Council Agenda 18 November 2026

Meeting will be held at the Otago Regional Council Chamber, Aonui, 180 High Street, Dunedin, Otago. This meeting will be live streamed on the ORC YouTube channel.

Members:
Cr Hilary Calvert (Chair)
Cr Kevin Malcolm (Deputy Chair)
Cr Robbie Byars
Cr Chanel Gardner
Cr Neil Gillespie
Cr Matt Hollyer
Cr Gary Kelliher
Cr Michael Laws
Cr Andrew Noone
Cr Gretchen Robertson
Cr Alan Somerville
Cr Kate Wilson

Senior Officer: Richard Saunders, Chief Executive
Meeting Support: Kylie Darragh, Governance Support Officer

18 November 2026 10:30 AM

Agenda Topic — Page

Agenda 1

1. WELCOME

Cr Kevin Malcolm will say a reflection to open this meeting.

2. APOLOGIES

No apologies had been received at the time of publishing.

3. PUBLIC FORUM

No requests to speak had been received at the time of publishing.

4. CONFIRMATION OF AGENDA

The agenda to be confirmed as published.

5. DECLARATIONS OF INTEREST

Members are reminded of the need to stand aside from decision-making when a conflict arises between their role as an elected representative and any private or other external interest they might have. The Register of Member's Pecuniary Interests can be found on the ORC Website.

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To update Council on the performance of Public Transport and Total Mobility services for Quarter 1 2026/27, being 1 July 2026 – 30 September 2026.

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To adopt a meeting schedule for the Otago Regional Council for 2027.

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10. NOTICES OF MOTION

No notices of motion had been submitted at the time of publishing.

11. CLOSURE

Otago Regional Council

Council
MINUTES

Minutes of an ordinary meeting of the Otago Regional Council held in the Otago Regional Council Chamber, Aonui, 180 Hight Street, Dunedin on Wednesday 28 October 2026, commencing at 10:30 am

PRESENT

Cr Hilary Calvert	*(Chair)*
Cr Kevin Malcolm	*(Deputy Chair)*
Cr Robbie Byars	
Cr Chanel Gardner	
Cr Neil Gillespie	
Cr Matt Hollyer	
Cr Gary Kelliher	
Cr Michael Laws	*(online)*
Cr Andrew Noone	
Cr Gretchen Robertson	
Cr Alan Somerville	
Cr Kate Wilson	

DRAFT

1. WELCOME

Cr Byars said a reflection to open the meeting. Chair Calvert welcomed Councillors, members of the public and staff to the meeting at 10:30 am. Staff present included Richard Saunders (Chief Executive), Anita Dawe (GM Regional Planning and Transport), Nick Donnelly (GM Finance), Tom Dyer (GM Science and Resilience), Joanna Gilroy (GM Environmental Delivery), Tami Sargeant (GM People and Corporate), Amanda Vercoe (GM Strategy and Customer, Deputy CE), Cara Jordan (Governance Support), Dianne Railton (Team Leader Governance), Kylie Darragh (Governance Support).

2. APOLOGIES

There were no apologies for this meeting.

3. PUBLIC FORUM

3.1. Cat Dillon, online, spoke on behalf of Wai Wanaka on alpine lakes research funding, there was an opportunity for questions, the Chair thanked Cat for attending.

3.2. Kim Schiller, online, Project Bruce, spoke on the Balclutha to Dunedin bus service, there was an opportunity for questions, the Chair thanked Kim for attending.

3.3. Linda Moore, Clutha Development Inc, spoke on the Balclutha to Dunedin bus service, there was an opportunity for questions, and the Chair thanked Linda for attending.

3.4. Paul Kavanagh, online, Southern Lakes Sanctuary, spoke on restoring biodiversity through predator control, there was an opportunity for questions, the Chair thanked Paul for attending.

3.5. Rhys Millar, Predator Free Dunedin, spoke on the Large-scale Environment Fund, there was an opportunity for questions, the Chair thanked Rhys for attending.

4. CONFIRMATION OF AGENDA

Cr Wilson Moved, Cr Somerville seconded

That the supplementary paper "Decision on changes to Dunedin Bus Timetables" be accepted to the agenda and heard as matter 11.8.

MOTION CARRIED

5. DECLARATIONS OF INTERESTS

Councillors were reminded of the need to stand aside if a conflict of interest arises. Cr Hollyer noted that he would sit back from the table for matter 11.2 Large-scale Environment Fund.

6. PRESENTATIONS

6.1. The Otago Southland Helicopter Rescue Trust presented their Annual Report Representing the Trust was Stephen Woodhead (Trustee), Vivienne Seaton (Secretary / Manager) and Graeme Gale (Managing Director). There was an opportunity for questions from Councillors, the Chair thanked the Trust for attending.

6.2. Otago Catchments Community Inc. presented their Annual Report. Representing the OCC was Hanna Stalker (OCC Chairperson) and Craig Simpson (OCC Regional Manager) . There was an opportunity for questions on the report, the Chair thanked the OCC for attending.

DRAFT

7. CONFIRMATION OF MINUTES

Resolution: Cr Hollyer Moved, Cr Somerville Seconded

That the minutes of the Council meeting held on 23 September 2026, and the Extraordinary Council meeting of 7 October 2026 be confirmed as a true and accurate record.

MOTION CARRIED

8. ACTIONS (STATUS OF COUNCIL RESOLUTIONS)

Open actions from resolutions of the Council were reviewed.

9. CHAIRPERSON'S AND CHIEF EXECUTIVE'S REPORTS

9.1. Chairperson's Report

Chair Calvert was available to respond to questions on the report.

Resolution: Cr Noone Moved, Cr Byars Seconded

That the report be noted.

MOTION CARRIED

Cr Gardner left the meeting at 12:37 pm.
Cr Gardner returned to the meeting at 12:39 pm.
Cr Laws left the meeting at 12:40 pm.
Cr Laws returned to the meeting at 12:43 pm.

9.2. Chief Executive's Report

Richard Saunders (Chief Executive) was available to respond to questions on the report.

Resolution: Cr Hollyer Moved, Cr Gillespie Seconded

That the report be noted.

MOTION CARRIED

At 12:46 Cr Robertson Moved, Cr Gardner Seconded

That Council adjourn until 1:15 pm.

MOTION CARRIED

10. RECOMMENDATIONS ADOPTED AT COMMITTEE MEETINGS

10.1. Recommendations of the Audit and Risk Committee

Resolution CM26-251: Cr Malcolm Moved, Cr Gardner Seconded

That the Council adopts the recommendation of the 25 September 2026 Audit and Risk Committee.

MOTION CARRIED

Cr Laws returned to the meeting at 1:21 pm.

11. MATTERS FOR CONSIDERATION

11.1. Annual Report 2025/26 - Adoption

[YouTube 2:58] This report sought to adopt Council's Annual Report 2025-2026 for the period 1 July 2025 to 30 June 2026. Cr Malcolm, Portfolio Lead, introduced the paper. Sarah Munro (Group Financial Controller) and Nick Donnelly (General Manager Finance) were available to respond to questions on the report.

DRAFT

Resolution CM26-252: Cr Malcolm Moved, Cr Gardner Seconded
That the Council:

1) ***Receives*** *this report.*
2) ***Approves*** *the amendment to the report in Note 33 Contingent Liabilities for Risk Pool.*
3) ***Approves*** *and adopts the Annual Report for the year ended 30 June 2026.*
4) ***Authorises*** *the Chairperson and Chief Executive to sign the Annual Report 2025-2026 and Representation Letter on behalf of Council.*

MOTION CARRIED

11.2. Large-scale Environment Fund

[YouTube 3:03] This report sought Council decisions on funding applications from Southern Lakes Sanctuary and Predator Free Dunedin through the Large-scale Environmental Fund. Both applications exceed the Governance Group's delegated funding threshold and have therefore been referred to Council for consideration against the approved eligibility and assessment criteria and within the fund's available budget. Cr Gardner, Portfolio Lead, introduced the paper. Richard Saunders (Chief Executive) was available to respond to questions on the report. Cr Hollyer sat back from the table due to a conflict of interest.

Resolution CM26-253: Cr Robertson Moved, Cr Malcolm Seconded
That the Council:

1) ***Notes*** *that the Large-scale Environmental Fund Governance Group assessed the Southern Lakes Sanctuary and Predator Free Dunedin applications against the approved framework and recommends that Council approve both applications for the full amounts requested. The funding decisions have been referred to Council because the requests exceed the Group's delegated authority.*
2) ***Approves*** *funding of $600,000 per year for three years, totalling $1.8 million excluding GST, for the Southern Lakes Sanctuary proposal, subject to a three-year funding agreement, agreed annual work programmes and budgets, defined deliverables and measures, staged payments, confirmation of co-investment and reporting requirements.*
3) ***Approves*** *funding of $500,000 per year for three years, totalling $1.5 million excluding GST, for the Predator Free Dunedin proposal, subject to a three-year funding agreement, agreed annual work programmes and budgets, defined deliverables and measures, staged payments, confirmation of co-investment and reporting requirements.*
4) ***Delegates*** *to the Chief Executive authority to finalise and execute a funding agreement for any project approved by Council, including annual work programmes and budgets, conditions, milestones, measures, staged payments, co-investment requirements and reporting, and to defer or adjust later-year payments where delivery, financial performance, programme viability or co-investment is not satisfactory, provided any material reduction in outcomes, major change in scope or request for additional Council funding is referred back to Council.*
5) ***Supports*** *Southern Lakes Sanctuary and Predator Free Dunedin pursuing the regional collaboration opportunity described in this report, where Council approves funding for both projects, within the scope and capacity of their approved agreements. No additional Council funding is sought for this opportunity, and any separate new programme or activity outside the approved scopes will require a separate proposal and approval process.*

MOTION CARRIED
Cr Hollyer abstained from the vote.

11.3. Balclutha to Dunedin Public Transport Investigations

[YouTube 4:09] This paper reported on the ORC Annual Plan 2025/26 direction to investigate public transport options for connecting Balclutha to Dunedin including consideration of Dunedin Airport. Cr Hollyer, Portfolio Lead, introduced the paper. Robyn Hyde (Transport Planning Lead), Jack Cowie (Transport Planner) and Anita Dawe (GM Regional Planning and Transport) were available to respond to questions on the report.

Resolution CM26-254: Cr Hollyer Moved, Cr Wilson Seconded

That the Council:

1) ***Notes** this report and the accompanying technical note "Balclutha to Dunedin bus service investigation, October 2026" [Attachment 1 of the report].*
2) ***Notes** the completion of the investigation into public transport options connecting Balclutha and Dunedin including consideration of Dunedin Airport as requested in the Annual Plan 2025/26.*
3) ***Requests** that staff prepare further information to enable Council to consider the Balclutha to Dunedin Public Transport Service proposal as part of Long-Term Plan considerations.*

MOTION CARRIED

11.4. Annual Compliance Report 2025-2026

[YouTube 4:39] This report provides the Council with the ORC Annual Compliance Monitoring Report for the 2025/26 financial year. Cr Noone, Portfolio Lead, introduced the paper. Simon Wilson (Manager Compliance) Eve Aitken (Team Leader Compliance) and Jo Gilroy (GM Environmental Delivery) were available to respond to questions on the report.

Resolution CM26-255: Cr Noone Moved, Cr Malcolm Seconded

That the Council:

1) ***Approves** the ORC Annual Compliance Monitoring Report 2025/26FY*
2) ***Delegates** to the Chief Executive, the power to approve minor editorial changes to the Annual Compliance Monitoring Report 2025/26FY subsequent to this meeting to correct any errors or readability.*

MOTION CARRIED

At 3:12 pm Cr Wilson Moved, Cr Somerville Seconded

That Council adjourn until 3:25 pm.

MOTION CARRIED

Cr Laws left the meeting at 3:25 pm.
Cr Hollyer left the meeting at 3:44 pm.
Cr Hollyer returned to the meeting at 3:45 pm.

11.5. Issues and Opportunities for Managing the Otago Coast

[YouTube 5:05] The purpose of this report was to provide Council with:

a. the Otago Coast Engagement Report which synthesises engagement feedback on Coastal Issues and Opportunities in Otago, and
b. the Otago Coast Issues and Opportunities Report, which summarises ORC's knowledge about issues affecting Otago's Coast, and identifies the opportunities for future management frameworks.

Cr Kate Wilson, Portfolio Lead, introduced the paper. Tom De Pelsemaeker (Team Leader

Freshwater and Land Policy & Planning), James Adams (Senior Policy Analyst), Amy Young (Senior Policy Analyst) and Anita Dawe (GM Regional Planning and Transport) were available to respond to questions on the report.

Resolution CM26-256: Cr Wilson Moved, Cr Gillespie Seconded
That the Council:
***1) Notes** this paper*
***2) Adopts** the Otago Coast Engagement Report and Otago Coast Issues and Opportunities Report, as a foundation to inform future regulatory and non-regulatory coastal management.*
MOTION CARRIED
Cr Byars and Cr Kelliher voted against.

Cr Gillespie left the meeting at 4:05 pm.
Cr Gillespie returned to the meeting at 4:06 pm.

11.6. Drinking Water Sources in Otago

[YouTube 5:26] This report introduced an outline of the Water Services Act 2021 as it applies to the Otago Regional Council, present the Drinking Water Sources in Otago Report dated September 2026 for the period 1 January 2025 to 31 December 2025, and demonstrated how ORC is meeting its obligations under the Water Services Act 2021 to share, publish and report on the quality and quantity of source water for drinking. Cr Robertson, Portfolio Lead, introduced the paper. Helen Trotter (Water Quality Scientist), Amir Levy (Groundwater Scientist) and Ben Mackey (Manager Science) were available to respond to questions on the report.

Resolution CM26-257: Cr Robertson Moved, Cr Somerville Seconded
That the Council:
***1) Notes** this report.*
MOTION CARRIED

11.7. Treasury Management Policy Review

[YouTube 5:54] This paper sought to adopt an updated Treasury Management Policy and Statement of Investment Policy and Objectives following review of those documents by the Audit and Risk Committee. Cr Malcolm, Co-Chair of Audit and Risk Committee, introduced the paper. Richard Saunders (Chief Executive) was available to respond to questions on the report.

Resolution CM26-258: Cr Malcolm Moved, Cr Gardner Seconded
That the Council:
***1) Notes** this report and the attached Draft Treasury Management Policy and Draft Statement of Investment Policy and Objectives.*
***2) Approves** the changes that have been made to the documents.*
***3) Adopts** the Draft Treasury Management Policy and Draft Statement of Investment Policies and Objectives.*
MOTION CARRIED

11.8. Changes to Dunedin Bus Timetables

[YouTube 5:58] This paper noted the issues arising following widespread Dunedin network changes introduced on 1 October 2026 and sought Council's endorsement for the process to appropriately review and respond to the feedback received. Cr Somerville, Portfolio Lead, introduced the paper. Anita Dawe (GM Regional Planning and Transport) was available to respond to questions on the report.

Resolution CM26-259: Cr Somerville Moved, Cr Hollyer Seconded

That the Council:

1) ***Notes*** *this report.*
2) ***Notes*** *that an external consultant has been engaged to support a rapid review of the Dunedin network changes.*
3) ***Notes*** *that a small number of priority changes will be made to early morning services to reinstate previous levels of service where these changes can be delivered within approved budgets.*
4) ***Notes*** *that a further paper will be brought to Council with options for resolving the issues identified*

MOTION CARRIED

12. NOTICES OF MOTION

None received.

13. CLOSURE

There was no further business, and Chair Calvert declared the meeting closed at 4:36 pm.

_____ _____

Chairperson Date

DRAFT

Meeting Date	Document	Item	Status	Action Required	Assignee/s	Action Taken	Due Date
24-06-2026	Council Meeting Supplementary Agenda - 24 June 2026	S&R2614 South Dunedin Future - 3 Proposed Adaptation Futures	In Progress	Resolution CM26-191 That a South Dunedin engineered flood protection system be designed and costed for inclusion in a future report for public consultation, this work is to be undertaken in partnership with the Dunedin City Council.	General Manager Regional Planning and Transport, General Manager Science and Resilience	17/07/2026 Governance Support Officer GM Regional Planning and Transport: Staff are working through the scope , timelines and cost of developing the additional option. An update will be provided to Council in due course. 10/09/2026 Governance Support Officer Update to be provided to September Council. 13/10/2026 Executive Assistant, Operations Council decisions and direction in June resulted in material changes to the SDF programme. Further to the memo provided in July, DCC Council will consider options for infrastructure investment in South Dunedin over the next 0–30 years in November as part of long term plan processes. Subject to these decisions, additional advice on longer term adaptation planning options for South Dunedin will be provided to both Councils. - Jonathan Rowe	2-08-2026

8.1. Chairperson's Report

Prepared for: Council

Author: Cr Hilary Calvert (Chairperson)

Date: 18 November 2026

RECOMMENDATION

That the Council:

*1) **Notes** this report.*

INTRODUCTION

[1] This report provides an update on Council business and the Chair's activities during the reporting period, including the October Council meeting, stakeholder and community meetings, and recent media engagement.

COUNCIL BUSINESS

[2] At its meeting on 28 October 2026, Council adopted its 2025/26 Annual Report, outlining services delivered, progress against targets and areas needing further work. It recorded a better-than-budget financial result. Council also updated the policies guiding its borrowing and investments.

[3] Council approved $3.3 million excluding GST over three years through the Large-scale Environmental Fund to support pest control in the Southern Lakes and Dunedin. The fund is designed to help communities and organisations work together on larger environmental projects, making greater and faster progress and delivering benefits that last for future generations. It aims to bring together local knowledge, expertise and funding so Council's investment can achieve more than it could alone.

[4] Southern Lakes Sanctuary will receive $1.8 million to maintain and expand predator control, while Predator Free Dunedin will receive $1.5 million for pest elimination work and to protect existing conservation gains. With Council funding both proposals, the two organisations have jointly committed to sharing their experience and expertise with community pest-control groups elsewhere in Otago through the 'One Regional Opportunity'. This includes practical advice, training, technology and proven ways to monitor results, helping emerging projects get underway faster and avoid duplicating effort. This support will be provided within the capacity of the approved programmes and without additional Council funding.

[5] Bus services were another focus, including problems following the 1 October changes to Dunedin's bus network. A rapid review, supported by an external consultant, is underway, and options to address the problems will return to Council. Council also requested more information on a possible Balclutha/Dunedin bus service, including consideration of Dunedin Airport, for the next Long-Term Plan.

[6] Council adopted two coastal reports bringing together community feedback and information on issues affecting Otago's coast. These will help inform future coastal management, rather than introduce new rules at this stage.

[7] Council also approved the annual report on checks that environmental rules and resource consent conditions are being followed and considered information on drinking water sources.

OTAGO MAYORAL FORUM

[8] The Chair attended an informal Otago Mayoral Forum discussion on 19 October about how the Forum could advocate for Otago following the general election, including opportunities to meet with incoming Ministers. Further discussion will take place at the next Otago Mayoral Forum on Friday 13 November.

STAKEHOLDER AND COMMUNITY ENGAGEMENT AND EVENTS

[9] The Chair, Deputy Chair or alternate attended the following events and meetings:

October 2026

- RSG Mayors/Chairs & CEOs - follow on informal session of available Mayors and Chairs, 15 October 2026 (attended by Deputy Chair Kevin Malcolm)
- Otago Mayoral Forum - catch up, 19 October 2026
- LGNZ briefing: Hon Rachel Brooking discusses Labour's approach to resource management, 20 October 2026
- North East Valley Drop-in Community Session, 21 October 2026
- LGNZ Regional Chairs, Mayors, and Deputies only time, 27 October 2026

RECENT MEDIA ENGAGEMENT

[10] The following media items were monitored during the reporting period and included reference to, or comment from, the Chair:

October 2026

- Landmark Regional Deal to Shape Future of Otago Central Lakes - Scoop, 6 October
- Landmark Regional Deal to shape future of Otago Central Lakes - Neighbourly, 7 October
- Growing pains drive new partnership - The Press, 8 October
- School transport key in bus fare decision - Otago Daily Times, 9 October
- Inside Otago mayors' group chat - Oamaru Mail, 9 October
- Pressure should go on central government to get students on bus to school, chairwoman says - Otago Daily Times, 9 October
- Laws not looking to force a by-election - Otago Daily Times, 21 October
- Otago Southland Rescue Helicopter Trust reports to ORC - Otago Regional Council, 28 October
- Two environmental groups granted more than $3 million as questions asked - Otago Daily Times, 29 October
- Report on sludge may stay secret - Otago Daily Times, 29 October
- Lauder residents voice concerns - The News Alexandra, 29 October

KEY CORRESPONDENCE TO AND FROM THE CHAIR

Correspondence received

- N/A

ATTACHMENTS

Nil

8.2. Chief Executive's Report

Prepared for: Council

Activity: Governance - Council

Endorsed by: Richard Saunders (Chief Executive)

Date: 18 November 2026

PURPOSE

[1] This report provides Council with an overview of Otago Regional Council's (ORC) key projects and current operational focus.

EXECUTIVE SUMMARY

[2] Development of the 2027–37 Long-Term Plan continues following Council's October budget discussions, with further refinement and planning for community consultation underway.

[3] October customer interactions totalled 9,477, with rates and public transport prominent enquiry themes. Customer satisfaction was 93%, while the call service level fell to 65%.

[4] Immediate operational priorities include addressing Dunedin bus timetable issues and progressing the Lauder consent conditions review, alongside ongoing compliance monitoring.

RECOMMENDATION

That the Council:

*1) **Notes** this report.*

LONG-TERM PLAN

[5] Work on the 2027–37 Long-Term Plan is focused on refining budgets, work programmes and levels of service, and identifying savings. Council met on 29 and 30 October to consider the proposed budgets and potential consultation items. More detailed activity information is helping make clear what ORC proposes to deliver, what it will cost and how it could be funded. This will support Council's consideration of priorities, affordability and the implications of different choices for services. A further meeting in November will enable Council to provide feedback to staff and help refine the proposed budgets and work programmes, ahead of further Council decisions and direction in early December.

[6] Early feedback from communities, mana whenua, other councils and partner organisations has helped shape the draft work programmes, including opportunities to coordinate work and avoid duplication.

[7] Planning for public consultation in 2027 focuses on making the proposals and choices easy to understand and giving people across Otago opportunities to have a say. The proposed approach includes existing community events and familiar places, supported by information through a range of channels. Council is scheduled to discuss the approach in November, ahead of decisions on consultation topics and engagement arrangements in December.

CUSTOMER EXPERIENCE

[8] Customer interaction volumes were higher than the rolling 12-month average during October, with 9,477 interactions recorded against an average of 6,092 per month. Volumes increased by 2,001 compared with October last year. Phone enquiries remained the largest channel at 3,546, followed by email at 3,016, reception at 1,533 and social media at 1,382. Full data is available in Attachment 1.

[9] Key enquiry themes during October were rates billing and public transport. Rates enquiries included customers who had not received an emailed invoice, customers who received an invoice more than once, and routine questions about balances, direct debits and contact details.

[10] Transport enquiries included feedback on timetable changes, late services, driver errors and cancellations, alongside routine questions about lost property, driver behaviour and timeliness. Social media contact was highest on posts about the Ōamaru bus launch, timetable and fare zone changes, public transport during the cruise ship season, the rescue helicopter and the Large-scale Environmental Fund.

[11] Customer satisfaction was 93%, while the overall service level for calls decreased to 65%. Customer sentiment tracking was limited during the month. Reception activity totalled 1,533 visits, including 1,453 in Dunedin and 80 in Queenstown.

[12] Enquiries managed through the Customer Relationship Management system totalled 5,632 in October. Finance accounted for 65% of enquiries, followed by Strategy and Customer at 15%, Planning and Transport at 13%, Environmental Delivery at 5%, and Science and Resilience, People and Corporate and the Executive Leadership Team at less than 1% each.

GENERAL COUNCIL BUSINESS

[13] A community-led project is helping identify which Otago wetlands are used by the critically endangered matuku-hūrepo/Australasian bittern. Knowing where these birds occur will help inform efforts to protect them and manage their habitat. The five-year project is entering its final year and is funded by ORC and led by the Otago Branch of Birds New Zealand, with support from conservation partners, landowners and community groups. Monitoring has recorded the birds across the Catlins, Coastal Otago, Maniototo, Central Otago and Whakatipu Basin, including at least 50 detections from sound recordings.

[14] Orbus Ferries is trialling services every half hour during busy travel times between Queenstown Bay and Frankton. The aim is to make ferry travel a more convenient alternative to driving and help ease traffic congestion and pressure on parking in Queenstown. The operator is providing the extra services at no additional cost to ORC

ratepayers. The ferry stops at Queenstown Bay, Bayview, Frankton Marina and the Hilton, giving residents and visitors more options to travel by water rather than road.

[15] Council is seeking more information about a possible bus service between Balclutha and Dunedin before considering it through the 2027–37 Long-Term Plan. At its 28 October meeting, Council considered an investigation that identified three return trips a day, seven days a week, using one bus as the preferred option. The service could also connect to Dunedin airport. It would cost an estimated $589,000 a year to run, with a further $100,000 to set it up. Estimates of passenger numbers and fare income are preliminary. Possible funding for a two-year trial includes fares, ORC funding and a contribution from NZ Transport Agency Waka Kotahi. No decision has been made to introduce the service.

[16] ORC has acknowledged the concerns raised by the community about the Lauder waste discharge consent. A decision has been made to review the conditions of SJ Allen Holdings Limited's consent to discharge five types of waste onto land at its Lauder property. The decision follows consideration of several matters, including the information available when the original consent decision was made. ORC has formally notified the consent holder under section 128 of the Resource Management Act 1991, explaining which conditions are being reviewed and why.

[17] The review must follow the process set out in law. This includes a separate assessment of whether the review should be notified. Any decision to change the consent conditions will be made only after that process is complete.

[18] The consent holder can continue operating while the review is underway, provided it follows the existing consent conditions. ORC will continue to monitor the site and check whether those conditions are being met.

[19] A review, supported by an external consultant, is examining the issues caused by the Dunedin bus timetable and route changes introduced on 1 October and identifying their causes. Priority adjustments are being prepared for early morning services on Route 18 (Peninsula) and Route 78 (Mosgiel), while staff work with the operator on driver training issues. Options for addressing the remaining issues will be brought to Council, informed by passenger complaints, operator feedback and discussions with community boards. Consultation requirements will be considered as part of those decisions.

STAKEHOLDER - COMMUNITY ENGAGEMENT AND EVENTS

[20] Key events and meetings attended, with upcoming attendance identified below.

- Lindsay Creek Community Engagement (21 October)
- Lauder community meeting (25 October)
- Otago Chief Executives Forum (23 October)
- Civil Defence Emergency Management Coordinating Executive Group (23 October)
- Consents Managers Forum (5 November)

KEY CORRESPONDENCE TO AND FROM THE CHIEF EXECUTIVE

Correspondence Received

- N/A

Correspondence Sent

- N/A

OPTIONS

[21] As this is a report for noting, there are no options to consider.

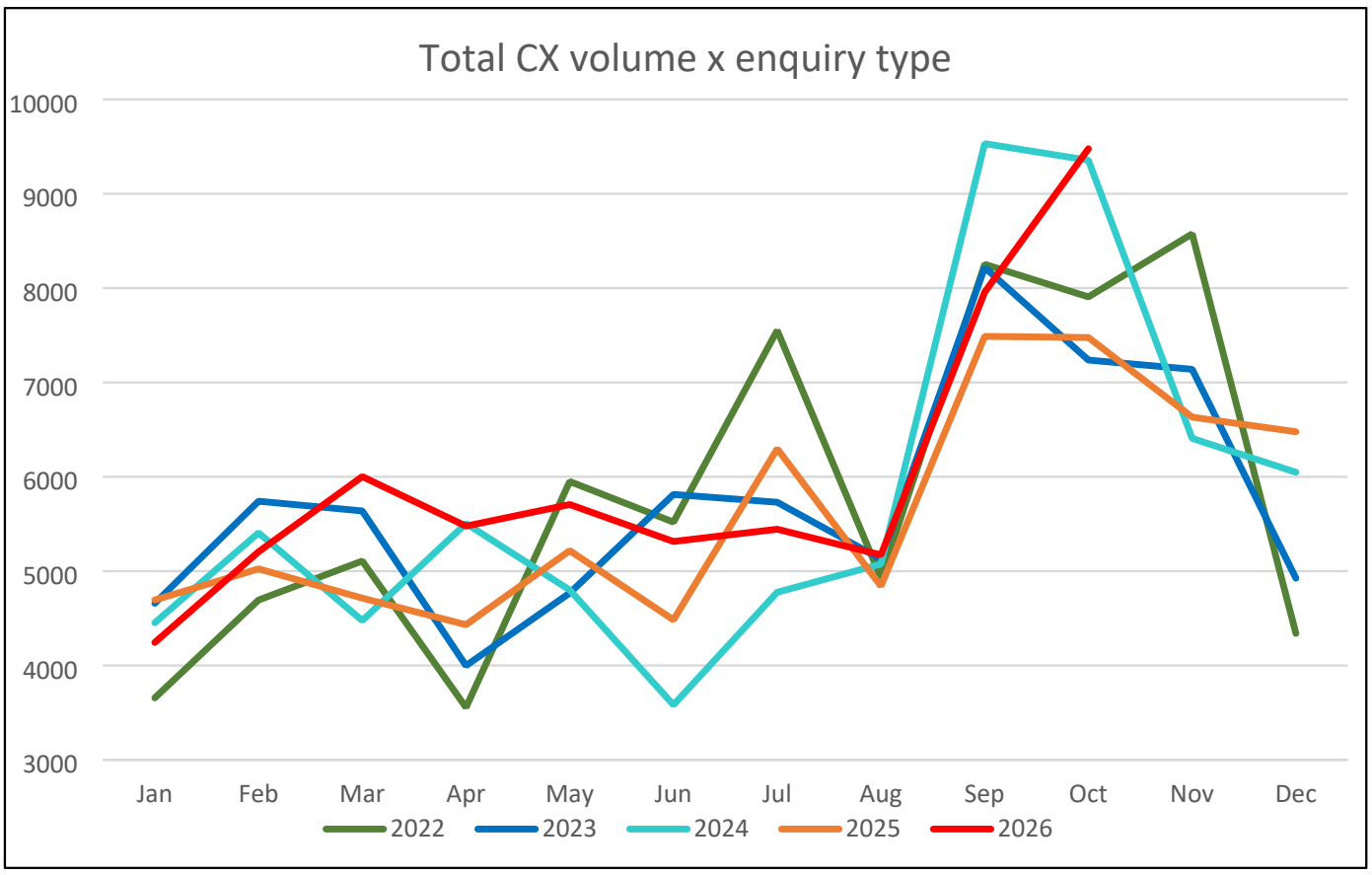
ATTACHMENTS

1. Customer Report October 2026 [**8.2.1** - 2 pages]

October 2026 Customer Report

Rolling 12-month customer interaction volume average is 6092 per month

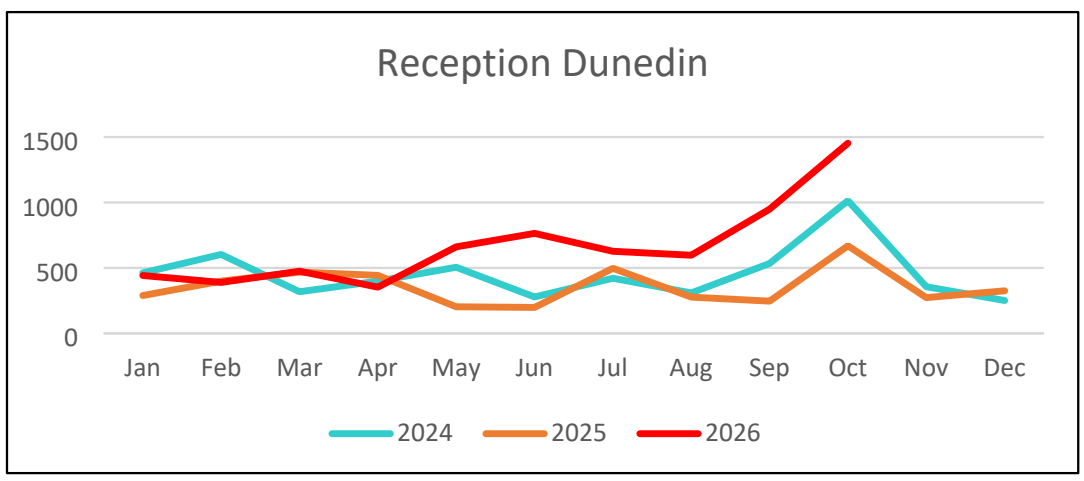
This month's customer volume total: **9477**
(reception = 1533, phone = 3546, email = 3016, social 1382)

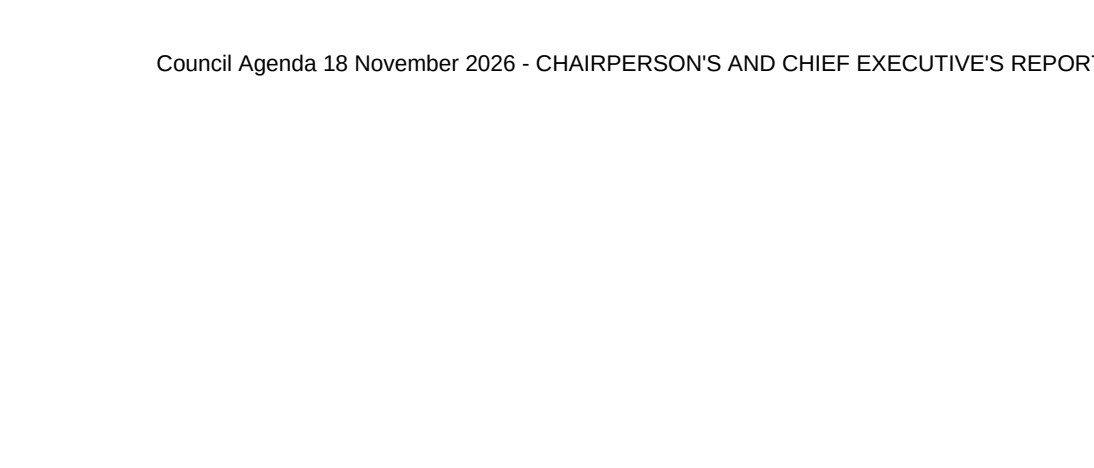


- Total customer interaction volume increased by 2001 compared to this month last year
- Customer sentiment tracking was low.
- Total service level for all calls decreased to 65%
- Total customer satisfaction rating this month: 93%.

Enquiry themes:

- Rates: Haven't received email invoice yet, have received email invoice multiple times.
  Routine enquiries: balance, direct debit, wrong mailing address, update email/postal info.
- Transport: GTFS changes feedback, GTFS late/timing, GTFS driver error issues, Cancellations
  Routine enquiries: Lost Property, driver behaviour, timeliness.
- Social media: highest contact posts: PT Oamaru launch, GTFS changes, PT zone changes, PT cruise ship season, Rescue Helicopter, Large scale environment fund
- Reception visitors: Dunedin = 1453, Queenstown = 80.


Reception Dunedin
1500
1000
500
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
2025
2026


Reception Queenstown
100
80
60
40
20
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2024
2025
2026

Customer Satisfaction
100%
96%
92%
88%
84%
80%
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
2023/2024
2024/2025
2025/2026
2026/2027

9.1. Quarter 1 Finance Report - 30 September 2026

Prepared for:	Council
Report No.	FIN2622
Activity:	Finance
Authors:	Nick Donnelly (General Manager Finance), Sarah Munro (Group Financial Controller), Sean Geary (Manager Financial Planning and Analysis)
Endorsed by:	Nick Donnelly (General Manager Finance)
Date:	18 November 2026
Portfolio Leads:	Cr Malcolm and Cr Gardner, Finance

PURPOSE

[1] To present Council's Financial Reports for the 3-month period to 30 September 2026 being Quarter 1 of the 2026-2027 financial year.

EXECUTIVE SUMMARY

[2] The actual operating surplus for the 3 months ending 30 September 2026 is $1,157,000. This is $62,000 behind budget of $1,219,000.

[3] Actual operating revenue is $34,074,000 which is $286,000 (0.8%) under budget of $34,361,000. Grants and Subsidies and lower than budget due to timing of flood protection project funding. This is offset by higher other revenue which includes additional regulatory fees and charges and bus fares

[4] Actual operating expenditure is $32,333,000 which is $1,118,000 (3.3%) under budget of $33,452,000. Other expenses are below budget by $1,605,000 which includes underspends in Policy and Planning and Science.

[5] Other gains and losses are -$584,000 which is due to a loss on the Managed fund for this period.

[6] The Quarter 1 forecast provides an early indication of the year end result. The forecast year end deficit is -$3,351,000 which is $2,096,000 below the full year budget deficit of -$1,255,000. Key forecast surplus/deficit variances include:

- Higher Dunedin PT bus contract costs due to higher CPI adjusted costs and the unbudgeted extension to Oamaru.
- Total Mobility subsidies are forecast at the maximum currently agreed with NZTA.
- STED's includes unbudgeted cost as sites have been transferred from TA's.
- Higher Operational Property costs including higher power, rates and rent (Queenstown and Oamaru).

- Lower gain in the value of the managed fund reflecting the current year to date result (noting this will be updated to reflect actual market returns as the year progresses).

[7] Further commentary on these variances, capital expenditure, the Statement of Financial Position, Reserves and the Treasury Report are provided in the discussion section below.

RECOMMENDATION

That the Council:

1) ***Notes** this report and the attached Financial Reports for September 2026 (Quarter 1 of the 2026-2027 financial year).*

BACKGROUND

[8] This report includes the following attached reports:

- **SCRE and Activity Reports**
  - Statement of Comprehensive Revenue and Expense (SCRE) reports showing operating surplus/deficit for the year to date and forecast for the period ending 30 September 2026.
  - Results are compared to the budget included in the Annual Plan 2026-2027.
  - Includes results for Council as whole, a year-to-date summary by Activity and results for each Group of Activities (this includes additional analysis by Significant Activity).
  - Capital expenditure.
- **Statement of Financial Position**
  - Balance sheet as at quarter end compared to previous year end (30 June 2026) and budget for the financial year-end (30 June 2027).
- **Reserves Report**
  - Summary of Council's reserves including movements in each reserve.
- **Treasury Report**
  - Further detail and analysis of cash, investments (managed fund) and borrowings.

DISCUSSION

Operating Surplus Variance – Actual Year to Date

[9] The actual operating surplus for the 3 months ending 30 September 2026 is $1,157,000. This is $62,000 behind budget of $1,219,000. Analysis of variance by activity is shown in the table below.

COUNCIL - YEAR TO DATE	Revenue			Expenditure			Surplus / (Deficit)			
For the period ending: September 2026	Actual	Budget	Variance	Actual	Budget	Variance	Actual	Budget	Variance	NOTES
Consents & Compliance	4,204	3,650	554	4,154	3,576	(578)	50	74	(24)	
Governance & Community	3,881	3,856	26	3,594	3,883	289	287	(28)	315	Timing/budget phasing - includes LTP costs
Regional Plans & Policies	557	555	2	305	548	243	252	7	245	Timing
REGIONAL LEADERSHIP	8,643	8,061	582	8,053	8,007	(46)	590	53	536	
Air	308	307	1	312	271	(40)	(4)	36	(39)	
Biodiversity	2,352	2,479	(126)	1,818	1,818	()	534	661	(127)	Timing
Water	4,823	4,786	37	3,771	4,406	635	1,052	380	672	Timing - Planning $332k, Science $392k
ENVIRONMENT	7,483	7,572	(88)	5,901	6,495	594	1,582	1,076	506	
Emergency Management	1,034	1,028	6	1,016	961	(54)	19	67	(49)	
Flood Protection	1,549	2,403	(854)	2,005	2,516	512	(455)	(113)	(342)	Lower Clutha revenue accrual resersal -$820k offset by River Management +$450k (timing/budget phasing)
Natural Hazards	880	860	20	550	511	(39)	330	349	(19)	
SAFETY AND RESILIENCE	3,464	4,292	(828)	3,570	3,988	418	(107)	303	(410)	
Public Transport - Dunedin	7,889	7,877	12	7,399	7,452	54	490	425	66	
Public Transport - Other	1,137	1,042	95	868	881	13	270	161	108	Total Mobility
Public Transport - Wakatipu	4,068	4,131	(63)	3,826	4,010	184	242	120	122	Timing - bus contracts
Regional Land Transport Planning	186	203	(16)	204	243	39	(18)	(40)	23	
Stock Truck Effluent Disposal	75	43	32	110	43	(67)	(35)		(35)	
TRANSPORT	13,355	13,296	60	12,406	12,630	224	950	666	284	
Corporate Support	10	38	(28)	833	552	(281)	(824)	(515)	(309)	Property - power, rates and rent (Queenstown, Oamaru)
Finance & Treasury	1,120	1,103	16	1,570	1,779	209	(450)	(676)	226	Timing/budget phasing - includes audit fee accrual reserval and rates postage
CORPORATE	1,129	1,141	(11)	2,403	2,331	(72)	(1,274)	(1,190)	(83)	
TOTAL REVENUE & EXPENDITURE	34,074	34,361	(286)	32,333	33,452	1,118	1,741	909	832	
Other Gains/Losses	(584)	310	(894)			-	(584)	310	(894)	Timing - loss in Q1 (expected to recover over remainder of year)
TOTAL COUNCIL	33,490	34,671	(1,181)	32,333	33,452	1,118	1,157	1,219	(62)	

Table 1: Year to date surplus / (deficit) variance by key activities

Operating Surplus Variance – Forecast

[10] The forecast year end deficit is -$3,351,000 which is $2,096,000 below the full year budget deficit of -$1,255,000. Analysis of variance by activity is shown in the table below.

COUNCIL - FORECAST	Revenue			Expenditure			Surplus / (Deficit)			
For the year ending: June 2027	Forecast	Budget	Variance	Forecast	Budget	Variance	Forecast	Budget	Variance	NOTES
Consents & Compliance	15,523	14,600	922	15,519	14,600	(919)	4		4	
Governance & Community	15,448	15,423	26	15,076	15,246	170	372	176	196	Lower staff costs - Comms, Business Support
Regional Plans & Policies	2,222	2,220	2	2,161	2,220	58	60		60	
REGIONAL LEADERSHIP	33,193	32,242	950	32,756	32,066	(690)	437	176	260	
Air	1,228	1,226	1	1,275	1,225	(50)	(48)	1	(49)	
Biodiversity	9,635	9,916	(280)	12,044	12,000	(44)	(2,409)	(2,085)	(324)	Biosecurity -$199k - will review at Q2
Water	19,342	19,305	37	19,290	19,409	120	52	(104)	157	
ENVIRONMENT	30,205	30,447	(242)	32,609	32,635	26	(2,404)	(2,188)	(216)	
Emergency Management	4,120	4,114	6	4,177	4,114	(63)	(58)		(58)	
Flood Protection	13,432	13,470	(38)	12,009	12,117	107	1,422	1,354	69	
Natural Hazards	4,577	4,557	20	4,941	4,965	24	(363)	(407)	44	
SAFETY AND RESILIENCE	22,129	22,141	(13)	21,128	21,195	68	1,001	946	55	
Public Transport - Dunedin	31,281	31,533	(252)	30,168	29,883	(285)	1,113	1,650	(537)	Bus contracts CPI and Oamaru extension not in budget
Public Transport - Other	2,835	3,467	(632)	3,434	3,467	32	(599)		(599)	Total Mobility revenue forecast as agreed with NZTA
Public Transport - Wakatipu	16,753	16,550	203	16,297	16,092	(205)	456	458	(2)	
Regional Land Transport Planning	978	941	37	941	941	1	38	()	38	
Stock Truck Effluent Disposal	360	173	188	787	173	(615)	(427)	()	(427)	Sites transferred from TA's not budgeted
TRANSPORT	52,207	52,663	(456)	51,626	50,555	(1,072)	581	2,108	(1,528)	
Corporate Support	122	150	(28)	2,951	2,376	(575)	(2,828)	(2,226)	(603)	Property - power, rates and rent (Queenstown, Oamaru)
Finance & Treasury	5,883	5,867	16	6,969	7,178	209	(1,086)	(1,312)	226	Timing - reflects year to date and should correct over remainder of year
CORPORATE	6,005	6,017	(11)	9,920	9,554	(366)	(3,915)	(3,538)	(377)	
TOTAL REVENUE & EXPENDITURE	143,739	143,510	228	148,039	146,005	(2,033)	(4,300)	(2,495)	(1,805)	
Other Gains/Losses	345	1,240	(894)			-	345	1,240	(894)	Reflects Q1 actual which should recover over remainder of year
TOTAL COUNCIL	144,084	144,750	(666)	148,039	146,005	(2,033)	(3,955)	(1,255)	(2,700)	

Table 2: Forecast surplus / (deficit) variance by activity

Surplus Funding Impact – Actual Year to Date

[11] Analysis of the funding impact of the actual operating surplus/(deficit) variance is shown in table below.

