.

Recommendation 3: Consider phasing out carbon/GHG emitting cruise ships from Piopiotahi Milford Sound.

Managing cruise ship size: The energy requirements and emissions of cruise ships are determined by size, age and design. The highest emissions are produced by the largest ships that offer the most extensive range of onboard facilities and entertainments. In order to ensure that cruise emissions decrease Visit Flanders recommends the need to manage ship visits based on size, year of construction and technologies available to reduce emissions.

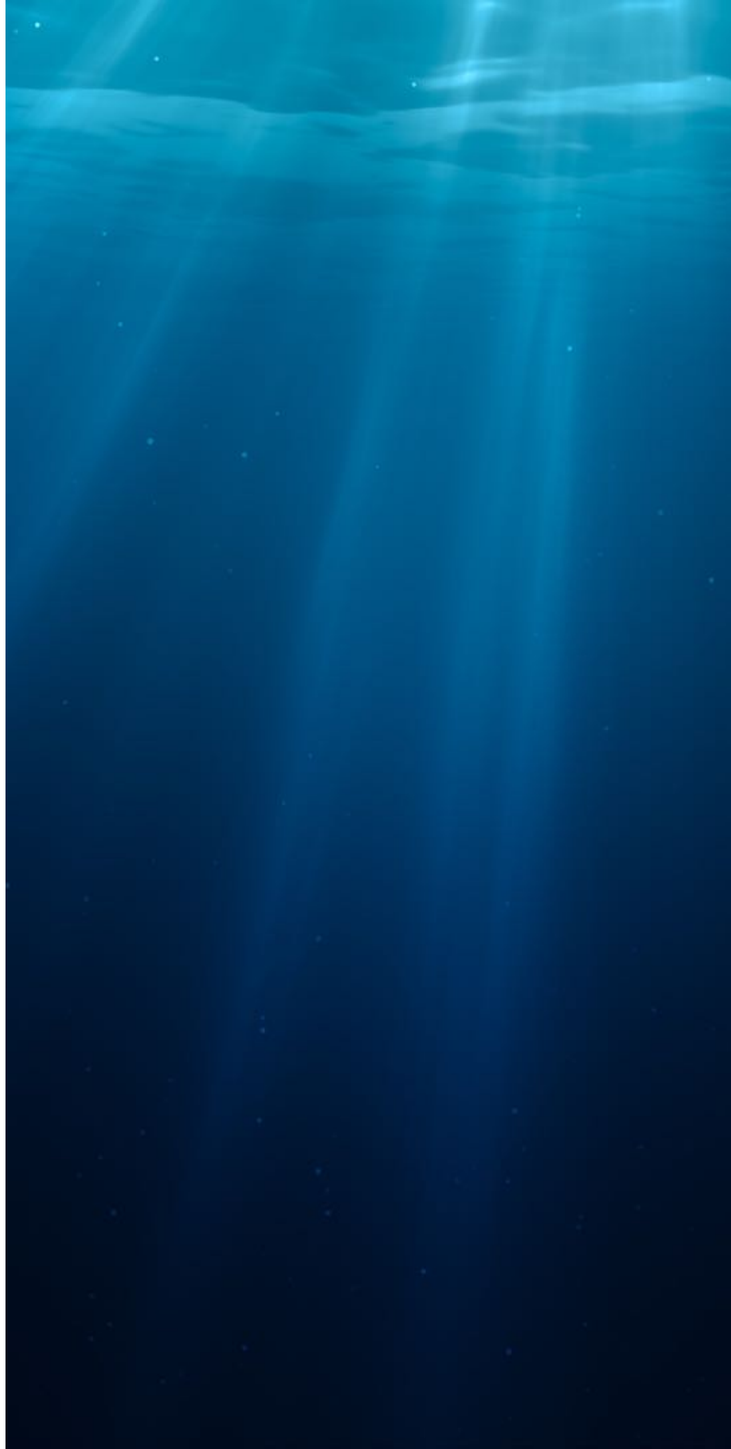
In the case of Piopiotahi Milford Sound the size of cruise ships is also relevant to efforts to manage the impacts of mass tourism on visitor experiences, including visual and noise impacts. The Regional Coastal Plan for Southland does already recognise that the increasing number and size of cruise ships may diminish the values that attract people to Fiordland.[31]

Global fleet of cruise ships: The International Maritime Organisation (IMO) distinguishes the global cruise ship fleet on the basis of gross tonnage:

1. Large cruise ships: Those greater than 10,000 gross tonnes (GT) represent 55% of the cruise fleet and emit approximately 90% of sector emissions; [7]
2. Small cruise ships: Those less than or equal to 10,000 GT represent 45% of the global cruise ship fleet and emit approximately 10% of the total gross cruise sector GHG emissions.