COUNCIL - YEAR TO DATE	Surplus / (Deficit)			Variance Funding		
For the period ending: September 2026	Actual	Budget	Variance	General Reserve	Targeted Reserves	Other
Consents & Compliance	50	74	(24)	(38)	14	-
Governance & Community	287	(28)	315	315	-	-
Regional Plans & Policies	252	7	245	245	-	-
REGIONAL LEADERSHIP	590	53	536	522	14	-
Air	(4)	36	(39)	(39)	-	-
Biodiversity	534	661	(127)	(84)	(42)	-
Water	1,052	380	672	725	(53)	-
ENVIRONMENT	1,582	1,076	506	601	(95)	-
Emergency Management	19	67	(49)	-	(49)	-
Flood Protection	(455)	(113)	(342)	18	(360)	-
Natural Hazards	330	349	(19)	(19)	-	-
SAFETY AND RESILIENCE	(107)	303	(410)	(1)	(409)	-
Public Transport - Dunedin	490	425	66		66	
Public Transport - Other	270	161	108	108		
Public Transport - Wakatipu	242	120	122		122	
Regional Land Transport Planning	(18)	(40)	23	23		
Stock Truck Effluent Disposal	(35)		(35)	(35)		
TRANSPORT	950	666	284	96	187	-
Corporate Support	(824)	(515)	(309)	(305)	-	(4)
Finance & Treasury	(450)	(676)	226	226	-	-
CORPORATE	(1,274)	(1,190)	(83)	(80)	-	(4)
TOTAL REVENUE & EXPENDITURE	1,741	909	832	1,139	(303)	(4)
Other Gains/Losses	(584)	310	(894)	(894)		
TOTAL COUNCIL	1,157	1,219	(62)	245	(303)	(4)

Table 3: Actual operating surplus / (deficit) funding allocation by activity

Capital Expenditure

[12] Actual capital expenditure is $629,000 which is $775,000 under budget of $1,404,000. This is mainly due to lower spend in the Operational Property and Vehicles activities.

Statement of Financial Position

[13] Key items to note in the Statement of Financial Position are:

- Total equity as at 30 September 2026 is $997,252,000 which is an increase of $1,156,000 over the year.
- Cash on hand is $18,963,000.

- The managed fund balance is $33,340,000 (in Other financial assets).
- Borrowing is $190,253,000 which includes Council core debt of $25,000,000, Council short-term funding of $15,000,000 and on lending to Port Otago of $150,000,000 (the remainder is accrued interest on ORC debt at balance date).

Reserves Report

[14] The Reserves Report provides a summary of Council's reserves as at 30 September 2026 and the movements in each reserve over the year to date.

[15] Key items to note in the Reserves Report are:

- Historic transport reserves are shown separately from any operational surpluses/deficits (this was effective from the start of the LTP 2024-34 period beginning on 1 July 2024).

Treasury Report

[16] Key items to note in the Treasury Report are:

- Cash and term deposits have increased $5,450,000 over the year.
- The Managed Fund balance has decreased $266,000 over the year (this is $721,000 under budget for the year).
- Total debt has increased $15,000,000 over the year. This is due to Council borrowing $15,000,000 as short term funding until rates are received at the end of October 2026. Port Otago on-lending remains unchanged at $150,000,000.
- Council's cost of debt including swaps is 3.898%.

SUMMARY OF CONSIDERATIONS

Community Outcomes

This work aligns with the following community outcomes from the ORC 2024-2034 Long-Term Plan:

Whole of Organisation

This work supports the whole organisation and, therefore, all Community Outcomes.

Councillor Priority Actions

Not applicable.

Alignment With Central Government Legislation

There is no specific national policy statement or central government direction that is directly applicable to this work.

Alignment With ORC Internal Policy

There is no specific ORC policy that is directly applicable to this work.

Financial Considerations

There are no financial considerations associated with the production of this report. This report provides Council's financial result for the reporting period outlining actual financial performance against the relevant Long-Term / Annual Plan.

Legal/Compliance Risk

There is insignificant/minor risk that decisions arising from this report could expose Council to litigation, regulatory non-compliance, or breach of policy/legislation. The recommendation is

that Council notes the report, which provides Council's actual financial result for the period against the Annual Plan 2026-27 budget. There is no specific national policy statement, central government direction or ORC policy directly applicable to this work, and there are no financial considerations associated with producing the report.

Reputational Risk
There is insignificant/minor risk that decisions arising from this report could adversely impact Council's reputation or community trust. The year to date operating surplus of $1,157,000 is slightly below the budget of $1,219,000, and the report explains the main variances, including the timing of flood protection project funding and the loss on the managed fund.

Climate Resilience
The impacts of climate-related risks (e.g. flooding, drought, extreme winds, coastal erosion, wildfires) on this work has not been assessed.

Carbon Emissions
The implications of this work on organisational or regional greenhouse gas emissions has not been assessed.

He Mahi Rau Rika: Significance, Engagement and Māori Participation Policy
Not Applicable.

Engagement with Mana Whenua
There has been no engagement with mana whenua or Māori specifically for this work.

Stakeholder Engagement
There has been no engagement with external stakeholders and/or the public specifically for this work.

Communications
Not Applicable.

NEXT STEPS

[17] Not Applicable.

ATTACHMENTS

1. SCRE and Activity Reports September 2026 [**9.1.1** - 9 pages]
2. Statement of Financial Position September 2026 [**9.1.2** - 1 page]
3. Reserves Summary September 2026 [**9.1.3** - 1 page]
4. Treasury Report September 2026 [**9.1.4** - 1 page]

Management Reports

Statement of Comprehensive Revenue Expenditure for Whole of Council	2
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Statement of Comprehensive Revenue Expenditure	Year to Date			Full Year Forecast		
Whole of Council	Actual	Budget	Variance	Forecast	Budget	Variance
For the period ending: September						
Revenue						
Rates	17,186	17,117	70	68,536	68,467	70
Grants and subsidies	5,161	6,344	(1,183)	28,689	29,992	(1,303)
Dividends	5,283	5,000	283	20,283	20,000	283
Investment revenue	1,349	1,616	(267)	6,198	6,465	(267)
Other revenue	5,095	4,283	811	20,636	18,586	2,050
Total revenue	**34,074**	**34,361**	**(286)**	**144,343**	**143,510**	**832**
Expenditure						
Employee benefit expenses	10,811	10,428	(383)	43,995	43,270	(725)
Depreciation and amortisation	773	779	6	3,126	3,115	(11)
Finance costs	1,515	1,406	(109)	5,734	5,625	(109)
Other expenses	19,234	20,839	1,605	95,183	93,995	(1,189)
Internal Charges/Recoveries	-	()	()			()
Total operating expenditure	**32,333**	**33,452**	**1,118**	**148,039**	**146,005**	**(2,033)**
Other Gains/Losses	(584)	310	(894)	345	1,240	(894)
Surplus/(Deficit)	**1,157**	**1,219**	**(62)**	**(3,351)**	**(1,255)**	**(2,096)**
Fair value gain/loss on shares in subsidiary	-	-	-	31,954	31,954	-
	-	-	-	-	-	-
Other Comprehensive Revenue and Expenses	-	-	-	**31,954**	**31,954**	-
Total other Comprehensive Revenue and Expenses	1,157	1,219	(62)	28,603	30,699	(2,096)

COUNCIL - YEAR TO DATE	Revenue			Expenditure			Surplus / (Deficit)		
	Actual	Budget	Variance	Actual	Budget	Variance	Actual	Budget	Variance
Consents & Compliance	4,204	3,650	554	4,154	3,576	(578)	50	74	(24)
Governance & Community	3,881	3,856	26	3,594	3,883	289	287	(28)	315
Regional Plans & Policies	557	555	2	305	548	243	252	7	245
REGIONAL LEADERSHIP	**8,643**	**8,061**	**582**	**8,053**	**8,007**	**(46)**	**590**	**53**	**536**
Air	308	307	1	312	271	(40)	(4)	36	(39)
Biodiversity	2,352	2,479	(126)	1,818	1,818	()	534	661	(127)
Water	4,823	4,786	37	3,771	4,406	635	1,052	380	672
ENVIRONMENT	**7,483**	**7,572**	**(88)**	**5,901**	**6,495**	**594**	**1,582**	**1,076**	**506**
Emergency Management	1,034	1,028	6	1,016	961	(54)	19	67	(49)
Flood Protection	1,549	2,403	(854)	2,005	2,516	512	(455)	(113)	(342)
Natural Hazards	880	860	20	550	511	(39)	330	349	(19)
SAFETY AND RESILIENCE	**3,464**	**4,292**	**(828)**	**3,570**	**3,988**	**418**	**(107)**	**303**	**(410)**
Public Transport - Dunedin	7,889	7,877	12	7,399	7,452	54	490	425	66
Public Transport - Other	1,137	1,042	95	868	881	13	270	161	108
Public Transport - Wakatipu	4,068	4,131	(63)	3,826	4,010	184	242	120	122
Regional Land Transport Planning	186	203	(16)	204	243	39	(18)	(40)	23
Stock Truck Effluent Disposal	75	43	32	110	43	(67)	(35)		(35)
TRANSPORT	**13,355**	**13,296**	**60**	**12,406**	**12,630**	**224**	**950**	**666**	**284**
Internal	(3)	25	(28)	1,146	926	(220)	(1,148)	(901)	(248)
Overheads	1,132	1,116	16	1,257	1,406	148	(125)	(289)	164
CORPORATE	**1,129**	**1,141**	**(11)**	**2,403**	**2,331**	**(72)**	**(1,274)**	**(1,190)**	**(84)**
TOTAL COUNCIL	**34,074**	**34,361**	**(286)**	**32,333**	**33,452**	**1,118**	**1,741**	**909**	**832**
Other Gains & Losses	(584)	310	(894)				(584)	310	(894)
TOTAL COUNCIL	**33,490**	**34,671**	**(1,181)**	**32,333**	**33,452**	**1,118**	**1,157**	**1,219**	**(63)**

REVENUE & EXPENSES	Year to Date			Full Year Forecast		
Regional Leadership	Actual	Budget	Variance	Forecast	Budget	Variance
Revenue						
Grants and subsidies	9	20	(10)	68	78	(10)
Other revenue	1,751	1,187	564	6,285	4,748	1,537
Rates	6,882	6,854	28	27,444	27,416	28
Total revenue	**8,643**	**8,061**	**582**	**33,797**	**32,242**	**1,555**
Expenditure						
Depreciation and amortisation	17	15	(2)	64	62	(2)
Employee benefit expenses	4,148	4,305	157	17,659	17,866	207
Internal Charges/Recoveries	2,150	2,100	(50)	8,452	8,402	(50)
Other expenses	1,737	1,586	(151)	6,581	5,736	(845)
Total operating expenditure	**8,053**	**8,007**	**(46)**	**32,756**	**32,066**	**(690)**
Surplus/(Deficit)	590	53	536	1,041	176	864

Significant Activities	Year to Date			Full Year Forecast		
	Actual	Budget	Variance	Forecast	Budget	Variance
CONSENTS & COMPLIANCE						
COMPLIANCE MONITORING & CONTAMINATED SITES						
Revenue	1,665	1,627	37	7,185	6,510	676
Expenditure	1,656	1,592	(65)	6,574	6,510	(65)
CONSENT PROCESSING						
Revenue	1,674	1,180	495	5,548	4,719	829
Expenditure	1,706	1,157	(549)	5,609	4,719	(890)
HARBOUR MANAGEMENT						
Revenue	255	265	(9)	1,050	1,059	(9)
Expenditure	236	260	24	1,036	1,059	24
INCIDENT RESPONSE & ENFORCEMENT						
Revenue	610	578	32	2,344	2,313	32
Expenditure	555	567	12	2,301	2,313	12
Surplus/(Deficit)	50	74	(24)	608		608
GOVERNANCE & COMMUNITY						
CHIEF ADVISOR TO CE AND CHAIR						
Revenue	65	65		260	260	
Expenditure	72	55	(17)	277	260	(17)
COMMUNICATIONS AND MARKETING						
Revenue	583	581	2	2,325	2,323	2
Expenditure	470	569	99	2,255	2,323	68
CUSTOMER AND GOVERNANCE						
Revenue	1,019	1,015	4	4,065	4,061	4
Expenditure	810	949	139	3,755	3,884	130
EXECUTIVE MANAGEMENT						
Revenue	655	653	3	2,613	2,611	3
Expenditure	722	634	(88)	2,698	2,611	(88)
GOVERNANCE & FINANCIAL CONTRIBUTIONS						
Revenue	55	55		221	221	
Expenditure	36	54	18	203	221	18
LEGAL COUNSEL						
Revenue	310	309	1	1,237	1,236	1
Expenditure	262	305	43	1,167	1,236	69
MANAGEMENT ACCOUNTANT						
Revenue	205	204	1	818	817	1
Expenditure	209	199	(10)	827	817	(10)
ORGANISATIONAL PLANNING AND PERFORMANCE						
Revenue	366	365	1	1,460	1,458	1
Expenditure	237	358	121	1,437	1,458	21
PARTNERSHIPS AND ENGAGEMENT						
Revenue	307	296	11	1,196	1,185	11
Expenditure	456	452	(3)	1,191	1,185	(6)
STRATEGY						
Revenue	314	313	1	1,253	1,252	1
Expenditure	320	307	(13)	1,265	1,252	(13)
Surplus/(Deficit)	287	(28)	315	372	176	196
REGIONAL PLANS & POLICIES						
REGIONAL PLANNING & POLICIES						
Revenue	557	555	2	2,222	2,220	2
Expenditure	305	548	243	2,161	2,220	58
Surplus/(Deficit)	252	7	245	60		60

REVENUE & EXPENSES	Year to Date			Full Year Forecast		
Environment	Actual	Budget	Variance	Forecast	Budget	Variance
Revenue						
Grants and subsidies	286	443	(157)	1,621	1,933	(311)
Other revenue	40	-	40	40	-	40
Rates	7,158	7,129	29	28,544	28,515	29
Total revenue	**7,483**	**7,572**	**(88)**	**30,205**	**30,447**	**(242)**
Expenditure						
Depreciation and amortisation	134	131	(3)	546	526	(20)
Employee benefit expenses	2,706	2,602	(104)	11,292	10,797	(495)
Internal Charges/Recoveries	1,544	1,529	(15)	6,130	6,116	(15)
Other expenses	1,517	2,233	716	14,641	15,197	556
Total operating expenditure	**5,901**	**6,495**	**594**	**32,609**	**32,635**	**26**
Surplus/(Deficit)	1,582	1,076	506	(2,404)	(2,188)	(216)

Significant Activities	Year to Date			Full Year Forecast		
	Actual	Budget	Variance	Forecast	Budget	Variance
AIR						
AIR MONITORING						
Revenue	215	214	1	858	857	1
Expenditure	252	181	(71)	906	856	(50)
REGIONAL PLAN: AIR						
Revenue	93	92		370	369	
Expenditure	60	90	30	369	369	-
Surplus/(Deficit)	(4)	36	(39)	(48)	1	(49)
BIODIVERSITY						
BIODIVERSITY IMPLEMENTATION						
Revenue	370	368	2	1,474	1,472	2
Expenditure	121	79	(42)	3,599	3,557	(42)
BIODIVERSITY SCIENCE & MONITORING						
Revenue	352	346	6	1,389	1,383	6
Expenditure	289	199	(91)	1,473	1,383	(91)
BIOSECURITY						
Revenue	1,631	1,765	(134)	6,772	7,061	(288)
Expenditure	1,408	1,541	133	6,971	7,061	89
Surplus/(Deficit)	534	661	(127)	(2,409)	(2,085)	(324)
WATER						
ENVIRONMENTAL MANAGEMENT						
Revenue	566	563	2	2,255	2,253	2
Expenditure	503	553	50	2,203	2,253	50
LAND & WATER IMPLEMENTATION						
Revenue	533	505	28	2,209	2,181	28
Expenditure	501	368	(133)	2,254	2,286	32
LAND & WATER PLANNING						
Revenue	694	692	3	2,769	2,766	3
Expenditure	352	682	330	2,772	2,766	(5)
LAND & WATER SCIENCE AND MONITORING						
Revenue	3,030	3,026	4	12,108	12,104	4
Expenditure	2,415	2,803	388	12,061	12,104	43
Surplus/(Deficit)	1,052	380	672	52	(104)	157

REVENUE & EXPENSES		Year to Date			Full Year Forecast	
Safety and Resilience	Actual	Budget	Variance	Forecast	Budget	Variance
Revenue						
Grants and subsidies	(831)	67	(898)	5,209	5,241	(32)
Other revenue	203	150	53	602	599	3
Rates	4,092	4,075	17	16,318	16,301	17
Total revenue	**3,464**	**4,292**	**(828)**	**22,129**	**22,141**	**(13)**
Expenditure						
Depreciation and amortisation	228	220	(9)	888	879	(9)
Employee benefit expenses	1,713	1,593	(120)	6,729	6,608	(120)
Internal Charges/Recoveries	854	870	16	3,466	3,482	16
Other expenses	775	1,305	531	10,045	10,226	180
Total operating expenditure	**3,570**	**3,988**	**418**	**21,128**	**21,195**	**68**
Surplus/(Deficit)	(107)	303	(410)	1,001	946	55

Significant Activities		Year to Date			Full Year Forecast	
	Actual	Budget	Variance	Forecast	Budget	Variance
EMERGENCY MANAGEMENT						
EMERGENCY MANAGEMENT						
Revenue	1,034	1,028	6	4,120	4,114	6
Expenditure	1,016	961	(54)	4,177	4,114	(63)
Surplus/(Deficit)	19	67	(49)	(58)		(58)
FLOOD PROTECTION						
ALEXANDRA FLOOD PROTECTION						
Revenue	139	89	50	356	356	
Expenditure	38	62	24	341	356	14
EAST TAIERI DRAINAGE						
Revenue	191	191	1	763	762	1
Expenditure	220	246	27	1,017	997	(21)
LEITH FLOOD PROTECTION SCHEME						
Revenue	394	393	2	1,572	1,570	2
Expenditure	163	157	(6)	721	715	(6)
LWR CLUTHA FLOOD PROTECTION & DRAINAGE						
Revenue	(396)	372	(768)	2,286	2,218	68
Expenditure	447	394	(52)	2,359	2,306	(52)
LWR TAIERI FLOOD PROTECTION SCHEME						
Revenue	308	402	(94)	4,669	4,734	(65)
Expenditure	298	320	22	1,761	1,783	22
NON SCHEME MANAGEMENT						
Revenue	20	20		79	79	
Expenditure	1	20	18	61	79	18
RIVER MANAGEMENT - CENTRAL						
Revenue	103	102		409	409	
Expenditure	95	164	69	658	660	2
RIVER MANAGEMENT - CLUTHA						
Revenue	122	121		486	485	
Expenditure	79	212	133	828	854	26
RIVER MANAGEMENT - DUNEDIN						
Revenue	67	66		266	266	
Expenditure	200	188	(12)	778	758	(20)
RIVER MANAGEMENT - WAITAKI						
Revenue	164	164	1	655	655	1
Expenditure	72	188	116	963	988	25
RIVER MANAGEMENT - WAKATIPU/WANAKA						
Revenue	142	142	1	567	567	1
Expenditure	110	253	143	954	1,023	69
RIVER MANAGEMENT OVERSIGHT						
Expenditure	1	(1)	(2)	2	()	(2)
SCHEME OVERSIGHT						
Revenue	(13)	36	(49)	94	143	(49)
Expenditure	(25)	35	60	83	143	60
TOKOMARIRO DRAINAGE						
Revenue	48	48		192	192	
Expenditure	57	47	(10)	328	318	(10)
WEST TAIERI DRAINAGE						
Revenue	262	259	3	1,038	1,035	3
Expenditure	249	229	(20)	1,156	1,137	(20)
Surplus/(Deficit)	(455)	(113)	(342)	1,422	1,354	69
NATURAL HAZARDS						
FLOOD & LOW FLOW RISK MANAGEMENT						
Revenue	154	154	1	616	615	1
Expenditure	73	101	28	587	615	28
NATURAL HAZARDS						
Revenue	726	706	19	3,962	3,942	19
Expenditure	477	410	(67)	4,353	4,350	(4)
Surplus/(Deficit)	330	349	(19)	(363)	(407)	44

REVENUE & EXPENSES	Year to Date			Full Year Forecast		
Transport	Actual	Budget	Variance	Forecast	Budget	Variance
Revenue						
Grants and subsidies	5,698	5,815	(117)	21,791	22,740	(949)
Other revenue	2,846	2,689	157	11,229	10,756	473
Rates	4,811	4,792	20	19,187	19,167	20
Total revenue	**13,355**	**13,296**	**60**	**52,207**	**52,663**	**(456)**
Expenditure						
Depreciation and amortisation	49	45	(4)	185	181	(4)
Employee benefit expenses	367	399	32	1,625	1,657	32
Internal Charges/Recoveries	243	239	(3)	961	957	(3)
Other expenses	11,747	11,946	199	48,856	47,759	(1,097)
Total operating expenditure	**12,406**	**12,630**	**224**	**51,626**	**50,555**	**(1,072)**
Surplus/(Deficit)	**950**	**666**	**284**	**581**	**2,108**	**(1,528)**

Significant Activities	Year to Date			Full Year Forecast		
	Actual	Budget	Variance	Forecast	Budget	Variance
PUBLIC TRANSPORT - DUNEDIN						
Revenue	7,889	7,877	12	31,281	31,533	(252)
Expenditure	7,399	7,452	54	30,168	29,883	(285)
PUBLIC TRANSPORT - OTHER						
Revenue	1,137	1,042	95	2,835	3,467	(632)
Expenditure	868	881	13	3,434	3,467	32
PUBLIC TRANSPORT - WAKATIPU						
Revenue	4,068	4,131	(63)	16,753	16,550	203
Expenditure	3,826	4,010	184	16,297	16,092	(205)
REGIONAL LAND TRANSPORT PLANNING						
Revenue	186	203	(16)	978	941	37
Expenditure	204	243	39	941	941	1
STOCK TRUCK EFFLUENT DISPOSAL						
Revenue	75	43	32	360	173	188
Expenditure	110	43	(67)	787	173	(615)
Surplus/(Deficit)	**950**	**666**	**284**	**581**	**2,108**	**(1,528)**

REVENUE & EXPENSES	Year to Date			Full Year Forecast		
Corporate	Actual	Budget	Variance	Forecast	Budget	Variance
Revenue						
Dividends	5,283	5,000	283	20,283	20,000	283
Grants and subsidies	-	-	-	-	-	-
Investment revenue	1,349	1,616	(267)	6,198	6,465	(267)
Other revenue	254	258	(4)	2,480	2,484	(4)
Rates	(5,757)	(5,733)	(24)	(22,956)	(22,932)	(24)
Total revenue	**1,129**	**1,141**	**(11)**	**6,005**	**6,017**	**(11)**
Expenditure						
Depreciation and amortisation	344	367	23	1,444	1,467	23
Employee benefit expenses	1,876	1,528	(347)	6,689	6,342	(347)
Finance costs	1,515	1,406	(109)	5,734	5,625	(109)
Internal Charges/Recoveries	(4,790)	(4,739)	51	(19,009)	(18,958)	51
Other expenses	3,458	3,769	311	15,061	15,078	17
Total operating expenditure	**2,403**	**2,331**	**(72)**	**9,920**	**9,554**	**(366)**
Fair value gain/loss on shares in subsidiary						
Fair value gain/loss on shares in subsidiary	-	-	-	31,954	31,954	-
	-	-	-	31,954	31,954	-
Surplus/(Deficit)	(1,274)	(1,190)	(84)	28,039	28,416	(377)

Significant Activities	Year to Date			Full Year Forecast		
	Actual	Budget	Variance	Forecast	Budget	Variance
INTERNAL						
INFORMATION SYSTEMS						
Revenue		-			-	
Expenditure	505	511	6	2,110	2,137	27
ORC PROPERTY - OPERATIONAL						
Revenue	3	25	(22)	78	100	(22)
Expenditure	348	()	(348)	631		(631)
RATES COLLECTION						
Revenue	(6)	-	(6)	1,448	1,453	(6)
Expenditure	237	358	121	1,332	1,453	121
VEHICLES						
Revenue	-	-	-	-	-	-
Expenditure	56	57	1	238	229	(9)
Surplus/(Deficit)	(1,148)	(901)	(248)	(2,786)	(2,265)	(520)
OVERHEADS						
CORPORATE SUPPORT/RECORDS						
Expenditure	(7)	(9)	(2)	2		(2)
FINANCE						
Revenue	4	25	(21)	79	100	(21)
Expenditure	(169)	15	184	(84)	100	184
HEALTH & SAFETY						
Revenue	-	-	-	-	-	-
Expenditure	3	(4)	(7)	7		(7)
HUMAN RESOURCES						
Expenditure	(72)	(5)	66	(45)		45
KURIWAO LEASES						
Revenue	7	13	(6)	44	50	(6)
Expenditure		3	2	8	10	2
TREASURY						
Revenue	1,122	1,078	43	4,357	4,313	43
Expenditure	1,502	1,406	(95)	5,721	5,625	(95)
Fair value gain/loss on shares in subsidiary	-	-	-	31,954	31,954	-
Surplus/(Deficit)	(125)	(289)	164	30,824	30,681	143

Capital Expenditure	Year to Date			Full Year Forecast		
Whole of Council	Actual	Budget	Variance	Forecast	Budget	Variance
Air Monitoring	(25)	-	25	155	156	1
Biodiversity Science & Monitoring	-	65	65	195	261	65
Biosecurity	-	-	-	-	-	-
Environmental Management	-	-	-	-	-	-
Land & Water Science and Monitoring	116	138	22	550	552	2
Environment	**92**	**203**	**112**	**901**	**969**	**69**
Compliance Monitoring & Contaminated Sites	4	-	(4)	4	-	(4)
Harbour Management	-	5	5	16	22	5
Incident Response & Enforcement	1	2	1	6	8	1
Communications and Marketing	-	-	-	-	-	-
Regional Leadership	**4**	**7**	**3**	**27**	**30**	**3**
Emergency Management	-	-	-	-	-	-
East Taieri Drainage	11	-	(11)	1,314	1,303	(11)
Leith Flood Protection Scheme	-	-	-	102	102	-
Lwr Clutha Flood Protection & Drainage	147	-	(147)	2,247	2,100	(147)
Lwr Taieri Flood Protection Scheme	112	111	(1)	7,085	7,084	(1)
River Management - Clutha	-	5	5	16	21	5
River Management - Dunedin	5	15	11	968	979	11
River Management - Wakatipu/Wanaka	-	-	-	52	52	-
Scheme Oversight	4	-	(4)	4	-	(4)
Tokomariro Drainage	-	-	-	306	306	-
West Taieri Drainage	1	-	(1)	1,711	1,710	(1)
Flood & Low Flow Risk Management	-	-	-	-	-	-
Natural Hazards	-	-	-	-	-	-
Safety and Resilience	**280**	**132**	**(148)**	**13,806**	**13,658**	**(148)**
Public Transport - Dunedin	-	-	-	-	-	-
Public Transport - Wakatipu	11	-	(11)	11	-	(11)
Stock Truck Effluent Disposal	-	-	-	-	-	-
Transport	**11**	**-**	**(11)**	**11**	**-**	**(11)**
Information Systems	135	228	93	819	912	93
ORC Property - Operational	108	547	439	1,750	2,189	439
Vehicles	-	274	274	821	1,095	274
Finance	-	13	13	39	52	13
Health & Safety	-	-	-	-	-	-
Corporate	**243**	**1,062**	**819**	**3,429**	**4,248**	**819**
Total Council Capital Expenditure	629	1,404	775	18,173	18,905	732

STATEMENT OF FINANCIAL POSITION

AS AT 30 SEPTEMBER 2026 $'000	September 2026 Current Year Actual	 Prior Year Actual	 Year to Date Variance	2027 Current Year Budget
Assets				
CURRENT ASSETS				
Cash and cash equivalents	18,963	13,512	5,450	3,810
Trade and other receivables	73,311	14,923	58,388	18,590
Property held for sale	0	0	0	0
Related party receivable	121,500	150,000	(28,500)	150,000
Other financial assets	33,169	33,435	(266)	33,997
Other Current Assets	3,553	3,815	(262)	0
Borrower Notes	125	125	0	0
Total Current Assets	**250,621**	**215,811**	**34,810**	**206,397**
NON-CURRENT ASSETS				
Shares in subsidiary	847,874	847,874	0	850,799
Property, plant and equipment	116,346	116,473	(127)	137,428
Intangible assets	25	38	(12)	813
Related party receivable	28,500	0	28,500	0
Investment Property	17,821	17,825	(4)	17,341
Borrower Notes	625	625	0	750
Total Non-Current Assets	**1,011,191**	**982,834**	**28,357**	**1,007,131**
Total Assets	**1,261,812**	**1,198,645**	**63,167**	**1,213,528**
Liabilities				
CURRENT LIABILITIES				
Trade and other payables	70,057	22,080	47,977	23,753
Employee entitlements	4,250	5,334	(1,084)	3,105
Borrowings	146,753	160,136	(13,383)	159,881
Total Current Liabilities	**221,060**	**187,550**	**33,510**	**186,739**
NON-CURRENT LIABILITIES				
Non current borrowings	43,500	15,000	28,500	37,250
Total Non-Current Liabilities	**43,500**	**15,000**	**28,500**	**37,250**
Total Liabilities	**264,560**	**202,550**	**62,010**	**223,989**
NET ASSETS	**997,252**	**996,096**	**1,156**	**989,539**
Equity				
PUBLIC EQUITY				
Public Equity	134,461	133,304	1,156	132,808
Total Public Equity	**134,461**	**133,304**	**1,156**	**132,808**
RESERVES				
Reserves	862,791	862,791	0	856,731
Total Reserves	**862,791**	**862,791**	**0**	**856,731**
TOTAL EQUITY	**997,252**	**996,096**	**1,156**	**989,539**

SUMMARY OF RESERVES

AS AT 30 September 2026 $'000	Opening Balance 1-Jul-2026	Transfers In	Transfers Out	Closing Balance 30-Sept-2026
GENERAL RESERVES				
General Reserve	84,292	15,602	(15,296)	84,597
Asset Replacement Reserve	3,615	-	-	3,615
Building Reserve	3,024	-	-	3,024
Emergency Response Reserve	5,052	-	-	5,052
Kuirwao Endowment Reserve	6,372	-	-	6,372
Asset Revaluation Reserve	16,854	-	-	16,854
Port Share Revaluation Reserve	827,874	-	-	827,874
Total General Reserves	**947,083**	**15,602**	**(15,296)**	**947,388**
TARGETED RESERVES				
River Management				
River Management Central	(81)	103	(95)	(73)
River Management Clutha	(1,112)	122	(79)	(1,069)
River Management Dunedin	(396)	67	(200)	(529)
River Management Queenstown Lakes	476	142	(110)	508
River Management Waitaki	1,008	164	(72)	1,100
Flood & Drainage				
Alexandra Flood	246	139	(38)	347
Leith Flood	(9,434)	394	(163)	(9,203)
Lower Clutha Flood & Drainage	(5,127)	(396)	(447)	(5,970)
Lower Taieri Flood	(666)	308	(298)	(656)
West Taieri Drainage	(2,205)	262	(249)	(2,192)
East Taieri Drainage	(746)	191	(220)	(775)
Tokomairiro Drainage	(173)	48	(57)	(182)
Transport				
Dunedin Transport	1,323	7,437	(7,399)	1,361
Dunedin Transport - Historic Balance	(8,867)	452	-	(8,415)
Queenstown Transport	502	3,952	(3,826)	628
Queenstown Transport - Historic Balance	(1,398)	116	-	(1,282)
Other				
Catchment Management	291	1,468	(1,125)	634
Biosecurity	(1,058)	1,565	(1,296)	(789)
Wilding Pines	-	65	(112)	(46)
Emergency Management	172	1,034	(1,016)	191
Navigational Safety	(202)	255	(236)	(183)
Infrastructure Assets Reserve	76,460	-	-	76,460
Total Targeted Reserves	**49,013**	**17,888**	**(17,037)**	**49,864**
TOTAL RESERVES	**996,096**	**33,490**	**(32,333)**	**997,252**

TREASURY REPORT

AS AT 30 September 2026 $'000	September 2026 Actual	June 2026 Actual	Variance	Summary by Quarter

Cash and Term Deposits	Current vs Previous Year End			Previous 4 Quarters			
BALANCES	**Sept-2026**	**Jun-2026**	**YTD Movement**	**25/26 Q1 Sep-25**	**25/26 Q2 Dec-25**	**25/26 Q3 Mar-26**	**25/26 Q4 Jun-26**
Cash	18,963	13,512	5,450	27,878	9,720	9,841	13,512
Term Deposits	0	0	0	0	25,000	19,000	0
Cash and Term Deposits	**18,963**	**13,512**	**5,450**	**27,878**	**34,720**	**28,841**	**13,512**

Managed Fund	Current vs Previous Year End			Previous 4 Quarters			
ASSET ALLOCATION	**Sept-2026**	**Jun-2026**	**YTD Movement**	**25/26 Q1 Sep-25**	**25/26 Q2 Dec-25**	**25/26 Q3 Mar-26**	**25/26 Q4 Jun-26**
Cash	1,219	1,440	(220)	1,287	1,238	1,455	1,440
NZ Fixed Interest	7,794	7,607	187	11,051	7,404	7,301	7,607
International Fixed Interest	7,219	6,787	433	2,909	6,928	6,686	6,787
Total - Defensive	**16,233**	**15,834**	**399**	**15,247**	**15,570**	**15,442**	**15,834**
NZ Property	305	897	(592)	1,017	965	865	897
NZ Equities	5,534	5,182	352	5,227	5,443	5,088	5,182
Australian Equities	5,468	4,940	528	4,796	4,660	4,712	4,940
International Equities	5,800	6,753	(953)	5,085	5,510	5,317	6,753
Total - Growth	**17,107**	**17,772**	**(666)**	**16,126**	**16,578**	**15,982**	**17,772**
Total Managed Fund Balance	**33,340**	**33,606**	**(266)**	**31,373**	**32,148**	**31,424**	**33,606**

PORTFOLIO PERFORMANCE	**YTD Actual**	**YTD Budget**	**Variance**	**25/26 Q1 Sep-25**	**25/26 Q2 Dec-25**	**25/26 Q3 Mar-26**	**25/26 Q4 Jun-26**
Interest	69	100	(31)	125	132	63	104
Dividends	283	88	196	173	119	183	141
Other (Fees)	(34)		(34)	(32)	(33)	(28)	(34)
Market Value Gain / (Loss)	(584)	267	(852)	1,215	557	(944)	1,971
Desposit / (Withdrawal)			0	0	0	0	0
Total Portfolio Performance	**(266)**	**455**	**(721)**	**1,481**	**776**	**(725)**	**2,182**

Borrowing	Current vs Previous Year End			Previous 4 Quarters			
LGFA DEBT	**Sept-2026**	**Jun-2026**	**YTD Movement**	**25/26 Q1 Sep-25**	**25/26 Q2 Dec-25**	**25/26 Q3 Mar-26**	**25/26 Q4 Jun-26**
Council	**40,000**	**25,000**	**15,000**	**40,000**	**25,000**	**25,000**	**25,000**
Port Otago	**150,000**	**150,000**	**0**	**146,573**	**149,976**	**150,000**	**150,000**
Total LGFA Debt	**190,000**	**175,000**	**15,000**	**186,573**	**174,976**	**175,000**	**175,000**

Cost of Funds							**3.235%**
COUNCIL DEBT	**Amount**	**Maturity**	**Rate**	**BKBM**	**Margin**	**Rate**	**Current BKBM**
Commercial Paper	15,000	Nov-2026	3.128%	2.928%	0.200%	3.128%	0.200%
Commercial Paper	5,000	Dec-2026	3.090%	2.890%	0.200%	3.090%	3.435%
Floating Rate Note	5,000	Apr-2027	3.560%	2.860%	0.700%	3.560%	3.935%
Fixed Rate Bond	5,000	May-2028	5.700%				
Floating Rate Note	5,000	Apr-2029	3.925%	2.875%	1.050%	3.925%	4.285%
Floating Rate Note	5,000	May-2030	3.700%	2.970%	0.730%	3.700%	3.965%
Total Council Debt	**40,000**		**3.670%**	**2.899%**	**0.670%**	**3.569%**	**3.905%**

SWAPS	**Amount**	**Maturity**	**Rate**	**Live**	**vs Current BKBM**	**Net Cost / (Benefit)**
3 Years: 15-Apr-2025	2,000	May-2028	3.520%	2,000	0.285%	5,700
3 Years: 15-Apr-2026	5,000	May-2029	4.115%	5,000	0.880%	44,000
6 Years: 15-Apr-2025	5,500	May-2031	3.990%	5,500	0.755%	41,525
Total Swaps	**12,500**		**3.965%**	**12,500**	**0.730%**	**91,225**

COST OF FUNDS (Including Swap Cost)	**Amount**	**Maturity**	**Rate**	**Budget AP26/27**	**Rate Variance**	**Act vs Bud Variance $**
Total Debt	**40,000**		**3.898%**	**3.300%**	**0.598%**	**239,220**

9.2. Non-Financial Activity Performance as at Quarter 1 30 September 2026

Prepared for:	Council
Report No.	GOV2612
Activity:	Organisational Planning and Performance
Authors:	Vanessa Vidallon (Corporate Planning Business Partner)
Endorsed by:	Amanda Vercoe (General Manager Strategy and Customer)
Date:	18 November 2026
Portfolio Leads:	Cr Malcolm and Cr Gardner, Finance

PURPOSE

[1] To report the Council's quarter one non-financial activity performance results for the 3-month period ended 30 September 2026.

EXECUTIVE SUMMARY

[2] The Activity Performance Report shows non-financial performance against the measures and targets defined in the Annual Plan 2026-27, year three of the Long-Term Plan 2024-34 (LTP).

[3] The LTP provides detailed performance targets for years one to three, and in less detail for years four to ten. These service measures and targets are periodically reviewed as part of the Annual Plan process, to reflect improvement in how ORC measures performance, and changes in the understanding and expectations of performance.

[4] This report covers year three of the Long-Term Plan, being the 2026/27 financial year. It presents the 63 service performance measures and targets, with results showing the expected year-end status of each measure.

[5] Of the 63 service performance measures, 51 are on track to achieve their targeted performance, 3 are at risk, 0 are off track, 5 are not due to be reported and 4 are for reference only.

[6] The 'Discussion' section talks to the different categories of service performance achievement, and the attachment to this report provides the detailed results and associated commentary for quarter one.

[7] A definition of the status for quarterly reporting and end of year reporting is provided.

[8] We will continue to review and improve our performance approach.

RECOMMENDATION

That the Council:

1) ***Notes** this report.*
2) ***Notes** that the attached Activity Performance Report for the period 1 July 2026 to 30 September 2026 being quarter one of the 2026-27 financial year.*

BACKGROUND

[9] This report includes non-financial performance information relating to the service delivery activities in the Annual Plan 2026-27, which was adopted on 29 April 2026.

[10] Progress over the 2026-27 financial year is reported to Council on a quarterly basis. At year-end, the Annual Report 2026-27 is completed, and following external audit, is approved by Council.

DISCUSSION

[11] The attachment shows activity performance recorded against the service measures and targets included in the Annual Plan 2026-27. As of 30 September 2026, there are 63 service targets, 51 are on track, 3 are at risk, 0 are off track, 5 are not due to be reported and 4 are for reference only.

On track (green)

[12] Of the 63 service targets, 51 (81%) are currently on track to be achieved.

- There is one additional target that has been set since the Annual Plan 2026-27 adoption. It is noted here for completeness and audit accountability purposes.

  Land and Water activity, and the measure of site-specific projects are developed for selected degraded waterbodies.

  At the time of Annual Plan 2026-27 finalisation, the Annual Plan states no target, future projects to be determined. Projects are continuing in Lake Tuakitoto and Waiwhakaata Lake Hayes to build on work completed in previous years. Budget has been allocated to these projects specifically through the Annual Plan. The original target of “At least 80% of project actions are progressed as scheduled” will be carried over to maintain the original service promise to the community.

At risk (yellow)

[13] For Quarter one, three measures are assessed as at risk of not meeting their year-end target.

- Climate change and resilience activity and the target of adequate staff are trained and capable to coordinate a region wide response.

  The number of staff trained and capable of coordinating a region wide response is not yet at the level set out in the Training and Capability Strategy. This shortfall is managed through external support. Work is ongoing to improve participation through integration with the new HRIS Pulse system and targeted capability initiatives.

- Transport activity, and the target of reviewing and adopting the RLTP by 30 June 2027.

  The Government Policy Statement for Transport will not be released until 2027. This is highly likely to have an impact on the ability to approve the Regional Land Transport Plan.

  Arrival punctuality target for Whakatipu of 90% on-time arrivals to planned destination.

  Arrival punctuality is below target at 57%. Significant congestion across the Whakatipu network is causing delays, driven largely by external factors. Performance is likely to continue to trend off track if conditions do not materially improve.

Off track (red)

[14] For Quarter one, there are no measures reported as off track.

No Data Due (grey)

[15] Five transport measures are not due to reported. The results are part of the annual survey which will be reported in quarter four non-financial service performance report.

Reference only (light grey)

[16] Four service measure have no set targets and are all due to the Government RMA reform. These service measures include:

- Support integrated and well managed urban growth across Otago
- Complete the Land and Water Regional Plan (LWRP)
- Complete a review of the Regional Plan: Coast
- Complete a review of the Regional Plan Air

Continuous Improvement

[17] This financial year's reporting statuses have been updated to reflect the impact of the Government reform. As a result, several targets could not be set for the Annual Plan 2026-27. Where a target has not been set, this is reflected in the measure's reporting status.

Status definitions – Quarterly reporting

STATUS	STATUS KEY	QUARTERLY [Q1–Q3]
On track	Green	Performance is on track to reach end of year target.
At risk	Amber	Emerging risks to performance have been identified, but management action is being taken to recover performance.
Off track	Red	Performance is significantly below expectations.
Reporting overdue	Black	No reporting status and data received from named owner.

No data due/Not assessable	Grey	No data is due this quarter.
Reference only	Light Grey	Reported for context or completeness, no target able to be set (due to legislation delays).

Status definitions – End-of-year reporting:

STATUS	STATUS KEY	YEAR END [Q4]
Target achieved	Green	Performance target achieved.
Partially achieved	Amber	Applied where pre-defined measurable progress against the target is demonstrated but the full target is not met, or where a required report is delivered within the relevant Annual Plan/LTP year but after the stated timeframe and target date.
Not achieved	Red	Target not met - result falls outside the pre-demarcated level of measurable progress.
Reporting overdue	Black	Reporting overdue. No data was received at year end.
No data due/Not assessable	Grey	No data due/not assessable. Data is not yet available, awaiting verification or timing. Or not assessable, because the condition has not been triggered.
Reference only	Light Grey	Reported for context or completeness, no target able to be set (due to legislation delays).
ALL - ROUNDING CONSISTENCY	N/A	The Decimal Alignment Principle for reporting consistency. Where a target is specified as zero decimal places, it is consistent with methodology (using standard mathematical rounding convention) to align actual results to the same decimal precision. This is standard practice in service performance frameworks, applied to ensure fair comparison of material achievement and avoid false decimal exactitude.

[18] We will continue to review and improve our performance approach – increasing the clarity of reported performance to drive stronger transparency.

OPTIONS

[19] There are no options as this is a noting report.

SUMMARY OF CONSIDERATIONS

Community Outcomes
This work aligns with the following community outcomes from the ORC 2024-2034 Long-Term Plan:

Whole of Organisation

This work supports the whole organisation and, therefore, all Community Outcomes.

Councillor Priority Actions
Not applicable.

Alignment with Central Government Legislation
This work is consistent with relevant central government policy and direction. Specifically, it aligns with Local Government Act 2002; section 98 by comparing the Council's actual activities and performance for the year against the intended activities and levels of service set out in the Annual Plan 2026-27.

Alignment with Otago Regional Council Internal Policy
There is no specific ORC policy that is directly applicable to this work.

Financial Considerations
There are no direct financial implications arising from this report.

Legal Compliance/Risk
There is insignificant/minor risk that decisions arising from this report could expose Council to litigation, regulatory non-compliance, or breach of policy/legislation.

Reputational Risk
Accurate performance reporting supports public confidence in the Council's transparency and accountability.

Climate Resilience
The impacts of climate-related risks (e.g. flooding, drought, extreme winds, coastal erosion, wildfires) on this work has not been assessed.

Carbon Emissions
The implications of this work on organisational or regional greenhouse gas emissions has not been assessed.

He Mahi Rau Rika: Significance, Engagement and Māori Participation Policy
Not Applicable

Engagement with Mana Whenua
There has been no engagement with mana whenua or Māori specifically for this work.

Stakeholder Engagement
There has been no engagement with external stakeholders and/or the public specifically for this work.

Communications
This is a noting paper and no decision-making is required.

NEXT STEPS

[20] The quarter two Non-financial Activity Performance Report is programmed for consideration at the first Council meeting of 2027.

ATTACHMENTS

1. Q1 Non-financial service performance results 26-27 [**9.2.1** - 7 pages]

Activity Performance Report

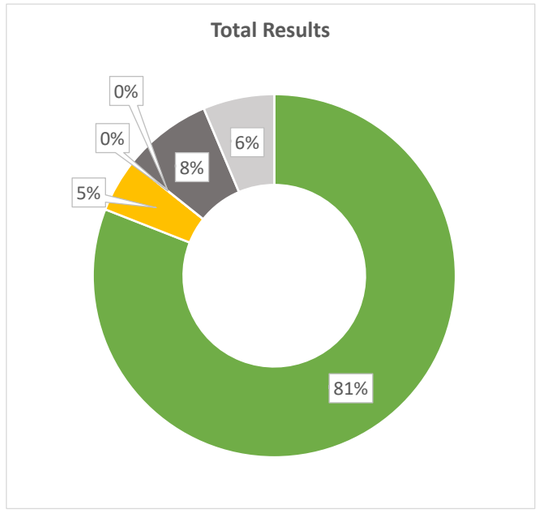
2026-27 QUARTER ONE – @ September 2026

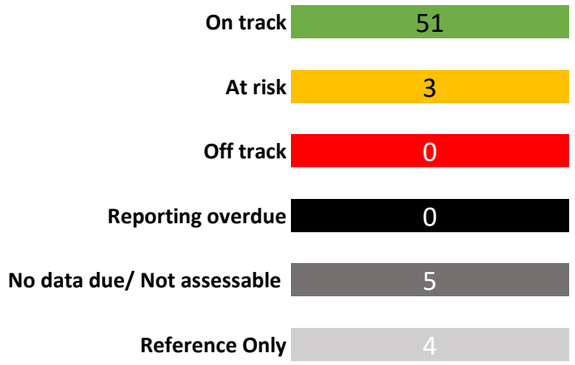
Otago Regional Council

www.orc.govt.nz

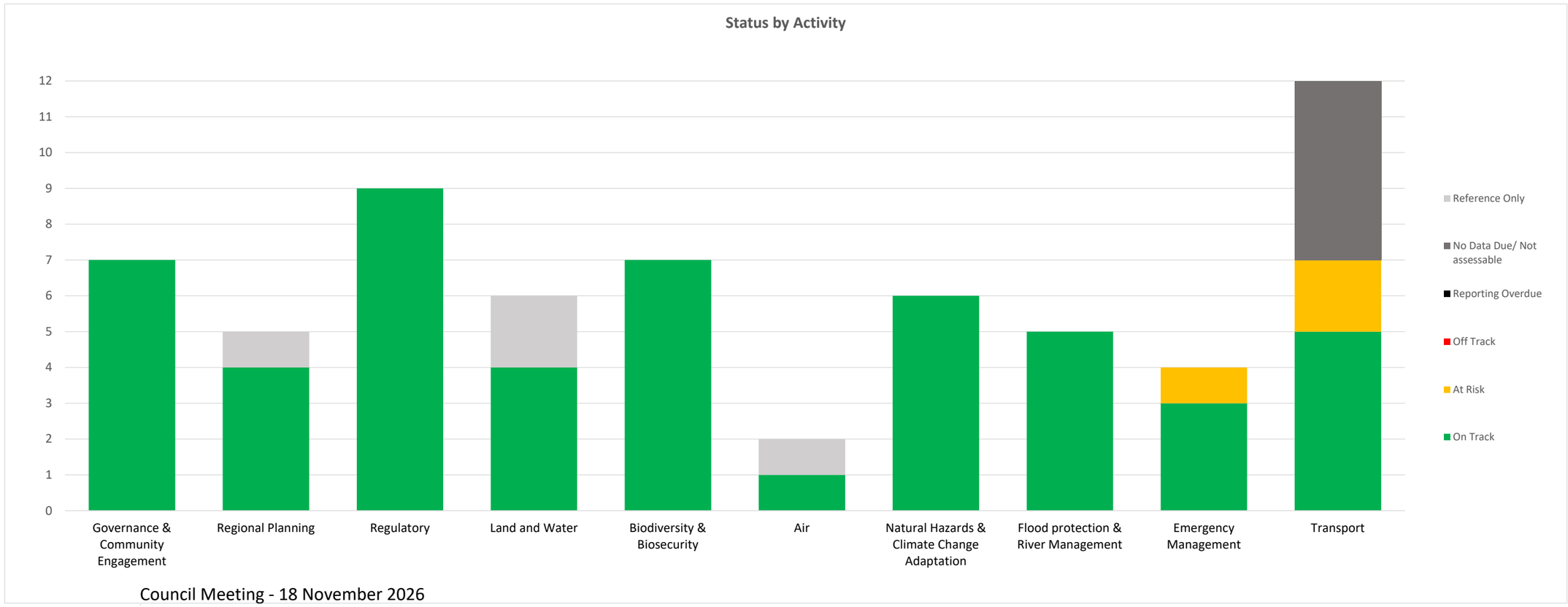
Service Delivery Performance

The 2026-27 Annual Plan contains 35 level of service statements, 60 measures and 63 targets related to activities being delivered.





A full list of measures, targets and the results for each quarter is included at the end of this report.



REGIONAL LEADERSHIP				
Governance & Community Engagement	**TARGET**	**Q1**	**COMMENT**	**GM**
Percentage of official information requests responded to within 20 working days of being logged	**100%**		We expect to be 100% compliant at end of year. There were 69 LGOIMA requests received for quarter one.	Tami Sargeant
Deliver our Long-Term Plan, annual reviews of the LTP, and reporting of performance against plan as per the statutory requirements	**LTP 2027-37 adopted by Council prior to 30 June 2027**		Expected to be delivered on time and to scope and budget.	Amanda Vercoe
Deliver our Long-Term Plan, annual reviews of the LTP, and reporting of performance against plan as per the statutory requirements.	**Council financial and activity performance against the Year 2 LTP 2024-34 reported to Council by October 2026.**		Reporting of Council financial and activity performance against Year 2 LTP 2024-34 was reported to Council as EOY/Q4 in September, as the full Annual Report to ARC in Sept, and will go to Council in October 2026 which is on track.	Amanda Vercoe
Percentage of council agendas are publicly available two working days or more before a meeting	**100%**		Expected to be 100% on target.	Amanda Vercoe
Biennial survey is conducted to understand and improve community awareness, perceptions and expectations of ORC.	**Report against the action plan to Council by March 2027.**		Actions have been assigned and communicated a check in with everyone on individual actions will happen at the start of November. Action plan is progressing well and will be delivered on time.	Amanda Vercoe
Customers express high levels of satisfaction with customer service provision.	**Meet or exceed satisfaction target of 85%.**		Customer satisfaction is currently tracking at 93% average over the previous 12 months.	Amanda Vercoe
Increase opportunities for engagement with diverse groups across Otago to lift awareness and understanding of the work of the regional council and seek feedback on performance.	**Maintain or increase numbers.**		On track. Similar numbers recorded for Otago Polyfest, room to increase in some other events.	Amanda Vercoe
Regional Planning	**TARGET**	**Q1**	**COMMENT**	**GM**
Develop a regional biodiversity strategy and implement ORC actions.	**ORC actions from the regional biodiversity strategy are implemented, and the effectiveness of the strategy is monitored and reported to Council annually.**		Implementation of ORC actions in the Strategy is well underway.	Amanda Vercoe
Develop a Regional Climate Change Strategy and implement ORC actions.	**ORC actions from the Regional Climate Change Strategy are implemented.**		Implementation of ORC actions in the Strategy is well underway or completed.	Amanda Vercoe
Develop a Regional Climate Change Strategy and implement ORC actions.	**The effectiveness of the strategy is monitored and reported to Council annually.**		A report will be brought to Council in June 2027 detailing the implementation and effectiveness of the Strategy, as required by the Level of Service measure.	Amanda Vercoe
Develop a Regional Air Quality Strategy and implement ORC actions.	**Regional Air Quality Strategy is adopted by June 2027.**		Work on Priority Action CPA8 is underway and may highlight areas where the current 2019 air quality strategy could be revised and replaced with a new strategy.	Amanda Vercoe
Support integrated and well managed urban growth across Otago.	**No target**		Target unable to be set due to Government RMA reform.	Anita Dawe
Regulatory	**TARGET**	**Q1**	**COMMENT**	**GM**
Maintain 24-hour/7 day a week response for environmental incidents	**Pollution hotline staff available/on call 24/7.**		Expected to meet yer-end target.	Jo Gilroy

Maintain 20 appropriately trained responders for maritime oil pollution incidents.	**20 responders attend 3 exercises per year.**		Expected to meet year end target.	Jo Gilroy
Percentage of resource consent applications processed in accordance with Resource Management Act 1991 legislative timeframes.	**≥98%**		100% of consents have been processed within timeframes since the start of the new financial year.	Jo Gilroy
Percentage of performance monitoring returns completed each year, as per the Compliance Audit and Performance Monitoring Schedule targets.	**≥90%**		On track to meet the end of year target. Year-to-date: 110%. Q1 performance of 110% reflects a deliberate focus on progressing work ahead of anticipated impacts from RMA reform transitional consenting, the usual December/January slowdown and NextGen implementation next year. This proactive approach is to help manage these key upcoming periods while maintaining statutory performance.	Jo Gilroy
Percentage of significant non-compliance identified where action is taken in accordance with Compliance Policy.	**100%**		Expected to meet year-end target.	Jo Gilroy
Percentage of programmed inspections/audits completed each year, as per the Compliance Audit and Performance Monitoring Schedule targets.	**≥90%**		Expected to meet year-end target.	Jo Gilroy
Maintain compliance with Port and Harbour Marine Safety Code.	**Annual self review is completed by ORC and Port Otago Ltd (POL) and signed off by the chief executives.**		Expected to meet year end target.	Jo Gilroy
The safety campaign for recreational 'boaters' is delivered.	**Develop and deliver a recreational boating engagement plan.**		Expected to meet year end target	Jo Gilroy
Percentage of public enquiries for consent information completed within 10 working days.	**98%**		100% of public enquiries were answered within 10 working days.	Jo Gilroy

On track	At risk	Off track	Reporting overdue	No data due/ Not assessable	Reference only

ENVIRONMENT				
Land and Water	**TARGET**	**Q1**	**COMMENT**	**GM**
Complete the Land and Water Regional Plan (LWRP)	**No target**		Target unable to be set due to Government RMA reform.	Anita Dawe
ORC led and community/landowner supported workshops and events are delivered which promote best practice land management for soil conservation, water quality and/or the efficient use of water.	**At least 12 ORC led workshops or events are delivered annually**		Eight ORC led workshops or events are delivered to date. On track with target.	Jo Gilroy
Site specific projects are developed for selected degraded waterbodies.	**At least 80% of project actions are progressed as scheduled.**		Projects are continuing in Lake Tuakitoto and Waiwhakaata Lake Hayes to build on work completed in previous years. Budget has been allocated to these projects specifically through the Annual Plan. The original target of "At least 80% of project actions are progressed as scheduled" will be carried over to maintain the original service promise to the community. This is on track.	Jo Gilroy
Catchment Action Plans (CAPs) give effect to the ICM programme and are developed in partnership with iwi and in collaboration with the community.	**One Catchment Action Plan (CAP) to be presented to Council for approval by 30 June 2027.**		There are 4 CAPs in progress for this financial year - Taiari/ Taieri CAP, Dunedin Coastal CAP, Inland and Lower Mata-au/Clutha CAP. Target expected to be achieved.	Jo Gilroy
Report the results of environmental monitoring for freshwater, land use, estuarine, and regional coastal environments.	**Annual report for each of the 4 environments to Council prior to 30 June 2027.**		On track- reporting for the four environments scheduled early/mid 2027	Tom Dyer
Complete a review of the Regional Plan: Coast.	**No target**		Target unable to be set due to Government RMA reform.	Anita Dawe
Biodiversity & Biosecurity	**TARGET**	**Q1**	**COMMENT**	**GM**
Actions within the Biosecurity Operational Plan (BOP) are progressed.	**90% of pest management actions are achieved.**		Pest management actions are underway and progressing. This is on track.	Jo Gilroy
Externally funded biosecurity projects/programmes are implemented as per their agreements.	**90% of deliverables in the agreements with Central Government are progressing as scheduled.**		Externally funded biosecurity programmes—including the Wallabies Eradication Programme, Wilding Conifers Progressive Containment Programme, and Check Clean Dry—are progressing as scheduled. No issues expected.	Jo Gilroy

Biodiversity Forum-based joint projects to enhance indigenous biodiversity are developed.	**At least one new project is developed and implemented with biodiversity forum partners.**		This is on track. A Biodiveristy forum was held this quarter - project scopes were discussed with one project to progress into implementation phase. Further discussions on other projects to be revisited at the next hui.	Jo Gilroy
Joint projects are implemented against milestones.	**At least 80% of project actions are progressed as scheduled.**		This is on track. Potential new projects have been identified for 2026/27 financial year and were presented at the September 2026 forum. These align with the ORC Indigenous Biodiversity Strategy and Integrated Catchment Management Catchment Action Plans.	Jo Gilroy
Alignment between initiatives and deliverables receiving Council funding, and Council's strategic biodiversity strategic objectives.	**All environmental projects and initiatives are aligned to at least one of the Council's environmental strategic objectives.**		Environmental projects and initiatives included in this measure are ECO Fund and Predator Free Dunedin. Both are aligned with goal 1 of our environmental strategic directions. All ECO Fund funding categories were developed to align with Council's environmental strategic objectives.	Jo Gilroy
Externally funded freshwater projects/programmes are delivered as per their agreements.	**90% of deliverables in the agreements with Central Government are progressing as scheduled.**		This represents the Hill Country Erosion project. This is on track to meet MPI milestones and any agreed contract variations.	Jo Gilroy
Report the results of environmental monitoring for regional indigenous biodiversity ecosystems.	**Annual report on monitoring programme completed and reported to Council on 30 June 2027.**		Annual report on monitoring programme will be completed and reported by 30 June 2027.	Tom Dyer
Air	**TARGET**	**Q1**	**COMMENT**	**GM**
Implement a regional air monitoring programme.	**Annual report on monitoring programme on previous calendar year completed and reported to Council.**		On track.	Tom Dyer
Complete review of the Regional Plan Air.	**No target**		Target unable to be set due to Government RMA reform.	Anita Dawe

On track	At risk	Off track	Reporting overdue	No data due/ Not assessable	Reference only

CLIMATE CHANGE AND RESILIENCE				
Natural Hazards & Climate Change Adaptation	**TARGET**	**Q1**	**COMMENT**	**GM**
Natural hazards information is available via the web-based Otago Natural Hazards Database	**Database is accessible and up-to-date 100% of the time.**		Database was accessible and up to date 100% of the time during the reporting period.	Tom Dyer
Percentage of flood warnings that are issued in accordance with the flood warning manual	**100%**		24-hour flood management and response system operated during the reporting period. No issue expected.	Tom Dyer
Deliver a natural hazards management and adaptation work programme based on a new prioritisation process.	**Annual review of priorities is completed by June 2027.**		No issue expected.	Tom Dyer
Implement prioritised natural hazard risks adaptation works.	**Actions developed, implemented and reviewed, as per Head of Lake Whakatipu natural hazard adaptation strategy.**		Implementation planning and delivery underway. No issue expected.	Tom Dyer
Implement prioritised natural hazard risks adaptation works	**Support the South Dunedin Future Programme - South Dunedin Future natural hazards adaptation plan progresses as per annual work plan**		The impact of decisions and directions on the SDF programme timeframes are being assessed by the project team. This will be reflected in the next reporting period. Support is continuing to the revised work programme.	Tom Dyer

Implement prioritised natural hazard risks adaptation works.	**Phase 3 and phase 4 of the Clutha Delta natural hazards adaptation programme completed by 30 June 2027**		No issue expected. Alignment with Lower Clutha Catchment Action Plan underway, especially for the collection of values and actions.	Tom Dyer
Flood protection & River Management	**TARGET**	**Q1**	**COMMENT**	**GM**
Percentage of scheme renewals programme: Major flood protection and control works are maintained, repaired, and renewed to the key standards defined in relevant planning documents.	**≥85% of renewal programmes completed**		The delivery programme and key mile stones for 2026/2027 are being developed to align with LTP and AP requirements.	Tom Dyer
Percentage of scheme maintenance programme: Major flood protection drainage and control works are maintained, repaired, and renewed to the key standards defined in relevant planning documents.	**≥85% of planned maintenance programme completed**		Planned work programme is expected to acheive the 85% completion target.	Tom Dyer
Percentage of planned maintenance programme: Channel works are maintained, repaired, and renewed to the key standards defined in relevant planning documents.	**≥85% of planned maintenance programme completed**		Work is expected to progress to plan for the year.	Tom Dyer
The flood repair programme is made available to affected communities within 3 months of the event.	**100%**		There have been no flood events this FY.	Tom Dyer
Percentage of identified and reported issues that have been investigated and appropriate action determined and communicated to affected landholders within 20 working days.	**98%**		Expected to meet end of year KPI.	Tom Dyer
Emergency Management	**TARGET**	**Q1**	**COMMENT**	**GM**
Emergency Management Otago staff are available to respond 24/7 to a Civil Defence emergency	**Maintain a duty roster for 24/7 365 coverage for initial responses to Civil Defence emergencies.**		Duty roster coverage in place and operational, three staff members are available at all times after hours. Target met.	Tom Dyer
Provide a regional coordination facility (ECC) capable of coordinating a region-wide emergency.	**An appropriate facility as defined in the CDEM Partnership Agreement is available for immediate activation.**		The Aonui building has been established as a full-time hot facility. In alignment with the EMC Partnership Agreement, the site is equipped with the necessary infrastructure, workspace, and adequately trained personnel to support sustained 24-hour operations when required. The facility is maintained in a state of readiness, allowing for immediate activation without the need for setup or lead time. The new facility exceeds the functionality of the previous hot facility.	Tom Dyer
Support is provided to Emergency Management Otago to fulfil Otago CDEM Group requirements as defined in the CDEM Act and CDEM.	**Fulfil all requirements as the administering authority and the Otago CDEM Partnership Agreement.**		All admin matters are being delivered as per current partnership agreement. The Emergency Management Act 2026 has been enacted. This coincides with the LTP process for councils. New legislation prompts a reconsideration of the terms of the partnership agreement and those discussions continue.	Tom Dyer
Provide a regional coordination facility (ECC) capable of coordinating a region-wide emergency.	**Adequate staff (as defined in the Group Training and Capability Strategy) are trained and capable to coordinate a region wide response.**		The number of staff trained and capable of coordinating a region-wide response is not yet at the level set out in the Training and Capability Strategy. This shortfall is managed through external support. Two controllers have commenced training. Work is ongoing to improve participation through integration with the new HRIS Pulse system and targeted capability initiatives.	Tom Dyer

On track	At risk	Off track	Reporting overdue	No data due/ Not assessable	Reference only

TRANSPORT				
Transport	**TARGET**	**Q1**	**COMMENT**	**GM**
The Regional Land Transport Plan (RLTP) is reviewed and submitted in line with the Land Transport Management Act 2003 and any guidance issued by the New Zealand Transport Agency.	**RLTP review completed and adopted by Council by 30 June 2027.**		The Government Policy Statement for Transport will not be released until 2027. This is highly likely to have an impact on the ability to approve the RLTP.	Anita Dawe
Service reliability - % Whakatipu scheduled services delivered.	**>95%**		We are expecting to reach the yearly target. YTD is 98%.	Anita Dawe
Service reliability - % Dunedin scheduled services delivered.	**>95%**		This is on track to meet the yearly target. YTD is 98%.	Anita Dawe
Departure punctuality - % Whakatipu on-time departures from point of origin.	**>90%**		No issues expected at this time of the year. YTD is 90%.	Anita Dawe
Departure punctuality - % Dunedin on-time departures from point of origin.	**>90%**		Currently tracking behind the target, with 86% of services departing within the identified time window. Staff are working to improve this across the year.	Anita Dawe

Arrival punctuality - % Whakatipu on-time arrivals to planned destination.	**>90%**		Arrival punctuality is below target at 57%. Significant congestion across the Whakatipu network is causing delays, driven largely by external factors. Performance is likely to continue to trend off track if conditions do not materially improve.	Anita Dawe
Arrival punctuality - % Dunedin on-time arrivals to planned destination.	**>90%**		Currently tracking behind the target, with 79% of services arriving on time. Staff are working to improve this across the year.	Anita Dawe
Overall passenger satisfaction with Dunedin Public Transport system at annual survey	**Maintain or increase 3 yr rolling average ≥90%**		Survey is completed in Q4.	Anita Dawe
Overall passenger satisfaction with Whakatipu Public Transport system at annual survey	**Maintain or increase 3 yr rolling average ≥90%**		Survey is completed in Q4.	Anita Dawe
Annual public transport boardings in Queenstown	**Increase**		Survey is completed in Q4.	Anita Dawe
Annual public transport boardings in Dunedin	**Increase**		Survey is completed in Q4.	Anita Dawe
Overall passenger satisfaction with Total Mobility system at annual survey.	**Maintain or increase 3 yr rolling average ≥90%**		Survey is completed in Q4.	Anita Dawe

On track | At risk | Off track | Reporting overdue | No data due/ Not assessable | Reference only

9.3. Annual Report Biosecurity 2025-2026

Prepared for:	Council
Report No.	ENV2611
Activity:	Environmental Implementation
Author:	Libby Caldwell (Manager Environmental Implementation), Michelle Ewans (Biosecurity Specialist - Terrestrial), Robert Win (Team Leader Biosecurity), Tim Cooper (Team Leader Biosecurity Compliance), Murray Boardman (Performance and Delivery Specialist)
Endorsed by:	Joanna Gilroy (General Manager Environmental Delivery)
Date:	18 November 2026
Portfolio Leads:	Cr Noone and Cr Byars, Environmental Delivery

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PURPOSE

[1] To report on the implementation of the Biosecurity Operational Plan 2024-25 for the period 1 July 2025 to 30 June 2026, as required under Section 100C (2) of the Biosecurity Act 1993.

EXECUTIVE SUMMARY

[2] A Biosecurity Operational Plan (BOP) is required by the Biosecurity Act 1993 to detail the nature and scope of activities the Council undertakes in the annual implementation of the Regional Pest Management Plan. Under Section 100C(2) of the Act, ORC" must prepare a report on the operational plan and its implementation not later than 5 months after the end of each financial year" and "provide a copy of the report to the Minister or council." This paper, including the attachments, fulfils that requirement.

[3] The 2025-26 Biosecurity Operational Plan had 70 Key Performance Indicators (KPIs). Eleven KPIs were not measurable as the required events did not occur, which leaves 59 KPIs that were measured. Overall, 49 KPIs were fully achieved or exceeded (achievement rate of 83%). Seven KPIs were partially achieved (12%) with three KPIs not achieved (5%).

[4] Overall, the achievement rate for FY2025-26 showed a slight improvement compared to the previous year with a continuation of the upward trend in achievement over the past six years.

RECOMMENDATION

That the Council:

1) ***Notes** this report and the range of work undertaken to give effect to Otago's Regional Pest Management Plan and the Biosecurity Act*
2) ***Notes** the lessons learnt from the 2025-26 Biosecurity Operational Plan are being applied to the delivery of the 2026-27 Biosecurity Operational Plan.*
3) ***Notes** that this report and the attached Biosecurity Operational Plan 2024-25 Report will be provided to the Minister for Biosecurity as required under Section 100C (2) of the Biosecurity Act 1993.*

BACKGROUND

[5] In accordance with the Biosecurity Act 1993, the Otago Regional Pest Management Plan (RPMP) 2019-2029 was adopted in November 2019. The RPMP details the plants and animals that are declared pests in the Otago region, explains why they are declared as pests and outlines how each pest will be managed over a ten-year period. The RPMP is a Council plan that is operationalised by the Biosecurity Team.

[6] An annual operational plan is required by the Act to detail the nature and scope of activities the Council intends to deliver as it implements the RPMP. The Biosecurity Operational Plan (BOP) details the range of activities that will be undertaken by Council to manage pests in Otago for the year

[7] The BOP enacts the RPMP and details how the RPMP objectives will be met through specific deliverables (actions), performance measures, and targets.

DISCUSSION

[8] A summary of achievement towards the delivery of the BOP 2025-26 is presented in the attached document (Appendix 1: Biosecurity Operational Plan 2025-26 Assessment of Performance), detailing the achievement of each Key Performance Indicator (KPI)).

[9] The 2025-26 BOP had 70 Key Performance Indicators (KPIs). Eleven KPIs were not measurable as the required events did not occur, which leaves 59 KPIs that were measured. Overall, 49 KPIs were fully achieved or exceeded (achievement rate of 83%). Seven KPIs were partially achieved (12%) with three KPIs not achieved (5%).

[10] Overall, the achievement rate for FY2025-26 showed a slight improvement compared to the previous year. As shown in Figure 1, there has been an upward trend in achievement over the past six years.

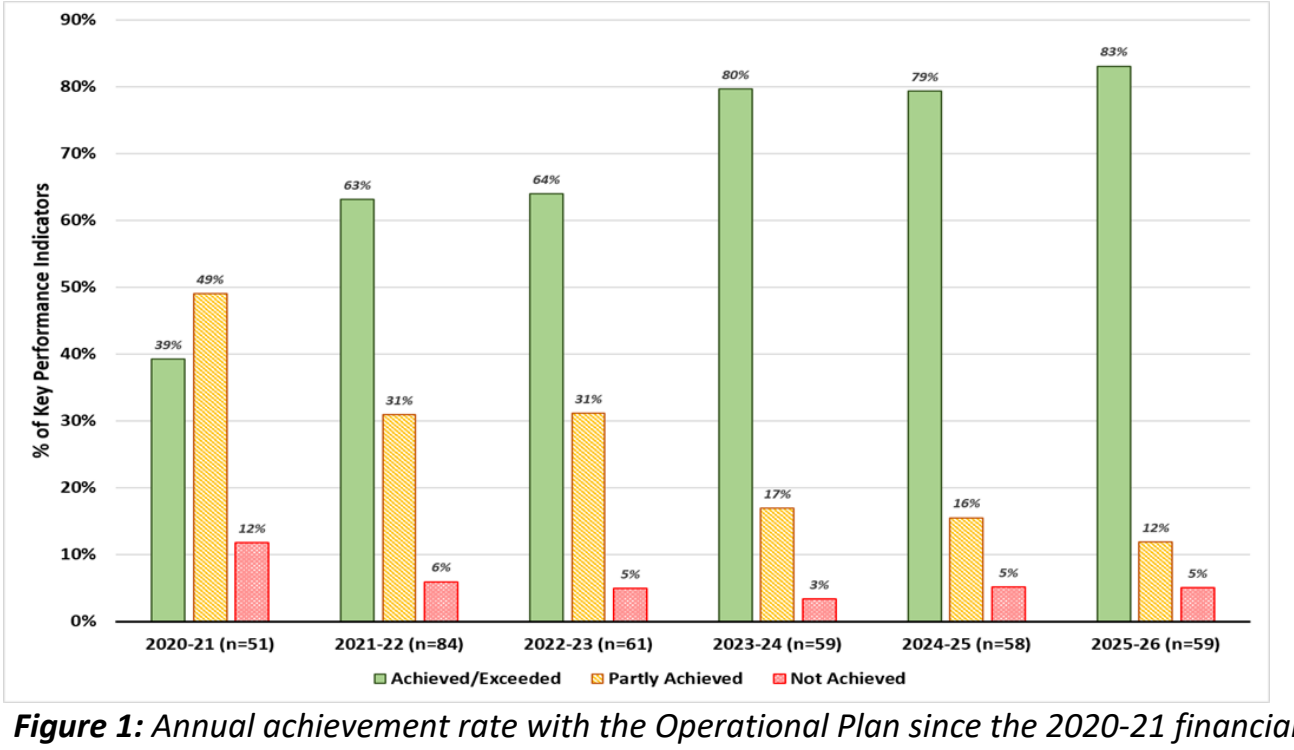


Figure 1: *Annual achievement rate with the Operational Plan since the 2020-21 financial year.*

[11] Figure 2 below shows the geographical spread of biosecurity compliance inspections, wallaby control operations, wilding conifer control operations, and monitoring activities during the year, July 2025 – June 2026.

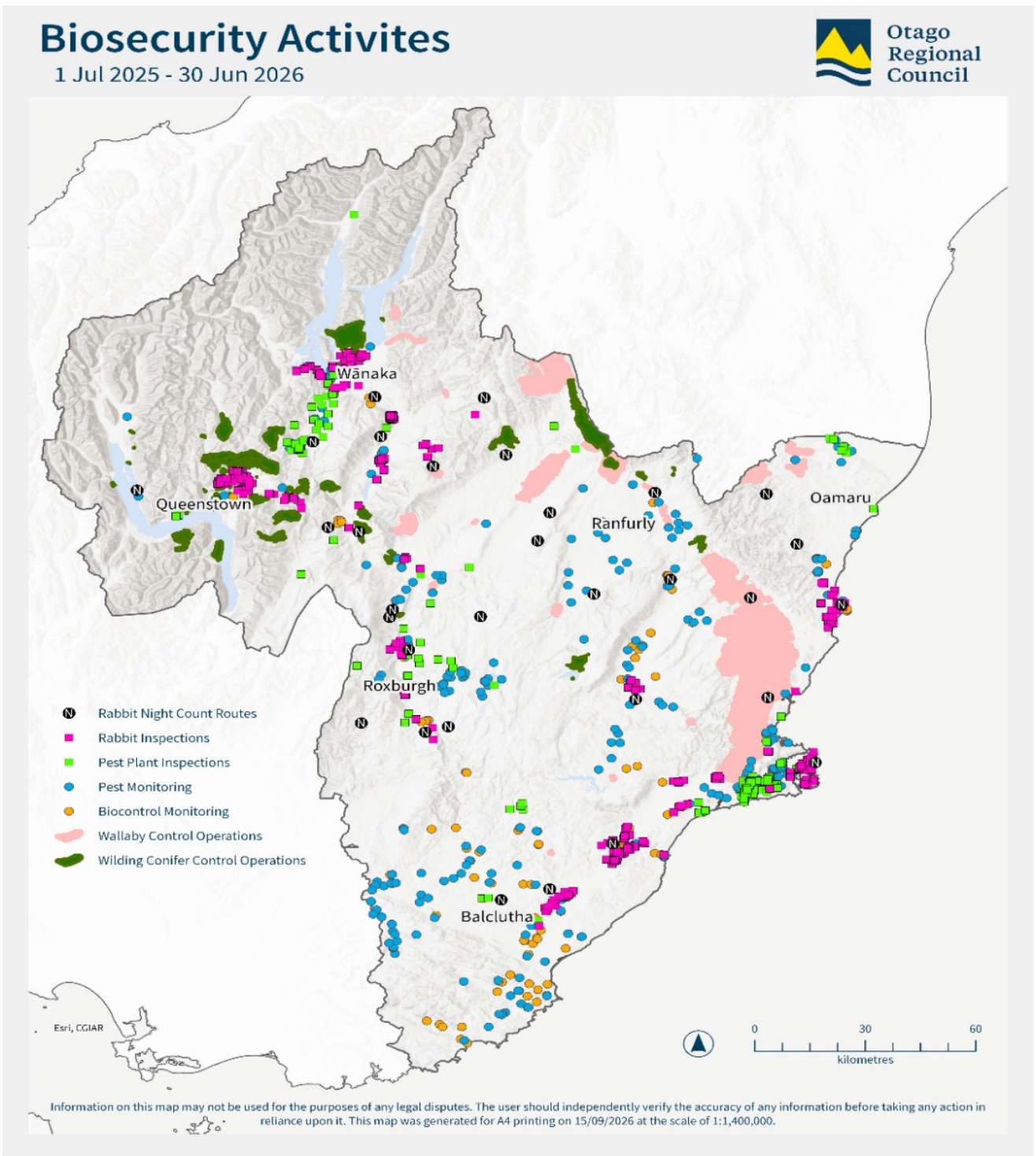


Figure 2: *Geographic spread of biosecurity activities: July 2025 – June 2026.*

Rabbit Inspections

[12] Over the 2025-26 financial year, 461 rabbit inspections were completed against a target of 422 (109.2%). 412 rabbit inspections were completed in non-community programme areas with a further 49 rabbit inspections completed in community programme areas[1].

[13] Overall, 39.3% of rabbit inspections were compliant with 60.7% being non-complaint (Table 1). In comparison, 37.6% were compliant and 62.4% non-compliant in the previous year (Table 2). While there is a marginal improvement in the compliance to the RPMP rules compared to the previous year, the change in the compliance rate is not statistically significant (p = 0.606) between the two financial years.

Table 1: Rabbit inspection compliance and non-compliance: July 2025 – June 2026

Compliance Status	Compliant	Non-compliant	Total
New Inspection	71 (15.4%)	88 (19.1%)	**159 (34.5%)**
Re-Inspection	110 (23.9%)	192 (41.6%)	**302 (65.5%)**
Total	**181 (39.3%)**	**280 (60.7%)**	**461**

Table 2: Rabbit inspection compliance and non-compliance: July 2024 – June 2025

Compliance Status	Compliant	Non-compliant	Total
New Inspection	60 (13.0%)	72 (15.7%)	**132 (28.7%)**
Re-Inspection	113 (24.6%)	215 (46.7%)	**328 (71.3%)**
Total	**173 (37.6%)**	**287 (62.4%)**	**460**

[14] Care is needed when comparing against previous year results due to the varying context of the inspections. Inspected properties can cover a range of topographies each having an underlying proneness to rabbit infestation. In turn, the actual prevalence of rabbits in any specific area will depend on the level of control, virus activity, and ecological factors. When properties are marginally non-compliant (i.e. MMS 4), it is more likely they can be controlled faster and can become compliant quicker. In comparison, areas that have higher infestations (i.e. MMS ≥ 5) are likely to take longer to achieve compliance as it may require more than one annual cycle of intensive control before a property is able to become compliant (e.g. two, or more, re-inspections).

[15] The analysis of paired inspection data[2] from 77 non-compliant properties shows that, based on the median, there was a decrease of one level in the Modified McLean Scale (MMS) between non-compliant first inspections and the subsequent re-inspection. This change is significant[3] and provides support that inspections, as part of an integrated pest management strategy, have a positive effect in the sustainable control of rabbits. This is

[1] A community rabbit programme is a defined area where ORC supports a community level response to rabbit management by bringing together affected landowners and occupiers to discuss the problem and collectively work out solutions.

[2] Paired analysis compares properties that were non-compliant at first inspection which then had a follow-up reinspection during FY25/26.

[3] Technical details: Using the Wilcoxon signed-rank test, there was a significant result (W=180.50 and $p < 0.001$). It is important to acknowledge that as the MMS is an exponentiated scale, the change of one MMS level is notable.

consistent to findings that were presented in the RPMP Effectiveness Review of June 2025.[4]

Pest Inspections (Non-rabbits)

[16] 395 non-rabbit pest inspections were completed against a target of 415 (95.2%), with 931 monitoring visits (excluding biocontrol visits).

[17] Table 3 shows the compliance rate for non-rabbit pest inspections for 2025-26, with a comparison to 2024-25 in Table 4. When comparing between the previous year, more non-compliance was observed in 2025-26 than for 2024-25 (67.8% compared to 58.6%), which is significant (p = 0.0128). This difference can be explained by focusing on known sites for FY205-26 rather than a more surveillance approach undertaken in the previous year. This means that it was more likely that there was a historical presence of pests – and the presence of a pest is the principal condition as to whether the pest can be classified as non-complaint.[5]

Table 3: Non-Rabbit inspection compliance and non-compliance: July 2025 – June 2026

Compliance Status	Compliant	Non-compliant	Total
New Inspection	36 (9.1%)	106 (26.8%)	**142 (35.9%)**
Re-Inspection	91 (23.0%)	162 (41.0%)	**253 (64.1%)**
Total	**127 (32.2%)**	**268 (67.8%)**	**395**

Table 4: Non-Rabbit inspection compliance and non-compliance: July 2024 – June 2025

Compliance Status	Compliant	Non-compliant	Total
New Inspection	39 (13.2%)	75 (25.4%)	**114 (38.6%)**
Re-Inspection	83 (28.1%)	98 (33.2%)	**181 (61.4%)**
Total	**122 (41.4%)**	**173 (58.6%)**	**295**

[18] Table 5 and 6 present the monitoring visit data in terms of 'presence-absence[2] for 2025-26 and 2024-25, respectively.

Table 5: Non-Rabbit monitoring visits: July 2025 – June 2026

Occurrence Status	Absent	Present	Total
Monitoring visits	**398 (42.7%)**	**533 (57.3%)**	**931**

Table 6: Non-Rabbit monitoring visits: July 2024 – June 2025

Occurrence Status	Absent	Present	Total
Monitoring visits	**796 (28.0%)**	**2,045 (72.0%)**	**2,841**

[19] Based on the infestation grades recorded during monitoring visits, 2025/26 showed that, based on the respective proportions, there were fewer extensive infestations than the previous year while higher rates of low-level infestations or absence. While more analysis is needed to make a formal conclusion, the movement from extensive to low-

[4] An update on the RPMP Effectiveness Review is discussed below in the section "Update on the RPMP Effectiveness Review – implementation of recommendations"

[5] The presence of a pest does not automatically mean non-compliant. Under the RPMP some pests can be present yet are compliant (e.g. ragwort).

level infestations would be a promising trend as this could suggest there is some degree of sustained control or progressive containment being achieved.

Pest Management Engagement

[20] A total of 347 Freshwater Ambassador survey interactions were completed over summer as part of the “Check, Clean, Dry” campaign, which aimed to educate and raise awareness about preventing the spread of aquatic weeds, with a particular focus on lagarosiphon. In addition to the completed surveys, ambassadors engaged with members of the public through conversations and outreach activities, resulting in more than 920 total public interactions.

[21] Staff also attended community events to support best practice pest control, this included 6 regional A&P shows and other council strategic events.

[22] 456 pest related enquiries were received through the ‘report a pest’ website and phone calls to customer services with 380 responded to (83.5%) within the set timeframe of 10 working days.

Compliance and Enforcement

[23] A total of 763 letters (excluding Notices of Direction) were sent to occupiers or landowners advising them of inspection outcomes, an increase from 653 letters in 24/25. Timeliness also improved, with 88% of letters issued within three weeks of inspection, exceeding the target of 75% and representing a substantial improvement on 78.3% achieved in 24/25. Performance within six weeks increased from 89.9% in 24/25 to 99% in 25/26, bringing results much closer to the 100% target.

[24] A total of 26 Notices of Direction (NODs) were issued to non-compliant properties that met the required NOD criteria, more than double the 12 NODs issued in 24/25. This increase reflects a stronger compliance response and greater use of formal regulatory tools to address properties that had not achieved the required standard. As with the previous year, all properties issued with a NOD will be re-inspected to assess progress towards compliance. If the property remains non-complaint, default work will be undertaken where necessary to ensure compliance outcomes are achieved.

Highly Pathogenic Avian Influenza (HPAI) H5N1 (Bird Flu)

[25] Highly Pathogenic Avian Influenza (HPAI) H5N1, commonly known as bird flu, is a serious viral disease that primarily affects wild and domestic birds. The disease can cause significant mortality events in some bird species and, while infection of mammals and humans is possible, such cases remain rare. The Ministry for Primary Industries (MPI) leads New Zealand's HPAI response through a collaborative "One Health" approach, working closely with the Department of Conservation, Health New Zealand, and other government agencies. ORC is responsible for coordinating regional preparedness activities, supporting consistent public messaging, and managing response operations on ORC-owned land.

[26] New Zealand has recorded three confirmed detections of HPAI H5N1, all in the North Island. The most recent detection was confirmed on 21 August in a northern giant petrel found deceased on a remote beach at Cape Palliser in the Wairarapa. To date, there is no evidence of mass mortality in wildlife populations, and the virus has not been detected in commercial or backyard poultry.

[27] Key activities included working with regional partners to prepare and implemented an Otago H5N1 bird flu preparedness plan, hosted a multi-agency scenario-testing workshop involving territorial authorities and partner agencies, development of carcass disposal consenting pathways, establishment of a regional bird mortality reporting and tracking dashboard, and ongoing work to clarify roles, responsibilities, and incident management structures.

African Feather Grass Incursion Response

[28] During 2026, staff commenced response work for two known African feather grass infestations in North Otago, located near Ngapara and Waianakarua. African feather grass is listed under the exclusion programme within the RPMP. ORC's role is to respond to any incursions of exclusion species to prevent their establishment in the Otago Region.

[29] At the Ngapara site, delimiting surveys of the affected and neighbouring properties found no additional infestations, providing confidence that the incursion remains localised. Control works were completed, including excavation and removal of plants and associated rhizome material. The treated area has been covered with a weed-suppression system and is now subject to ongoing monitoring.

[30] At the Waianakarua site, monitoring has shown a positive response to herbicide treatment, with most plants exhibiting no active growth. Follow-up herbicide treatment is planned for spring, alongside continued site surveillance.

[31] Pathway tracing investigations were undertaken to assess potential spread through historic construction activities. No additional infestations have been identified through these investigations.

[32] Research conducted in partnership with the University of Otago confirmed that African feather grass at the Waianakarua site could produce viable seed, with some seeds successfully germinating under testing conditions. These findings reinforce the importance of the rapid response programme and ongoing monitoring efforts.

[33] Community engagement formed an important part of the response. Public information meetings were held in Herbert and Ngapara townships, attracting strong local interest, and an awareness campaign encouraged residents to check properties and report suspect plants.

[34] The response has now entered a monitoring phase, with priorities including ongoing surveillance of known sites, monitoring of locations identified through pathway tracing, follow-up control work at Waianakarua, continued community awareness activities, and long-term surveillance to support eradication goals. Staff acknowledge the valuable support provided by landowners, stakeholders, researchers, contractors, and the local community throughout the response.

Mediterranean Fanworm Surveillance and Eradication Programme

[35] Mediterranean Fanworm (*Sabella*) is a marine pest that can have significant impacts on coastal and harbour environments. It is listed as an Unwanted Organism under the Biosecurity Act 1993. As part of a programme to eradicate Sabella in Otago Harbour after Sabella was detected in 2019, ORC undertakes ongoing surveillance activities to detect and remove any remaining *Sabella* and ensure eradication.

[36] Surveillance of Port Otago and surrounding marine areas was completed using commercial dive contractors, with six dive days undertaken during the reporting period. Prior to the surveys, a detailed *Sabella* identification and removal guide was developed, and on-site briefings were provided to dive teams to support accurate identification, removal, and reporting of suspect specimens.

[37] During the surveys, two specimens were collected and submitted to the Marine Invasive Taxonomic Service (MITS) for identification. One specimen was confirmed as a native fanworm species. The second specimen was an unusually large empty tube, approximately 200 mm in length. MITS determined that the tube was not *Sabella* and was associated with a native sabellid species despite its unusually large size.

[38] No *Sabella* detections were recorded during the reporting period. The last detection of Sabella was in 2024, and a minimum of five consecutive years without detections is required before eradication can be formally declared. Ongoing surveillance will continue to provide confidence that any remaining specimens, including those previously undetected or too small to be readily identified growing on wharf piles, are identified and removed.

[39] To support future response readiness, ORC has secured the necessary resource consent approvals to undertake hull and structure wrapping should a high-density infestation be detected in the future. This ensures rapid deployment of containment and treatment measures if required.

Regional Pest Management Plan Review

[40] The review of Otago's Regional Pest Management Plan (RPMP) made considerable progress during the year. A Council Reference Group, including councillors Noone, Gillespie, Wilson and Malcolm; and mana whenua representatives, was established and have met regularly to provide strategic guidance and oversight of the review process.

[41] The early engagement phase was completed, generating strong interest from communities, stakeholders, agencies, and organisations across Otago. More than 1,200 pieces of feedback were received, and over 200 individuals and organisations participated in discussions on proposed pest species and high-value sites. This feedback is now informing the development of the updated plan.

[42] Engagement with mana whenua continued through representation on the Council Reference Group and targeted engagement with rūnaka, supported by cultural impact assessments. Ongoing collaboration is helping ensure cultural values and perspectives are reflected in the proposed plan.

[43] Technical work advanced, with Biosecurity Impact Assessments drafted for approximately 160 pest species and six proposed high-value sites. Analysis of the costs and benefits of management options is also underway, alongside the preparation of statutory reports required under the Biosecurity Act.

[44] Looking ahead, the project will focus on refining management options for complex species and sites, undertaking a second phase of targeted stakeholder engagement, and developing a proposal for a new Regional Pest Management Plan. Formal public consultation on the proposed plan is expected to follow in 2027.

Biosecurity Innovation

[45] The Biosecurity Team continued to invest in innovative technologies to improve the collection of surveillance and monitoring data, supporting both the Regional Pest Management Plan (RPMP) review and the targeting of compliance activities.

[46] Examples included the use of aerial imagery and fixed-wing aircraft to identify gorse and broom infestations requiring follow-up compliance action, and the use of thermal imaging drones to undertake rabbit night counts as an alternative to traditional ground-based motorbike and spotlight surveys.

[47] Figure 3 compares rabbit detections per kilometre from thermal drone surveys and traditional motorbike counts across 26 rabbit monitoring routes throughout Otago.