Large cruise ships produce disproportionate emissions and high environmental and social imapcts. Small vessels produce lower emissions per passenger than large cruise ships and offer greater scope to transition to new technologies that use alternative fuels.[7]

Recommendation 4: Consider banning all large cruise ships, as defined by gross tonnage and passenger numbers, from Piopiotahi Milford Sound.



Segmenting cruise markets: Ocean cruise ships can be segmented based on space ratio (number of gross tonnes per passenger) and passenger to crew ratio (number of passengers per crew member). Key segments include luxury, mass market, premium and niche expedition cruises. Economic, environmental and social impacts vary between large and small cruise ships and the market segments that they serve.

Expedition cruises take place on smaller ships with fewer passengers - typically 100-120 and up to 200-300 passengers – and visit a wider range of locations.

> **Recommendation 5:** Small expedition cruise ships be permitted to enter Piopiotahi Milford Sound as long as they meet emissions standards and other key environmental standards.

Expedition cruises offer the opportunity to visit fragile and remote environments where ecological and social capacity thresholds can be easily exceeded. They are also a high growth part of the cruise industry with some cruise companies moving to meet a shift in demand for lower volume cruise experiences that offer opportunities for local cultural engagement. Growth in this market requires that expedition cruise capacities are monitored and managed, and capped if necessary.

> **Recommendation 6:** Consider capping expedition cruise ship visits to Piopiotahi Milford Sound to predetermined levels in accordance with nature conservation and visitor management outcomes.

Integrating cruise tourism with the aspirations of communities and mana whenua: The mass market cruise market is served by large ships that function as enclaves of luxury consumption. This is an all-inclusive resort-style model that based on high volume and high growth. It is a high carbon model that operates largely in isolation of host communities and makes little or no economic or cultural contribution.

Expedition cruises have a different production and consumption profile which, if managed well, may offer the opportunity to lift the quality of (cruise) tourism by being integrated with the ambitions and aspirations outlined in Destination Management Plans.

Smaller expedition cruises typically offer schedules based on a capacity to transport passengers ashore for full day shore excursions, potentially including locations in Southland such as Piopiotahi Milford, Rakiura Stewart Island and Bluff. Shore excursions are informed by onboard education programmes that offer local interpretation often provided by local interpreters. Shore excursions afford opportunities to visit a wider range of local sites which allows the opportunity for passengers to engage with local communities, and opportunities for unstructured activities that promote spending in local businesses.

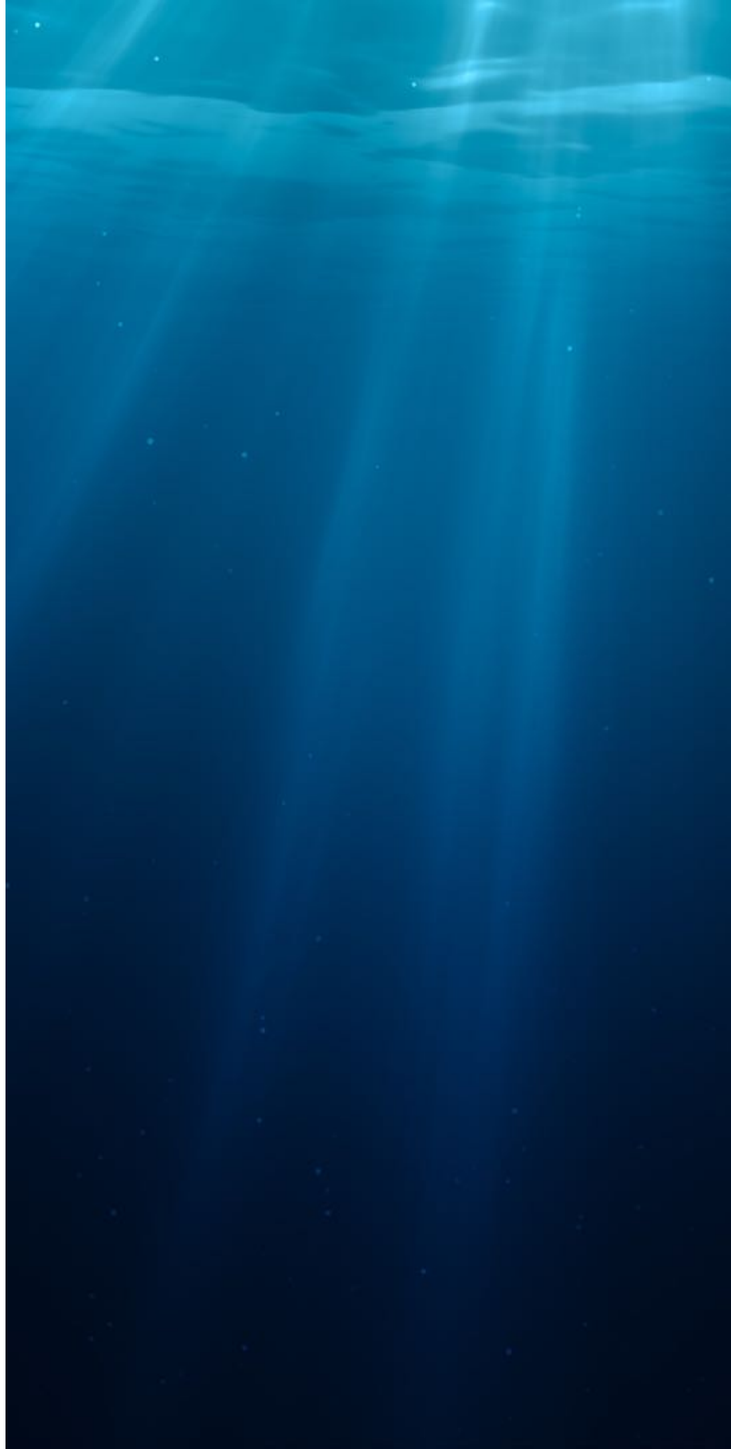
Expedition cruises also offer scope for sustainability outcomes that are not available to mass market mega cruise ships. These include onboard sustainability initiatives such as electric zodiacs to provide zero emissions shore access, plant-based menus, and the use of local food and beverage supplies, local cultural interpreters and local tour services. In some cases expedition cruises identify and support local projects, lead fundraising initiatives and make donations.