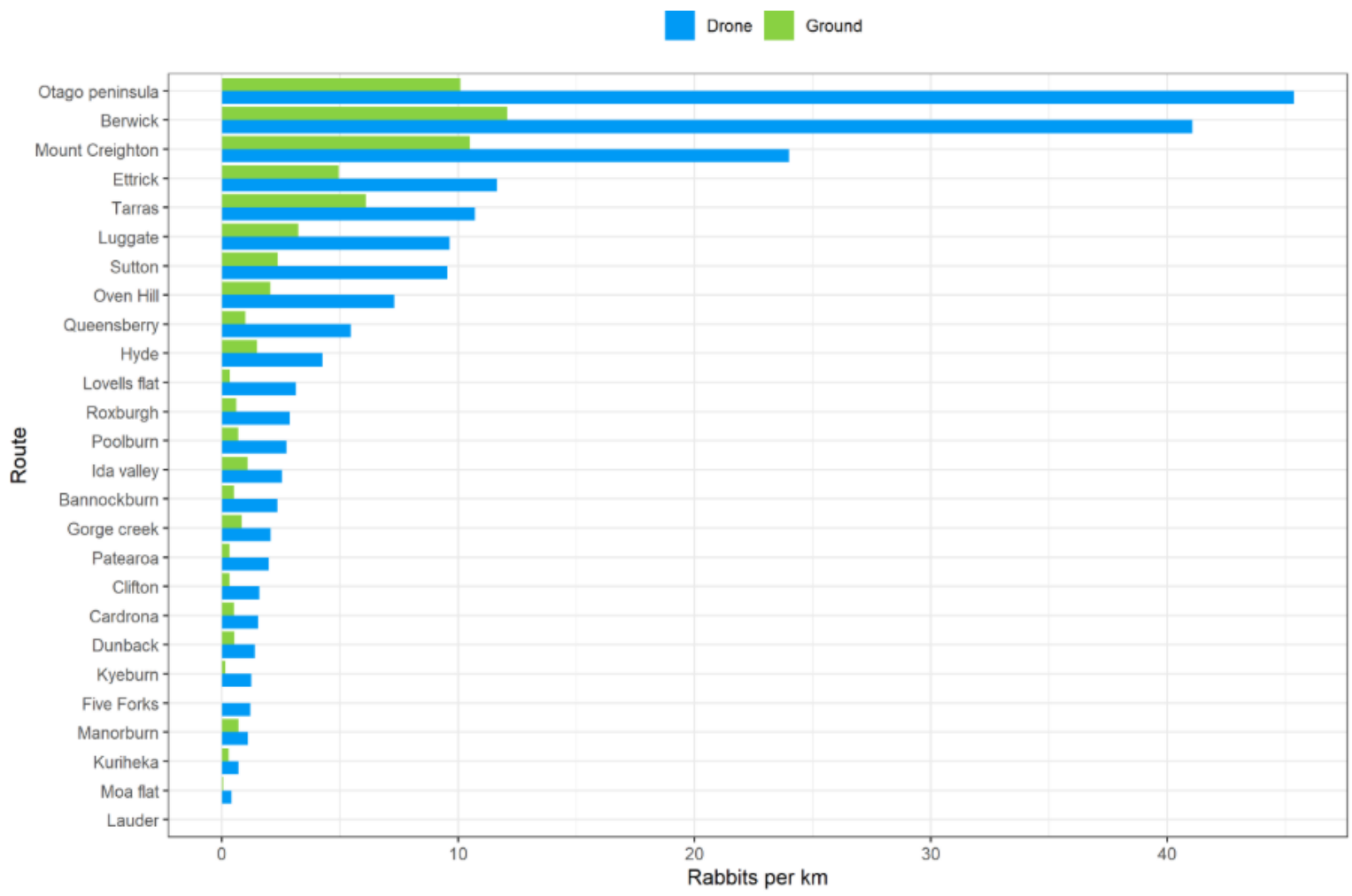


Figure 3: *Comparison of rabbit counts (rabbits per km observed), Ground based (green) and drone based (blue) for 26 rabbit night count routes in Otago.*

[48] The results demonstrated that thermal drones consistently detected higher numbers of rabbits than traditional survey methods, indicating that thermal imaging provides a more effective and reliable approach for monitoring rabbit populations. The technology has proven to be a viable tool for rabbit surveillance across Otago, while also improving operator safety and survey efficiency.

[49] Building on these results, further development and refinement of drone-based monitoring methods is planned, with the long-term objective of transitioning from traditional rabbit night count routes to thermal drone surveys as the primary monitoring approach. This investment in technology will support more accurate data collection and better inform future pest management decisions.

Priority Actions- Biosecurity

[50] During the reporting period, ORC has begun to implement biosecurity related priority actions aimed at improving pest management outcomes, including work to establish Rabbit Working Group focused on enhanced rabbit control initiatives, assessing opportunities for a step change to eradication of lagarosiphon, and supporting community and voluntary efforts to manage wilding pines across the region.

Biosecurity Service Improvements

[51] During the year, a range of improvements were implemented across biosecurity operations to strengthen compliance, improve consistency, and better target resources to areas of greatest risk and value. Key improvements included:

a. Increased emphasis on ensuring compliance with Regional Pest Management Plan (RPMP) rules, resulting in a higher number of inspections and notices of direction compared to 24/25. (refer to tables 1-6 above).
b. Standardisation and acceleration of compliance timeframes across pest species to improve consistency, efficiency, and accountability.
c. Increased use of targeted inspections in areas where significant investment and community awareness already exist.
d. Stronger use of the enforcement provisions available under the Biosecurity Act to address repeated instances of non-compliance, including default works.
e. Prioritisation of surveillance and monitoring activities in areas with the highest biodiversity, economic, or cultural values to maximise the effectiveness of biosecurity investment.
f. Enhanced communication and engagement to ensure land occupiers, stakeholders, and communities have a clear understanding of pest management objectives, responsibilities, and regulatory requirements.

[52] These improvements have strengthened the effectiveness of the biosecurity programme and helped support more consistent and targeted delivery of pest management outcomes across Otago.

Update on the RPMP Effectiveness Review – Implementation of Recommendations

[53] In the 24-25 Financial year, ORC commissioned Sapere Consultants to review the effectiveness of the Regional Pest Management Plan.[6] The RPMP Effectiveness Review was presented to Council on 5th June 2025.[7] This review highlighted that while some

[6] The RPMP Effectiveness Review (2025) by Sapere is available at: orc-rpmp-effectiveness-evaluation-report-april-2025-final-web.pdf.
[7] Item 9.2 in Environmental Delivery Committee Paper 5th June 2025: 20250605-ed-agenda.pdf.

elements of the RPMP were effective, other areas were less so. Overall, the review concluded that ORC was only partially effective in achieving pest objectives stated in the RPMP.

[54] To improve effectiveness, the RPMP Effectiveness Review listed 13 recommendations. These recommendations were accepted by Council[8].

[55] During August-October 2026, Sapere was commissioned to review the progress taken to implement these recommendations (known as the "Review of Actions"). The Sapere report is attached to this paper as Appendix 2. Of the 13 original recommendations to improve RPMP effectiveness:

a. Seven have been substantially implemented and incorporated into operational planning, processes or programme delivery.
b. Four have shown significant progress, although some elements remain under development or limited evidence of full implementation.
c. Two showed partial progress where the recommendations have been addressed in principle, but implementation remains incomplete.
d. No recommendations were assessed as showing little or no meaningful progress.

[56] Progress with implementing the recommendations was observed in three areas:

a. Compliance and enforcement – e.g. formal compliance framework, standardised inspection and re-inspection processes,
b. Communication and engagement – e.g. a communications framework, increased its focus on audience-specific communication, including success stories,
c. Monitoring and surveillance – e.g. targeted monitoring of priority areas, investment in drone-based monitoring and remote sensing.

[57] Areas of further development were noted in the areas of stakeholder engagement, public participation in pest monitoring (citizen-science), and outcome-based monitoring.

[58] An updated Implementation Plan based on the "Review of Actions" into the recommendations from the RPMP Effectiveness Review is attached as Appendix 3.

SUMMARY OF CONSIDERATIONS

Community Outcomes

This work aligns with the following community outcomes from the ORC 2024–2034 Long-Term Plan: a healthy environment and communities that are resilient and empowered to act. The work completed helps to protect indigenous biodiversity, strengthen community-led environmental action and support enduring environmental outcomes across Otago.

Councillor Priority Actions

The biosecurity work programme aligns with three priority actions:

- Strengthen pest management outcomes for control of rabbits, with the establishment of a working group and a focus on practical delivery, partnerships, and community and landowner collaboration.

[8] Resolution EDC25-102 in Environmental Delivery Committee Minutes 5th June 2025 20250605-ed-committee-minutes.pdf.

- Assess opportunities for eradication or a step-change intervention for lagarosiphon, including appropriate funding options and delivery models.
- Support community and voluntary efforts to control wilding pines. Advocate for fair contributions from government and those responsible for the source of the wildings.

Alignment with Central Government Legislation
The biosecurity programme delivers functions consistent with national direction for indigenous biodiversity, pest management and supports the delivery of the national wilding conifer programme and national wallaby programme. It also delivers functions under the Biosecurity Act (1993), including the Regional Pest Management Plan, but also compliance regarding defined 'Unwanted Organisms' and 'National Pest Plant Accord'.

Alignment with Otago Regional Council Internal Policy
The biosecurity programme delivers work are consistent with the Long-Term Plan 2024–2034, Council Priority Actions, the Indigenous Biodiversity Strategy and relevant pest management and catchment priorities.

Financial Considerations
To deliver the Biosecurity work programme, the Annual Plan provides in the Biosecurity budget, for 18 staff working full time on Biosecurity to deliver this activity. Total costs associated with the delivery of this programme are estimated at $5,288,416 (this includes: specialist technical input procurement of materials, delivery of control work, support for community groups and staff time).

Legal Compliance/Risk
In line with the Biosecurity Act (1993), it is desirable that the attached report is proactively submitted to the Minister of Biosecurity prior to the 30 November 2026.

Reputational Risk
Key reputational risks include perceived failure to achieve stated outcomes under the Regional Pest Management Plan. These risks can be managed through regular public reporting.

Climate Resilience
Climate change poses risks to biosecurity through factors such as the establishment of new pests, change in the ecological range of current pests and shifts in introduction pathways.

Carbon Emissions
Programme delivery will involve travel, field operations and equipment use. Any emissions are expected to be minor relative to the scale of the programme and should be managed through normal operational planning.

He Mahi Rau Rika: Significance, Engagement and Māori Participation Policy
The biosecurity programme is within the purpose and budget established through the Long-Term Plan 2024-2034.

Engagement with Mana Whenua
The biosecurity programme maintains relationships with mana whenua through Aukaha and Te Ao Mārama Inc. No direct engagement was undertaken in the preparation of the annual report.

Stakeholder Engagement
Staff work within an engagement strategic plan to support the implementation of the Regional Pest Management Plan. This will focus on biosecurity priorities, actions and active community education and advocacy.

Communications
Staff work within a communications strategic plan to support the implementation of the Regional Pest Management Plan. This will focus on biosecurity priorities, actions and active community education and advocacy.

NEXT STEPS

[59] The attached report will be provided to the Minister for Biosecurity (Appendix 4).

ATTACHMENTS

1. Appendix 1_Biosecurity Operational Plan 2025-26 Annual Report_KPIs [**9.3.1** - 13 pages]
2. Appendix 2_Review of Actions following the RPMP Effectiveness Review [Sapere] [**9.3.2** - 58 pages]
3. Appendix 3_Updated Implementation Plan from Review of Actions (Oct 2026) [**9.3.3** - 5 pages]
4. Appendix 4_Draft Letter to Minister_Biosecurtiy Annual Report 25-26 [**9.3.4** - 1 page]

Appendix 1: Biosecurity Operational Plan 2025-26
Assessment of Performance

Implementing the Regional Pest Management Plan 2019-29

This appendix presents an assessment of the Biosecurity Operational Plan 2025-26 and reviews the achievement of the Key Performance Indicators (KPIs) as listed in the plan. This report is divided into the five pest control programmes as outlined in the Regional Pest Management Plan 2019-29.

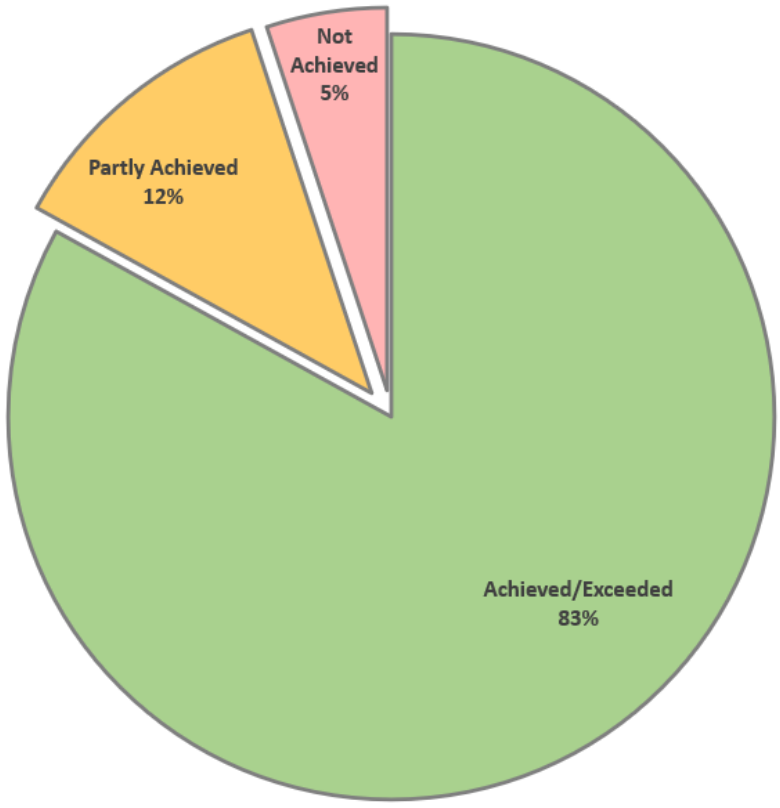


Figure 1: Snapshot of Biosecurity Performance in 2025-26

Key Legend

	Achieved/Exceeded	100% or more achieved
	Partly Achieved	Between 1-99% achieved
	Not Achieved	0% achieved
---	**Not Measurable**	Not able to be measured

Summary

The 2025-26 BOP had 70 Key Performance Indicators (KPIs). Eleven KPIs were not measurable as the required events did not occur, which leaves 59 KPIs that were measured. Overall, 49 KPIs were fully achieved or exceeded (achievement rate of 83%). Seven KPIs were partially achieved (12%) with three KPIs not achieved (5%). Where all KPIs were met the lessons learnt box maybe left blank.

1. Exclusion Pest Programme

ORC will prevent six high threat pest plants from establishing in the region.

Exclusion Pest Programme

Objective: Preclude the establishment of the following plant pests (listed below) in the Otago region for the duration of the RPMP: African feather grass, Chilean needle grass, Egeria, False tamarisk, Hornwort, and Moth plant.

		Target	Actual	
KPI 1	% of investigations commenced within 2 working days of a suspected exclusion pest sighting.	100%	100%	✓
KPI 2	% of incursion response plans enacted within 5 working days of incursion confirmation.	100%	100%	✓

Comments	KPI 1: Suspected exclusion species reported 25 March 2026 (African feather grass). Investigation commenced within 24 hours with a site visit 26 March 2026. Also, continued surveillance of possible Ergeria and False Tamarisk presence from eDNA sampling in 2024/25. No presence found. KPI 2: African feather grass formally confirmed 31 March 2026. Incursion response commenced 31/03/26 with a delimitation survey. Investigations into Ergeria and False Tamarisk did not confirm any presence.
Lessons Learnt	Improvements could be made in pathways management for aquatic species.

2. Eradication Pest Programmes

ORC will eliminate spiny broom, and eradicate Bennett's wallaby and rooks from the region.

Bennett's Wallaby

Objective: Reduce all infestations of Bennett's wallaby to zero levels within the Otago region to prevent adverse effects on economic well-being and the environment.

		Target	Actual	
KPI 1	Response within 5 working days of a reported wallaby sighting.	100%	100%	✓

KPI 2	% of Operational Advisory Group meetings attended.	100%	100%	
KPI 3	Fulfil requirements of MPI funding agreement.	100%	100%	

Comments	KPI 1: All 55 reported sightings responded to within five working days.
Lessons Learnt	

Rooks

Objective: Reduce rook populations to zero density, within the RPMP period and maintain this status until eradication is attained.

		Target	Actual	
KPI 1	% of investigations commenced within 2 working days of a suspected eradication pest sighting, to confirm an incursion.	100%	n/a	---
KPI 2	% of incursion response plans enacted within 5 working days after incursion confirmed.	100%	n/a	---
KPI 3	Develop an annual workplan for monitoring of all known rookeries, prior to 1 July 2025.	1	1	
KPI 4	All known sites monitored as described in the annual workplan.	100%	100%	
KPI 5	% of communication, education, and awareness initiatives completed as described in the annual workplan.	100%	100%	

Comments	KPI 1 & 2: No reports of rooks being sighted (in this performance year)
Lessons Learnt	Improved surveillance and detection techniques using thermal drones will be trialled to aid eradication efforts.

Spiny broom

Objective: Reduce spiny broom populations to zero density within the RPMP period and maintain this status until eradication is attained.

		Target	Actual	
KPI 1	% investigations commenced within 2 working days of a suspected exclusion pest sighting, to confirm an incursion.	100%	n/a	---
KPI 2	% incursion response plans enacted within 5 working days of confirmation of incursion.	100%	n/a	---

KPI 3	Develop an annual workplan for monitoring of spiny broom at known sites, prior to 1 July 2025.	1	1	
KPI 4	% of known sites monitored as described in the annual workplan.	100%	100%	
KPI 5	Where spiny broom is found at a known sites as identified in the annual workplan, control of those plants is undertaken prior to the next seeding event occurring.	100%	100%	
KPI 6	% of communication, education, and awareness initiatives completed, as described in the annual workplan.	100%	100%	

Comments	KPI 4: All three known sites (and surrounding areas) were monitored.
Lessons Learnt	Additional surveillance needed to confirm eradication.

3. Progressive Containment Pest Programmes

ORC aims to contain and reduce the extent of 11 pest plants (or groups of plants) across the region.

Wilding conifers

Objective: Contain wilding conifers within the region (in accordance with national strategy), reduce infestation densities where practicable and prevent their spread to new locations

		Target	Actual	
KPI 1	% of actions from the regional strategy commenced within specified due timeframes.	100%		
KPI 2	% of Operational Advisory Group meetings attended.	100%		
KPI 3	% of requirements of MPI funding agreement fulfilled.	100%		

Comments	KPI 1: One action: *Lead an overview of territorial authorities' rules and conditions relating to conifer control and recommendations for improvement provided if required.'* was deferred to later (new timeframe) due to local government reform direction.
Lessons Learnt	National Pest Plan being developed at national level to support wilding conifer programme with additional funding.

African love grass

Objective: Contain African love grass to its 20 known sites within the region, reduce its densities at these sites and prevent spread to new sites.

		Target	Actual	
KPI 1	Develop an annual workplan for monitoring of known ALG sites prior to 1 July 2025.	1	1	
KPI 2	% of known ALG sites monitored as described in the annual workplan.	100%	115%	
KPI 3	In any site, where ALG is found and where control is determined to be required, control is undertaken prior to the next seeding event occurring.	100%	100%	
Comments	KPI 2: All twenty known sites monitored plus 3 additional sites.			
Lessons Learnt	Additional surveillance and control needed to progressively contain known sites within Otago.			

Nassella tussock

Objective: Contain Nassella tussock to known areas within the region, reduce its densities at these sites and prevent spread to new sites.

		Target	Actual	
KPI 1	Develop an annual workplan for inspections of known nassella tussock sites prior to 1 July 2025.	1	1	
KPI 2	% of known sites inspected as described in the annual workplan.	100%	186%	
KPI 3	In any <u>new sites</u>, where Nassella tussock is found, appropriate actions are undertaken to facilitate control to the required level for Nassella tussock in Otago.	100%	n/a	---
KPI 4	Where a new site is identified, re-inspections will occur within required timeframes to ensure appropriate control is being undertaken.	100%	n/a	---
Comments	KPI 2: In additional to the 38 known locations, a further 33 visits have been conducted to control and contain Nassella tussock. KPI 3: No new sites for Nassella found, only active sites inspected			
Lessons Learnt	Nassella tussock is a persistent plant with a hardly seed. This requires a long-term management approach to control and contain.			

Old Man's Beard

Objective: Contain old man's beard to known areas within the region, reduce its densities at the above sites and prevent spread to new locations.

		Target	Actual	
KPI 1	Develop an annual workplan for inspections in known OMB sites in Otago, where those sites intersect with	1	1	

	areas of identified high-value biodiversity, prior to 1 July 2025.			
KPI 2	% of known sites inspected, as described in the annual workplan.	100%	87%	
KPI 3	In any new sites, where old man's beard is found, appropriate actions are undertaken to facilitate control to the required level for OMB in Otago.	100%	n/a	---
KPI 4	Where a new site is identified, re-inspections will occur within required timeframes to ensure a control is being undertaken.	100%	n/a	---

Comments	KPI 2: 173 inspections conducted of 200 known Old Man's Beard sites targeted in annual work plan. This species was treated as lower priority due to response actions for African Feather Grass.
Lessons Learnt	Greater emphasis is needed on prioritising sites for compliance where impact is greatest to biodiversity.

Spartina

Objective: Progressively contain and reduce the geographic distribution or extent of spartina within the Otago region to minimise or prevent adverse effects on economic well-being and the environment.

		Target	Actual	
KPI 1	Develop an annual workplan for monitoring of known spartina sites in Otago, prior to 1 July 2025.	1	1	
KPI 2	% of known sites monitored, as described in the annual workplan.	100%	100%	
KPI 3	In any site, where spartina is found, facilitate control to occur with landowner or external agencies prior to the next seeding event occurring.	100%	100%	
KPI 4	Undertake an investigation into the use of remote sensing for spartina with a view to create efficiencies within the programme by 30 June 2026.	1	0	

Comments	KPI 4 Initial investigation found that the use of drones to detect Spartina infestations was challenging due to the small number and limited extent of known infestations, reducing the potential value of a drone-based detection trial. As a result, the proposed trial was not progressed and was removed from the work programme, with resources instead prioritised towards core programme delivery.
Lessons Learnt	Additional work needed to align ORC and DOC's surveillance and control to increase effectiveness of programme across Otago.

Six Containment Plants

Objective: Contain [1] spartina to known areas within the region, reduce its densities at the known sites and prevent spread to new sites and [2] the six pest plants (Bomarea, Boneseed, Bur daisy, Cape Ivy, Perennial nettle, White-edged nightshade) within the region, reduce their densities at known sites and prevent spread to new sites

		Target	Actual	
KPI 1	Develop an annual workplan for known containment pest plants in Otago, prior to 1 July 2025.	1	1	✓
KPI 2	% of known sites inspections, as described in the annual workplan.	100%	78%	✓
KPI 3	In any new sites, where containment pest plants are found, appropriate actions are undertaken to facilitate control to the required level for containment pest plants in Otago.	100%	n/a	---
KPI 4	Where a new site is identified, re-inspections will occur within the required timeframes to ensure control is being undertaken.	100%	n/a	---

Comments	KPI 2: 118 inspections completed against 152 known sites listed in the work plan. Resources were redirected to incursion response for African Feather Grass. KPI 3 & 4: No new sites found, only active sites inspected.
Lessons Learnt	

4. Sustained Control Pest Programmes

ORC will enforce rules to ensure control of rabbits and five widespread pest plants (or groups of plants) to reduce their impacts and spread.

Feral rabbits

Objective: Ensure continuing control of feral rabbits to manage their spread and to reduce adverse effects and impacts on economic wellbeing and the environment.

		Target	Actual	
KPI 1	Develop an annual workplan for rabbit inspections in Otago, prior to 1 July 2025.	1	1	✓
KPI 2	% of sites inspected, as described in the annual workplan.	100%	109%	✓
KPI 3	In any inspected site, where rabbit control is required, appropriate actions are undertaken to	100%	98.5%	−

	facilitate control to at or below MMS 3 for rabbits in Otago.			
KPI 4	Develop an annual workplan for community rabbit programmes in Otago, prior to 1 July 2025.	1	1	
KPI 5	% of community rabbit programmes where landowner engagement is undertaken as per the annual workplan.	100%	100%	
KPI 6	Seek approval from Council to include a funding stream through the ECO Fund process to support rabbit management.	1	1	
KPI 7	Allocate approved ECO Funding (for fencing) to eligible and successful applications by 30 June 2026.	100%	100%	
KPI 8	Review rabbit management programme (including associated community rabbit programme) to determine effectiveness and identify improvements by 28 February 2026.	1	See comments	
KPI 9	Findings of rabbit management review to be presented to Council by 30 June 2026	1	0	

Comments	KPI 2: 461 rabbit inspections (including re-inspections) completed against a target of 422. KPI 3: 191 letters were sent due to non-compliant inspections out of a total of 194 non-compliant inspections. KPI 5: Six Community Rabbit Programmes provided with guidance on best practice rabbit management and supported coordination between land-owners and stakeholders. KPI 6: Approved in Council Meeting, September 2025 KPI 7: $102,200 allocated to three projects in June 2026. Disbursements of funds extend into FY26-27 KPI 8: Started process in July 2025 with Scope of Work finalised in March 2026. Still negotiating with consultant and pending Council paper on Rabbit advisory Group in December 2026. KPI 9: Deferred until FY26/27 once report generated and rabbit working group.
Lessons Learnt	Work has started to establish a rabbit working group to build on and address gaps in the rabbit programme and support the priority action of Council.

Gorse and broom

Objective: Ensure continuing control of gorse and broom, that prevents land free of these pests from becoming infested and reduces adverse effects on the economic (and environmental) wellbeing of occupiers regionwide.

		Target	**Actual**	

KPI 1	Develop an annual workplan for gorse and broom inspections in Otago, prior to 1 July 2025.	1	1	
KPI 2	% of known sites inspections, as described in the annual workplan.	100%	123%	
KPI 3	In any monitored site, where gorse and/or broom control is determined to be required, appropriate actions are undertaken to facilitate control to the required level for gorse and/or broom in Otago.	100%	100%	
KPI 4	Undertake an investigation into the use of remote sensing for gorse and broom with a view to create efficiencies within the programme by 30 June 2026.	1	See comments	

Comments	KPI 2: 98 inspections of 80 known lists listed in annual workplan. KPI 3: Letters sent to landowners/occupiers of affected properties. KPI 4: Plan developed, contractor in place but field work to be completed in July-Aug 2026.
Lessons Learnt	Surveillance is finding that the current known distribution of Gorse and Broom is greater than expected and additional resourcing for compliance and surveillance is being prioritised in high value areas.

Russell lupin

Objective: Instigate boundary controls of Russell lupin to prevent spread (e.g. the planting and subsequent seeding) of wild lupin plants, and to reduce adverse effects in rural zoned land.

		Target	Actual	
KPI 1	Develop an annual workplan for Russell lupin monitoring in Otago, prior to 1 July 2025.	1	1	
KPI 2	% of known sites monitored, as described in the annual workplan.	100%	50%	
KPI 3	In any site, where Russell lupin control is determined to be required, appropriate actions are undertaken to facilitate control to the required level for Russell lupins in Otago.	100%	See comments	

Comments	KPI 2: 2 of 4 known sites inspected. 2 of 4 sites no longer cropping wild Russell lupin.
Lessons Learnt	Inspections have indicated that Russel lupin cropping is less prevalent than historically.

Ragwort and Nodding thistle

Objective: Over the duration of the Plan, implement sustained control of nodding thistle and ragwort on rural zoned land within specified distances of property boundaries throughout the

Otago region to prevent their spread in order to minimise adverse effects on production values and economic well-being.				
		Target	**Actual**	
KPI 1	Respond to GNR enquiries around ragwort and nodding thistle within 10 working days.	100%	n/a	---
Comments	KPI 1: No enquires or complaints received.			
Lessons Learnt				

Biocontrol

Objective: Implement sustained control of nodding thistle and ragwort on rural-zoned land within specified distances of property boundaries throughout the Otago region (Good Neighbour Rules; 'GNR') to prevent their spread to minimise adverse effects on production values and economic well-being.

		Target	Actual	
KPI 1	Develop an annual workplan for biocontrol activities in Otago, prior to 1 July 2025.	1	1	✓
KPI 2	Implement biocontrol in approved sites as described in annual workplan.	100%	372%	✓
KPI 3	Provide an annual summary of biocontrol releases and monitoring undertaken for control of pest plant species, in Otago.	1	See comments	✓
Comments	KPI 2: 93 biocontrol activities undertaken against a target of 25. KPI 3: Refer to annual report for details.			
Lessons Learnt	Internal working group established to support ongoing programme of work.			

5. Site-led Pest Programmes

Otago Peninsula, West Harbour – Mount Cargill and Quarantine & Goat Islands

Objective: Otago Regional Council will take a lead role in supporting community groups and agencies in bringing about the desired levels of environmental protection to these sites [Otago Peninsula (9,000 ha), West Harbour & Mt Cargill (12,500 ha) and Quarantine & Goat Islands].

		Target	Actual	
KPI 1	Develop an annual workplan for site-led programmes, prior to 1 July 2025.	1	1	✓

KPI 2	% stated activities in the workplan that were successfully supported by ORC.	100%	100%	

Comments	KPI 2: Three meetings attended during the year.
Lessons Learnt	

Lagarosiphon

Objective: Support LINZ in controlling and eradicating lagarosiphon in the region's rivers and lakes

		Target	Actual	
KPI 1	Support LINZ in the management and control of lagarosiphon by ensuring that disbursements are made in accordance with the provisions outlined in the approved funding agreement.	100%	100%	
KPI 2	% of communication, education, and awareness initiatives for lagarosiphon through the 'Check, Clean Dry' Program completed, as described in the annual workplan.	100%	100%	

Comments	KPI 1: All disbursements made this year as planned. KPI 2: Seven events, 12 media releases, 13 social media posts, pamphlets and information material distributed. CCD activities reached a minimum of 920 people through 347 surveys.
Lessons Learnt	Work has begun to progress lagarosiphon priority action exploring step change approaches.

6. Freshwater and Marine Programmes

Freshwater

To raise public awareness and identify and detect the presence of priority freshwater pest species by:

- Conducting targeted surveillance around the Otago region
- Ensuring the Freshwater Monitoring and Surveillance Plan remains current and effective by incorporating updated methods and target species
- Engagement with corbicula response at national level

		Target	Actual	
KPI 1	Update the Freshwater Monitoring and Surveillance Plan to include appropriate methods and include relevant freshwater pest species by 1 October 2025.	1	1	

KPI 2	Undertake required monitoring of priority water bodies identified in the updated Freshwater Monitoring and Surveillance Plan to determine the presence of lagarosiphon and other freshwater pest species.	100%	20%	
KPI 3	% of communication, education, and awareness initiatives for freshwater pests through the 'Check, Clean Dry' Program completed, as described in the annual workplan.	100%	100%	
KPI 4	Engage with corbicula and other responses through attendance of national level and cross regional level meeting attendance	100%	100%	

Comments	KPI 2: 6 of 30 monitoring visits completed due reprioritisation of resources for response to African Feather Grass response.
Lessons Learnt	Surveillance of priority waterbodies completed by utilizing Freshwater Ambassadors as additional resource.

Marine

To raise public awareness and identify and manage the presence of priority marine pest species by

- Developing a Marine Monitoring and Surveillance Plan for Otago
- Eradicate the Mediterranean Fanworm from Otago harbour
- Engagement with the sector on pathways management

		Target	Actual	
KPI 1	Co-development of a Marine Monitoring and Surveillance Plan with tangata whenua by 31 December 2025.	1	1	
KPI 2	Deliver an incursion response plan to aim for eradication of the Mediterranean Fanworm by 30 June 2026.	1	10%	
KPI 3	% of communication, education, and awareness initiatives for marine pests through the 'Protect your Paradise' Program completed, as described in the annual workplan.	100%	100%	
KPI 4	Engage with the development of a sector position to pathways management through attendance of national and cross regional level meetings.	100%	100%	

Comments	KPI 1: 26 of 27 monitoring activities listed in plan completed. KPI 2: Working with Port Otago to develop a surveillance plan to be delivered in early 2027. KPI 3: Seaweek and Science Festival events attended. All applicable marine meetings attended.

Lessons Learnt	Early detection through ongoing surveillance is essential to ensure the successful eradication of *Sabella* from the Otago Harbour.

Otago Regional Pest Management Plan

Review of Actions following the RPMP Effectiveness Review

Dr Jamie O'Hare and Dr Julius Ohrnberger
October 2026



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Executive summary

Purpose of this review

In 2025, Otago Regional Council (ORC) commissioned Sapere to undertake an interim evaluation of the Otago Regional Pest Management Plan (RPMP) 2019–2029. The review identified recommendations to improve programme effectiveness, particularly in public awareness, compliance and enforcement, monitoring and surveillance, and information management.

This review assesses ORC's actions in response to those recommendations. It does not re-evaluate RPMP effectiveness or pest management outcomes but considers the extent to which the recommendations have been implemented or progressed.

Summary of findings

ORC has made significant progress in responding to and implementing the recommendations from the 2025 Effectiveness Review. Progress is evident across communications, compliance and enforcement, monitoring and surveillance, and the use of data and technology to support pest management activities. In other areas, actions have progressed from planning into operational processes. The evidence is strongest on the implementation of new actions, systems and processes. Evidence of changes in public awareness, compliance behaviour and pest outcomes is less developed and is still emerging. Remaining priorities relate to embedding emerging initiatives, strengthening data integration, and demonstrating measurable outcomes from the changes that have been implemented.

Areas of progress

- **Compliance and enforcement** have seen notable progress. ORC has established a formal compliance framework, standardised inspection and re-inspection processes, and developed processes for Notices of Direction, default works and cost recovery in cases of repeated non-compliance. These actions respond to key findings from the 2025 review.
- **Communication and engagement** have also progressed. ORC has developed a communications framework, increased its focus on audience-specific communication, strengthened communication of RPMP responsibilities and compliance requirements, and established a planned programme for communicating biosecurity achievements and success stories. Some examples of success story communications are evident, particularly through community and site-led projects, although the evidence does not yet demonstrate consistent delivery across the wider RPMP programme or the effect of these communications on public awareness and engagement.
- **Monitoring and surveillance** have progressed through expanded inspection programmes, targeted monitoring of priority areas, investment in drone-based monitoring projects, and investigation of remote sensing and machine-learning technologies.

Table 1: Summary of progress

Recommendation	Status	Summary of progress
Simplify the RPMP presentation, accessibility and reach	Green	Communications planning and accessible public-facing material are in place.
Clarify rules and target communication to key audiences	Green	Targeted guidance and audience-specific engagement have been developed.
Share more success stories	Amber-Green	A planned pipeline and examples exist, but sustained programme-wide delivery is not yet demonstrated.
Communicate consequences of non-compliance and enforcement successes	Amber-Green	Compliance pathways are documented; public-facing delivery and outcome communication remain developing.
Increase and better target inspections and re-inspections	Green	Expanded programmes, formal follow-up processes and priority-area targeting are operational.
Target enforcement where investment and awareness already exist	Green	Priority pest programmes are supported by targeted inspection and enforcement activity.
Leverage data to optimise enforcement	Green	Inspection, compliance and spatial data is used in enforcement decisions.
Use default work and cost recovery powers	Green	The framework is established and the first default work has been completed.
Integrate citizen-science and stakeholder data	Amber-Green	Useful examples exist, but integration remains project-based.
Incentivise public data contributions	Amber	Participation is encouraged, but targeted incentives and reporting campaigns remain limited.
Introduce outcome-based monitoring	Amber	Foundations have strengthened, but routine outcome monitoring is not yet consistent.
Invest in technology and staff capability	Amber-Green	Drone, remote-sensing and capability initiatives are progressing, largely through trials.
Prioritise significant data gaps and high-value areas	Green	Operational planning and targeted projects focus effort on priority areas and information needs.

Areas for further development

- Progress is less developed in areas relating to the integration of stakeholder and citizen-science data, public participation in monitoring, and outcome-based monitoring. While there are examples of activity in these areas, their application across the RPMP programme is less consistent.
- There is also limited evidence at this stage of the extent to which implemented actions have resulted in measurable changes in public awareness, compliance behaviour, pest outcomes or overall programme effectiveness.

1. Introduction

In 2025, Otago Regional Council (ORC) commissioned Sapere to undertake an interim evaluation of the effectiveness of the Otago Regional Pest Management Plan (RPMP) 2019-2029. The review assessed the extent to which ORC was on track to achieve the RPMP's objectives and identified areas where implementation was effective, partially effective, ineffective, or where evidence was insufficient to draw conclusions.

The review concluded ORC was partially effective in delivering the RPMP. Notable successes were identified in:

- exclusion pest management
- rook eradication
- spartina control
- several site-led initiatives.

However, the review also identified opportunities for improvements, relating to public awareness of RPMP obligations, compliance with pest management rules, enforcement activities, and monitoring coverage.

Three priority areas for improvement were identified:

1. Raising public awareness of the RPMP
2. Improving compliance and enforcement
3. Strengthening monitoring and surveillance activities.

1.1 The purpose of reviewing actions taken since the 2025 review

The 2025 review provided a series of recommendations intended to improve the effectiveness of the **current** RPMP and inform development of future pest management planning. Given the importance of these recommendations to achieving the RPMP's objectives by 2029, it is appropriate to assess the extent to which ORC has responded to and implemented the review findings.

Reviewing actions taken since the effectiveness evaluation serves two purposes:

1. It provides accountability regarding ORC's response to the recommendations and findings of the review.
2. It enables an assessment of whether the identified issues and risks are being addressed and whether the changes made are likely to improve future programme performance and outcomes.

1.2 Scope of this assignment

This work examines ORC's response to the recommendations and priority areas for improvement identified through the 2025 RPMP Effectiveness Review. It considers the actions undertaken to improve public awareness and communication, strengthen compliance and enforcement practices, enhance monitoring and surveillance activities, and address broader programme-level recommendations.

This work does not seek to re-evaluate the effectiveness of individual pest programmes or reassess pest outcomes. Rather, it assesses the extent to which ORC has implemented or progressed the recommendations arising from the 2025 review, considers how it has responded to identified improvement areas, and identifies any remaining gaps, risks, or areas requiring further attention.

This review has three objectives:

1. **Assess ORC's response to the 2025 RPMP Effectiveness Review** by identifying the actions undertaken since the review and assessing the extent to which its recommendations have been addressed.
2. **Evaluate progress against the priority improvement areas identified in the review**, with a focus on:
    - raising public awareness and understanding of the RPMP
    - strengthening compliance and enforcement activities
    - enhancing monitoring and surveillance practices.
3. **Identify remaining gaps, challenges, and opportunities for further improvement** to support the effective implementation of the RPMP over the remainder of the 2019–2029 plan period.

1.3 Our approach

The review adopts a document-based assessment, supplemented by a small sample of targeted interviews, of ORC's response to the recommendations arising from the 2025 RPMP Effectiveness Review. These discussions focused particularly on inspection and re-inspection activity, operation of the strengthened compliance framework, communications, monitoring and surveillance, and the use of data in operational decision-making.

The assessment is structured around the three priority improvement areas identified by the 2025 review:

- raising public awareness of the RPMP
- improving compliance and enforcement activities
- strengthening monitoring and surveillance practices.

The review also considers broader programme-level recommendations, where relevant, including improvements to communication, stakeholder engagement, data management, and organisational capability.

1.3.1 Assessment framework

The review is guided by three questions:

1. What actions has ORC taken in response to the 2025 review findings and recommendations?
2. To what extent do those actions address the priority improvement areas identified in the review?
3. What gaps, risks, or opportunities remain to support effective implementation of the RPMP through to 2029?

The findings are presented by recommendation theme, supported by evidence of actions undertaken and a qualitative assessment of the progress made. Recommendations are given an overall status, following a Red, Amber, Amber-Green, Green (RAAG) system, based on actions taken, the extent to which actions address improvement areas identified in the 2025 Sapere review, and any remaining gaps.

Table 2: RAAG system

Status	Reason
Red	Little or no meaningful progress is evident. The recommendation has either not been implemented, has not progressed beyond initial discussion or planning, or there is insufficient evidence to demonstrate that substantive action has been taken.
Amber	Partial progress appears to have been made; recommendation addressed in principle, but other elements remain incomplete.
Amber-Green	Significant progress appears to have been made and key components implemented, but some elements remain under development or lack evidence of full implementation.
Green	Recommendation appears substantially implemented and incorporated into operational planning, processes or programme delivery.

Green recommendations are considered on track. Amber-Green recommendations indicate substantive progress but incomplete implementation. Amber recommendations indicate partial progress and require further effort. Red would indicate recommendations that are off track or not yet progressed.

1.3.2 Limitations of the review

The review is not intended to provide a comprehensive evaluation of RPMP effectiveness or assess changes in pest outcomes since 2025. Such an assessment would require additional monitoring, compliance, and outcome data. Instead, the review focuses on ORC's response to the 2025 Effectiveness Review and the extent to which the recommended actions have been implemented or progressed.

Other limitations relevant for interpreting the findings are as follows:

- **Implementation timeframes**: The 2025 Effectiveness Review did not specify implementation timeframes or milestones for individual recommendations. The status ratings in this review

therefore reflect the level of implementation observed at the time of assessment, rather than progress against a defined schedule.

- **Evidence base**: Consistent with the Description of Services, this was an internal review based on documentation and evidence supplied by ORC; gathering or independently verifying external evidence was outside scope. The material supplied provides a useful basis for assessing actions undertaken, but the findings should be interpreted as an assessment of ORC's documented response rather than an independently generated evaluation of implementation and outcomes.
- **Stakeholder perspectives**: Wider external stakeholder engagement was outside scope because this was an internal review. Discussions were therefore largely confined to ORC staff and representatives, and the assessment places greater emphasis on ORC's reported actions and documentation than on external stakeholder perspectives regarding implementation, effectiveness or outcomes.

2. Progress since the 2025 Effectiveness Review

This section provides an overview of ORC's progress in responding to the findings and recommendations of the 2025 Effectiveness Review. It summarises the main actions taken, considers the extent to which these actions address the priority areas identified in the earlier review, and highlights the key gaps and opportunities that remain. It also provides an overall assessment of progress across the individual recommendations, with the supporting evidence and detailed assessments presented in the following section.

2.1 What actions has ORC taken?

ORC has undertaken a substantial programme of work in response to the recommendations of the 2025 RPMP Effectiveness Review. The most significant actions include the following:

- Establishment of a formal compliance and enforcement framework, including documented compliance pathways, expanded use of Notices of Direction, default work procedures and cost recovery processes.
- Expansion of inspection, re-inspection, monitoring and surveillance programmes, including dedicated inspection targets across several priority pest programmes.
- Development of a strategic communications approach focused on improving public awareness, understanding of RPMP obligations, and communication of programme outcomes.
- Increased use of compliance, inspection and spatial information to support enforcement and operational decision-making.
- Investment in monitoring technologies and surveillance capability, including drone-based monitoring, thermal imaging trials and remote sensing investigations.
- Continued support for community-led and site-led initiatives that generate additional pest management and monitoring information.

Evidence from interviews suggests organisational changes have also supported implementation. ORC has separated its biosecurity programme and compliance functions, providing greater clarity around roles and allowing staff undertaking compliance work to focus more directly on inspection, follow-up and enforcement activities. ORC staff reported that the team has recently reached full capacity, although the restructure, recruitment and associated capability-building have taken time to embed. These changes appear to have strengthened the organisational foundations for implementing the recommendations, although some of the resulting systems and capability remain relatively new.

2.2 To what extent have these actions addressed the priority improvement areas?

The evidence indicates ORC has made notable progress in addressing the three priority improvement areas identified by the 2025 review.

2.2.1 Public awareness

ORC has developed a communications framework, increased focus on audience-specific communication, strengthened communication of landowner responsibilities, and incorporated public awareness and success-story initiatives into programme delivery. While evidence of outcomes remains limited, the available evidence indicates progress in implementing the actions recommended by the review.

2.2.2 Compliance and enforcement

ORC has strengthened and more fully operationalised its compliance and enforcement approach. This includes more structured inspection planning and re-inspection processes, clearer and more consistent escalation pathways, and increased follow-through where non-compliance persists. Importantly, the available evidence indicates movement beyond the use of inspections and Notices of Direction, with default work now having been undertaken in practice. The principal change since the 2025 review is therefore not simply the existence of compliance powers or processes, but stronger supporting procedures and greater evidence that the escalation pathway is being applied operationally.

2.2.3 Monitoring and surveillance

ORC has expanded monitoring and surveillance activity, increased focus on high-risk and high-value areas, and trialled the use of technology such as thermal drones to support monitoring. Some initiatives remain under development, but the available evidence indicates progress towards the intent of the original recommendations.

2.3 What opportunities remain?

Although substantial progress has been made, several opportunities remain, which are set out below.

2.3.1 Monitoring outcomes and impacts of actions

Although many recommendations have been implemented or progressed, there is less evidence available regarding their impact on awareness, compliance behaviour, pest outcomes or programme effectiveness. As a result, it is currently more straightforward to assess whether recommended actions have been implemented than to determine the extent to which they are producing the intended effects. Interviews with ORC staff reinforced this limitation. In several areas, including communications and compliance, ORC is increasingly able to describe activity and reach, but does not yet have sufficient longitudinal evidence to determine whether these changes are producing sustained changes in behaviour or outcomes.

2.3.2 Data integration

Examples of community- and stakeholder-generated information are evident, although there is limited evidence of systematic integration of these data sources into ORC monitoring and decision-making processes.

2.3.3 Embedding emerging initiatives

Several initiatives, including outcome-based monitoring, remote sensing, thermal drone monitoring, and other emerging technologies remain in development, trial or early implementation phases. Some maturation is necessarily dependent on time, particularly where baseline data must be established before changes in outcomes can be assessed. However, transition from trial activity to routine programme delivery is unlikely to occur automatically. ORC will need to deliberately evaluate which approaches provide sufficient value, determine where they should be incorporated into business-as-usual practice, and provide the necessary resourcing, capability, processes and ongoing investment to support adoption. This is therefore both a matter of allowing emerging initiatives time to demonstrate their value and actively managing their transition into operational practice where the evidence supports doing so.

2.3.4 ORC is in a state of transition

The interviews suggest that ORC is currently in a transition from establishing improved systems and capability to demonstrating their effects. Organisational changes, increased staffing capability, clearer compliance responsibilities, shorter follow-up timeframes and greater use of enforcement mechanisms provide evidence that several recommendations are now being implemented operationally. However, in many areas the corresponding outcome evidence will lag implementation. It remains too early to determine whether these changes have produced sustained improvements in compliance behaviour, public awareness or pest outcomes.

2.4 Progress against recommendations from the Effectiveness Review

The overall pattern indicates that ORC has substantially implemented many of the actions recommended in the 2025 review. Recommendations that remain in progress are concentrated around public and stakeholder participation, outcome-based monitoring, communications delivery and the transition of emerging approaches into routine practice. Table 3Table 2 on pages 9 to 12 outlines our assessment and recommended actions.

2.5 Preparatory work for the next RPMP

Although this review focuses primarily on actions taken to improve implementation of the current RPMP, discussions with ORC staff also identified several areas of work that are expected to inform development of the next RPMP.

ORC staff advised that assessment work is underway for the next RPMP, covering approximately 100 species. They noted that the process is drawing on a range of inputs, including cultural impacts. This provides an opportunity to make consideration of cultural values more explicit, particularly given the limited supporting evidence available on how these were incorporated into prioritisation under the current RPMP.

Staff also described work underway to strengthen monitoring and data capability. They identified limitations in historical outcome data and noted that a more formal monitoring approach, with clearer targets and more targeted data collection, is being developed. Additional surveillance capability, mapping, drones and common data platforms are also being introduced, with the longer-term aim of a more integrated approach to monitoring and information management.

More broadly, staff described recent organisational changes intended to strengthen strategic capability. These include separating programme and compliance functions, clarifying responsibilities between teams, adding monitoring capability, and undertaking training as the new structure is embedded. The programmes team is intended to provide greater strategic oversight of whether individual programmes are achieving their objectives.

Taken together, discussions with ORC staff indicate that work is underway across several areas relevant to the longer-term issues identified in the 2025 Effectiveness Review. Much of this work remains developmental, so it is too early to assess its effectiveness or implementation against recommendations relating to the next RPMP. However, the work underway appears to be establishing relevant foundations through the current RPMP review process and improvements in monitoring, data and organisational capability.

Table 3: Summary of the assessment of progress on recommendations from the Effectiveness Review

Recommendation from Effectiveness Review	Status (RAAG)	Summary of progress	Recommended actions
Simplify the RPMP presentation, accessibility and reach	Green	Communications planning, public-facing materials and audience-focused communication approaches have been developed to improve accessibility and understanding of RPMP information.	• Continue developing simplified, public-facing RPMP materials, including visual summaries, fact sheets and online content tailored to the needs of specific audiences. • Develop a concise public guide to the RPMP that sets out key rules, responsibilities and priority pests using plain language and accessible visual design. • Expand the use of accessible communication products, including posters, social media content, videos and QR-enabled resources, to clearly communicate the actions expected of landowners and the wider public. • Introduce measures to assess communication effectiveness, such as public awareness surveys, website analytics, QR-code engagement data, reporting rates and stakeholder feedback, to determine whether improved communication is increasing awareness and supporting compliance. • Maintain a focus on accessible, audience-specific engagement throughout development and implementation of the next RPMP Review communications programme.
Clarify rules and target communication to key audiences	Green	Targeted communication initiatives, guidance material and planned fact sheets have been developed to improve understanding of RPMP obligations and responsibilities.	• Develop audience-specific guidance on RPMP rules for key stakeholder groups, including rural landowners, lifestyle block owners, community groups, Crown agencies and territorial authorities. • Continue implementing targeted communication approaches using a mix of fact sheets, FAQs, website content, social media, mail-outs and community meetings. • Consider expanding the use of practical examples and case studies to illustrate how RPMP rules apply in real-world situations, particularly in relation to Good Neighbour Rules and compliance obligations. • Explore ways to assess stakeholder understanding of rules and responsibilities, such as through surveys, workshop feedback and engagement analytics. • Regularly review and update explanatory materials to help ensure they remain clear, accessible and aligned with operational practice. • Use future operational reporting, where appropriate, to assess whether improved communication and clarification of rules are contributing to improved compliance outcomes.
Improve transparency to and motivation of public by sharing more success stories	Amber-Green	ORC has incorporated success-story communications into its communications strategy and programme planning, although evidence of sustained delivery remains limited.	• Continue developing and delivering the dedicated “Good News Stories” communications programme, with a regular pipeline of success stories maintained over time. • Consider further promoting successful projects, particularly those that demonstrate strong community participation, innovation and measurable environmental outcomes. • Consider developing an annual “Biosecurity Successes” report that brings together major achievements across pest management programmes and demonstrates how funding is contributing to outcomes. • Strengthen the links between success stories and RPMP objectives, helping the public to understand how individual projects contribute to broader regional goals. • Consider introducing measures to assess the effectiveness of success-story communications, including audience reach, engagement metrics, public awareness surveys and stakeholder feedback. • Continue highlighting the contributions of communities, landowners and volunteers to reinforce positive behaviours and encourage wider participation in pest management initiatives.
Communicate more clearly the consequences of non-compliance following inspections, while also	Amber-Green	Compliance pathways and enforcement processes have been formalised and documented, but evidence of	• Finalise and publish the proposed Compliance Handbook and Compliance Pathway Fact Sheet to provide clear, public-facing information about compliance and enforcement processes, landowner and occupier responsibilities, and the potential consequences of non-compliance.

Recommendation from Effectiveness Review	Status (RAAG)	Summary of progress	Recommended actions
highlighting success stories resulting from enforcement efforts		public-facing communication of enforcement outcomes is still developing.	• Consider incorporating compliance and enforcement case studies into annual biosecurity reporting and communications activity, including examples where compliance action has contributed to successful pest management outcomes. • Consider establishing measures to assess whether awareness and understanding of compliance obligations and enforcement consequences are improving among landowners and occupiers. • Continue using channels such as the Pest Hub, social media, newsletters and community engagement activities to communicate successful compliance outcomes, as well as the potential consequences of persistent non-compliance. • Consider annual reporting on compliance and enforcement activity, including Work Requests, Notices of Direction, default works, compliance rates and successful resolution of non-compliance cases. This could help demonstrate the operation and effectiveness of the compliance framework and reinforce expectations around compliance.
Increase the number of new and re-inspections. Consider targeting areas with highest biodiversity or economic/cultural value first	Green	Inspection programmes have expanded significantly, with formal re-inspection processes and prioritisation of high-value biodiversity areas incorporated into operational planning.	• Continue implementing the expanded inspection and re-inspection programmes established through the 2025-26 and 2026-27 operational plans. • Consider reporting annually on actual inspection and re-inspection delivery against targets to provide greater visibility of implementation and effectiveness. • Consider developing a formal prioritisation framework that explicitly incorporates biodiversity, economic and cultural values into inspection planning. • Complete the evaluation of thermal drone and remote sensing trials and, where appropriate, consider incorporating successful approaches into routine monitoring and compliance programmes. • Strengthen reporting on re-inspection outcomes, including the extent to which follow-up activity is contributing to improved compliance. • Continue using surveillance and emerging technologies to support the identification of new infestations, refine risk-based targeting and enable proactive compliance activity in priority areas.
Target enforcement efforts where investments and awareness are already in place	Green	Enforcement activity has been focused on priority pest programmes, supported by inspection planning, compliance information and pest distribution data.	• Continue directing enforcement effort towards high-priority programmes such as rabbits, old man's beard, containment pest plants and wilding conifers, where compliance activity, monitoring and public awareness are already established. • Consider developing and documenting a prioritisation framework that incorporates biodiversity, economic and cultural values alongside compliance and infestation data when identifying enforcement priorities. • Consider reporting annually on enforcement activity and outcomes within priority programmes, including inspections undertaken, Notices of Direction issued, compliance improvements and relevant environmental outcomes. • Continue using inspection history, compliance records and pest distribution data to identify areas of persistent non-compliance and focus enforcement resources where intervention is most likely to achieve positive outcomes. • Consider providing greater transparency around how biodiversity, economic and cultural priorities are balanced when determining annual compliance and enforcement priorities
Leverage data to optimise enforcement efforts	Green	Compliance, inspection and spatial data is now actively used to support enforcement prioritisation and decision-making.	• Continue using inspection, compliance and pest distribution data to identify persistent non-compliance and inform enforcement priorities and resource allocation. • Complete the thermal drone rabbit monitoring trial and assess whether the improved detection methods could support routine monitoring, compliance targeting and enforcement planning. • Consider developing additional reporting to demonstrate how compliance data informs inspection planning, enforcement priorities and resource allocation. • Explore opportunities to incorporate additional information sources, including monitoring programmes, external datasets and emerging technologies, to further support evidence-based enforcement decisions.

Recommendation from Effectiveness Review	Status (RAAG)	Summary of progress	Recommended actions
			• Monitor and report on whether the increased use of compliance data is contributing to changes in compliance rates, enforcement effectiveness and pest management outcomes over time.
Utilise powers under the Act of default work and cost recovery in cases of repeated non-compliance	Green	default work and cost recovery processes have been established and embedded within compliance procedures. ORC completed its first default work in August 2026, achieving RPMP compliance, and has identified further potential cases for consideration.	• Continue applying the established default work and cost recovery framework where repeated non-compliance persists and voluntary compliance pathways have been exhausted. • Consider annual reporting on enforcement activity and outcomes, including Notices of Direction issued, default work cases undertaken, costs recovered and subsequent compliance outcomes. • Monitor whether the use of default work powers is associated with improved compliance and reduced repeat non-compliance across priority pest programmes. • Consider publishing appropriate case studies or summary information on enforcement activity and outcomes, while continuing to refine Biosecurity Enforcement Group processes and cost recovery arrangements to support consistent, proportionate and efficient enforcement.
Fill data gaps by leveraging citizen science and integrating stakeholder data	Amber-Green	Community and stakeholder-generated data is being utilised in some programmes, although integration remains project-based rather than systematic across the RPMP.	• Continue promoting public pest reporting and citizen science through tools such as the ORC pest reporting system and iNaturalist. • Consider establishing processes for routinely incorporating stakeholder-generated information, including site-led project data, drone surveys, GIS datasets and community monitoring records, into ORC monitoring and planning activities. • Consider developing data-sharing arrangements with key community groups and project partners, alongside technical or GIS support where appropriate, to improve the consistency, compatibility and ongoing use of externally generated information. • Consider reporting on how citizen science and stakeholder-generated data contribute to pest detection, surveillance and management decisions, to better demonstrate their value and inform future participation.
Incentivise the public to contribute data where gaps are present	Amber	Community participation and reporting are encouraged, but there is limited evidence of targeted incentive programmes aimed at addressing identified data gaps.	• Continue supporting community-led monitoring and surveillance projects that supplement ORC's monitoring, particularly in areas where information or surveillance coverage is limited. • Develop a more targeted approach to public pest reporting, identifying priority species or areas where additional information would be most valuable and focusing reporting efforts accordingly. • Consider a more structured citizen science approach, building on existing platforms such as iNaturalist and relationships with community groups to support more consistent collection and sharing of pest data. • Explore options for encouraging public reporting, such as recognition initiatives, targeted campaigns or community challenges, particularly for priority pests. • Strengthen processes for incorporating community-generated information into ORC's monitoring and surveillance systems, including approaches to data quality, verification and use in decision-making. • Monitor and report on public participation outcomes, including reporting activity, citizen science contributions and examples where community information has supported pest detection or addressed information gaps. • Continue raising awareness of priority pests and reporting pathways, with greater focus on linking communication activities to improved reporting and surveillance outcomes.
Consider introducing outcome-based monitoring	Amber	Monitoring systems, baseline datasets and surveillance capability have strengthened, although routine outcome-based monitoring is not yet consistently implemented.	• Continue developing outcome-based monitoring across RPMP programmes, including measures of pest abundance, distribution, infestation extent and spread alongside activity and compliance measures. • Develop a consistent set of outcome indicators for major pest programmes, linked to programme objectives and tracked over time. • Build on existing baseline datasets through repeat monitoring to assess changes over time and better demonstrate the outcomes of pest management interventions.

Recommendation from Effectiveness Review	Status (RAAG)	Summary of progress	Recommended actions
			• Progress the evaluation and use of remote sensing and machine learning where these can improve measurement of pest extent, spread and change over time, including opportunities for landscape-scale monitoring. • Strengthen the use of monitoring data in programme planning and prioritisation, including greater visibility of how surveillance findings and pest trends inform resource allocation and management responses. • Expand reporting on programme effectiveness, bringing pest trends and management outcomes alongside operational performance measures to provide a clearer picture of progress towards RPMP objectives. • Continue strengthening surveillance, monitoring and impact assessment capability, including the functions identified in the Biosecurity Programmes Team operating model, to support outcome-focused reporting and decision-making. • Consider a region-wide framework for assessing RPMP outcomes, bringing together surveillance, compliance, spatial and programme monitoring data to provide a more consolidated view of pest status and management effectiveness.
Invest in capacity and capability by utilising tools such as AI-enabled traps, drones and remote sensing; additionally, provide training for biosecurity staff	Amber-Green	ORC has invested in drone monitoring, remote sensing investigations and specialist capability, although several initiatives remain in pilot or development phases.	• Complete evaluation of current technology trials and consider pathways for operational adoption, particularly for thermal drone monitoring and remote sensing. Where trials demonstrate potential improvements in detection, coverage or efficiency, consider opportunities to incorporate these approaches into routine surveillance and monitoring. • Consider developing a technology roadmap for the biosecurity programme to identify priority technologies, indicative implementation timeframes, capability requirements and expected benefits, providing a more structured basis for future investment. • Continue exploring AI-enabled monitoring technologies, including AI-assisted image analysis, automated species detection and AI-enabled trapping systems, to assess their potential application across a wider range of RPMP pests and further align with the intent of the original recommendation. • Consider a structured training and capability development programme for biosecurity staff, covering areas such as drone operations, GIS, remote sensing, machine learning, spatial analysis and emerging surveillance technologies, to support the effective use of new technologies. • Continue strengthening surveillance and monitoring capability within the Biosecurity Programmes Team, including the specialist monitoring, assessment and technical advisory functions identified in the proposed team structure. • Explore opportunities to broaden the application of emerging technologies across additional pest programmes, building on existing work in rabbit monitoring, pest plant surveillance and remote sensing, including potential applications in freshwater, marine, wilding conifer and containment programmes. • Monitor and report on the benefits of technology adoption, including potential improvements in detection, surveillance coverage, operational efficiency, health and safety, cost effectiveness and resource prioritisation, to help inform future investment and decision-making. • Continue collaboration with other councils, research organisations and technology providers to share expertise, explore opportunities for joint development and support the adoption of proven surveillance tools and analytical approaches.
Prioritise efforts where data gaps are most significant, focusing first on areas with the highest biodiversity or economic/cultural value	Green	Monitoring and surveillance are increasingly targeted towards identified priority sites, containment areas and high-value biodiversity locations.	• Continue directing monitoring and surveillance resources towards high-value biodiversity sites, priority waterbodies, active containment areas and locations where baseline information remains limited, including through targeted projects and drone-based surveillance where this address identified information gaps. • Consider developing a consistent approach for identifying and prioritising data gaps across RPMP pests and programmes to support transparent monitoring priorities. • Strengthen documentation of how biodiversity, economic and cultural values are considered when setting monitoring and surveillance priorities. • Consider annual reporting on key data gaps addressed and how the resulting information has informed pest management decisions and resource allocation.

3. Assessment of progress against recommendations of the Effectiveness Review

This section covers each recommendation of the Effectiveness Review, assigns a status to it, based on the RAAG framework, details the evidence reviewed, provides an overall assessment of progress, and suggests next steps.

3.1 Recommendation 1

Simplify the RPMP presentation, accessibility and reach.

The Effectiveness Review identified low public awareness of the RPMP as a significant constraint on its effectiveness. Key findings indicated that the RPMP document was viewed as "lengthy and hard to read," while public understanding of RPMP rules and responsibilities remained low and communication efforts were not consistently reaching key audiences. Consequently, Sapere's highest-priority recommendation was to "Simplify the RPMP presentation, accessibility and reach."

The recommended actions included using plain language and visual formats to simplify the plan, improving accessibility, providing greater clarity around rules and responsibilities, targeting communications to key audiences, and increasing the visibility of success stories and pest management information.

3.1.1 Status

Green: Communications planning, public-facing materials and audience-focused approaches show substantial implementation. Remaining gaps relate to completing some planned materials, delivering success stories more consistently, and showing their reach and effect.

3.1.2 Evidence reviewed

Table 4: Evidence reviewed - Recommendation 1

Source of evidence	Evidence
Biosecurity Programmes Communications Strategic Approach (2026/27)	Establishes a communication framework focused on providing information that is "timely, accessible and user-friendly." Commits to using plain language, audience-centred messaging and multiple communication channels including websites, social media, publications, advertising and stakeholder communications. Identifies the RPMP review as a high-priority communications activity with dedicated budget and engagement objectives.
RPMP Review Project Plan (2025-2028)	Includes preparation of a dedicated RPMP Review Communications Plan and Engagement Plan. Provides for development of public-facing discussion documents, online content and consultation materials. Includes provision of an online version of the future RPMP and embeds

	communications and engagement expertise within the review project structure.
Public-facing pest reporting poster	Demonstrates implementation of simplified public communications. Uses plain language, visual pest identification, a simple reporting call-to-action, QR-code enabled reporting and step-by-step instructions. Provides an accessible reporting pathway without requiring users to navigate the RPMP document or understand regulatory terminology.

3.1.3 Assessment

There is strong evidence that ORC has responded to the recommendation and progressed from planning to implementation.

The original review found that limited awareness of the RPMP was undermining both compliance and programme effectiveness. Stakeholders reported low awareness of their obligations, confusion about rules, and difficulties engaging with the lengthy and complex RPMP document. In response, Sapere specifically recommended simplifying the RPMP through the use of plain language, improved accessibility, targeted communication, and greater use of visual and audience-focused communication methods.

The Biosecurity Programmes Communications Strategic Approach directly responds to these findings by establishing plain language, audience-centred communication, and user-friendly information as core communication principles. It also expands the range of communication channels and allocates resources to RPMP-related communications and engagement.

The RPMP Review Project Plan provides further evidence of organisational commitment, embedding communication and engagement planning within the review process and providing for more accessible consultation and online content.

The pest reporting poster provides tangible evidence that these principles are being translated into practice. The poster distils the biosecurity message into a clear and actionable public message, improves accessibility through visual identification and QR-enabled reporting, and provides a mechanism for extending RPMP-related messaging into the wider community.

Overall, the evidence demonstrates substantial progress in simplifying the presentation of biosecurity and RPMP-related information and improving its accessibility to the public.

3.1.4 Remaining gaps

Although considerable progress appears to have been made, some aspects of the original recommendation remain incomplete:

- The public-facing pest reporting poster example focuses primarily on pest reporting and awareness rather than explaining RPMP rules and landowner responsibilities.
- There is no evidence currently demonstrating whether improved communication has translated into measurable increases in public awareness, understanding or compliance.

- The RPMP itself remains a complex statutory document, and evidence of a fully simplified public-facing version of the RPMP has not yet been provided.
- There is limited evidence on the extent of distribution, audience reach, or effectiveness of communication materials.
- Sapere placed particular emphasis on sharing success stories and increasing the visibility of programme outcomes. This priority is now explicitly reflected in the Communications Strategic Approach, and there are examples of successful projects being communicated publicly. However, the evidence does not yet demonstrate that success-story communications are being delivered systematically across the RPMP or that their reach and effectiveness are being routinely assessed.

3.1.5 Suggested next steps:

1. Prepare a limited set of simple, public-facing materials for the current RPMP, focused on the highest-priority rules, responsibilities and pests.
2. Plan the fuller suite of visual summaries, fact sheets and online guidance as part of implementation of the new RPMP, once approved.
3. Use existing channels, including posters, social media content and QR-enabled resources, to clearly communicate immediate actions expected of landowners and the wider public.
4. Establish proportionate measures of communication reach and engagement now, and develop a fuller effectiveness framework alongside the new RPMP.
5. Maintain accessible, audience-specific engagement throughout development and implementation of the new RPMP communications programme.

3.2 Recommendation 2

Clarify rules and target communication to key audiences.

The Effectiveness Review found that awareness and understanding of RPMP rules and responsibilities varied across stakeholder groups and, in some cases, was relatively limited. Stakeholders identified some uncertainty around landowner obligations, Good Neighbour Rules, compliance expectations, and the respective roles of ORC and other agencies. The review therefore recommended that ORC continue to clarify RPMP rules and tailor communication to the needs of key audiences, rather than relying primarily on broad, general messaging. This was identified as an important opportunity to support greater understanding and, in turn, contribute to improved compliance and pest management outcomes.

3.2.1 Status

Green: Clear evidence of targeted communication programmes, guidance material, fact sheets and audience-specific engagement activities.

3.2.2 Evidence reviewed

Table 5: Evidence reviewed - Recommendation 2

Source of evidence	Evidence
Biosecurity Programmes Communications Strategic Approach (2026/27)	The strategy directly addresses the need to clarify RPMP rules and responsibilities by establishing communication objectives focused on educating landowners and occupiers about their obligations under the RPMP. It commits to audience-centred communication, recognising that messages and communication channels should be tailored to specific audiences. The strategy also includes a dedicated communications workstream focused on "Rules / Landowner Occupier Responsibilities / ORC Role," supported through education campaigns, fact sheets, customised information packs, pest management planning templates and stakeholder-specific communications.
Biosecurity Operational Plans (2025/26 and 2026/27)	The operational plans reinforce ORC's role in providing education, advice and information to landowners, occupiers and the wider public, with an explicit commitment to ensuring land occupiers understand their responsibilities under the RPMP. The plans explain the role of RPMP rules, compliance obligations and enforcement pathways in plain language, while also introducing audience-specific engagement initiatives such as Rabbit Working Groups, Community Rabbit Programmes, freshwater sector engagement and marine stakeholder engagement. The 2026/27 plan further improves clarity through simplified descriptions of pest management programmes and an expanded glossary of regulatory and compliance terminology.
Cardrona GABFA & Extension Area Action Plan (2026)	The action plan provides good examples of implementation. Developed in response to identified compliance and pest management challenges in the Cardrona and Crown Range area, it includes a dedicated engagement and communications programme focused on ensuring landowners, communities and partner agencies understand RPMP rules, responsibilities and compliance processes. Planned actions include development of guidance material, fact sheets, updated website content, mail-outs, social media content and community meetings. The plan also includes plain-language explanations of regulatory concepts such as Good Neighbour Rules, occupier obligations and compliance pathways, alongside stakeholder-specific engagement with organisations including DOC, LINZ, QLDC, NZTA and Wai Wānaka.

3.2.3 Assessment

There is evidence of solid progress implementing this recommendation.

The original review found that while some rural landowners had a good understanding of their responsibilities, there was also some uncertainty around RPMP rules, compliance obligations and the respective roles of different organisations. Stakeholders highlighted areas of uncertainty relating to Good Neighbour Rules, landowner responsibilities and compliance expectations. The review also

noted an opportunity to make communication more targeted to the audiences most directly affected by RPMP requirements.

The Communications Strategic Approach provides a direct response by making landowner education, rule clarification and audience-specific communication explicit objectives. Rather than focusing solely on general awareness, the strategy seeks to tailor communications to different audiences and develop specific resources that explain responsibilities and obligations.

The operational plans support this direction by identifying education and advice as important delivery functions and incorporating communication and awareness activities within specific pest programmes. The 2026–27 operational plan also provides clearer explanations of programme types and includes definitions of technical compliance terminology, which may help improve the accessibility and understanding of regulatory information.

The clearest evidence of implementation is provided by the Cardrona GABFA Action Plan. Compared with the higher-level strategy documents, the plan sets out more specific actions for educating and engaging a defined audience. These include preparing guidance on RPMP rules and responsibilities, developing fact sheets, updating website content, undertaking mail-outs and community meetings, and establishing communication pathways tailored to different stakeholder groups. The plan also includes explanatory FAQs covering several areas identified in the Sapere review as sources of uncertainty, including occupier responsibilities and Good Neighbour Rules.

Interviews reinforced the distinction between delivering and measuring communications activity. ORC staff described an increasing use of targeted communications and local engagement, including community-focused pilots linked to compliance activity. However, while measures of communication reach and engagement may be available for some channels, ORC does not currently have evidence demonstrating whether these activities have changed awareness, behaviour or compliance. Emerging pilots provide an opportunity to strengthen this evidence by comparing engagement and compliance outcomes over time.

Taken together, the evidence demonstrates that ORC has moved beyond recognising the issue and has begun implementing structured, audience-focused initiatives designed to clarify regulatory requirements and improve understanding among those most affected by RPMP rules.

3.2.4 Remaining gaps

Although considerable progress has been made, some aspects of the recommendation remain incomplete:

- There is currently limited evidence of whether these communication initiatives have resulted in measurable improvements in understanding of RPMP rules or changes in compliance behaviour.
- Much of the available evidence relates to planned or early-stage implementation activities, with less evidence available from completed evaluations of their effectiveness.
- While targeted communication approaches are increasingly evident, there is less information on the extent to which urban residents, lifestyle block owners and other groups identified by Sapere as having lower awareness are being specifically reached.

- Some RPMP requirements, particularly the Good Neighbour Rules and compliance processes, may continue to present challenges in understanding despite the additional explanatory material now available.
- There is currently limited evidence of systematic, ongoing monitoring of stakeholder understanding or feedback on the clarity and usefulness of communications.

3.2.5 Suggested next steps

1. Prepare limited interim guidance for the current RPMP where clarification is most needed, including priority rules, Good Neighbour Rules and compliance obligations.
2. Develop the fuller suite of audience-specific guidance for rural landowners, lifestyle block owners, community groups, Crown agencies and territorial authorities as part of implementing the new RPMP.
3. Continue targeted communication through existing channels, using practical examples and case studies where these can be produced without significant new investment.
4. Use surveys, workshop feedback and engagement analytics proportionately during the transition, and establish a more systematic approach when the new RPMP comes into force.
5. Review and update explanatory material to align with the approved new RPMP and subsequent operational practice.

3.3 Recommendation 3

Improve transparency to and motivation of public by sharing more success stories.

The Effectiveness Review found that, while a significant amount of biosecurity work was being undertaken across Otago Regional Council, much of this activity was not readily visible to the public. Stakeholders indicated that there was scope to improve awareness of successful outcomes, the contribution of rates-funded programmes to pest management, and the role of community and landowner efforts in supporting RPMP objectives. Sapere recommended that ORC strengthen transparency and motivation by actively sharing success stories, demonstrating programme achievements, recognising community contributions, and showing how investment in biosecurity is contributing to measurable environmental outcomes.

3.3.1 Status

Amber-Green: Strong planning and examples exist, but evidence of systematic and ongoing delivery of success-story communications has potential to expand beyond what is done at present. Recommendation is progressing well but could be further embedded.

3.3.2 Evidence reviewed

Table 6: Evidence reviewed - Recommendation 3

Source of evidence	Evidence
Biosecurity Programmes Communications Strategic Approach (2026/27)	The strategy includes a dedicated high-priority communications workstream focused on "Good News Stories" and identifies "Celebrating Success" as a key communications priority. It highlights successful projects and outcomes that could be shared publicly, including the African Feather Grass (AFG) incursion response and the Darwin's barberry drone control project on the Otago Peninsula. The strategy also sets an objective of strengthening trust, understanding and connection between Otago residents and ORC's biosecurity work by increasing the visibility of outcomes and achievements.
Strategic Communications & Engagement Activities Programme	A structured annual programme of communications activities has been developed to share positive outcomes and successes. Planned "Good News" stories include the AFG response, Moeraki rabbit programme, Site-Led Fund outcomes, Cardrona GABFA activities, Egeria and False Tamarisk responses, Sabella surveillance, and HPAI preparedness activities. The programme also provides opportunities to highlight the contributions of landowners and communities to successful pest management outcomes.
Biosecurity Operational Plans (2025/26 and 2026/27)	Both operational plans commit ORC to annual public reporting on implementation of the Biosecurity Operational Plan, with progress reported through Council reporting processes and made available on ORC's website. This provides greater transparency around programme delivery, outputs and outcomes.
SWAT Site-Led Project Final Report – Pikiwhara/Sandymount (2025)	The project provides a useful example of a success story that could be shared publicly. With support from ORC's site-led funding, SWAT undertook actual drone-based surveillance across 314 ha of reserve land of initially planned 441ha, identifying and removing 19 Darwin's barberry plants before significant ecological impacts occurred. The project also established a high-quality baseline dataset to support future monitoring, identified previously unknown wilding pine infestations, and helped reduce the potential for further seed spread within a high-value ecological area. It involved 37 community participants and contributed 332 hours (172h of volunteers and 160h of contractors). The report describes the project as a successful example of community-led pest management supported through ORC funding and collaboration. The project was also promoted through newsletters, podcasts, stakeholder communications and community reporting.

3.3.3 Assessment

There is good evidence that ORC has responded positively to this recommendation, progressing from recognising the importance of sharing success stories to incorporating them more systematically into communications planning and delivery.

The original review found that public awareness of biosecurity achievements was limited and that greater transparency around programme outcomes could help build trust, increase understanding of ORC's role and encourage participation in pest management activities. Stakeholders identified greater visibility of successful projects, funding outcomes and examples of effective community action as areas where communication could be strengthened.

The Communications Strategic Approach responds directly to these findings through a dedicated "Good News Stories" programme and by identifying successful projects for communication to the public. The strategy moves beyond general awareness-raising to focus on demonstrating achievements, celebrating success and highlighting how ORC funding and community partnerships contribute to environmental outcomes.

The Strategic Communications and Engagement Activities programme provides evidence that these priorities have been translated into planned communications outputs. A formal programme of success stories has been developed, including stories highlighting landowner support, community-led initiatives, site-led outcomes and successful responses to emerging pests. This indicates an active and structured approach to improving transparency and showcasing biosecurity achievements.

The SWAT Pikiwhara/Sandymount project provides a useful example of the type of story Sapere recommended ORC share more broadly. The project demonstrates measurable environmental outcomes, significant community participation, effective use of ORC funding and innovative pest management techniques. It also generated a range of public communications, including newsletters, podcasts and stakeholder updates. The project illustrates how biosecurity outcomes can be communicated in ways that improve visibility of programme achievements while also highlighting the contribution of community participation.

Overall, the evidence indicates that ORC has established systems and processes for identifying, developing and communicating success stories, and has begun putting these into practice through strategic communications planning and the promotion of successful projects and community initiatives.

3.3.4 Remaining gaps

Although substantial progress has been made, there are some areas where the response could be further strengthened:

- There is currently limited evidence of whether success-story communications are contributing to increased public awareness, trust or participation.
- Although communications activities are being planned, further reporting on audience reach, engagement and overall effectiveness would help assess their impact.
- The evidence reviewed provides examples of success stories relating to individual projects and initiatives. While ORC's communications programme identifies a broader pipeline of potential stories across biosecurity activities, there is not yet sufficient evidence to demonstrate how consistently success stories are being communicated across the full range of pest management programmes.

- There is an opportunity to more clearly link reported successes to RPMP objectives and demonstrate how public investment is contributing to regional biosecurity outcomes.
- A more formal framework for routinely measuring and reporting biosecurity programme achievements to the wider public could further strengthen transparency and demonstrate progress over time.

3.3.5 Suggested next steps

1. Continue developing and delivering the dedicated "Good News Stories" communications programme, with a regular pipeline of success stories maintained over time.
2. Consider further promoting successful projects, particularly those that demonstrate strong community participation, innovation and measurable environmental outcomes.
3. Consider developing an annual "Biosecurity Successes" report that brings together major achievements across pest management programmes and demonstrates how funding is contributing to outcomes.
4. Strengthen the links between success stories and RPMP objectives, helping the public to understand how individual projects contribute to broader regional goals.
5. Consider introducing measures to assess the effectiveness of success-story communications, including audience reach, engagement metrics, public awareness surveys and stakeholder feedback.
6. Continue highlighting the contributions of communities, landowners and volunteers to reinforce positive behaviours and encourage wider participation in pest management initiatives.

3.4 Recommendation 4

Communicate more clearly the consequences of non-compliance following inspections, while also highlighting success stories resulting from enforcement efforts.

The Effectiveness Review identified a need for ORC to strengthen communication around compliance and enforcement. The review found that, while inspections and Notices of Direction were being used, there was limited public understanding of the consequences of non-compliance and little visibility of enforcement outcomes or the successes achieved through compliance activity. Sapere recommended that ORC communicate more clearly what happens when non-compliance is identified and use success stories to demonstrate the value and effectiveness of pest management and enforcement efforts.

3.4.1 Status

Amber-Green: Compliance pathway is now clearly documented internally, but limited evidence exists that the public has received or understood those messages and limited evidence of enforcement success stories being communicated externally.

3.4.2 Evidence reviewed

Table 7: Evidence reviewed - Recommendation 4

Source of evidence	Evidence
Biosecurity Compliance Process Manual (2024-2025)	The compliance process has been formally documented with clear escalation pathways from inspections through Work Requests, Notices of Direction, default works and, where required, prosecution. The process requires occupiers to be informed of their obligations, compliance timeframes, the consequences of non-compliance and potential enforcement actions, with standardised communication processes intended to ensure transparency, consistency and equity. Work Request letters identify pest obligations and compliance deadlines, include maps showing infestation locations, and advise that formal action may follow if compliance is not achieved. Notices of Direction explicitly state that non-compliance is an offence and may result in default works or prosecution, while Landowner Advice Letters notify property owners when formal enforcement action has commenced. Communication continues throughout the process, including through Completion of Works letters, Notices of Direction Satisfied letters, Notices of Intention to Act on Default, and acknowledgement of payment following cost recovery. Formal communication products therefore now accompany all major compliance and enforcement stages.
ORC CARDRONA GABFA & EA Action Plan 2026 DRAFT V1	The action plan includes a dedicated communications and engagement workstream. Guidance material is to explain RPMP objectives, rules, responsibilities, pest management measures, and "how ORC will provide fairness, consistency, and transparency through the compliance process." The plan also requires communication of inspection outcomes through Letters of Compliance and Work Request Letters and includes community engagement activities designed to explain compliance pathways.
Biosecurity Programmes Communications Strategic Approach 2026-27	The communications strategy sets clear objectives to educate landowners and occupiers about their responsibilities under the RPMP, increase understanding of pest rules, support regulatory and compliance obligations, and raise awareness of pest management activities. It includes initiatives focused on communicating "Rules / Landowner Occupier Responsibilities / ORC Role," alongside the proposed development of a Compliance Handbook and Compliance Pathway Fact Sheet. The strategy also identifies "Good news stories," "Celebrating Success," community programme success stories, site-led project outcomes, predator-free initiatives and other pest management wins as communication priorities. These activities are intended to improve public awareness, reinforce understanding of compliance responsibilities, and demonstrate the positive outcomes and value of ORC's biosecurity programmes.

3.4.3 Assessment

There is evidence that ORC has taken several steps to address this recommendation, particularly in relation to communicating compliance pathways and the consequences of non-compliance.

A significant development is the formal compliance framework documented in the Biosecurity Compliance Process Manual (2024-2025). The manual sets out staged communication throughout the compliance process, including Work Requests, Work Request Extensions, Notices of Direction, Default Works Notices, landowner notifications and final compliance confirmations. The process is intended to progressively inform occupiers about what is required of them, the relevant timeframes and the potential consequences if compliance is not achieved. This is consistent with Sapere's recommendation to communicate more clearly what happens following the identification of non-compliance.

The evidence also suggests a move towards greater consistency and transparency in the compliance process. This includes standardised timeframes, written communication products, formal notification requirements and documented escalation pathways intended to provide greater clarity for landowners and occupiers. The development of communication material explaining ORC's role, compliance processes, rules and responsibilities further support this direction.

There is also evidence of activity addressing the second part of the recommendation concerning the use of success stories. The draft communications strategy includes work focused on good-news stories, community and site-led successes, predator-free initiatives, project outcomes and celebrating biosecurity achievements. This provides a basis for increasing the visibility of successful pest management activities and communicating positive outcomes to the wider community.

Overall, the available evidence suggests that ORC has made progress in responding to the recommendation, with communication about compliance and enforcement now incorporated into operational processes and success stories identified as a component of strategic communications planning. There may be scope to continue building on these foundations, particularly by demonstrating how consistently these approaches are being applied and the extent to which they are improving public understanding and awareness.

3.4.4 Remaining gaps

- While the compliance process clearly sets out enforcement consequences, there is limited evidence available to demonstrate how widely this information has been communicated to the public or whether public understanding of these consequences has improved.
- Much of the available evidence relates to communication planning and the design of compliance processes. There is less evidence of implementation and outcomes, such as the publication and reach of compliance pathway materials, changes in public awareness, or stakeholder feedback on understanding of enforcement consequences.
- The communications strategy places a strong emphasis on general success stories and programme achievements. There is less evidence of specific communication about enforcement outcomes, such as successful compliance following Notices of Direction, default works or cost recovery actions. This was a particular aspect of the original Sapere recommendation.

- Some communications initiatives remain in draft or development stages, including the proposed Compliance Handbook, Compliance Pathway Fact Sheet and materials explaining the regulatory process.

3.4.5 Suggested next steps:

1. Finalise and publish the proposed Compliance Handbook and Compliance Pathway Fact Sheet to provide clear, public-facing information about compliance and enforcement processes, landowner and occupier responsibilities, and the potential consequences of non-compliance.
2. Consider incorporating compliance and enforcement case studies into annual biosecurity reporting and communications activity, including examples where compliance action has contributed to successful pest management outcomes.
3. Consider establishing measures to assess whether awareness and understanding of compliance obligations and enforcement consequences are improving among landowners and occupiers.
4. Continue using channels such as the Pest Hub, social media, newsletters and community engagement activities to communicate successful compliance outcomes, as well as the potential consequences of persistent non-compliance.
5. Consider annual reporting on compliance and enforcement activity, including Work Requests, Notices of Direction, default works, compliance rates and successful resolution of non-compliance cases. This could help demonstrate the operation and effectiveness of the compliance framework and reinforce expectations around compliance.

3.5 Recommendation 5

Increase the number of new and re-inspections. Consider targeting areas with highest biodiversity or economic/cultural value first.

The Effectiveness Review found that inspection and compliance activity was concentrated on a relatively small number of pests, with re-inspection rates in a number of cases below established targets. The review recommended increasing both new inspections and re-inspections to support the identification of non-compliant properties and strengthen follow-up activity. It also recommended that inspection effort be prioritised towards areas of higher biodiversity, economic and cultural value, where pest management investment could have the greatest impact. Improved monitoring, surveillance and targeted compliance activity were identified as important to supporting delivery of RPMP objectives and effective enforcement.

3.5.1 Status

Green: Operational plans include expanded inspection programmes, formal re-inspection processes and prioritisation of biodiversity areas. This recommendation appears largely implemented.

3.5.2 Evidence reviewed

Table 8: Evidence reviewed - Recommendation 5

Source of evidence	Evidence
Biosecurity Operational Plans (2025/26 and 2026/27)	Old man's beard inspections are explicitly targeted to high-value biodiversity areas, with inspections required in known sites intersecting identified high-value biodiversity and, subsequently, within designated priority areas. Re-inspection requirements have also been formalised for old man's beard, Nassella tussock and containment pest plants, with targets requiring follow-up inspections where new sites are identified. Annual inspection programmes and inspection targets have been expanded across multiple pest programmes. By 2026-27, targets include 600 rabbit inspections, 200 Nassella tussock inspections, 160 containment pest plant inspections, 250 gorse and broom compliance inspections, and targeted inspections within containment buffer areas. Formal re-inspection procedures have been established. The documentary evidence indicates that a re-inspection should occur within three weeks after the applicable compliance period expires. This is distinct from the length of the compliance period itself. Surveillance and monitoring are increasingly prioritised on a risk basis, including inspections within active sites and buffer areas, surveillance within New Gorse and Broom Free Areas, and prioritisation of Category High freshwater waterbodies before medium-priority sites.
Internal Meeting Notes – ECan Remote Sensing (Jan 2025)	ORC investigated remote sensing technologies capable of identifying pest infestations, linking infestations to landowner boundaries and determining compliance or non-compliance. The technology was considered more efficient than traditional ground surveillance and able to focus effort on sites of highest need.
Improving detection and monitoring of rabbit populations using thermal drones	ORC is trialling thermal drone monitoring across all 31 rabbit monitoring routes. The project aims to improve rabbit detection, identify hotspots requiring monitoring or compliance follow-up, and provide a stronger evidence base to target future inspection effort.
SWAT Final Report Review and SWAT Year 1 Report – Pikiwhara/Sandymount	ORC-funded drone surveillance was undertaken within a high-value biodiversity site-led area identified as a high-risk location for Darwin's Barberry invasion. The project established baseline monitoring information, identified new infestations, supported ground verification and control work, and created information to guide future monitoring and inspection activity.

3.5.3 Assessment

There is good evidence that ORC has implemented this recommendation and incorporated its principles into operational planning and programme delivery.

The original recommendation had two key components: increasing the number of new inspections and re-inspections, and prioritising inspections in areas of high biodiversity, economic or cultural value. The available evidence indicates progress against both elements.

The Biosecurity Operational Plans show an increase in the scale and structure of inspection activity. Inspection programmes are now supported by annual work plans, quantified inspection targets and formal re-inspection requirements across a number of pest programmes. The 2026-27 operational plan in particular provides for increased inspection effort, including compliance inspection programmes for rabbits, Nassella tussock, containment pest plants, and gorse and broom. Re-inspections are also incorporated into programme delivery and supported by defined operational timeframes.

There is also evidence that ORC has adopted a more targeted approach to prioritisation. One example is the explicit targeting of old man's beard inspections in areas of identified high-value biodiversity. Other examples include surveillance of high-priority freshwater sites, targeted containment area inspections and monitoring within sensitive site-led biodiversity projects.

ORC has also explored technologies that could support improved detection, surveillance and targeting. Investigations into remote sensing and thermal drone monitoring are intended to improve identification of infestations, increase monitoring coverage and support more efficient targeting of inspection and compliance effort. These initiatives are consistent with the recommendation's intent to expand and better target inspection activity.

Interview evidence provides some indication that these changes are translating into increased operational activity, while also clarifying the relevant timeframes. ORC staff described a standard three-month compliance period now generally being applied, subject to extension where circumstances warrant. This does not conflict with the documentary requirement to undertake a re-inspection within three weeks after that compliance period expires: the two timeframes relate to different stages of the process. Staff also reported a substantial increase in inspection activity compared with the previous year, including approximately 50 inspections undertaken in one recent week compared with around five per week at a similar point previously. This comparison is indicative and was not supported by systematic annual performance data, but it is consistent with the documentary evidence of an expanded inspection programme and suggests increased inspection capacity is beginning to translate into delivery.

Overall, the evidence indicates that ORC has moved beyond the recommendation stage and incorporated its principles into operational planning, compliance programmes and the development of monitoring systems. The evidence for prioritisation is strongest for biodiversity. There is some evidence of economic considerations, but less evidence that economic and cultural values are applied consistently. While there remains scope to further develop and refine these approaches, the direction of travel is consistent with the intent of the original recommendation.

3.5.4 Remaining gaps

- While biodiversity-based prioritisation is evident, there is less direct evidence of economic and cultural values being applied consistently as decision-making criteria across all inspection programmes.
- Recent interview evidence indicates that inspection activity has increased and that shortened re-inspection timeframes are being applied. However, comprehensive reporting of actual inspection and re-inspection delivery against annual targets, and the resulting effects on compliance, remains limited.
- Remote sensing and thermal drone initiatives remain largely in trial, investigation or development phases, with further work needed before these approaches are fully integrated into routine compliance operations.
- There is limited evidence of how inspection targeting decisions are prioritised where biodiversity, economic and cultural objectives may compete, indicating an opportunity to provide greater visibility of the basis for prioritisation decisions.

3.5.5 Suggested next steps

1. Continue implementing the expanded inspection and re-inspection programmes established through the 2025-26 and 2026-27 operational plans.
2. Consider reporting annually on actual inspection and re-inspection delivery against targets to provide greater visibility of implementation and effectiveness.
3. Develop a formal prioritisation framework that defines biodiversity, economic and cultural criteria, records how each criterion informs inspection priorities, and includes a process for testing cultural-value criteria with mana whenua before they are applied.
4. Complete the evaluation of thermal drone and remote sensing trials and, where appropriate, consider incorporating successful approaches into routine monitoring and compliance programmes.
5. Strengthen reporting on re-inspection outcomes, including the extent to which follow-up activity is contributing to improved compliance.
6. Continue using surveillance and emerging technologies to support the identification of new infestations, refine risk-based targeting and enable proactive compliance activity in priority areas.

3.6 Recommendation 6

Target enforcement efforts where investments and awareness are already in place (i.e. old man's beard, rabbits, bomarea, wilding pines). Also consider prioritisation of areas with highest biodiversity or economic/cultural value.

The Effectiveness Review found that compliance and enforcement activity across the RPMP could be strengthened, despite significant investment in inspections, monitoring and awareness-raising for

several high-profile pests. The review recommended initially focusing enforcement effort on pests where ORC had already made substantial investment and where public awareness was relatively well established, specifically identifying old man's beard, rabbits, bomarea and wilding pines. The rationale was that strengthening enforcement in these areas could help build on existing investment and support improvements in compliance outcomes. Sapere also recommended prioritising enforcement activity in areas of high biodiversity, economic or cultural value, where non-compliance could pose greater risks to environmental, economic or community outcomes.

3.6.1 Status

Green: Strong alignment between operational plans, inspection targets and Sapere's identified priority pests. Evidence suggests targeted enforcement has become established practice.