> **Recommendation 7:** Consider requiring expedition cruise ship visiting Pioptiotahi Milford Sound to comply with independent monitoring of economic, social and cultural costs and benefits.

> **Recommendation 8:** Consider how expedition cruise visits to Pioptiotahi Milford Sound can be aligned with Destination Management Plans and the aspirations of mana whenua.

Displacement effects: High volume cruise tourism is incompatible with the outstanding natural and cultural values of Pipiotahi Milford Sound and the wider Te Wāhipounamu World Heritage fiords as defined by UNESCO, national parks legislation and the Fiordland Marine Guardians. These include values of scenic grandeur, naturalness, remoteness and natural quiet, as well as cultural values that New Zealanders and international visitors strongly believe should be protected in perpetuity.

> **Recommendation 9:** Consider the need for the regulation and management of expedition cruise tourism in Piopiotahi Milford Sound to be applied to the wider Te Wāhipounamu World Heritage fiords to manage potential displacement effects.



References

229. Visitor Solutions and Fresh Info (2021). Tourism Report. 10 March 2021. https://www.milfordopportunities.nz/assets/Projects/210331-Tourism-Report.pdf
230. Howitt, O. J. A., Revol, V. G. N., Smith, I. J., Rodger, C. J. (2010). Carbon emissions from international cruise ship passengers' travel to and from New Zealand, Energy Policy, 38(5): 2552-2560.
231. Jones, P., Comfort, D., & Hillier, D. (2019). Sustainability and the world's leading ocean cruising companies. *Journal of Public Affairs*, *19*(1), e1609. https://onlinelibrary.wiley.com/doi/full/10.1002/pa.1609
232. Friends of the Earth (2023). Cruising versus land vacationing: A comparison of vacation carbon footprints in Seattle. https://foe.org/wp-content/uploads/2023/04/Comparison_of_CO2_Emissions_v2.pdf
233. McVeigh, K (2024). 'Biggest, baddest' – but is it the cleanest? World's largest cruise ship sets sail. 26 January 2024. https://www.theguardian.com/environment/2024/jan/26/icon-of-the-seas-largest-cruise-ship-human-lasagne-climate-fuel-lng-greenwashing
234. Buzova, D. (2023). Cruise ships and sustainability. In *The Palgrave Handbook of Global Sustainability* (pp. 2067-2077). Cham: Springer International Publishing. https://link.springer.com/content/pdf/10.1007/978-3-031-01949-4_131.pdf
235. Kantar (2023). Consumer insights to support the development and implementation of Milford Opportunities Project Masterplan. May 2023. https://www.milfordopportunities.nz/assets/Final-Milford-Opportunities-Project-Masterplan-Domestic-Consumer-v2.pdf
236. Kantar (2023). People's views on the Milford Opportunities Master Plan. September 2023. https://www.milfordopportunities.nz/assets/MOP-Kantar-research-summary-A3-Sept2023.pdf
237. WWF (2023). Science-based targets for the maritime transport sector. May 2023. https://sciencebasedtargets.org/resources/files/SBTi-Maritime-Guidance.pdf
238. Faber, J., S. Hanayama, S. Zhang, P. Pereda, B. Comer, E. Hauerhof, W. Schim van der Loeff, et al. (2021). *Fourth IMO Greenhouse Gas Study 2020.* London: International Maritime Organization. https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Fourth%20IMO%20GHG%20Study%202020%20-%20Full%20report%20and%20annexes.pdf