3.6.2 Evidence reviewed

Table 9: Evidence reviewed - Recommendation 6

Source of evidence	Evidence
RPMP Review of Actions	ORC advises that compliance and inspection data is now used to identify areas of persistent or significant non-compliance and inform enforcement priorities. Inspection results, pest distribution information and previous compliance activity are used to target enforcement effort and focus resources where they are likely to achieve the greatest benefit.
Biosecurity Compliance Process Manual (2024-2025)	The annual inspection planning process provides a structured approach to prioritising new inspections, taking into account annual biosecurity priorities, available resources, management areas and strategic planning processes. Properties and pests are identified through annual planning workshops, rather than relying solely on reactive responses. The compliance process also incorporates environmental and strategic considerations when determining whether enforcement action should proceed. Notices of Direction assessment criteria consider factors including potential biodiversity impacts, effects on neighbouring properties, infestation severity and alignment with annual biosecurity priorities. Biodiversity impacts are also considered as part of decisions relating to both Notices of Direction and default works.
Biosecurity Operational Plans (2025/26 and 2026/27)	The operational plans provide for targeted compliance and inspection activity across a range of priority pest programmes and environmentally significant areas. Old man's beard has a dedicated compliance programme, with inspections focused on priority and containment buffer areas to support containment objectives, including targets of 100 inspections in priority areas and 20 in containment buffer sites. Feral rabbits are also a significant focus, with 600 inspections planned across active sites and the establishment of a Rabbit Working Group to support ongoing control and partnerships. Wilding conifers remain a priority programme, supported through implementation of the regional strategy,

	collaboration with the national programme, and community involvement in control activities. Containment pest plants, including bomarea, are subject to a targeted compliance inspection programme, with 160 inspections planned across active sites. The operational plans also provide for prioritised inspection and monitoring of high-priority freshwater waterbodies and site-led biodiversity programmes, indicating that environmental significance continues to be considered in the allocation of inspection and monitoring activity.

3.6.3 Assessment

There is evidence that ORC has incorporated the principles of this recommendation into its compliance decision-making and operational planning.

The recommendation was to focus enforcement on pest programmes where investment and awareness already existed, while also prioritising areas of high biodiversity, economic or cultural value. The operational plans include dedicated compliance and inspection programmes for old man's beard, rabbits, containment pest plants including bomarea, and wilding conifers, with defined inspection targets and operational objectives. Tey also provide for prioritised monitoring of high-priority freshwater waterbodies and site-led biodiversity programmes.

There is also evidence of greater use of information to support prioritisation. Inspection information, pest distribution data and compliance history are used to identify significant non-compliance and inform decisions about where compliance effort should be directed.

The Compliance Process Manual also provides a structured basis for enforcement decisions, with consideration given to factors such as infestation severity, biodiversity and neighbouring property impacts, annual programme priorities and the likely effectiveness of enforcement action.

Overall, the available evidence suggests that ORC has established a more structured approach to prioritising compliance and enforcement effort, broadly consistent with the intent of the recommendation. The evidence is strongest for biodiversity-based prioritisation. There is less evidence that economic and cultural values are applied in a clear and consistent way across programmes.

3.6.4 Remaining gaps

- Biodiversity-based prioritisation is evident, although there is less direct evidence of how economic and cultural values are systematically incorporated into enforcement prioritisation across programmes.
- While targeted inspection programmes and annual targets have been established, the available evidence is more focused on planned activity than on achieved enforcement outcomes or improvements in compliance.
- The operational plans demonstrate targeting of old man's beard, rabbits, bomarea and wilding conifers, although there is limited information on how competing priorities between programmes are assessed and ranked when resources are constrained.

- There is also limited evidence on how tangata whenua values or cultural priorities directly inform operational enforcement targeting, beyond broader references to stakeholder engagement and site-led programmes.

3.6.5 Suggested next steps

1. Continue directing enforcement effort towards high-priority programmes such as rabbits, old man's beard, containment pest plants and wilding conifers, where compliance activity, monitoring and public awareness are already established.
2. Develop and document a prioritisation framework that combines compliance and infestation data with explicit biodiversity, economic and cultural criteria; identifies how trade-offs are recorded; and provides for mana whenua input to the cultural criteria and relevant priority-setting.
3. Consider reporting annually on enforcement activity and outcomes within priority programmes, including inspections undertaken, Notices of Direction issued, compliance improvements and relevant environmental outcomes.
4. Continue using inspection history, compliance records and pest distribution data to identify areas of persistent non-compliance and focus enforcement resources where intervention is most likely to achieve positive outcomes.
5. Consider providing greater transparency around how biodiversity, economic and cultural priorities are balanced when determining annual compliance and enforcement priorities.

3.7 Recommendation 7

Leverage data to optimise enforcement efforts.

The Effectiveness Review found that ORC was collecting increasing amounts of compliance, inspection and pest monitoring data, with scope to make greater use of this information to support enforcement decisions. The review noted that valuable data on compliance and non-compliance was being gathered through inspections, monitoring activities and GIS systems, although there was less evidence of this information being systematically used to inform where enforcement effort should be directed. Sapere recommended making greater use of existing compliance and biosecurity data to identify priority locations, target enforcement activity towards areas and landowners experiencing persistent non-compliance, focus resources where they could deliver the greatest pest management benefit, and support the effectiveness and efficiency of compliance operations. The review identified greater use of data to inform and target enforcement as an opportunity to strengthen compliance outcomes and make better use of investment in monitoring and inspection.

3.7.1 Status

Green: Compliance manual and operational processes show clear use of compliance, inspection and pest distribution data to influence enforcement decisions.

3.7.2 Evidence reviewed

Table 10: Evidence reviewed - Recommendation 7

Source of evidence	Evidence
RPMP Review of Actions	ORC advises that compliance and inspection data is now used to identify areas of persistent or significant non-compliance and inform enforcement priorities. Information from inspections, previous compliance activity and pest distribution is used to target enforcement efforts and focus resources where they are likely to provide the greatest benefit.
Biosecurity Compliance Process Manual (2024-2025)	The compliance process incorporates structured collection and use of inspection and compliance information. New inspections, re-inspections, compliance outcomes, infestation ratings, pest distribution data and previous enforcement histories are recorded and considered when determining future actions. Annual inspection planning also takes account of biosecurity priorities, available resources and compliance information. The Compliance Process Manual sets out formal reporting processes, including inspection reports, recommendation reports, Notices of Direction decision reports, enforcement reviews and case histories. Historical inspection outcomes, infestation trends, previous communications, compliance histories, biodiversity impacts and documented risk assessments are considered when making enforcement decisions. In particular, prior to issuing Notices of Direction or progressing to default works, officers are required to review relevant historical information. Overall, the available evidence indicates that accumulated inspection and compliance information is incorporated into enforcement and planning decisions. The manual describes the use of inspection data, GIS mapping, dashboards, infestation ratings, polygon mapping and compliance datasets to support prioritisation of inspections, enforcement action, monitoring and case management.
Improving detection and monitoring of rabbit populations using thermal drones	ORC is trialling thermal drone surveys across all 31 rabbit monitoring routes to improve detection and survey coverage and reduce potential under-reporting. The trial is intended to generate a more representative dataset across different rabbit densities, habitats and geographic locations, with survey data spatially referenced and compared with historic datasets. This is expected to provide a stronger evidence base for understanding rabbit abundance and distribution and inform future monitoring and management decisions.

3.7.3 Assessment

There is evidence that ORC has incorporated greater use of data into compliance and enforcement activities, consistent with the intent of the recommendation.

ORC reports that inspection data, compliance information and pest distribution records are being used to identify persistent non-compliance and inform enforcement priorities. The Biosecurity Compliance Process Manual (2024-2025) also sets out processes that draw on inspection histories, infestation ratings, compliance outcomes and spatial information to support inspection planning, Notices of Direction, default works and enforcement reviews.

The manual further describes the use of structured digital records, GIS, property information, dashboards and reporting to support compliance activity. This provides evidence of a more systematic approach to collecting and using information in operational decision-making.

ORC's thermal drone rabbit monitoring trial provides a further example of investment in improved data collection. The trial is intended to improve detection and survey coverage and provide more representative information to support future monitoring and management decisions.

Overall, the available evidence suggests that data is now being used across inspection planning, prioritisation, compliance management and enforcement decision-making, although the extent to which this has improved enforcement outcomes is less clear.

3.7.4 Remaining gaps

- Although data is being used to inform enforcement decisions, there is limited evidence of measurable improvements in compliance outcomes that can be directly linked to its increased use.
- The compliance system makes substantial use of internally collected inspection and compliance data. There is less evidence of broader integration of external datasets, citizen science information or predictive analytics approaches identified in the Sapere review.
- The thermal drone project remains a trial, with results and operational implications yet to be established for routine compliance planning.
- Although data is used to support operational decisions, there appears to be limited public reporting on how enforcement priorities are determined and how compliance data informs annual enforcement programmes.

3.7.5 Suggested next steps

1. Continue using inspection, compliance and pest distribution data to identify persistent non-compliance and inform enforcement priorities and resource allocation.
2. Complete the thermal drone rabbit monitoring trial and assess whether the improved detection methods could support routine monitoring, compliance targeting and enforcement planning.

3. Consider developing additional reporting to demonstrate how compliance data informs inspection planning, enforcement priorities and resource allocation.
4. Explore opportunities to incorporate additional information sources, including monitoring programmes, external datasets and emerging technologies, to further support evidence-based enforcement decisions.
5. Monitor and report on whether the increased use of compliance data is contributing to changes in compliance rates, enforcement effectiveness and pest management outcomes over time.

3.8 Recommendation 8

Utilise powers under the Act of default work and cost recovery in cases of repeated non-compliance.

The Effectiveness Review found that ORC's compliance approach relied primarily on education, inspections and Notices of Direction, with scope to strengthen escalation where non-compliance continued. ORC has begun issuing increasing numbers of Notices of Direction. We also found evidence of at least one default work since the Effectiveness Review. This is positive as Sapere considered limited use of enforcement measures could reduce the effectiveness and credibility of the compliance framework and place additional pressure on compliant landowners and community groups.

Accordingly, the review recommended that ORC make greater use of its statutory powers to undertake default work and recover costs from landowners in cases of repeated non-compliance, particularly where inspections and re-inspections had not achieved the required pest control outcomes. The recommendation was intended to strengthen compliance, support behavioural change and improve the returns from investment in monitoring and inspection programmes.

3.8.1 Status

Green: A formal framework is in place, and initial use of default work powers has been shown in practice.

3.8.2 Evidence reviewed

Table 11: Evidence reviewed - Recommendation 8

Source of evidence	Evidence
RPMP Review of Actions	ORC states that Notices of Direction are now used as a regular enforcement practice where non-compliance is identified. ORC further records that a process for completing default works has been established and is being used where required.
Biosecurity Compliance Process Manual (2024-2025)	The manual establishes formal procedures for progressing default works under section 128 of the Biosecurity Act where a property remains non-compliant following a Notice of Direction, no grounds exist for an

	extension, and impacts on biodiversity, neighbouring properties or pest management objectives remain significant. The process includes review and approval through the Biosecurity Enforcement Group, contractor procurement, service of Notices of Intention to Act on Default, implementation of control works and post-work inspections. It also sets out processes for recovering the costs of default works, including invoicing, compounding charges for unpaid debts and, where standard recovery processes are unsuccessful, the use of statutory liens against property under section 129 of the Biosecurity Act.
Additional evidence on default work (October 2026)	Documents the first completed default work case for old man's beard. Following nine inspections, repeated work requests, a Notice of Direction and an extension, the Biosecurity Enforcement Group approved default work in June 2026. Contractor work was completed on 25 August 2026 and achieved RPMP compliance. The evidence also records three further potential default work matters for consideration in November 2026: two relating to rabbit control and one to old man's beard.
Biosecurity Operational Plans (2025/26 and 2026/27)	The operational plans identify enforcement through RPMP rules as a core method of pest management and explicitly note that failure to comply with RPMP rules can lead to enforcement action by ORC. The glossary further recognises Default Action as work undertaken by ORC where a Notice of Direction has not been complied with and where costs can subsequently be recovered.

3.8.3 Assessment

There is evidence that ORC has responded to this recommendation by establishing a formal framework for the use of default works and cost recovery powers.

The recommendation followed Sapere's finding that there was limited evidence of non-compliance being progressed beyond Notices of Direction, including limited use of follow-through consequences for repeated non-compliance. Since then, ORC has developed, updated and completed in December 2025 the Biosecurity Compliance Process Manual (2024-2025), which sets out a staged enforcement pathway covering Notices of Direction, default works, cost recovery, prosecution and, where required, statutory liens. The manual also defines the circumstances in which these powers may be used and establishes governance arrangements for decision-making.

There is clear evidence that the framework is being applied in practice. Additional evidence documents ORC's first completed default work case, involving old man's beard. The case followed nine inspections, three work requests, a Notice of Direction and an extension. After consideration by the Biosecurity Enforcement Group in June 2026, contractor work was undertaken on 25 August 2026 and achieved compliance with the RPMP. The same evidence records three further potential default work matters for consideration in November 2026—two for rabbit control and one for old man's beard—indicating that the process is moving from a single completed case towards continued operational use.

The interviews provide additional evidence that elements of this framework are now being applied in practice. ORC staff reported increased use of Notices of Direction and confirmed that default works have recently been undertaken (as opposed to none at the time of the Effectiveness Review). Staff also described compliance expectations and follow-up activity as increasing as the restructured team develops experience and capability. This strengthens the evidence that escalation mechanisms established through the compliance framework have moved beyond procedural design into operational use.

It remains too early, however, to determine the effect of these changes on overall compliance. ORC staff indicated that the strengthened framework is still being embedded and that changes in compliance rates are likely to take longer to become apparent. The immediate evidence of progress is therefore strongest at the level of increased activity, follow-up and use of enforcement mechanisms, rather than demonstrated changes in compliance behaviour.

Overall, the available evidence indicates that ORC has established both formal procedures and governance arrangements for progressing persistent non-compliance beyond Notices of Direction and using default work and cost recovery powers where appropriate.

3.8.4 Remaining gaps

- The additional evidence confirms one completed default work case and identifies three potential cases for further consideration. Quantitative information on costs recovered and subsequent compliance outcomes over time remains limited.
- The completed old man's beard case demonstrates practical implementation, but it is too early to assess the scale, consistency and efficiency of default work and cost recovery across pest programmes.
- It is not yet clear whether the use of default works and cost recovery has influenced compliance behaviour or reduced repeat non-compliance across priority pest programmes. There is also limited public reporting on enforcement outcomes, recovery rates or examples of compliance improvements resulting from these actions.

3.8.5 Suggested next steps

1. Continue applying the established default work and cost recovery framework where repeated non-compliance persists and voluntary compliance pathways have been exhausted.
2. Consider annual reporting on enforcement activity and outcomes, including Notices of Direction issued, default work cases undertaken, costs recovered and subsequent compliance outcomes.
3. Monitor whether the use of default work powers is associated with improved compliance and reduced repeat non-compliance across priority pest programmes.
4. Consider publishing appropriate case studies or summary information on enforcement activity and outcomes, while continuing to refine Biosecurity Enforcement Group processes and cost recovery arrangements to support consistent, proportionate and efficient enforcement.

3.9 Recommendation 9

Fill data gaps by leveraging citizen science and integrating stakeholder data.

The Effectiveness Review found that ORC's monitoring and surveillance activity was concentrated on a relatively small number of pests, with data gaps remaining across several RPMP species. The review noted that more comprehensive monitoring information could strengthen ORC's ability to assess pest prevalence, evaluate programme effectiveness, prioritise interventions and support evidence-based management decisions. At the same time, stakeholders, community groups, neighbouring councils and citizen scientists were already collecting valuable pest information through initiatives such as iNaturalist and local monitoring programmes.

Sapere recommended that ORC address identified data gaps by making greater use of citizen science, integrating relevant stakeholder-held datasets, encouraging public reporting of pests, and partnering with organisations already undertaking monitoring activities. The recommendation aimed to improve data coverage, reduce duplication of effort, strengthen surveillance capability and build a more comprehensive evidence base to support pest management, monitoring, compliance and future RPMP decision-making.

3.9.1 Status

Amber-Green: Good examples exist, but integration appears project-based rather than systematic across the RPMP.

3.9.2 Evidence reviewed

Table 12: Evidence reviewed - Recommendation 9

Source of evidence	Evidence
Public-facing pest reporting poster	ORC has developed public reporting material encouraging members of the public to report priority pest species and "something new or unfamiliar," including recording locations, taking photographs and submitting reports through ORC's pest reporting system. The material notes that public reporting can contribute to protecting Otago's biodiversity.
SWAT Final Report Review and SWAT Year 1 Report – Pikiwhara/Sandymount	The SWAT project generated a range of new environmental data, including geolocated drone imagery, pest occurrence records, GIS mapping products, spreadsheets of pest observations, wilding pine mapping and field-verified pest locations. This established baseline information for the wider site-led area and documented pest occurrences for future monitoring and management. Pest observations, including Darwin's Barberry records and associated photographs, were uploaded to iNaturalist and incorporated into mapping systems and location datasets. The project demonstrates the contribution community groups can make to environmental data collection and spatial mapping, while also

	identifying opportunities for greater collaboration with ORC around spatial data and GIS capability.
ORC CARDRONA GABFA & EA Action Plan 2026 DRAFT V1	The action plan includes collaboration with stakeholders, annual reporting, data capture and sharing arrangements through memorandums of understanding, use of compliance information, surveillance information and stakeholder engagement to improve understanding of pest distribution and management outcomes.

3.9.3 Assessment

There is evidence that ORC has taken steps towards implementing this recommendation, particularly by encouraging public reporting and supporting stakeholder-led data collection.

The public pest reporting material encourages members of the public to report pest sightings, including location information and photographs, providing a mechanism for citizen reporting to contribute to pest surveillance. The SWAT project provides a further example, generating drone imagery, geospatial data, pest occurrence records, baseline monitoring information and iNaturalist records. These activities demonstrate the potential for stakeholder-generated information to supplement ORC's monitoring and identify pest occurrences that may otherwise be missed.

However, the available evidence provides fewer examples of systematic integration of stakeholder and citizen science datasets into ORC's wider data systems and RPMP decision-making. While collaboration and data sharing are evident, there is less evidence of formal processes for routinely integrating, analysing and using external datasets alongside ORC's own information.

Overall, the evidence indicates progress towards the recommendation, with stakeholder and citizen-generated data contributing to surveillance, but less evidence of a fully integrated approach across the RPMP.

3.9.4 Remaining gaps

- Evidence of stakeholder and citizen science data collection is largely project-based, with limited evidence of a formal region-wide approach for integrating these datasets into ORC's operational systems and decision-making across pest programmes.
- There is limited evidence of standardised data-sharing arrangements, common data standards or centralised repositories for externally generated pest information.
- Although ORC encourages public pest reporting, there is limited evidence on the volume of reports received, how they are incorporated into operational activities, or the extent to which they have helped address identified monitoring and data gaps.

3.9.5 Suggested next steps

1. Continue promoting public pest reporting and citizen science through tools such as the ORC pest reporting system and iNaturalist.

2. Consider establishing processes for routinely incorporating stakeholder-generated information, including site-led project data, drone surveys, GIS datasets and community monitoring records, into ORC monitoring and planning activities.
3. Consider developing data-sharing arrangements with key community groups and project partners, alongside technical or GIS support where appropriate, to improve the consistency, compatibility and ongoing use of externally generated information.
4. Consider reporting on how citizen science and stakeholder-generated data contribute to pest detection, surveillance and management decisions, to better demonstrate their value and inform future participation.

3.10 Recommendation 10

Incentivise the public to contribute data where gaps are present.

The Effectiveness Review found that data gaps remained for several RPMP pests, with opportunities to strengthen ORC's ability to assess pest prevalence, evaluate programme effectiveness and target management interventions. While ORC had invested in improving its own monitoring systems, the review noted that valuable pest data was also being collected by members of the public, community organisations and citizen science platforms, with scope to make greater use of these sources.

Sapere recommended that ORC actively encourage public participation in pest reporting, particularly in areas or for pest species where information was more limited. The review highlighted examples from other regions and programmes where approaches such as rewards for reporting priority pests or participation through citizen science platforms had supported increased detection and reporting. The intent of the recommendation was to improve data coverage, strengthen surveillance capability, support community participation in pest management, and provide ORC with additional information to inform monitoring, prioritisation and decision-making.

3.10.1 Status

Amber: Participation is encouraged, but there is little evidence of actual incentives, targeted reporting campaigns or structured citizen science programmes aimed at identified gaps.

3.10.2 Evidence reviewed

Table 13: Evidence reviewed - Recommendation 10

Source of evidence	Evidence
Biosecurity Operational Plans (2025/26 and 2026/27)	ORC identifies advocacy and education as a core delivery method, including providing information and advice to landowners and the public about pests and pest management. Multiple pest programmes contain communication, education and awareness targets aimed at increasing public awareness of priority pests, including rooks, spiny broom, lagarosiphon, freshwater pests and marine pests. The plans also include response targets for reported pest sightings and pest incursions, indicating reliance on externally sourced information. Freshwater and

	marine surveillance programmes specifically aim to raise public awareness while identifying and detecting priority pest species. Collectively, these actions support conditions under which pest information may be reported by members of the public, although they are not explicitly framed as initiatives to encourage reporting or address known data gaps.
SWAT Final Report Review and SWAT Year 1 Report – Pikiwhara/Sandymount	ORC funded a community-led surveillance project that generated new pest occurrence information through volunteer participation, drone surveys, field verification and mapping. The project established baseline pest data, identified previously unknown infestations and created datasets to support future monitoring. Project members uploaded Darwin's barberry observations, photographs and location information to iNaturalist, demonstrating the use of a citizen-science platform for sharing pest data. The project involved 37 community participants and 172 volunteer hours dedicated to pest detection, recording and reporting. The report also notes that awareness generated through the ORC-funded project increased pest detections by partner organisations and led to additional pest records being identified. The project produced community-generated pest datasets, maps and records that could be shared with ORC and other organisations for future monitoring and decision-making.

3.10.3 Assessment

There is evidence that ORC has taken actions consistent with the intent of this recommendation, particularly through support for community-led monitoring, citizen science and pest surveillance. However, the available evidence provides less indication of targeted initiatives specifically designed to incentivise public pest reporting or address identified data gaps.

A good example is ORC's support for the SWAT Pikiwhara/Sandymount project through the Site-Led Programme. The project generated baseline pest data identified previously unrecorded infestations and involved substantial community participation and volunteer effort. Participants also contributed pest observations through iNaturalist, demonstrating how community-generated information can contribute to pest surveillance and management.

The two most recent Biosecurity Operational Plans also includes public awareness and education activities, alongside response targets for reported pest sightings and incursions. These activities support public engagement with pest management and provide opportunities for information from the community to contribute to surveillance, although they are primarily framed around awareness and operational response rather than targeted incentives for reporting.

Overall, the evidence indicates that ORC has partially progressed this recommendation, particularly by supporting community participation and incorporating community-generated information into pest monitoring. There is less evidence of specific incentives or targeted reporting initiatives intended to address information gaps. The recommendation can therefore be considered addressed in principle, with scope for further development of more targeted approaches to encourage public reporting.

3.10.4 Remaining gaps

- While ORC has supported community participation in pest monitoring through funded projects and platforms such as iNaturalist, there is limited evidence of initiatives specifically encouraging public contributions in areas or for species where information gaps have been identified.
- The evidence suggests that public data contributions have been encouraged primarily through awareness raising, community partnerships and volunteer-led projects. There is less evidence of targeted reporting campaigns or structured citizen science initiatives aimed specifically at increasing reporting and improving data coverage.
- There is limited evidence of incentive-based approaches, such as rewards, recognition schemes or competitions, to encourage reporting of priority pests.
- Community-generated data has been collected through platforms such as iNaturalist and project datasets. However, it is less clear how this data is systematically incorporated into ORC's monitoring, surveillance and decision-making processes, or used to address identified information gaps across RPMP pest programmes.
- Much of the available evidence relates to a small number of ORC-supported community projects. There is less evidence of a region-wide or programme-wide approach to encouraging public reporting and using citizen-generated pest information across multiple pest programmes.
- While the operational plans include communication, education and awareness activities, it is less clear whether performance measures are in place to assess public participation, reporting rates, citizen science contributions or improvements in data coverage. This limits the ability to assess the extent to which these activities are increasing public contributions to pest surveillance.

3.10.5 Suggested next steps

1. Continue supporting community-led monitoring and surveillance projects that supplement ORC's monitoring, particularly in areas where information or surveillance coverage is limited.
2. Develop a more targeted approach to public pest reporting, identifying priority species or areas where additional information would be most valuable and focusing reporting efforts accordingly.
3. Consider a more structured citizen science approach, building on existing platforms such as iNaturalist and relationships with community groups to support more consistent collection and sharing of pest data.
4. Explore options for encouraging public reporting, such as recognition initiatives, targeted campaigns or community challenges, particularly for priority pests.
5. Strengthen processes for incorporating community-generated information into ORC's monitoring and surveillance systems, including approaches to data quality, verification and use in decision-making.

6. Monitor and report on public participation outcomes, including reporting activity, citizen science contributions and examples where community information has supported pest detection or addressed information gaps.
7. Continue raising awareness of priority pests and reporting pathways, with greater focus on linking communication activities to improved reporting and surveillance outcomes.

3.11 Recommendation 11

Consider introducing outcome-based monitoring.

The Effectiveness Review found that ORC's monitoring framework was largely focused on activities and outputs, such as the number of inspections, monitoring visits and control actions undertaken, with an opportunity to place greater emphasis on the outcomes arising from these activities. While activity-based measures provide useful information on effort and delivery, the review noted that they did not consistently demonstrate whether pest populations were declining, whether spread was being reduced, or whether RPMP objectives were being achieved.

Sapere therefore recommended complementing existing activity and output measures with outcome-based monitoring that tracks changes in pest abundance, distribution, infestation levels and pest spread over time. The intent of the recommendation was to strengthen the connection between management actions and environmental outcomes, support evidence-based decision-making, improve resource prioritisation, and provide a clearer assessment of the effectiveness of pest management interventions across the region. The review also noted that ORC's developing GIS and infestation-tracking systems provided a useful platform from which outcome-based monitoring could be further developed.

3.11.1 Status

Amber: Foundations have been established, but routine outcome monitoring appears less developed than activity/output monitoring.

3.11.2 Evidence reviewed

Table 14: Evidence reviewed - Recommendation 11

Source of evidence	Evidence
Biosecurity Operational Plans (2025/26 and 2026/27)	The operational plans place a strong emphasis on monitoring, surveillance and trend assessment rather than solely on compliance activity. ORC's stated methods of action note that monitoring is undertaken "to determine effectiveness of control and to understand trends of infestations." Multiple programmes include objectives focused on reducing pest extent, distribution or density (for example eradication, containment and sustained control programmes), and require monitoring of known sites to assess pest presence and spread over time. The plans also include investigations into the use of remote sensing for spartina and gorse and broom, with the stated objective of improving programme efficiency and monitoring capability. These provisions indicate an

	increasing focus on understanding pest status, prevalence, distribution and trends, rather than simply recording management actions undertaken.
SWAT Final Report Review and SWAT Year 1 Report – Pikiwhara/Sandymount	ORC funded a drone-based surveillance project that established baseline pest distribution information across a large site-led biodiversity area. The project generated high-resolution geospatial imagery, mapped pest occurrences, recorded infestation locations and identified previously unknown infestations. The report repeatedly describes the imagery and associated datasets as a baseline against which future surveys can measure landscape change, pest incursions and management outcomes. Pest locations were recorded in GIS systems, Excel databases, Google My Maps and iNaturalist, creating information that can be used to track changes in pest abundance and distribution over time rather than simply recording control activities undertaken. The project also demonstrated how emerging monitoring technologies can support assessment of pest spread, management effectiveness and future prioritisation decisions.
Internal Meeting Notes – ECan Remote Sensing (Jan 2025)	ORC explored remote sensing and machine-learning technologies capable of identifying pest distributions, delineating infestations as mapped polygons, linking infestations to landholder boundaries and improving surveillance efficiency. Discussions highlighted the ability to compare infestations over time, focus effort on areas of greatest need, identify containment areas more effectively, and generate consistent spatial information at landscape scale. The technology was seen as more efficient and accurate than traditional ground surveillance and capable of improving understanding of pest extent, distribution and spread, all of which are important components of outcome-based monitoring. The notes also identify potential applications for RPMP planning and monitoring changes in infestation patterns over time.
BS Programmes Vision and Where we are in progress	The Biosecurity Programmes Team vision and operating model identifies "Data Connection" and "Reporting" as core functions of the team and includes dedicated surveillance and monitoring leadership roles for both terrestrial and aquatic biosecurity programmes. The future team structure proposes a dedicated Terrestrial Surveillance & Monitoring Lead, Aquatic Surveillance & Monitoring responsibilities, Biosecurity Impact Assessments, Species Audit Reviews, Emerging Pest Assessments and Organism of Interest Assessments. While the document does not set out specific outcome measures, it demonstrates organisational investment in monitoring capability, impact assessment and data systems that would support a transition from activity-based reporting toward outcome-based assessment of pest status, spread and management effectiveness.

3.11.3 Assessment

There is evidence that ORC is progressing this recommendation and developing the systems, datasets and monitoring capability needed to support a more outcome-focused approach to pest management.

The two most recent Biosecurity Operational Plans provide evidence of a growing focus on understanding pest status and trends, with monitoring intended to assess control effectiveness and changes in pest extent, distribution and density. This provides a useful foundation for outcome-based monitoring, although routine outcome reporting is not yet evident across all RPMP programmes.

ORC is also exploring tools and approaches to strengthen outcome monitoring. Discussions with Environment Canterbury on remote sensing and machine learning considered how aerial imagery could be used to map infestations, monitor changes over time and improve understanding of pest distribution and spread. The SWAT Pikiwhara/Sandymount project similarly established baseline imagery and geospatial datasets to support future assessment of changes in pest distribution and infestation levels.

Interviews with ORC staff confirm that outcome-based monitoring remains an area of active development rather than an embedded programme-wide practice. Staff acknowledged that historical data is not yet sufficiently comprehensive to consistently demonstrate changes in pest outcomes and identified development of a more formal monitoring approach, including clearer targets and more targeted data collection, as a priority for the coming year. Additional surveillance and monitoring capability is being put in place to support this work.

Overall, ORC has strengthened the foundations needed for outcome-based monitoring, including staffing capability, spatial information, baseline datasets and surveillance tools. However, the documentary and interview evidence both indicate that the next step is to convert these foundations into a consistent monitoring framework that can demonstrate changes in pest abundance, distribution and spread over time. At present, evidence is considerably stronger for improved monitoring capability than for routine measurement of outcomes.

3.11.4 Remaining gaps

- Monitoring capability is being strengthened, although much of the available evidence relates to developing systems, baseline datasets and tools rather than routine measurement and reporting of environmental outcomes.
- The operational plans continue to emphasise activity and output measures, with less evidence of consistent indicators tracking changes in pest abundance, density, distribution, infestation extent or spread over time.
- Several programmes have outcome-focused objectives, such as reducing pest extent or achieving eradication, but there is less evidence of a region-wide framework for systematically tracking and reporting progress against these outcomes.
- Emerging technologies such as remote sensing and machine learning are still being explored and developed, with further work needed before they can support routine and consistent outcome monitoring across programmes.

- Baseline datasets are being established in some programmes and projects, such as the SWAT drone surveillance project, although there is less evidence of repeat monitoring to demonstrate changes in pest extent, abundance or spread over time.
- The Biosecurity Programmes Team structure includes surveillance, monitoring and impact assessment functions, although it is not yet clear how these activities are translating into regular programme-level outcome reporting or assessments of RPMP effectiveness.
- The link between monitoring results and resource prioritisation is not yet clear, with greater visibility of how pest trends inform programme design, funding and operational decisions potentially strengthening the approach.

3.11.5 Suggested next steps

1. Continue developing outcome-based monitoring across RPMP programmes, including measures of pest abundance, distribution, infestation extent and spread alongside activity and compliance measures.
2. Develop a consistent set of outcome indicators for major pest programmes, linked to programme objectives and tracked over time.
3. Build on existing baseline datasets through repeat monitoring to assess changes over time and better demonstrate the outcomes of pest management interventions.
4. Progress the evaluation and use of remote sensing and machine learning where these can improve measurement of pest extent, spread and change over time, including opportunities for landscape-scale monitoring.
5. Strengthen the use of monitoring data in programme planning and prioritisation, including greater visibility of how surveillance findings and pest trends inform resource allocation and management responses.
6. Expand reporting on programme effectiveness, bringing pest trends and management outcomes alongside operational performance measures to provide a clearer picture of progress towards RPMP objectives.
7. Continue strengthening surveillance, monitoring and impact assessment capability, including the functions identified in the Biosecurity Programmes Team operating model, to support outcome-focused reporting and decision-making.
8. Consider a region-wide framework for assessing RPMP outcomes, bringing together surveillance, compliance, spatial and programme monitoring data to provide a more consolidated view of pest status and management effectiveness.

3.12 Recommendation 12

Invest in capacity and capability by utilising tools such as AI-enabled traps, drones, and remote sensing; additionally, provide training for biosecurity staff.

The Effectiveness Review found that ORC continued to face capacity and capability challenges in monitoring and surveillance, despite improvements in staffing, data systems and biosecurity

resourcing during the RPMP period. Stakeholders and ORC staff noted the challenges of undertaking surveillance across a large geographic area, particularly for pests requiring extensive fieldwork, specialised knowledge or monitoring in difficult terrain. The review identified opportunities to improve detection, coverage and efficiency through greater use of emerging technologies, alongside ongoing staff training and capability development.

Sapere therefore recommended investing in tools such as AI-enabled monitoring systems, drones, remote sensing and other advanced surveillance technologies to complement existing approaches. The intent was to extend surveillance coverage, improve detection of emerging infestations, support evidence-based decision-making and improve the efficiency of monitoring across a broader range of pests and locations. The review also recognised that new specialist roles and investments in data systems provided a useful foundation for further developing these approaches.

3.12.1 Status

Amber-Green: Good progress through drone trials, remote sensing investigations and organisational capability development. However, much remains in pilot/testing phases and there is limited evidence of widespread operational adoption.

3.12.2 Evidence reviewed

Table 15: Evidence reviewed - Recommendation 12

Source of evidence	Evidence
Internal Meeting Notes – ECan Remote Sensing (Jan 2025)	ORC investigated remote sensing, aerial imagery and machine-learning technologies with Laurence Smith from Environment Canterbury to improve pest surveillance and monitoring. Discussions focused on using high-resolution imagery and AI models to identify pest infestations, delineate infestations as polygons, link infestations to property boundaries and determine compliance status. ORC explored opportunities to collaborate with Environment Canterbury and utilise existing algorithms and models. The technology was viewed as more effective and efficient than traditional ground surveillance, capable of improving detection accuracy, reducing field effort, enabling landscape-scale monitoring and supporting surveillance of pests such as gorse, broom and Nassella tussock. Staff also discussed future applications for wilding conifers, containment planning and climate-related spread modelling. The discussions demonstrate active investigation of AI-enabled and remote sensing technologies to expand surveillance capability and improve efficiency.
Improving detection and monitoring of rabbit populations using thermal drones	ORC developed and implemented a large-scale trial of thermal drone technology across all 31 rabbit monitoring routes in Otago to evaluate whether drones could complement or replace traditional spotlight-based rabbit surveys. The project was designed to assess detection performance, operational practicality, safety benefits and comparability with ORC's historical monitoring dataset. The business case identifies limitations of traditional field monitoring, including observer variability, access

	constraints, detection bias and health and safety risks, and evaluates thermal drones as a means of improving detection rates, increasing spatial coverage, reducing operational risk and improving monitoring efficiency. The trial involves direct comparison of drone and ground-based monitoring, collection of spatially referenced data, retention of thermal imagery for verification, and assessment across a wide range of habitats and rabbit densities.
SWAT Year 1 report Site-led Pikiwhara Sandymount and Rec.11_SWAT - final report review - 2024	ORC funded a drone-based surveillance project within the Pikiwhara/Sandymount Site-Led Programme to improve pest detection and monitoring capability across a 441 ha area. The project used high-resolution drone imagery, GPS tools, GIS software and spatial datasets to identify pest infestations that would have been difficult to locate through conventional field surveys. Drone imagery enabled identification of Darwin's barberry infestations, wilding pines and other pest plants, established baseline monitoring information and supported ground verification and control activities. The project also required participants to develop new GIS capability, with the drone contractor providing training and support to enable project members to work with QGIS and geospatial datasets. The project demonstrates practical application of drone technology to increase surveillance coverage, improve detection rates and build capability in the use of monitoring technologies.
BS Programmes Vision and Where we are in progress	ORC's proposed Biosecurity Programmes Team structure includes dedicated surveillance and monitoring capability, including a Terrestrial Surveillance & Monitoring Lead, Aquatic Surveillance & Monitoring responsibilities, Biosecurity Impact Assessments, Emerging Pest Assessments and Species Audit Reviews. The organisational model also emphasises continual learning, best practice, technical advice, data management and reporting. These structural changes indicate continued investment in specialist capability and technical capacity to support increasingly sophisticated surveillance, monitoring and assessment approaches.

3.12.3 Assessment

There is evidence that ORC is progressing this recommendation through investment in new technologies, surveillance approaches and specialist capability to improve biosecurity monitoring.

The clearest examples are the use of drones, remote sensing, GIS and emerging machine-learning technologies. ORC has trialled thermal drones across rabbit monitoring routes and supported drone-based surveillance at Pikiwhara/Sandymount, demonstrating practical applications for improving detection, coverage and spatial information. ORC has also explored remote sensing and machine learning with Environment Canterbury, including their potential to map infestations and monitor changes over time.

The proposed Biosecurity Programmes Team structure further supports this direction, with dedicated surveillance, monitoring, impact assessment and technical functions intended to strengthen specialist capability and data use.

While some technologies remain under investigation or trial, the evidence indicates that ORC is taking steps to strengthen monitoring capability and make greater use of technology. The reviewed material does not indicate that AI-enabled trapping technologies have been adopted, as specifically referenced in the original recommendation, but there is evidence of progress across several other areas identified in the recommendation.

3.12.4 Remaining gaps

- Many emerging technology initiatives remain in trial or evaluation phases, with further work needed to determine how technologies such as thermal drones, machine learning and remote sensing could be incorporated into routine surveillance.
- Investment has focused on drones, remote sensing and spatial monitoring, while there is less evidence of work with AI-enabled traps or other automated detection technologies specifically identified in the recommendation.
- Dedicated surveillance, monitoring and assessment functions are being developed, with opportunities to further strengthen staff capability in areas such as emerging technologies, GIS, data analytics and advanced surveillance techniques.
- Current evidence focuses largely on improved detection and surveillance capability, with further opportunity to assess and demonstrate the benefits of these technologies for detection rates, coverage, efficiency and programme outcomes.
- Applications appear concentrated in a small number of use cases, including rabbit monitoring, pest plant surveillance and aerial imagery, with potential to explore their use across a broader range of RPMP programmes.
- Collaborative work on emerging technologies is underway, including with Environment Canterbury, with scope to further develop a coordinated approach to technology adoption, including priorities, capability requirements and expected benefits.
- Specialist monitoring capability is being strengthened, with opportunities to further consider workforce development and succession planning as the use of advanced surveillance technologies grows.

3.12.5 Suggested next steps

1. Complete evaluation of current technology trials and consider pathways for operational adoption, particularly for thermal drone monitoring and remote sensing. Where trials demonstrate potential improvements in detection, coverage or efficiency, consider opportunities to incorporate these approaches into routine surveillance and monitoring.
2. Consider developing a technology roadmap for the biosecurity programme to identify priority technologies, indicative implementation timeframes, capability requirements and expected benefits, providing a more structured basis for future investment.
3. Continue exploring AI-enabled monitoring technologies, including AI-assisted image analysis, automated species detection and AI-enabled trapping systems, to assess their potential application across a wider range of RPMP pests and further align with the intent of the original recommendation.

4. Consider a structured training and capability development programme for biosecurity staff, covering areas such as drone operations, GIS, remote sensing, machine learning, spatial analysis and emerging surveillance technologies, to support the effective use of new technologies.
5. Continue strengthening surveillance and monitoring capability within the Biosecurity Programmes Team, including the specialist monitoring, assessment and technical advisory functions identified in the proposed team structure.
6. Explore opportunities to broaden the application of emerging technologies across additional pest programmes, building on existing work in rabbit monitoring, pest plant surveillance and remote sensing, including potential applications in freshwater, marine, wilding conifer and containment programmes.
7. Monitor and report on the benefits of technology adoption, including potential improvements in detection, surveillance coverage, operational efficiency, health and safety, cost effectiveness and resource prioritisation, to help inform future investment and decision-making.
8. Continue collaboration with other councils, research organisations and technology providers to share expertise, explore opportunities for joint development and support the adoption of proven surveillance tools and analytical approaches.

3.13 Recommendation 13

Prioritise efforts where data gaps are most significant, focusing first on areas with the highest biodiversity or economic/cultural value.

The Effectiveness Review found that ORC's monitoring and surveillance efforts were concentrated on a relatively small number of well-known pests, with information gaps remaining across a number of RPMP species and locations. The review identified opportunities to strengthen ORC's ability to assess pest prevalence, evaluate programme effectiveness, identify emerging threats and prioritise resources.

Recognising that it would not be practical or cost-effective to monitor all pests equally across the region, Sapere recommended a risk-based approach to prioritisation. This included focusing monitoring and surveillance on pests and locations where information gaps were greatest, while giving particular consideration to areas of high biodiversity value, economic importance or cultural significance. The recommendation was intended to support more strategic use of available resources, strengthen the evidence base for pest management decisions and help ensure monitoring and surveillance effort is directed towards areas of greatest priority.

3.13.1 Status

Green: Evidence shows clear prioritisation of biodiversity and identified knowledge gaps through operational planning and targeted projects.

3.13.2 Evidence reviewed

Table 16: Evidence reviewed - Recommendation 13

Source of evidence	Evidence
Biosecurity Operational Plans (2025/26 and 2026/27)	The operational plans provide targeted monitoring and surveillance focused on priority areas rather than broad, untargeted activity. Old man's beard inspections are directed towards priority areas and buffer sites, while freshwater monitoring prioritises Category High waterbodies before medium-priority locations. Monitoring and containment programmes for African love grass, Nassella tussock, old man's beard and containment pest plants also focus on active sites, buffer areas and containment boundaries. This indicates that monitoring resources are being directed towards locations where surveillance information is considered most relevant to programme delivery and environmental risk.
ORC CARDRONA GABFA & EA Action Plan 2026 DRAFT V1	The Crown Range and Cardrona Valley project was initiated in response to a management need identified through previous surveillance. The project focuses on compliance inspections, monitoring, stakeholder engagement and data collection within a defined priority Gorse and Broom Free Area. The area was selected following the identification of gorse and broom infestations in a location where protection of production and economic values is an objective. The action plan establishes baseline inspections and targeted compliance activity to improve understanding of pest distribution and compliance status within the project area.
SWAT Final Report Review and SWAT Year 1 Report – Pikiwhara/Sandymount	The SWAT project focused monitoring on the Pikiwhara/Sandymount Site-Led Project, which had previously been identified through ORC's site-led values, threats and impacts assessment as a high-risk area for Darwin's Barberry invasion. Drone surveys were used to address identified gaps in knowledge about pest distribution and establish baseline information. The project generated geospatial data, identified previously unknown infestations, recorded pest observations and established monitoring information for a biodiversity-rich reserve environment.

3.13.3 Assessment

There is evidence that ORC has adopted a more targeted approach to surveillance, monitoring and information gathering, with activity directed towards priority areas, known management zones, high-priority waterbodies and locations where information gaps have been identified.

The Biosecurity Operational Plan 2026-2027 provides for targeted monitoring of priority areas, active containment sites and Category High waterbodies, with freshwater monitoring prioritised according to environmental value and risk. The Crown Range and Cardrona Valley project provides a further example, using previous surveillance to define a priority area and establish baseline inspections to improve understanding of pest distribution and compliance status.

The SWAT project at Pikiwhara/Sandymount similarly targeted an area identified as having high biodiversity values and elevated Darwin's Barberry risk. Drone surveys were used to address identified information gaps and generated baseline data, including previously unknown pest infestations.

Overall, the evidence indicates that monitoring effort is increasingly directed towards areas of recognised environmental value, management risk or information need. Biodiversity considerations are most clearly evident in current operational prioritisation, with some evidence of economic considerations through programmes such as Gorse and Broom Free Areas. Interview evidence suggests that a more explicit consideration of cultural values is occurring through development of the next RPMP, including engagement with mana whenua, but there is less evidence that cultural values are currently applied through a formal or consistent prioritisation framework across existing operational programmes.

3.13.4 Remaining gaps

- Biodiversity-based prioritisation is evident, while there is less direct evidence of how cultural values are incorporated into monitoring priorities. Economic considerations are reflected in programmes such as Gorse and Broom Free Areas, although the methodology for incorporating these values into prioritisation is not always explicit.
- Much of the evidence relates to targeted projects and programme design, with limited evidence of a documented region-wide framework for identifying and ranking data gaps across RPMP pests.
- Additional reporting on identified data gaps and how these inform annual monitoring priorities would provide greater visibility of how the approach is applied in practice.

3.13.5 Suggested next steps

1. Continue directing monitoring and surveillance resources towards high-value biodiversity sites, priority waterbodies, active containment areas and locations where baseline information remains limited, including through targeted projects and drone-based surveillance where this address identified information gaps.
2. Consider developing a consistent approach for identifying and prioritising data gaps across RPMP pests and programmes to support transparent monitoring priorities.
3. Document how biodiversity, economic and cultural values are considered when setting monitoring and surveillance priorities, including defined criteria, a record of how trade-offs are resolved, and mana whenua input to the cultural criteria and relevant decisions.
4. Consider annual reporting on key data gaps addressed and how the resulting information has informed pest management decisions and resource allocation.

4. Priority actions for ORC

The priorities below draw together the recurring gaps and opportunities identified across the individual recommendation assessments. They are not intended to introduce a new programme of work for ORC, but to identify areas where continued attention would help consolidate the progress already made and strengthen the evidence of its impact over the remainder of the current RPMP period.

4.1.1 Demonstrate outcomes from the enhanced compliance and enforcement framework

A key development since the 2025 Effectiveness Review has been the establishment of a more structured compliance and enforcement framework, including expanded inspection programmes, formal re-inspection processes, increased use of Notices of Direction, and processes for default works and cost recovery.

The next priority should be demonstrating that these changes are delivering measurable improvements in compliance and pest management outcomes. This includes monitoring trends in repeat non-compliance, reporting enforcement outcomes, tracking compliance improvements following interventions, and assessing whether strengthened enforcement is contributing to the achievement of RPMP objectives. Although considerable effort has been invested in developing systems and processes, evidence of the impact of these changes remains limited.

4.1.2 Complete implementation of the communications and awareness programme

The original Effectiveness Review identified low awareness of the RPMP and limited understanding of landowner obligations as factors affecting programme effectiveness. ORC has responded through the development of a communications framework, improved public-facing information and targeted engagement initiatives.

A continued focus could be placed on moving from planning and material development to sustained implementation and evaluation. This includes further development of accessible public-facing RPMP information, compliance pathway material, rule guidance and targeted communications for key audiences. Monitoring awareness, understanding and compliance over time could also help assess the contribution of these activities to programme outcomes.

4.1.3 Strengthen integration of stakeholder and citizen-science data

The review identified several examples of community-generated monitoring data, including site-led projects, drone surveys and observations reported through platforms such as iNaturalist. However, these examples are largely project-based, with limited evidence of their integration into a consistent regional approach to information management.

Further integration of stakeholder-held information could provide an opportunity to strengthen surveillance capability and address remaining data gaps. Potential areas for development include practical data-sharing arrangements, identification of priority external datasets, improved compatibility between systems, and clearer processes for incorporating externally generated information into monitoring, planning and decision-making.

4.1.4 Progress outcome-based monitoring

ORC has invested in monitoring, surveillance and information systems and has begun establishing baseline datasets through initiatives such as drone-based monitoring, remote sensing investigations and spatial monitoring projects.

However, the available evidence indicates that monitoring remains focused largely on activities and outputs, with less evidence of systematic outcome-based monitoring. Developing a more outcome-focused monitoring framework would provide an opportunity to strengthen assessment during the remainder of the RPMP period. This could include tracking changes in pest abundance, distribution, infestation extent and spread over time, alongside existing activity and compliance measures. A stronger focus on outcomes could support assessment of programme effectiveness and inform future prioritisation decisions.

4.1.5 Transition successful technology trials into business-as-usual operations

ORC has investigated and trialled a range of technologies, including thermal drone monitoring, remote sensing, GIS-based analysis and machine-learning-assisted surveillance approaches. These initiatives provide examples of efforts to explore tools that may improve monitoring efficiency and detection capability.

Further evaluation could help determine which technologies provide sufficient value for incorporation into routine monitoring, surveillance and compliance activities. This would support decisions on the ongoing use of these approaches and help inform future investment across the region.

About Sapere

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Appendix 3: Updated Implementation Plan from Review of Actions on recommendations from the RPMP Effectiveness Review

#	Recommendation	Staff Assessment and Implementation Actions as of October 2026	Priority	Schedule[1]
1.	Simplify the RPMP presentation, accessibility and reach	• Develop simplified, public-facing RPMP materials, including visual summaries, fact sheets and online content tailored to the needs of specific audiences. • Expand the use of accessible communication products, including posters, social media content, videos and QR-enabled resources, to clearly communicate the actions expected of landowners and the wider public. • Introduce measures to assess communication effectiveness, such as public awareness surveys, website analytics, QR-code engagement data, reporting rates and stakeholder feedback, to determine whether improved communication is increasing awareness and supporting compliance. • Maintain a focus on accessible, audience-specific engagement throughout development and implementation of the next RPMP Review communications programme.	Medium	On going
2.	Clarify rules and target communication to key audiences	• As unable to change rules when RPMP is operational, this recommendation will form a major theme in the new RPMP. • Regularly update explanatory materials to help ensure they remain clear, accessible and aligned with operational practice. • Use future operational reporting, where appropriate, to assess whether improved communication and clarification of rules are contributing to improved compliance outcomes.	Medium	On Going
3.	Improve transparency to and motivation of public by sharing more success stories	• Develop and deliver dedicated “Good News Stories” communications programme, with a regular pipeline of success stories maintained over time. This includes a new page on the website that is in development. • Promote successful projects, particularly those that demonstrate strong community participation, innovation and measurable environmental outcomes. This includes a new page on the website that is in development. • Prepare an annual “Biosecurity Successes” report that brings together major achievements across pest management programmes and demonstrates how funding is contributing to outcomes. • Strengthen the links between success stories and RPMP objectives, helping the public to understand how individual projects contribute to broader regional goals. • Highlight the contributions of communities, landowners and volunteers to reinforce positive behaviours and encourage wider participation in pest management initiatives. • Hold an Otago biosecurity forum that enables success stories to be shared and for people to hear from experts.	Medium	On Going

[1] This is the schedule for implementation. As we have started these recommendations, this should focus on when the recommendation would substantially be completed.

4.	Communicate more clearly the consequences of non-compliance following inspections, while also highlighting success stories resulting from enforcement efforts.	• Publish the Compliance Handbook and Compliance Pathway Fact Sheet to provide clear, public-facing information about compliance and enforcement processes, landowner and occupier responsibilities, and the potential consequences of non-compliance. • Incorporate compliance and enforcement case studies into annual biosecurity reporting and communications activity, including examples where compliance action has contributed to successful pest management outcomes. • Establish measures to assess whether awareness and understanding of compliance obligations and enforcement consequences are improving among landowners and occupiers. • Use channels such as the Pest Hub, social media, newsletters and community engagement activities to communicate successful compliance outcomes, as well as the potential consequences of persistent non-compliance. • Report annually on compliance and enforcement activity, including Work Requests, Notices of Direction, Default Works, compliance rates and successful resolution of non-compliance cases. This could help demonstrate the operation and effectiveness of the compliance framework and reinforce expectations around compliance.	High	On Going / August 2027
5.	Increase the number of new and re-inspections. Consider targeting areas with highest biodiversity or economic/cultural value first.[2]	• Implement the expanded inspection and re-inspection programmes established through the 2025-26 and 2026-27 Operational Plans. • Report annually on actual inspection and re-inspection delivery against targets to provide greater visibility of implementation and effectiveness. • Develop formal prioritisation framework that explicitly incorporates biodiversity, economic and cultural values into inspection planning. • Complete the evaluation of thermal drone and remote sensing trials and, where appropriate, consider incorporating successful approaches into routine monitoring and compliance programmes. • Strengthen reporting on re-inspection outcomes, including the extent to which follow-up activity is contributing to improved compliance. • Adopt surveillance and emerging technologies to support the identification of new infestations, refine risk-based targeting and enable proactive compliance activity in priority areas.	High	On going
6.	Target enforcement efforts where investments and awareness are already in place (i.e. old man's beard, rabbits, bomarea, wilding pines). Also	• Direct enforcement effort towards high-priority programmes such as rabbits, Old Man's Beard, containment pest plants and wilding conifers, where compliance activity, monitoring and public awareness are already established. • Develop and document a prioritisation framework that incorporates biodiversity, economic and cultural values alongside compliance and infestation data when identifying enforcement priorities. • Report annual (within 5 months of end of FY) on enforcement activity and outcomes within priority programmes, including inspections undertaken, Notices of Direction issued, compliance improvements and relevant environmental outcomes.	High	On going / to meet council reporting timelines

[2] Note: this should be accompanied by appropriate enforcement activities (i.e. default work and cost recovery) as inspections alone will have limited impact without follow-through.

	consider prioritisation of areas with highest biodiversity or economic/cultural value.	• Use inspection history, compliance records and pest distribution data to identify areas of persistent non-compliance and focus enforcement resources where intervention is most likely to achieve positive outcomes. • Ensure greater transparency around how biodiversity, economic and cultural priorities are balanced when determining annual compliance and enforcement priorities		
7.	Leverage data to optimise enforcement efforts.	• Use inspection, compliance and pest distribution data to identify persistent non-compliance and inform enforcement priorities and resource allocation. • Complete the thermal drone rabbit monitoring trial and assess whether the improved detection methods could support routine monitoring, compliance targeting and enforcement planning. • Develop additional reporting to demonstrate how compliance data informs inspection planning, enforcement priorities and resource allocation. • Explore opportunities to incorporate additional information sources, including monitoring programmes, external datasets and emerging technologies, to further support evidence-based enforcement decisions. • Monitor and report on whether the increased use of compliance data is contributing to changes in compliance rates, enforcement effectiveness and pest management outcomes over time.	Medium	August 2027
8.	Utilise powers under the Act of default work and cost recovery in cases of repeated non-compliance.	• Apply established Default Work and cost recovery framework where repeated non-compliance persists and voluntary compliance pathways have been exhausted. • Report annually on enforcement activity and outcomes, including NODs issued, Default Work cases undertaken, costs recovered and subsequent compliance outcomes. • Monitor whether the use of Default Work powers is associated with improved compliance and reduced repeat non-compliance across priority pest programmes. • Publish appropriate case studies or summary information on enforcement activity and outcomes, while continuing to refine Biosecurity Enforcement Group processes and cost recovery arrangements to support consistent, proportionate and efficient enforcement.	High	On going / within 5 months of end of FY
9.	Fill data gaps by leveraging citizen science and integrating stakeholder data.	• Promote public pest reporting and citizen science through tools such as the ORC pest reporting system and iNaturalist. • Establish processes for routinely incorporating stakeholder-generated information, including site-led project data, drone surveys, GIS datasets and community monitoring records, into ORC monitoring and planning activities. • Develop data-sharing arrangements with key community groups and project partners, alongside technical or GIS support where appropriate, to improve the consistency, compatibility and ongoing use of externally generated information. • Consider reporting on how citizen science and stakeholder-generated data contribute to pest detection, surveillance and management decisions, to better demonstrate their value and inform future participation.	Low	On Going
10.	Incentivise the public to contribute	• Support community-led monitoring and surveillance projects that supplement ORC's monitoring, particularly in areas where information or surveillance coverage is limited.	Low	On Going

	data where gaps are present.	• Develop a more targeted approach to public pest reporting, identifying priority species or areas where additional information would be most valuable and focusing reporting efforts accordingly. • Consider a more structured citizen science approach, building on existing platforms such as iNaturalist and relationships with community groups to support more consistent collection and sharing of pest data. • Explore options for encouraging public reporting, such as recognition initiatives, targeted campaigns or community challenges, particularly for priority pests. • Strengthen processes for incorporating community-generated information into ORC's monitoring and surveillance systems, including approaches to data quality, verification and use in decision-making. • Monitor and report on public participation outcomes, including reporting activity, citizen science contributions and examples where community information has supported pest detection or addressed information gaps. • Continue raising awareness of priority pests and reporting pathways, with greater focus on linking communication activities to improved reporting and surveillance outcomes.		
11.	Consider introducing outcome-based monitoring.	• Develop outcome-based monitoring across RPMP programmes, including measures of pest abundance, distribution, infestation extent and spread alongside activity and compliance measures. • Develop a consistent set of outcome indicators for major pest programmes, linked to programme objectives and tracked over time. • Build on existing baseline datasets through repeat monitoring to assess changes over time and better demonstrate the outcomes of pest management interventions. • Progress the evaluation and use of remote sensing and machine learning where these can improve measurement of pest extent, spread and change over time, including opportunities for landscape-scale monitoring. • Strengthen the use of monitoring data in programme planning and prioritisation, including greater visibility of how surveillance findings and pest trends inform resource allocation and management responses. • Expand reporting on programme effectiveness, bringing pest trends and management outcomes alongside operational performance measures to provide a clearer picture of progress towards RPMP objectives. • Continue strengthening surveillance, monitoring and impact assessment capability, including the functions identified in the Biosecurity Programmes Team operating model, to support outcome-focused reporting and decision-making. • Consider a region-wide framework for assessing RPMP outcomes, bringing together surveillance, compliance, spatial and programme monitoring data to provide a more consolidated view of pest status and management effectiveness.	Low	On Going
12.	Invest in capacity and capability by utilising tools such as AI-enabled traps, drones, and remote sensing;	• Trial and if successful implement AI-enabled remote sensing technologies to enhance surveillance and pest management outcomes. • Deliver targeted training to build staff capability in the use of emerging biosecurity technologies and data-driven decision-making. • Establish processes to evaluate, share, and embed innovations that improve programme effectiveness and operational efficiency.	Low	On Going

	additionally, provide training for biosecurity staff.	• Strengthen partnerships and knowledge exchange opportunities to ensure staff remain current with emerging technologies and best practice.		
13.	Prioritise efforts where data gaps are most significant, focusing first on areas with the highest biodiversity or economic/cultural value.	• Continue directing monitoring and surveillance resources towards high-value biodiversity sites, priority waterbodies, active containment areas and locations where baseline information remains limited, including through targeted projects and drone-based surveillance where this address identified information gaps. • Develop a consistent approach for identifying and prioritising data gaps across RPMP pests and programmes to support transparent monitoring priorities. • Strengthen documentation of how biodiversity, economic and cultural values are considered when setting monitoring and surveillance priorities.	Medium	On Going

Draft

Hon Andrew Hoggard

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Dear Minister,

Otago Regional Council Biosecurity Annual Report 2025-26

On behalf of the Otago Regional Council (ORC), I am pleased to provide you with a copy of ORC's 2025–26 Annual Report on the Operational Plan for implementing the Otago Regional Pest Management Plan. The Annual Report was adopted by Council on XX November 2026.

As required under section 100B of the Biosecurity Act 1993, ORC prepares and submits an annual report describing how the Council has implemented its Regional Pest Management Plan and report on performance. This annual report outlines how ORC has delivered its pest management commitments as part of the 2024–2034 Long Term Plan.

I look forward to your response.

Yours sincerely

Cr Hilary Calvert

Chairperson

9.4. Conservation Status of Freshwater Fish in Otago

Prepared for: Council

Report No. S&R2624

Activity: Science

Author: Ciaran Campbell (Scientist – Freshwater Ecology)

Endorsed by: Tom Dyer (General Manager Science and Resilience)

Date: 18 November 2026

Portfolio Leads: Cr Kelliher and Cr Robertson, Science and Resilience

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PURPOSE

[1] This paper documents the conservation status of freshwater fishes in Otago.

EXECUTIVE SUMMARY

[2] This paper presents the first report on conservation statuses of freshwater fishes in Otago. It outlines the purpose of regional conservation status assessments and their role in monitoring to inform biodiversity and biosecurity.

[3] Regional councils manage indigenous biodiversity and monitor the environment. Conservation status reports are vital for evaluating environmental health, tracking management effectiveness, and guiding robust decisions, including consenting and biosecurity management. The national conservation status system is now complemented by a regional equivalent using the same rules-based framework to assess population sizes and trends of species. To enhance knowledge of Otago's biodiversity, ORC has now completed regional assessments for nine species groups, published species lists, and reported on species unique to the region.

[4] A total of 41 freshwater fishes were assessed. Of these fish species, 18 were Regionally Threatened, four were Regionally At Risk, four were Regionally Not Threatened, seven were Regionally Data Deficient, one was Regionally Extirpated (in other words, extinct), and seven were Regionally Introduced and Naturalised. In addition to the 41 freshwater fishes assessed, two other species were identified as Regionally Introduced, Not Established.

[5] Otago has more species of freshwater fish than any other region in Aotearoa New Zealand. These include species that are found only here, and ecologically important populations of other freshwater fishes. Of the 34 native freshwater fishes in Otago, one is globally extinct, and all but four species are at some heightened risk of extinction or conservation concern.

[6] Two species were assessed as Regionally Critical, the status with greatest risk of extinction from the Otago Region. One of these is Teviot flathead galaxias (*Galaxias* "Teviot") which is found only in Otago and restricted to headwaters of the Teviot River,

Lake Onslow, and a single tributary of the upper Taiari / Taieri River). The other is Canterbury mudfish (*Neochanna burrowsius*) which, in Otago, is restricted to a few small wetlands on the south bank of the Waitaki River.

RECOMMENDATION

That the Council:

*1) **Notes** this report.*

BACKGROUND – Regional Conservation Status Assessments

[7] Under the Resource Management Act 1991 (RMA 1991), regional councils are tasked with maintaining indigenous biodiversity[1] and monitoring the state of the environment[2]. Following recent resource management reforms and the enactment of the Natural Environment Act 2026 (NEA 2026), indigenous biodiversity responsibilities are now explicitly embedded within duties[3] and functions[4] of regional councils. To support these obligations – both under the current framework and throughout the transition period – conservation status reports are vital tools for evaluating environmental health, monitoring management effectiveness, and guiding robust biodiversity decisions.

[8] To evaluate national extinction risk based on population sizes and trends, the Department of Conservation – Te Papa Atawhai (DOC) administers a rules-based framework known as the New Zealand Threat Classification System (NZTCS)[5].

[9] Regional conservation status assessments help local authorities manage and protect biodiversity within their regions and can inform decisions and guide focus for biodiversity and/or biosecurity management. For example, knowledge of threatened species present at a site is of particular importance for consenting processes and conservation planning.

[10] The regional conservation status assessment process is standardised through the Regional Threat Classification System (RTCS) Manual, developed by ecologists from Te Uru Kahika (Regional and Unitary Councils Aotearoa) in collaboration with DOC[6]. The RTCS framework follows the rule-based approach of the NZTCS to assess the risk of extinction for species at a regional scale.

[11] ORC has already completed regional conservation status assessments for eight groups[7]. Five groups have been presented to Environmental Science and Policy Committee meetings since 2023, which were: reptiles[8], birds[9], amphibians[10], indigenous vascular plants[11], and bats[12].

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[1] RMA 1991, Section 30(1)
[2] RMA 1991, Section 35(2)
[3] NEA 2026, Section 228(1) and (2)
[4] NEA 2026, Section 229(1)
[5] https://nztcs.org.nz/
[6] https://www.doc.govt.nz/about-us/science-publications/conservation-publications/regional-threat-classification-system-manual-2026/. Dr Scott Jarvie (ORC) co-authored the manual.
[7] Amphibians, bats, birds, indigenous vascular plants, Onychophora, Orthoptera, reptiles, and selected mushroom fungi, https://www.orc.govt.nz/environment/biodiversity/regional-threat-assessments
[8] https://www.orc.govt.nz/media/14137/esp-agenda-20230426.pdf
[9] https://www.orc.govt.nz/media/cuajacpl/20240926-esp-agenda.pdf

[12] To further document the biodiversity of the region, ORC has also published species lists for 27 groups[13], reports on species first described in the Otago Region[14], and on species that are endemic to the Otago Region[15].

[13] Other councils have completed conservation status assessments on freshwater fishes in their regions, including Greater Wellington Regional Council, Auckland Council, and Horizons Regional Council. Further regional assessments on freshwater fishes are also planned, including by Northland Regional Council, Environment Canterbury, and Environment Southland.

[14] The conservation status of freshwater fishes is of relevance to regional councils given their role in managing health of freshwater ecosystems and species' habitats.

METHODOLOGY

[15] Applying the RTCS framework, ORC formed a panel of experts from DOC, an independent consultant, and ORC scientists to assess the conservation status of freshwater fishes in the Otago Region.

[16] The panel met for two days to determine the status and qualifiers for each species by critically assessing available data and drawing on their own expert knowledge. The panel considered the regional population size, regional population trend, current and likely future threats in the Otago Region. The method and data sources for this assessment are described in full in the report (Attachment 1).

[17] Brief descriptions of regional threat categories, relevant to the conservation status of freshwater fishes in Otago, have been derived from the RTCS and NZTCS manuals and are provided in Table 1.

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[10] https://www.orc.govt.nz/media/beugmwjc/20240627-esp-agenda.pdf
[11] https://www.orc.govt.nz/media/beugmwjc/20240627-esp-agenda.pdf
[12] https://www.orc.govt.nz/media/15330/2023-10-11-esp-agenda.pdf
[13] https://www.orc.govt.nz/environment/biodiversity/otago-s-lists-of-selected-species
[14]https://www.orc.govt.nz/media/crbllawp/type-localities-of-terrestrial-animals-plants-and-fungi-in-the-otago-region-2025.pdf
[15] https://www.orc.govt.nz/environment/biodiversity/only-in-otago

Table 1. Regional threat categories relevant to the conservation status of freshwater fishes in Otago. These were derived from the Regional Threat Classification Manual and New Zealand Threat Classification Manual.

Category	Description
Regionally Extirpated	The species is regionally extinct, and there is no doubt that the last individual in the region has died.
Regionally Data Deficient	Species that lack population size and trend data, or inability to distinguish between focal and related species.
Regionally Threatened	Species that have small populations in the region, which makes them highly susceptible to unpredictable events, and/or are declining at rates that mean the regional population(s) may be lost if trends are not arrested. Regionally Threatened freshwater fishes in Otago are assessed in one of three statuses: Regionally Critical, Regionally Endangered, and Regionally Vulnerable.
Regionally At Risk	Species that are declining in the region, buffered by large populations or slow rate of decline, or are biologically scarce or recovering from a Threatened status. Regionally At Risk freshwater fishes in Otago are assessed in one of two statuses: Regionally At Risk and Regionally Naturally Uncommon.
Regionally Not Threatened	Species that have a large population in the region that is stable or increasing and does not meet definitions for other categories.
Regionally Introduced and Naturalised	Species that are non-native to Aotearoa New Zealand and the region, and have both bred and spread in the wild.
Regionally Introduced, Not Established*	Species that are non-native to Aotearoa New Zealand and the region, and have not bred in the wild, or have bred in the wild but are no longer extant in the region.

*This category is not officially part of the assessment process, so freshwater fishes in this category are not included in counts of assessed fish.

RESULTS

[18] The conservation status of 41 freshwater fish species in Otago is presented in Attachment 1. Consistent with previous conservation status assessments, a spreadsheet of assessment results is available on the ORC website to accompany the report[16].

[19] Of these 41 fish species, 18 were Regionally Threatened, four were Regionally At Risk, four were Regionally Not Threatened, seven were Regionally Data Deficient, one was Regionally Extirpated (i.e., extinct in the region), and seven were Regionally Introduced and Naturalised. In addition to the 41 freshwater fishes assessed, two other species were identified as Regionally Introduced, Not Established (Figure 1). The conservation status of each species is presented in Table 2, with comprehensive results in Tables 1.1 and 1.2 of the report in Attachment 1.

[16] https://www.orc.govt.nz/media/krqbz1qm/species-list-of-freshwater-fishes-in-otago-oct-2026.xlsx



Figure 1. A total of 41 freshwater fishes were assessed in the Otago Region. Numbers of fish species in each of the categories and statuses are presented. ORC graphic designers develop these infographics to accompany conservation status reports on the ORC website (https://www.orc.govt.nz/regionalthreatassessments).

Table 2. Conservation statuses for freshwater fishes in Otago. Comprehensive results are provided in Tables 1.1 and 1.2 of the report (Attachment 1).

Category	Status	Species
Regionally Extirpated (1)		grayling
Regionally Threatened (18)	Regionally Critical (2)	Teviot flathead galaxias Canterbury mudfish
	Regionally Endangered (4)	lowland longjaw galaxias Nevis galaxias southern flathead galaxias alpine galaxias (Manuherikia)
	Regionally Vulnerable (12)	torrentfish Pomahaka galaxias Clutha flathead galaxias alpine galaxias (Southland) central Otago roundhead galaxias giant kokopu inanga Eldon's galaxias banded kokopu Gollum galaxias dusky galaxias Canterbury galaxias
Regionally At Risk (4)	Regionally Declining (2)	koaro Taieri flathead galaxias
	Regionally Naturally Uncommon (2)	bluegill bully redfin bully
Regionally Not Threatened (4)		yellow-eye mullet common bully upland bully black flounder

Regionally Data Deficient (7)	shortfin eel longfin eel estuarine triplefin lamprey giant bully common smelt Stokell's smelt
Regionally Introduced and Naturalised (7)	goldfish rainbow trout Chinook salmon perch brown trout brook char tench
Regionally Introduced, Not Established (2) *	grass carp Atlantic salmon

*This category is not officially part of the assessment process, so freshwater fishes in this category are not included in counts of assessed fish.

[20] The assessment process identified other results which are informative for management purposes. Otago Region currently holds a total of 33 native freshwater fish species, more than any other region in Aotearoa New Zealand. Otago is a national stronghold for eleven freshwater fishes, meaning more than 20 percent of the national population for each species is in the region. Of these fish species, nine are regionally endemic, meaning they are restricted to the Otago Region and occur nowhere else on Earth (e.g., Taieri flathead galaxias, *Galaxias depressiceps*, Figure 2). Management of the regionally endemic species can only occur in the Otago Region, which can help inform prioritisation of conservation efforts.



Figure 2. Taieri flathead galaxias (*Galaxias depressiceps*) in Waihemo / Shag River. This species is endemic to Otago, found exclusively in the Taieri and nearby catchments. Photo supplied by Nicholas Dunn (Department of Conservation).

[21] Management of some species and their habitats in Otago can be targeted. Six species occur in one location in the region:

- lowland longjaw galaxias in the Kākaunui / Kakanui River catchment
- Nevis galaxias in the Nevis River / Te Papapuni catchment
- alpine galaxias (Manuherikia) upstream of Fall's Dam in the Manuherekia catchment
- Teviot flathead galaxias in neighbouring headwaters of Lake Onslow, Teviot River, and the Taiari / Taieri River catchment
- Canterbury mudfish in wetlands on the banks of the Waitaki River
- Stokell's smelt in the mouth of the Waitaki River.

[22] Four of these fish species are endemic to Otago, indicating those entire species could be affected by a single catastrophic event. The other two species are also found in the Canterbury Region, where they are at severe risk of extinction.

[23] The assessment process also identified 17 freshwater fishes likely to move to a worse conservation status if current management ceases. Examples of management include protection and restoration of spawning habitat, fishery regulation, and elimination of invasive predator species from targeted reaches by ORC, DOC, or community groups. Two of these species were Regionally Critical – the most severely threatened status. For lamprey and freshwater-resident galaxiids, they are benefitting from habitat protection and for some, the removal of invasive predatory fish.

DISCUSSION

[24] The Otago Region has more species of freshwater fish than any other region in Aotearoa New Zealand. These include species that are found nowhere else on earth, and ecologically important populations of freshwater fishes. Of the 34 native freshwater fishes in Otago, one is globally extinct, and all but four species are at some heightened risk of extinction or conservation concern.

[25] Otago's rivers, lakes, and wetlands are home to nine regionally endemic freshwater fishes, which is high numerically and proportionally. Management of these species can only occur within the Otago Region. Furthermore, the Region is a stronghold for the survival and recovery of two other species. Six species occur in one location in the region, focusing the management of these species and habitats in Otago to singular locations.

[26] Otago Regional Council works collaboratively with iwi partners, stakeholders, catchment groups, the community, and landowners to manage freshwater through regulatory and non-regulatory avenues.

[27] Otago communities have a strong and growing interest in native freshwater fish and are investing significant time and effort into their protection. Catchment groups, landowners, iwi, schools, volunteers, and partner organisations are working across the region to restore habitats, improve waterway health, and address threats to native fish through activities such as riparian planting, fencing, weed control, fish passage improvements, and predator management.

[28] Examples include the East Otago Catchment Group's Upper Shag River Trout Removal Project, the Manuherikia Catchment Group's Thomsons Catchment Native Fish Barrier

Project, Phil Smith's Spec Creek Galaxiid Sanctuary – with support from Tiaki Maniototo, Toitū Te Hakapupu's Pleasant River Restoration, the Pomahaka Water Care Group's Tapanui Galaxiid Sanctuary, and initiatives led by WAI Wānaka, Low Burn Catchment Group, and North Otago Sustainable Land Management.

[29] These projects demonstrate strong local commitment to protecting Otago's unique freshwater biodiversity.

[30] Native freshwater fish are also a prominent focus in the development of Catchment Action Plans, reflecting the value that communities place on healthy waterways and indigenous species.

[31] Regional Conservation Status assessments help ORC target resources, track biodiversity trends, and measure the success of community and catchment group projects. These regional threat rankings guide local councils in managing regional ecosystems and refining biosecurity efforts. Notably, having precise knowledge of threatened species on-site is vital for guiding resource consent processes and long-term conservation planning.

COMMUNICATION

[32] The attached conservation status report will be released alongside dedicated websites for freshwater fishes[17] and fish passage[18]. Fish passage guidance has been sourced from a local expert consultant through an Otago Biodiversity Forum Collaborative Project. Fact sheets targeted at a variety of audiences including catchment groups and as resources for catchment advisors and other community facing staff are progressing, consistent with resources available for other biodiversity groups[19].

OPTIONS

[33] This report is for noting and therefore does not present options.

SUMMARY OF CONSIDERATIONS

Community Outcomes

This work aligns with the following community outcomes from the ORC 2024–2034 Long-Term Plan: Partnership, Communities, Environment, Resilience, Climate.

This assessment informs mana whenua, communities, and resource managers about the extinction risk facing freshwater fishes, helping guide conservation and management decisions. The findings can support collaborative action to improve freshwater ecosystem health and resilience to environmental and climate pressures.

Councillor Priority Actions

The work outlined in this paper provides foundational information that directly supports several of ORC's Priority Actions, spanning Science and Resilience (SRA1, SRA4), Strategy and Planning (SPA3), Environmental Delivery (EDA4, EDA7), Governance and Community Engagement (GCEA1), and Cross Portfolio (CPA1, CPA2).

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[17] https://www.orc.govt.nz/environment/biodiversity/otagos-species/fish
[18] https://www.orc.govt.nz/environment/water-care/lakes-rivers-and-streams/fish-passage
[19] https://www.orc.govt.nz/environment/biodiversity

Alignment with Central Government Legislation
Regional councils are tasked with maintaining indigenous biodiversity[20] and monitoring the state of the environment[21] under the Resource Management Act 1991 (RMA 1991). Under the Natural Environment Act 2026 (NEA 2026), these indigenous biodiversity responsibilities are now explicitly embedded for regional councils within duties[22] and functions[23]. To support these obligations – both under the current framework and throughout the transition period – conservation status reports are a recognised tool for evaluating environmental health, monitoring management effectiveness, and guiding robust biodiversity decisions.

Alignment with Otago Regional Council Internal Policy
This work aligns with Strategic Pou in the ORC Indigenous Biodiversity Strategy 2026.

Financial Considerations
Producing this report required approximately $25,000 of staff time, and $3,000 for funding the threat assessment workshop. We acknowledge in-kind support from Department of Conservation scientists in producing this assessment.

Legal Compliance/Risk
ORC has legislative responsibilities to protect significant indigenous biodiversity. These threat assessments enable ORC to understand the status and trends of species and ecosystems in the region.

Reputational Risk
The report is supported by the collective knowledge of experts on freshwater fishes. The reputation risk for Otago Regional Council to base decisions and to share this information is negligible.

Climate Resilience
The report assessed whether freshwater fishes are vulnerable to climate change. Through the assessment process, a total of 20 of the 33 native freshwater fish species were identified as vulnerable to climate change in the Otago Region.

Carbon Emissions
This has not been assessed as part of this work.

He Mahi Rau Rika: Significance, Engagement and Māori Participation Policy
Consistent with Table 2 of He Mahi Rau Rika: Significance, Engagement and Māori Participation Policy, Ngā Rūnanga will be informed of this report and output. The importance to mana whenua of freshwater, mahika kai, and taoka is recognised, as identified through formal engagements between ORC and mana whenua (e.g., Regional Policy Statement 2021, Proposed Land and Water Regional Plan for Otago: Draft for Notification 2023).

[20] RMA 1991, Section 30(1)
[21] RMA 1991, Section 35(2)
[22] NEA 2026, Section 228(1) and (2)
[23] NEA 2026, Section 229(1)

Engagement with Mana Whenua

Consultation with Aukaha, on behalf of mana whenua, has directed Otago Regional Council towards regional threat assessments of particular interest to mana whenua, including this assessment of freshwater fishes.

Aukaha (on behalf of ORC) sought involvement from Ngā Rūnanga to support the expert panel for the assessment of freshwater fishes in Otago. Discussions continue with mana whenua on preferences for engaging with this process, this output, and next steps.

Stakeholder Engagement

Stakeholders actively participate in regional freshwater fish initiatives through both formal and informal channels. Two experts from Department of Conservation – Te Papa Atawhai (DOC) were on the panel to assess freshwater fishes. Additional advice was sought from another DOC expert for grass carp, and from Otago Fish and Game about sports fishes in Otago.

A media release scheduled before December will direct public attention to this work on the ORC website. Staff have established direct engagement pathways with mana whenua, iwi partners, stakeholders, catchment groups and other interested parties. Furthermore, the education resources currently in development are detailed in the Communications section below.

DOC panellists will act as conduits to share this work nationally. Additionally, awareness of Otago's freshwater fishes and their threat status will be enhanced through a formal presentation at the National Freshwater Sciences Society Conference in December. More informal presentations will follow during upcoming collaborations with iwi, the University of Otago, Otago Fish and Game, the Clutha Fisheries Trust, and regional researchers.

Communications

The regional conservation statuses have a dedicated ORC webpage where the report and accompanying spreadsheets of assessment results are provided. The reports are also provided to members of the Otago Biodiversity Forum (facilitated by the Environmental Implementation team), whose memberships include mana whenua, territorial authorities, and other agencies. Accompanying the publication of most reports is a media release.

Educational resources, similar to other species groups, are developed to make information more accessible to members of the public and can be used in community science initiatives. Many such resources already exist on ORC's biodiversity webpages[24], including examples of factsheets on Otago's birds[25] and reptiles[26].

Alongside this report, a dedicated webpage for freshwater fishes in Otago has been developed designed with catchment advisors, catchment groups and others in mind. Additionally, a dedicated ORC webpage on fish passage guidance now complements information about fish passage resource consents. This information was sourced and collated by a local consultant and was funded and delivered through an Otago Biodiversity Forum Collaborative Project.

[24] https://www.orc.govt.nz/environment/biodiversity
[25] https://www.orc.govt.nz/environment/biodiversity/otagos-species/birds#factsheets
[26] https://www.orc.govt.nz/environment/biodiversity/otagos-species/reptiles#tfactsheets

NEXT STEPS

[34] Regional threat assessments for other groups will continue as part of the biodiversity science work programme.

[35] Work continues to compile lists for other species groups, which is a precursor to conducting a regional conservation status for a species group. Mana whenua have been consulted and are particularly interested to have completed assessments for marine mammals, in addition to those already done in Otago.

[36] Fact sheets on freshwater fishes, suitable for catchment groups, community groups, and community-facing staff are also progressing.

ATTACHMENTS

1. Conservation status of freshwater fishes in Otago [**10.5.1** – 60 pages]



Conservation Status of Freshwater Fishes in Otago

Ciaran Campbell, Richard Allibone, Nicholas Dunn, Daniel Jack, Pete Ravenscroft, Scott Jarvie

October 2026

Otago Threat Classification Series 17

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Otago Regional Council



Conservation status of freshwater fishes in Otago

October 2026 – Otago Threat Classification Series 17

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Conservation status of freshwater fishes in Otago

Otago Threat Classification Series is a scientific monograph series presenting publications related to regional threats assessments of groups of taxa in the Otago Region. Most will be lists providing regional threat assessments of members of a plant or animal group (e.g., amphibians, bats, birds, indigenous vascular plants, orthopterans, peripatus, reptiles, and selected mushroom fungi) and leverages off national assessments for the New Zealand Threat Classification System within the regional context.

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Galaxias aff. *paucispondylus* "Manuherikia", Threatened – Regionally Vulnerable. Photograph by Richard Allibone, Water Ways Consulting Inc.

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Executive Summary

This report provides the first assessment of the regional conservation status of freshwater fish taxa known to occur in the Otago Region since human arrival in Aotearoa New Zealand. A standardised methodology was used to assess the regional threat status of 41 freshwater fishes. Of these, 18 were assessed as Regionally Threatened (Regionally Critical = 2; Regionally Endangered = 4; Regionally Vulnerable = 12), four as Regionally At Risk (Regionally Declining = 2; Regionally Naturally Uncommon = 2), four as Regionally Not Threatened, seven as Regionally Data Deficient, seven as Regionally Introduced and Naturalised, and one as Regionally Extirpated. Otago serves as a national stronghold for 11 freshwater fish taxa, nine of which are endemic to the Region. Two additional taxa were identified as Regionally Introduced, Not Established.

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Introduction

Threat classifications play an important role in monitoring biodiversity and informing conservation actions. The New Zealand Threat Classification System (NZTCS) is used to assign threat statuses to candidate taxa (species, subspecies, varieties, and forma) in Aotearoa New Zealand (Townsend et al. 2008; Rolfe et al. 2022). Developed for terrestrial, freshwater, and marine biota (flora, fauna, and fungi), the NZTCS assesses taxa at the national scale using criteria based on population size, state, and trend, while also considering the impact of threats, recovery potential, and taxonomic certainty.

While the Department of Conservation – Te Papa Atawhai (DOC) holds national conservation functions through the Conservation Act 1987 and other legislation, regional and district councils have statutory obligations for indigenous biodiversity under the Resource Management Act 1991, and now under the Natural Environment Act 2026. The NZTCS is effective for informing conservation action, targeting resources, and monitoring biodiversity trends and conservation effectiveness at a national scale. However, national assessments can overlook situations where taxa are under greater pressure at regional or local scales.

The need for nationally consistent threat assessments at the regional scale led to the development of the Regional Threat Classification System (RTCS; Crisp et al. 2026). The RTCS extends the NZTCS by applying the same threat categories, status rankings, and criteria adjusted to regional scales, with additional qualifiers to capture attributes of regional importance. Regional assessments improve understanding of species' status across the landscape and help local government, iwi, and community groups prioritise complementary actions. Furthermore, they can strengthen regulatory protection for threatened species and contribute local knowledge to inform future national conservation assessments.

As of October 2026, regional conservation status assessments have already been completed in Otago for eight groups: amphibians (Jarvie 2025a), bats (Jarvie et al. 2023), birds (Jarvie et al. 2026b), indigenous vascular plants (Jarvie et al. 2026a), Onychophora (Jarvie 2025b), Orthoptera (Jarvie et al. 2026c), reptiles (Jarvie et al. 2025), and selected mushroom fungi (Jarvie & Cooper 2024). Specifically, for freshwater fishes, other councils have completed conservation status assessments in their Regions, including Greater Wellington Regional Council (Crisp et al. 2022), Auckland Council (Bloxham et al. 2023), and Horizons Regional Council (Hickey et al. 2025). This report provides a species list and the first conservation status for freshwater fishes in the Otago Region.

Methods

The threat status of freshwater fishes for Otago was assessed in March 2025 and updated in March 2026 by a panel of experts (Richard Allibone, Nicholas Dunn, Daniel Jack, Pete Ravenscroft, and Ciaran Campbell), with assistance from an Otago Regional Council (ORC) ecologist (Scott Jarvie), who has expertise in the RTCS process. This assessment covers freshwater fishes in the Region, following the Regional Threat Classification System manual (Crisp et al. 2026) as shown in Appendix 1, incorporating the list of regional qualifiers in Appendix 2, and the list of national qualifiers in Appendix 3. National threat statuses and national qualifiers from Dunn et al. (2018) were used to inform the regional assessment workshop and updated to be consistent with Dunn et al. (2025). Taxa are referred to by their scientific and common English names, consistent with the national assessment (Dunn et al. 2025). The use of te reo Māori and English in dual place names is based on the New Zealand Gazetteer (https://gazetteer.linz.govt.nz, administered by Toitū Te Whenua Land Information New Zealand), and guided by Kā Huru Manu – the Ngāi Tahu Atlas (https://kahurumanu.co.nz/atlas/).

Following Dunn et al. (2025), all taxa were classified as: 1) ‘taxonomically determinate’, i.e., legitimately and effectively published and generally accepted by relevant experts as distinct; or 2) ‘taxonomically unresolved’, i.e., used loosely to include both recognised but undescribed entities which still require formal taxonomic research to confirm their validity and provide them with a formal name and, occasionally, described species whose taxonomic validity is in question.

Using the standardised methodology, fish taxa not observed in Otago were first removed from consideration based on those recognised in the NZTCS list (Dunn et al. 2025). The next step was to identify Nationally Threatened and At Risk taxa that breed or are resident in the Region. For this assessment, all extant native freshwater fish taxa were confirmed as residents; no national or regional colonisers, migrants, or vagrants are present in the Otago Region. If more than 20% of the national population is breeding or resident for more than half their life cycle in the Region, taxa were assigned the National Stronghold qualifier and the NZTCS criteria applied. To ensure regional and national assessments do not conflict, the regional conservation status for taxa in the Threatened category must not be lower than the national status, for example, a Nationally Endangered taxon cannot be assessed as Regionally Vulnerable or lower but could be assessed as Regionally Critical (Crisp et al. 2026).

Regional thresholds were set at occupancy of more than 1,000 ha in accordance with standardised methodology (Crisp et al. 2026). If taxa did not meet the threshold, they were assigned a regional threat status by applying the NZTCS criteria to the regional

population. If taxa did meet the threshold and the population trend was ±10% stable or increasing, they were assigned the status Regionally Not Threatened.

For Nationally Not Threatened taxa, the regional population threshold was applied. If the population was not stable to increasing/decreasing by more than 10%, the NZTCS criteria were used to determine the regional threat status. Population trend criteria were applied based on current knowledge, projecting from recent past into the future over the next 10 years or three generations, whichever is the longer.

Freshwater fish taxa that have become established in Otago after deliberate or accidental introduction by humans are classified as Introduced and Naturalised. To be considered naturalised, taxa must have established a self-sustaining population in the wild over at least three generations and must have spread beyond the site of initial introduction. A category for Introduced, Not Established was used for freshwater fish taxa observed in Otago following Jarvie et al. (2026b), where: 1) a release is documented, but with no self-sustaining population in the wild; or 2) a deliberate introduction is documented, and published records indicate the species bred (or probably bred), but it is no longer extant.

To inform decisions on population numbers and distributions for the regional threat status of freshwater fish taxa, recent occurrence records (i.e., since 1940) were extracted and cleaned from the publicly accessible New Zealand Freshwater Fish Database (NZFFD, https://nzffdms.niwa.co.nz/, accessed February 2025) then taxonomically harmonised with the list of freshwater fish taxa in the NZTCS (Dunn et al. 2025) using expert knowledge of the names and distributions of freshwater fish taxa. The records were viewed in a locally operated dashboard using R v. 4.2.2 (R Core Team 2022) via the RStudio platform (Posit Team 2023). The main packages used were ‘shiny’ (Chang et al. 2021) and ‘flexdashboard’ (Iannone et al. 2020). The map layers used to view records were OpenStreetMap and Esri WorldImagery.

Further context was provided to the expert panel including published and unpublished reports such as the Climate Change Vulnerability Assessments for some taxa (Egan et al. 2020) and International Union for the Conservation of Nature (IUCN) Red List of Threatened Species assessment reports for taxa, where available (2025-2). For assessing non-diadromous galaxiid fishes, sub-population databases were used by the panel to inform area of occupancy (Dunn 2025b–p). These sub-population databases are outputs following methods devised by Dunn and O’Brien (2022) to integrate demographic and geospatial information to improve threat assessments and ultimately management of freshwater fishes. For all other taxa, the Otago area of occupancy was derived from Dunn (2025a) who sourced measured and modelled occupancies within freshwater and coastal hydrosystems (Snelder et al. 2004; Booker & Hicks 2013; Crow et al. 2014; Hume et al. 2016; White et al. 2022). Environmental DNA (eDNA) data, specifically publicly

available records from Wilderlab (https://wilderlab.co.nz/explore), were occasionally considered by the expert panel to support the distributional knowledge from known physical observations. The panel critically assessed available data and drew on their own expert knowledge to consider current and likely future threats to determine the status and qualifiers for each taxon.

In the tables with regional threat assessment information a notes column provides additional information where available. This may include the common name and threat status of indigenous taxa recorded in the IUCN Red List of Threatened Species status (2025-2; accessed, October 20, 2025), recorded distributions of regional endemic taxa (Appendix 4), locations of type localities (Appendix 5), the taxon's status from Climate Change Vulnerability Assessments (CCVA, Egan et al. 2020), relevant sub-population assessment data (Dunn 2025b–p), and fisheries stock status trend information for species in the quota management system (Fisheries New Zealand 2025).

Spatial identification of the habitats of freshwater fishes is useful for achieving environmental outcomes consistent with regional direction. Spatial presence in the Otago Region was determined using the taxonomically harmonised NZFFD records and further informed by sub-population assessments (Dunn 2025b–p). Information on the recent distribution of extant freshwater fish taxa in Otago is provided for each territorial authority (Table 2; Appendix 6), and for each Freshwater Management Unit (FMU), with the Clutha Mata-au FMU subdivided into five rohe (areas) (Table 3; Appendix 7).

Direction is given to regional councils in the National Policy Statement for Freshwater Management (NPS-FM 2020; Ministry for the Environment – Manatū Mō Te Taiao, 2025) to protect freshwater habitats, address fish passage issues, and provide habitats and conditions that support the recovery of threatened taxa. Further policy direction for taxa listed as Threatened by the IUCN is provided by the New Zealand Coastal Policy Statement 2010 (Department of Conservation – Te Papa Atawhai, 2025) and its accompanying Document for Policy 11(a) (Indigenous Biological Diversity – Biodiversity; Department of Conservation – Te Papa Atawhai, 2019). IUCN assessments are, therefore, considered particularly relevant for taxa found in the Coastal Environment, which includes the Coastal Marine Area (CMA, Appendix 6) and areas that influence and are influenced by coastal processes.

Many freshwater fish taxa assessed by Dunn et al. (2025) utilise habitats and conditions across the freshwater-marine continuum, either obligately or facultatively as part of their life history (McDowall 1990; Dunn et al. 2025). These habitats and conditions occur within and between the CMA and the wider Coastal Environment. While freshwater habitats in proximity to the coast are included within the Coastal Environment, this broader area has not yet been spatially delimited for the Otago Region (Otago Regional Council 2025a, 2025b). Consequently, spatial data or inferred presence based on life

history is provided for the Otago CMA (Appendix 6) but not yet determined for the broader Coastal Environment.

Results

A total of 41 freshwater fish taxa were assessed in the Otago Region since human arrival in Aotearoa New Zealand (Figure 1). Of these taxa, 18 are Regionally Threatened, four are Regionally At Risk, four are Regionally Not Threatened, seven are Regionally Data Deficient, seven are Regionally Introduced and Naturalised, and a single taxon is Regionally Extirpated. In addition to these 41 assessed fish taxa, two were Regionally Introduced, Not Established.

Of the 18 Regionally Threatened taxa in Otago, two are Regionally Critical, four are Regionally Endangered, and 12 are Regionally Vulnerable. Of the four Regionally At Risk taxa, two are Regionally Declining and two are Regionally Naturally Uncommon. The Regionally Extirpated species is globally extinct.

The Region was identified as a National Stronghold for eleven freshwater fish taxa, meaning these taxa are expected to have > 20% of their national population in Otago (Appendix 4). Of those taxa with National Strongholds, nine are Regional Endemics, meaning they are native to the Region and do not breed elsewhere (Appendix 4; Jarvie 2025c). A total of seven taxa were at their natural range limit within the Region, excluding the regionally endemic taxa. There are five freshwater fish taxa with type localities in the Otago Region (Appendix 5, Jarvie 2025d).

Conservation status of freshwater fishes in Otago

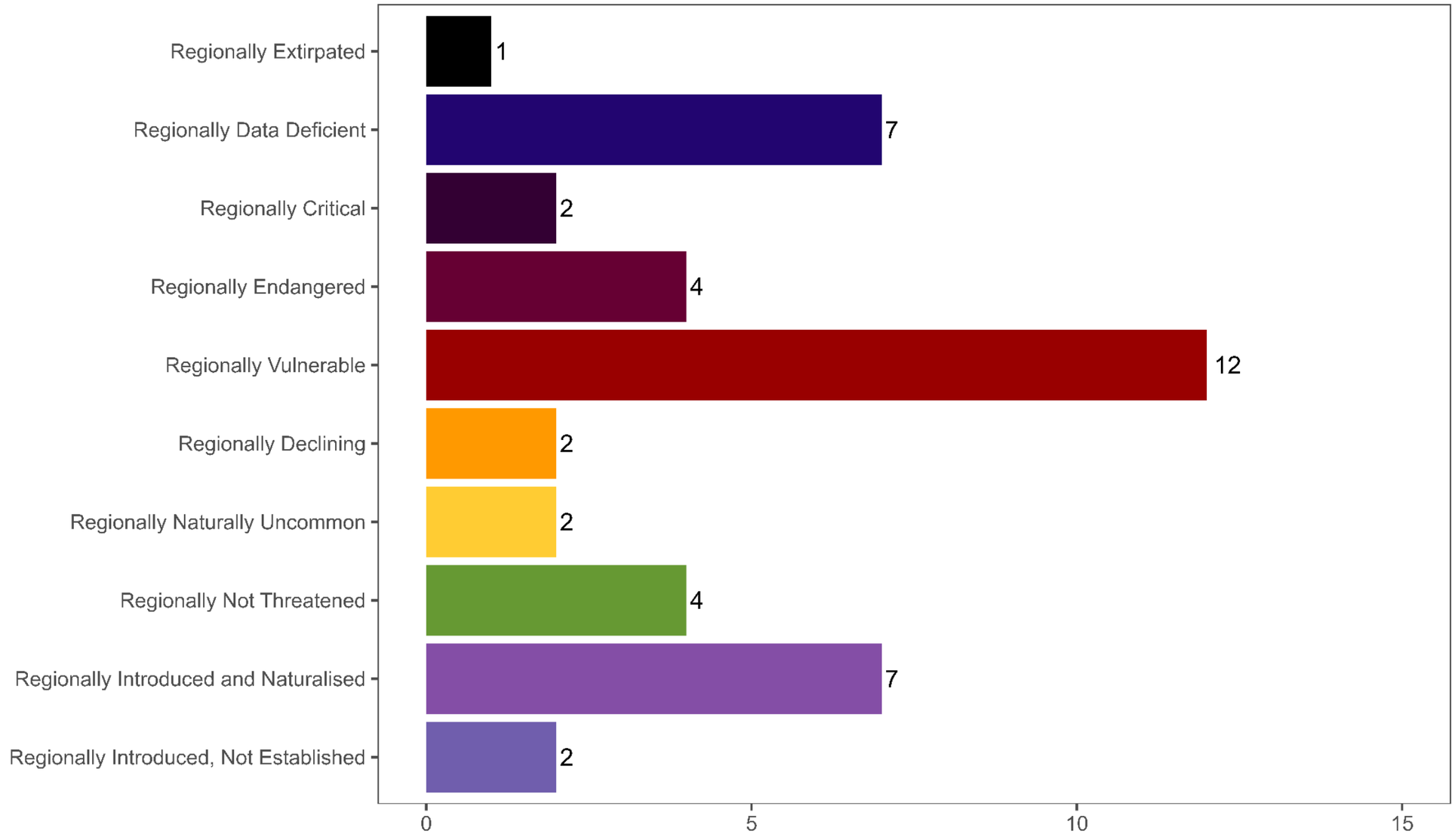


Figure 1. Conservation status of freshwater fishes in the Otago Region.

Table 1.1. Regional conservation status of freshwater fishes in Otago

Regional and national qualifiers are abbreviated as follows: CD = Conservation Dependent; CI = Climate Impact; CRN = Conservation Research Needed; DPR = Data Poor Recognition; DPS = Data Poor Size; DPT = Data Poor Trend; DE = Designated; FR = Former Range; INC = Increasing; NR = Natural Range Limit; NStr = National Stronghold; OL = One Location; PD = Partial Decline; PF = Population Fragmentation; RE = Regional Endemic; RR = Range Restricted; Sp = Biologically Sparse; TL = Type Locality; TO = Threatened Overseas. Other abbreviations are: DEC = declining; MATIND = mature individuals. National threat categories and criteria are summarised in Appendix 1 (see also Rolfe et al. 2022 and https://nztcs.org.nz). Qualifiers are defined in Appendices 2 (national qualifiers; Rolfe et al. 2022) and 3 (regional qualifiers; Crisp et al. 2026).

Common Name and Threat Status of indigenous taxa recorded in the IUCN Red List of Threatened Species (2025-2; accessed, October 20, 2025), recorded distributions of regional endemic taxa (Appendix 4), locations of type localities (Appendix 5), the taxon's status from Climate Change Vulnerability Assessments (CCVA, Egan et al. 2020), sub-population assessment data (Dunn 2025b–p), and fisheries stock status trend information for species in the quota management system (Fisheries New Zealand 2025) are noted where relevant.

Name and Authority	Common Name	National Conservation Status	Regional Criteria	National Stronghold	Regional Endemic	Regional Population	Regional Area	Regional Trend	Regional Confidence Population	Regional Confidence Trend	Regional Qualifiers	National Qualifiers	Notes
REGIONALLY EXTIRPATED (1)													
GLOBALLY EXTINCT (1)													
Taxonomically determinate (1)													
Prototroctes oxyrhynchus Günther 1870	grayling	Extinct											IUCN: Common Name and Threat Status: New Zealand Grayling, Extinct (West et al. 2014b).

Continued next page

Conservation status of freshwater fishes in Otago

Conservation status continued

Name and Authority	Common Name	National Conservation Status	Regional Criteria	National Stronghold	Regional Endemic	Regional Population	Regional Area	Regional Trend	Regional Confidence Population	Regional Confidence Trend	Regional Qualifiers	National Qualifiers	Notes
REGIONALLY DATA DEFICIENT (7)													
Taxonomically determinate (7)													
Anguilla australis Richardson 1841	shortfin eel	Not Threatened									CD, CI, DPS, DPT, SO	CI, SO	IUCN Threat Status: Near Threatened. The IUCN assessment applies to populations in Australia, New Caledonia, New Zealand, and Norfolk Island (Pike et al. 2019a). CCVA: High. Fisheries: Catches in the SFE 15 fish stock area have fluctuated without trend until 2015 and increased since. Low catches in 2022 and 2023 reduce certainty on catch per unit (Fisheries New Zealand 2025). Insufficient data was available to assess the predicted and ongoing trend for this taxon over three generations. Individuals caught or observed are often not differentiated from other eel taxa, which reduces the amount of reliable data available for this taxon.

Continued next page

Conservation status of freshwater fishes in Otago

Data Deficient continued

Name and Authority	Common Name	National Conservation Status	Regional Criteria	National Stronghold	Regional Endemic	Regional Population	Regional Area	Regional Trend	Regional Confidence Population	Regional Confidence Trend	Regional Qualifiers	National Qualifiers	Notes
Anguilla dieffenbachii Gray 1842	longfin eel	Declining									CD, CI, CR, DPS, DPT	CD, CI, DPT	IUCN Threat Status: Endangered (Pike et al. 2019b). CCVA: Very high. Fisheries: Catches in the LFE 15 fish stock area have fluctuated without trend until 2015 and increased since. Low catches in 2022 and 2023 reduce certainty on catch per unit (Fisheries New Zealand 2025). Insufficient data was available to assess the predicted and ongoing trend for this taxon over three generations. Individuals caught or observed are often not differentiated from other eel taxa, reducing the amount of reliable data available for this taxon.
Forsterygion nigripenne (Valenciennes 1836)	estuarine triplefin	Not Threatened											IUCN Threat Status: Least Concern (Franklin & Clements 2014). Freshwater fish surveying and monitoring sites do not typically overlap with *F. nigripenne* habitat.

Continued next page

Conservation status of freshwater fishes in Otago

Data Deficient continued

Name and Authority	Common Name	National Conservation Status	Regional Criteria	National Stronghold	Regional Endemic	Regional Population	Regional Area	Regional Trend	Regional Confidence Population	Regional Confidence Trend	Regional Qualifiers	National Qualifiers	Notes
Geotria australis Gray 1851	lamprey	Nationally Vulnerable									CD, CI, CR, DPS, DPT, S?O, Sp, TO	CI, CR, DPS, DPT, S?O	IUCN Common Name and Threat Status: Pouched lamprey, Data Deficient. The IUCN assessment applies to populations in Australia, Chile, and Aotearoa New Zealand (Baker & Bice 2022). CCVA: Very high. Insufficient data to assess population trends and area of occupancy, partly due to unreliability in results from current sampling and monitoring methods, or biases towards particular life stages. Development of new protocols and emerging techniques and technologies may help in the future (Baker et al. 2024).
Gobiomorphus gobioides (Valenciennes 1837)	giant bully	Naturally Uncommon									CR, DPR, DPS, DPT, RR	DPT, RR	IUCN Threat Status: Least Concern (Ling et al. 2014b). Differentiation from other bully species in the field can be difficult or unreliable. Insufficient data exists to assess area of occupancy and predicted and ongoing population trend. Freshwater fish surveying and monitoring sites do not typically overlap with *G. gobioides* habitat.

Continued next page

Conservation status of freshwater fishes in Otago

Data Deficient continued

Name and Authority	Common Name	National Conservation Status	Regional Criteria	National Stronghold	Regional Endemic	Regional Population	Regional Area	Regional Trend	Regional Confidence Population	Regional Confidence Trend	Regional Qualifiers	National Qualifiers	Notes
Retropinna retropinna (Richardson 1848)	common smelt	Declining									DPS, DPT	CI, CR, DPT, PD	IUCN Threat Status: Least Concern (Franklin et al. 2014). Insufficient data exists to assess population trend partly due to under-reporting in national databases, although juvenile common smelt have been observed at some river mouths in Otago during whitebait seasons (Campbell pers. obs., August – November 2013-2019). Freshwater fish surveying and monitoring sites do not typically overlap with *R. retropinna* habitat.
Stokellia anisodon (Stokell 1941)	Stokell's smelt	Nationally Critical									CI, CR, DPR, DPS, DPT, NR, OL	CI, CR, DPR, RR	IUCN Threat Status: Least Concern (David et al. 2014a). Unreliable differentiation of this from *R. retropinna*. Freshwater fish surveying and monitoring sites do not typically overlap with *S. anisodon* habitat.
REGIONALLY THREATENED (18)													
REGIONALLY CRITICAL (2)													
Taxonomically determinate (1)													
Neochanna burrowsius (Phillipps 1926)	Canterbury mudfish	Nationally Critical	A (3)				≤ 1 ha		Low	Low	CD, CR, DPS, DPT, EF, NR, OL, PF	CD, CI, EF, PF, RR, Sp	IUCN Threat Status: Critically Endangered (West et al. 2014f). Sub-population assessment: Dunn (2025p). Experiencing significant declines in the Canterbury Region, where this taxon is almost exclusively found (Dunn et al. 2025).

Continued next page

Conservation status of freshwater fishes in Otago

Regionally Critical continued

Name and Authority	Common Name	National Conservation Status	Regional Criteria	National Stronghold	Regional Endemic	Regional Population	Regional Area	Regional Trend	Regional Confidence Population	Regional Confidence Trend	Regional Qualifiers	National Qualifiers	Notes
Taxonomically unresolved (1)													
Galaxias "Teviot"	Teviot flathead galaxias (Teviot River)	Nationally Critical	A (3)	Yes	Yes		≤ 1 ha		Medium	Medium	CD, CI, CR, DPR, NR, NStr, OL, PF, RE, Rel	CD, CI, PF, RR	Endemic to Otago. Restricted to ten tributaries of the Te Awa Makarara/Teviot River. An outlying record exists in Red Swamp Creek, a tributary of the upper Taiari / Taieri River. Sub-population assessment: Dunn (2025f).
REGIONALLY ENDANGERED (4)													
Taxonomically determinate (1)													
Galaxias cobitinis McDowall & Waters 2002	lowland longjaw galaxias (Kakanui River)	Nationally Endangered	B (1)	Yes	Yes	250–1000 MATIND		STABLE ±10%	Medium	Medium	CD, CI, CR, EF, NR, NStr, OL, RE, TL, TLH	CD, CI, EF, OL	IUCN Threat Status: Critically Endangered (Allibone et al. 2014g). The IUCN assessment includes lowland longjaw galaxias in the Waitaki catchment, now recognised as a separate entity, namely *Galaxias* aff. *cobitinis* "Waitaki" (Dunn et al. 2025). Sub-population assessment: Dunn (2025j). Endemic to Otago. Found only within its natural range in the Kākaunui / Kakanui River. A conservation translocation into Waianakarua River is now believed to have failed (Dunn et al. 2025). Type locality: Kauru River. Population size for this taxon was assessed using the number of mature individuals, consistent with Dunn et al. (2025).

Continued next page

Conservation status of freshwater fishes in Otago

Regionally Endangered continued

Name and Authority	Common Name	National Conservation Status	Regional Criteria	National Stronghold	Regional Endemic	Regional Population	Regional Area	Regional Trend	Regional Confidence Population	Regional Confidence Trend	Regional Qualifiers	National Qualifiers	Notes
Taxonomically unresolved (3)													
Galaxias "Nevis"	Nevis galaxias (Nevis River)	Nationally Endangered	A (3)	Yes	Yes		≤ 10 ha	DEC: 30-50%	Low	Low	CD, CI, CR, DPS, DPT, NR, NStr, OL, PF, RE	CD, CI, EF, OL	IUCN Threat Status: Not Assessed, although noted and excluded from the assessment for *Galaxias gollumoides*, as they have previously been recognised as conspecifics. Sub-population assessment: Dunn (2025b). Endemic to Otago. Recorded only in the Nevis River / Te Papapuni catchment. It has been lost from historic mainstem sites and is now only found in tributaries above waterfall barriers.
Galaxias "southern"	southern flathead galaxias (Otago, Southland)	Declining	A (3)				≤ 10 ha	DEC: 10-30%	Low	Low	CD, CR, DPS, DPT, NR, PF, RR	CI, CR, DPT, EF, PF, RR, Sp	Sub-population assessment: Dunn (2025d).
Galaxias aff. *paucispondylus* "Manuherikia"	alpine galaxias (Manuherikia River)	Nationally Endangered	B (3)	Yes	Yes		≤ 10 ha	STABLE ±10%	Medium	Medium	CR, NR, NStr, OL, RE	CI, DPT, EF, OL	IUCN Threat Status: Not Assessed, although included in the assessment for *Galaxias paucispondylus*. This taxon has since been split from the parent taxon along with another recognised entity. Sub-population assessment: Dunn (2025g), noting recent survey work (Allibone 2025) and difficulty with estimating area of occupancy in braided river habitats. Endemic to Otago. Only known from upstream of Falls Dam in the Manuherekia / Manuherikia River.

Continued next page

Conservation status of freshwater fishes in Otago

Conservation status continued

Name and Authority	Common Name	National Conservation Status	Regional Criteria	National Stronghold	Regional Endemic	Regional Population	Regional Area	Regional Trend	Regional Confidence Population	Regional Confidence Trend	Regional Qualifiers	National Qualifiers	Notes
REGIONALLY VULNERABLE (12)													
Taxonomically determinate (9)													
Cheimarrichthys fosteri Haast 1874	torrentfish	Naturally Uncommon	C (3)				≤ 100 ha	DEC: 10-30%	Low	Low	CI, CR, DPS, DPT	DPS, RR	IUCN Threat Status: Vulnerable (Allibone et al. 2014c).
Galaxias anomalus Stokell 1959	central Otago roundhead galaxias	Nationally Vulnerable	C (3)	Yes	Yes		≤ 100 ha	DEC: 10-30%	Medium	Low	CD, CI, CR, DPT, EF, NR, NStr, PF, RE, RR, TL, TLH	CD, CI, EF, PF, RR	IUCN Threat Status: Critically Endangered (Allibone et al. 2014f) Sub-population assessment: Dunn (2025i). Endemic to Otago. Recorded in Taiari / Taieri River catchment and the Manuherekia / Manuherikia River within the Clutha River / Mata-Au. Type locality: Ophir Spring.
Galaxias argenteus (Gmelin 1789)	giant kokopu	Declining	B (3)				≤ 100 ha	STABLE ±10%	Low	Low	CD, CI, CR, DPS, DPT, RF, RR	CI, DPT, PD	IUCN Threat Status: Vulnerable (West et al. 2014e). CCVA: Moderate.
Galaxias eldoni McDowall 1997	Eldon's galaxias	Nationally Vulnerable	C (3)	Yes	Yes		≤ 100 ha	DEC: 10-30%	Medium	Low	CD, CR, DPT, NR, NStr, PD, PF, RE, RR, TL, TLH	CD, CI, PD, PF, RR	IUCN Threat Status: Critically Endangered (Allibone et al. 2014a). Sub-population assessment: Dunn (2025l). Endemic to Otago. Recorded in the Taiari / Taieri River and Tokomairaro River catchments. Type locality: Smugglers Creek.
Galaxias fasciatus Gray 1842	banded kokopu	Naturally Uncommon	B (3)				≤ 100 ha	STABLE ±10%	Low	Medium	CD, CI, CR, DPS, RR		IUCN Threat Status: Least Concern (West et al. 2014a). CCVA: High.
Galaxias gollumoides McDowall & Chadderton 1999	Gollum galaxias	Declining	B (3)				≤ 100 ha	STABLE ±10%	Low	Low	CI, DPR, DPS, DPT, NR, PF, RR	CI, DPT, PF, RR, Sp	IUCN Threat Status: Critically Endangered (Allibone et al. 2014e). Sub-population assessment: Dunn (2025m).

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Conservation status of freshwater fishes in Otago

Regionally Vulnerable continued

Name and Authority	Common Name	National Conservation Status	Regional Criteria	National Stronghold	Regional Endemic	Regional Population	Regional Area	Regional Trend	Regional Confidence Population	Regional Confidence Trend	Regional Qualifiers	National Qualifiers	Notes
Galaxias maculatus (Jenyns 1842)	inanga	Nationally Vulnerable					> 1000 ha	STABLE ±10%	Medium	Low	CD, CI, CR, DPT, T?O	CD, DPS, RR, SO?	IUCN Common Name and Threat Status: Common galaxias, Least Concern, noting the IUCN assessment applies to populations in Argentina, Australia, Chile, Falkland Islands, and Aotearoa New Zealand (Bice et al. 2019). CCVA: High. This taxon was assessed as Regionally Vulnerable, consistent with the national assessment (Dunn et al. 2025) and the standardised protocol (Crisp et al. 2026).
Galaxias pullus McDowall 1997	dusky galaxias	Nationally Vulnerable	C (3)	Yes	Yes		≤ 100 ha	DEC: 10-30%	Medium	Medium	CD, CI, CR, NR, NStr, PD, PF, RE, RR, TL, TLH	CD, CI DPT, PD, PF, RR	IUCN Threat Status: Critically Endangered (Allibone et al. 2014d). Sub-population assessment: Dunn (2025n). Endemic to Otago. Recorded in the Taiari / Taieri and Clutha River / Mata-Au catchments. Type locality: Stream draining Munro Dam.
Galaxias vulgaris Stokell 1949	Canterbury galaxias	Naturally Uncommon	B (3)				≤ 100 ha	STABLE ±10%	Medium	Low	CD, CI, DPT, NR, RR	CI, DPT, PF	IUCN Threat Status: Least Concern (Allibone et al. 2014h).
Taxonomically unresolved (3)													
Galaxias "Pomahaka"	Pomahaka galaxias (Pomahaka River)	Nationally Vulnerable	C (3)	Yes			≤ 100 ha	DEC: 10-30%	Medium	Low	CD, CI, CR, DPR, DPT, NR, NStr, PF, RR	CD, CI, DPT, PF, RR	Sub-population assessment: Dunn (2025c). This lineage currently includes some sub-populations previously assigned to *Galaxias* “lower Clutha” and *Galaxias* “species D” (Dunn et al. 2025).

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Conservation status of freshwater fishes in Otago

Regionally Vulnerable continued

Name and Authority	Common Name	National Conservation Status	Regional Criteria	National Stronghold	Regional Endemic	Regional Population	Regional Area	Regional Trend	Regional Confidence Population	Regional Confidence Trend	Regional Qualifiers	National Qualifiers	Notes
Galaxias "species D"	Clutha flathead galaxias (Clutha River)	Nationally Vulnerable	C (3)	Yes	Yes		≤ 100 ha	DEC: 10-30%	Medium	Low	CD, CI, CR, DPR, DPT, NR, NStr, PD, PF, RE	CD, CI, DPT, PF, RR	Sub-population assessment: Dunn (2025e). Endemic to Otago. Mostly confined to tributaries of the Clutha River/Mata-Au catchment, and also in some rivers in The Catlins area. This lineage includes sub-populations previously assigned to *Galaxias* "lower Clutha" and *Galaxias* "Pomahaka" (Dunn et al. 2025).
Galaxias aff. *paucispondylus* "Southland"	alpine galaxias (Southland)	Declining	B (3)				≤ 100 ha	STABLE ±10%	Low	Low	CR, DPS, DPT, NR, RR	CI, DPT, EF, PF, RR, Sp	IUCN Threat Status: Not Assessed, although included in the assessment for *G. paucispondylus*. This taxon is recognised outside of the IUCN process as split from the parent taxon along with another recognised affinis. Sub-population assessment: Dunn (2025h).
REGIONALLY AT RISK (4)													
REGIONALLY DECLINING (2)													
Taxonomically determinate (2)													
Galaxias brevipinnis Günther 1866	koaro	Declining	C (2)	Yes			> 10,000 ha	DEC: 10-30%	Low	Low	CR, DPS, DPT, NStr, S?O	CI, DPT, PD	IUCN Common Name and Threat Status: Climbing galaxias, Least Concern, noting the IUCN assessment applies to populations in Australia and Aotearoa New Zealand (Raadik et al. 2019). CCVA: High.

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Conservation status of freshwater fishes in Otago

Regionally Declining continued

Name and Authority	Common Name	National Conservation Status	Regional Criteria	National Stronghold	Regional Endemic	Regional Population	Regional Area	Regional Trend	Regional Confidence Population	Regional Confidence Trend	Regional Qualifiers	National Qualifiers	Notes
Galaxias depressiceps McDowall & Wallis 1996	Taieri flathead galaxias	Declining	A (2)	Yes	Yes		≤ 1,000 ha	DEC: 10-30%	Medium	Low	CD, CI, CR, DPT, NR, NStr, PD, PF, RE, RR, TL	Sp, CI, CD, DPT, PF, RR	IUCN Threat Status: Vulnerable (Allibone et al. 2020). Sub-population assessment: Dunn (2025k). Type locality: Healy Creek. Endemic to Otago. Recorded in the Taiari / Taieri River, Waihemo / Shag River, Waikōuaiti / Waikouaiti River, Akatore Creek, and Tokomairaro River catchments.
REGIONALLY NATURALLY UNCOMMON (2)													
Taxonomically determinate (2)													
Gobiomorphus hubbsi (Stokell 1959)	bluegill bully	Naturally Uncommon					< 100,000 ha	STABLE ±10%	Medium	Low	CI, CR, DPT		IUCN Threat Status: Vulnerable (Allibone et al. 2014b).
Gobiomorphus huttoni (Ogilby 1894)	redfin bully	Naturally Uncommon					< 100,000 ha	STABLE ±10%	Medium	Low	CI, CR, DPT, PD		IUCN Threat Status: Near Threatened (Ling et al. 2014a).

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Conservation status of freshwater fishes in Otago

Conservation status continued

Name and Authority	Common Name	National Conservation Status	Regional Criteria	National Stronghold	Regional Endemic	Regional Population	Regional Area	Regional Trend	Regional Confidence Population	Regional Confidence Trend	Regional Qualifiers	National Qualifiers	Notes
REGIONALLY NOT THREATENED (4)													
Taxonomically determinate (4)													
Aldrichetta forsteri (Valenciennes 1836)	yellow-eye mullet	Not Threatened					> 1000 ha	STABLE ±10%	Medium	Low	DPT, SO	DPT, SO	IUCN Common Name and Threat Status: yelloweyed mullet, Least Concern, noting the IUCN assessment applies to populations in Australia and Aotearoa New Zealand (David et al. 2014b). CCVA: Low. Fisheries: There is insufficient information to estimate stocks of yellow-eye mullet in the "YEM 3" fish stock area (Fisheries New Zealand 2025).
Gobiomorphus breviceps (Stokell 1939)	upland bully	Naturally Uncommon					> 1000 ha	STABLE ±10%	High	High			IUCN: Threat Status: Least Concern (West et al. 2014c), although includes the recently described sister lineage (*Gobiomorphus mataraerore*, Thacker et al. 2023).
Gobiomorphus cotidianus McDowall 1975	common bully	Not Threatened					> 1000 ha	STABLE ±10%	Medium	Medium			IUCN Threat Status: Least Concern (West et al. 2014d).
Rhombosolea retiaria Hutton 1874	black flounder	Not Threatened					> 1000 ha	STABLE ±10%	Medium	Low	CR, DPT	CI, CR, DPT	IUCN Threat Status: Data Deficient (David et al. 2014c). Fisheries: The lack of species-specific reporting limits the ability to assess long-term trends in stocks of black flounder (BFL) within the "FLA 3" flatfish stock area (Fisheries New Zealand 2025).

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Conservation status of freshwater fishes in Otago

Conservation status continued

Name and Authority	Common Name	National Conservation Status	Regional Criteria	National Stronghold	Regional Endemic	Regional Population	Regional Area	Regional Trend	Regional Confidence Population	Regional Confidence Trend	Regional Qualifiers	National Qualifiers	Notes
REGIONALLY INTRODUCED AND NATURALISED (7)													
Taxonomically determinate (7)													
Carassius auratus (Linnaeus 1758)	goldfish	Introduced and Naturalised										Inc	
Oncorhynchus mykiss (Walbaum 1792)	rainbow trout	Introduced and Naturalised											
Oncorhynchus tshawytscha (Walbaum 1792)	Chinook salmon	Introduced and Naturalised											
Perca fluviatilis Linnaeus 1758	perch	Introduced and Naturalised										Inc	
Salmo trutta Linnaeus 1758	brown trout	Introduced and Naturalised											
Salvelinus fontinalis (Mitchill 1814)	brook char	Introduced and Naturalised											
Tinca tinca (Linnaeus 1758)	tench	Introduced and Naturalised										Inc	

Two taxa in the Otago Region have been identified as Regionally Introduced, Not Established, where either a release has been documented with no record of self-sustaining population in the wild, or a deliberate introduction is documented, published records indicate the species bred (or probably bred), but it is no longer extant (Table 1.2).

Table 1.2. Regionally Introduced, Not Established freshwater fishes in Otago.

Name and Authority	Common Name	National Conservation Status	Notes
REGIONALLY INTRODUCED, NOT ESTABLISHED (2)			
Taxonomically determinate (2)			
Ctenopharyngodon idella (Valenciennes 1844)	grass carp		Not assessed by Dunn et al. (2025), as this taxon does not fit the New Zealand Threat Classification System criteria.
Salmo salar Linnaeus 1758	Atlantic salmon	Introduced and Naturalised	While its national status is uncertain, this taxon is highly likely extinct in the Otago Region (J. Couper pers. comm. 2026, Fish and Game; Dunn et al. 2025; Stokell 1955).

Presence of 41 extant freshwater fish taxa were assessed for the Coastal Marine Area, each Territorial Authority, and each Freshwater Management Unit or rohe in the Otago Region and summarised in Tables 2 and 3.

Table 2. Presence of extant freshwater fish taxa by territorial authority and Coastal Marine Area in the Otago Region.

Territorial authorities and a provisional Coastal Marine Area (CMA) are mapped in Appendix 6. *P* indicates a taxon was recently recorded (since 1940) in the New Zealand Freshwater Fish Database or in sub-population assessments (Dunn 2025b–p) to be present in a territorial authority or the CMA, except for grass carp which was inferred from unpublished observations; *LP* indicates a taxon has not been recorded present in the CMA but is inferred by life history.

Name and Authority	Common Name	Central Otago District Council	Clutha District Council	Dunedin City Council	Queenstown Lakes District Council	Waitaki District Council (Otago part only)	Coastal Marine Area
REGIONALLY THREATENED							
REGIONALLY CRITICAL							
Galaxias "Teviot"	Teviot flathead galaxias (Teviot River)	*P*					
Neochanna burrowsius (Phillipps 1926)	Canterbury mudfish					*P*	
REGIONALLY ENDANGERED							
Galaxias cobitinis McDowall & Waters 2002	lowland longjaw galaxias (Kakanui River)					*P*	
Galaxias "Nevis"	Nevis galaxias (Nevis River)	*P*					
Galaxias "southern"	southern flathead galaxias (Otago, Southland)		*P*		*P*		
Galaxias aff. *paucispondylus* "Manuherikia"	alpine galaxias (Manuherikia River)	*P*					
REGIONALLY VULNERABLE							
Cheimarrichthys fosteri Haast 1874	torrentfish	*P*	*P*	*P*		*P*	*LP*
Galaxias "Pomahaka"	Pomahaka galaxias (Pomahaka River)	*P*	*P*				
Galaxias "species D"	Clutha flathead galaxias (Clutha River)	*P*	*P*		*P*		
Galaxias aff. *paucispondylus* "Southland"	alpine galaxias (Southland)				*P*		
Galaxias anomalus Stokell 1959	central Otago roundhead galaxias	*P*		*P*			
Galaxias argenteus (Gmelin 1789)	giant kokopu		*P*	*P*		*P*	*LP*
Galaxias eldoni McDowall 1997	Eldon's galaxias		*P*	*P*			
Galaxias fasciatus Gray 1842	banded kokopu		*P*	*P*		*P*	*LP*
Galaxias gollumoides McDowall & Chadderton 1999	Gollum galaxias		*P*		*P*		
Galaxias maculatus (Jenyns 1842)	inanga	*P*	*P*	*P*		*P*	*LP*
Galaxias pullus McDowall 1997	dusky galaxias	*P*	*P*	*P*			
Galaxias vulgaris Stokell 1949	Canterbury galaxias					*P*	

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Conservation status of freshwater fishes in Otago

Presence continued

Name and Authority	Common Name	Central Otago District Council	Clutha District Council	Dunedin City Council	Queenstown Lakes District Council	Waitaki District Council (Otago part only)	Coastal Marine Area
REGIONALLY AT RISK							
REGIONALLY DECLINING							
Galaxias brevipinnis Günther 1866	koaro	*P*	*P*	*P*	*P*	*P*	*LP*
Galaxias depressiceps McDowall & Wallis 1996	Taieri flathead galaxias	*P*	*P*	*P*		*P*	
REGIONALLY NATURALLY UNCOMMON							
Gobiomorphus hubbsi (Stokell 1959)	bluegill bully		*P*	*P*		*P*	*LP*
Gobiomorphus huttoni (Ogilby 1894)	redfin bully		*P*	*P*		*P*	*LP*
REGIONALLY NOT THREATENED							
Aldrichetta forsteri (Valenciennes 1836)	yellow-eye mullet		*P*	*P*		*P*	*LP*
Gobiomorphus breviceps (Stokell 1939)	upland bully	*P*	*P*	*P*	*P*	*P*	
Gobiomorphus cotidianus McDowall 1975	common bully	*P*	*P*	*P*	*P*	*P*	*P*
Rhombosolea retiaria Hutton 1874	black flounder		*P*	*P*		*P*	*P*
REGIONALLY DATA DEFICIENT							
Anguilla australis Richardson 1841	shortfin eel	*P*	*P*	*P*		*P*	*LP*
Anguilla dieffenbachii Gray 1842	longfin eel	*P*	*P*	*P*	*P*	*P*	*LP*
Forsterygion nigripenne (Valenciennes 1836)	estuarine triplefin		*P*	*P*			*LP*
Geotria australis Gray 1851	lamprey	*P*	*P*	*P*		*P*	*LP*
Gobiomorphus gobioides (Valenciennes 1837)	giant bully		*P*	*P*		*P*	*LP*
Retropinna retropinna (Richardson 1848)	common smelt	*P*	*P*	*P*		*P*	*P*
Stokellia anisodon (Stokell 1941)	Stokell's smelt					*P*	*P*
REGIONALLY INTRODUCED AND NATURALISED							
Carassius auratus (Linnaeus 1758)	goldfish	*P*	*P*	*P*	*P*		
Oncorhynchus mykiss (Walbaum 1792)	rainbow trout	*P*	*P*	*P*	*P*		
Oncorhynchus tshawytscha (Walbaum 1792)	Chinook salmon	*P*	*P*	*P*	*P*	*P*	*P*
Perca fluviatilis Linnaeus 1758	perch	*P*	*P*	*P*	*P*	*P*	
Salmo trutta Linnaeus 1758	brown trout	*P*	*P*	*P*	*P*	*P*	*LP*
Salvelinus fontinalis (Mitchill 1814)	brook char	*P*	*P*	*P*	*P*	*P*	
Tinca tinca (Linnaeus 1758)	tench					*P*	
REGIONALLY INTRODUCED, NOT ESTABLISHED							
Ctenopharyngodon idella (Valenciennes 1844)	grass carp				*P*		

Table 3. Presence of extant freshwater fish taxa in Freshwater Management Units (FMU) in the Otago Region. The Clutha Mata-au FMU has been further subdivided into five rohe (areas).

Freshwater management units and rohe are mapped in Appendix 7. *P* indicates a taxon was recently recorded (since 1940) in the New Zealand Freshwater Fish Database or in sub-population assessments (Dunn 2025b–p) to be present in a FMU or rohe, except for grass carp which was inferred from unpublished observations.

Name and Authority	Common Name	North Otago FMU	Dunedin & Coast FMU	Taiari FMU	Catlins FMU	Clutha Mata-au FMU				
						Upper Lakes Rohe	Dunstan Rohe	Roxburgh Rohe	Manuherekia Rohe	Lower Clutha Rohe
REGIONALLY THREATENED										
REGIONALLY CRITICAL										
Galaxias "Teviot"	Teviot flathead galaxias (Teviot River)			*P*				*P*		
Neochanna burrowsius (Phillipps 1926)	Canterbury mudfish	*P*								
REGIONALLY ENDANGERED										
Galaxias cobitinis McDowall & Waters 2002	lowland longjaw galaxias (Kakanui River)	*P*								
Galaxias "Nevis"	Nevis galaxias (Nevis River)						*P*			
Galaxias "southern"	southern flathead galaxias (Otago, Southland)				*P*	*P*				
Galaxias aff. *paucispondylus* "Manuherikia"	alpine galaxias (Manuherikia River)								*P*	
REGIONALLY VULNERABLE										
Cheimarrichthys fosteri Haast 1874	torrentfish	*P*			*P*			*P*		*P*
Galaxias "Pomahaka"	Pomahaka galaxias (Pomahaka River)		*P*					*P*		*P*
Galaxias "species D"	Clutha flathead galaxias (Clutha River)			*P*	*P*		*P*	*P*	*P*	*P*
Galaxias aff. *paucispondylus* "Southland"	alpine galaxias (Southland)					*P*				
Galaxias anomalus Stokell 1959	central Otago roundhead galaxias			*P*					*P*	
Galaxias argenteus (Gmelin 1789)	giant kokopu	*P*	*P*	*P*	*P*					*P*
Galaxias eldoni McDowall 1997	Eldon's galaxias		*P*	*P*						
Galaxias fasciatus Gray 1842	banded kokopu	*P*	*P*	*P*	*P*					
Galaxias gollumoides McDowall & Chadderton 1999	Gollum galaxias				*P*	*P*				*P*
Galaxias maculatus (Jenyns 1842)	inanga	*P*	*P*	*P*	*P*			*P*		*P*
Galaxias pullus McDowall 1997	dusky galaxias			*P*				*P*		*P*
Galaxias vulgaris Stokell 1949	Canterbury galaxias	*P*								

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Conservation status of freshwater fishes in Otago

Presence continued

Name and Authority	Common Name	North Otago FMU	Dunedin & Coast FMU	Taiari FMU	Catlins FMU	Clutha Mata-au FMU				
						Upper Lakes Rohe	Dunstan Rohe	Roxburgh Rohe	Manuherekia Rohe	Lower Clutha Rohe
REGIONALLY AT RISK										
REGIONALLY DECLINING										
Galaxias brevipinnis Günther 1866	koaro	*P*	*P*	*P*	*P*	*P*	*P*	*P*	*P*	*P*
Galaxias depressiceps McDowall & Wallis 1996	Taieri flathead galaxias	*P*	*P*	*P*						
REGIONALLY NATURALLY UNCOMMON										
Gobiomorphus hubbsi (Stokell 1959)	bluegill bully	*P*	*P*		*P*					
Gobiomorphus huttoni (Ogilby 1894)	redfin bully	*P*	*P*	*P*	*P*					*P*
REGIONALLY NOT THREATENED										
Aldrichetta forsteri (Valenciennes 1836)	yellow-eye mullet	*P*	*P*	*P*						*P*
Gobiomorphus breviceps (Stokell 1939)	upland bully	*P*	*P*	*P*	*P*	*P*	*P*	*P*	*P*	*P*
Gobiomorphus cotidianus McDowall 1975	common bully	*P*	*P*	*P*	*P*	*P*	*P*	*P*	*P*	*P*
Rhombosolea retiaria Hutton 1874	black flounder	*P*	*P*	*P*	*P*					*P*
REGIONALLY DATA DEFICIENT										
Anguilla australis Richardson 1841	shortfin eel	*P*	*P*	*P*	*P*			*P*		*P*
Anguilla dieffenbachii Gray 1842	longfin eel	*P*	*P*	*P*	*P*	*P*	*P*	*P*	*P*	*P*
Forsterygion nigripenne (Valenciennes 1836)	estuarine triplefin		*P*		*P*					
Geotria australis Gray 1851	lamprey	*P*	*P*	*P*	*P*			*P*		*P*
Gobiomorphus gobioides (Valenciennes 1837)	giant bully	*P*	*P*		*P*					*P*
Retropinna retropinna (Richardson 1848)	common smelt	*P*	*P*	*P*	*P*			*P*		*P*
Stokellia anisodon (Stokell 1941)	Stokell's smelt	*P*								
REGIONALLY INTRODUCED AND NATURALISED										
Carassius auratus (Linnaeus 1758)	goldfish		*P*			*P*	*P*		*P*	*P*
Oncorhynchus mykiss (Walbaum 1792)	rainbow trout		*P*	*P*		*P*	*P*	*P*	*P*	*P*
Oncorhynchus tshawytscha (Walbaum 1792)	Chinook salmon	*P*	*P*	*P*		*P*	*P*	*P*		*P*
Perca fluviatilis Linnaeus 1758	perch	*P*	*P*	*P*	*P*		*P*	*P*	*P*	*P*
Salmo trutta Linnaeus 1758	brown trout	*P*	*P*	*P*	*P*	*P*	*P*	*P*	*P*	*P*
Salvelinus fontinalis (Mitchill 1814)	brook char	*P*	*P*	*P*		*P*	*P*		*P*	*P*
Tinca tinca (Linnaeus 1758)	tench	*P*								
REGIONALLY INTRODUCED, NOT ESTABLISHED										
Ctenopharyngodon idella (Valenciennes 1844)	grass carp					*P*	*P*			

Discussion

This report is the first regional conservation status for freshwater fish in the Otago Region. A total of 43 freshwater fish taxa were identified in the Otago Region since human arrival in Aotearoa New Zealand (Figure 1). Of the 41 taxa assessed using the standardised methodology, 18 are Regionally Threatened, four are Regionally At Risk, four are Regionally Not Threatened, seven are Regionally Data Deficient, seven taxa were Regionally Introduced and Naturalised, and a single taxon was identified as Regionally Extirpated. In addition to these assessed taxa, two taxa were identified as Regionally Introduced, Not Established.

Regionally Extirpated freshwater fish

Prototroctes oxyrhynchus was last observed in the early 1930s and is now confirmed as globally extinct (West et al. 2014b). Formerly widespread in lowland rivers and streams throughout the North Island/Te Ika-a-Māui and South Island/Te Waipounamu and previously known from Otago rivers (Lee & Perry 2019). In Tūhura Otago Museum, a specimen is stored with the collection site noted as Molyneux (Clutha) River.

Regionally Data Deficient freshwater fish taxa

The Otago Region has seven Regionally Data Deficient freshwater fish species (Table 1.1), which were assigned to this category for three main reasons. First, for five species (*Forsterygion nigripenne*, *Geotria australis*, *Gobiomorphus gobioides*, *Retropinna retropinna*, and *Stokellia anisodon*), information is mostly available from incidental captures and a limited number of species-specific or habitat-specific targeted surveys or monitoring programmes, limiting data available to confidently assess population size or trend. Additionally, for *S. anisodon*, their range has a very narrow known overlap with the Otago Region at the Waitaki River mouth, an artifact of the mid-river border with the Canterbury Region. For *G. australis*, their habitats may overlap with sampling effort but the methods until recently have either not targeted *G. australis* or have been ineffective at detecting them (Baker & Bice 2022; Baker et al. 2024).

Second, predicted and ongoing population trends for three generations of *Anguilla australis*, and *A. dieffenbachii* were unable to be determined during this assessment. Generation times are 20 years for *A. australis* (Pike et al. 2019a) and 30 years for *A. dieffenbachii* (Pike et al. 2019b). Area of occupancy was ascertained for these taxa (Dunn 2025a), but population trends held such uncertainty across three generations.

Third, identification of some taxa in freshwater fish monitoring or surveying is unreliable, either because differentiation is not attempted or recorded (e.g., *A. dieffenbachii*, *A. australis*, *G. gobioides*, *S. anisodon*), or because differentiation is difficult (e.g., *G. gobioides*, *S. anisodon*).

Regionally Threatened freshwater fish taxa

In the Otago Region, there were 18 Regionally Threatened freshwater fish taxa (Table 1.1). These include two Regionally Critical, four Regionally Endangered, and 12 Regionally Vulnerable taxa. Both *Neochanna burrowsius* and *Galaxias* "Teviot" are Regionally Critical and Nationally Critical, sharing the most severe regional and national threat statuses, respectively (Table 1.1).

The four Regionally Endangered taxa were *G. cobitinis*, *Galaxias* "Nevis", *Galaxias* "southern", and *Galaxias* aff. *paucispondylus* "Manuherikia" (Table 1.1). Of the four Regionally Endangered freshwater fish taxa, three had the Nationally Endangered status and the other had the At Risk – Declining status; this latter taxon has a more elevated conservation status regionally than nationally, reflecting greater conservation concern within the Region. Specifically, *Galaxias* "southern" occupies less than 10 ha in Otago, although it is more widespread in the Southland Region. *Galaxias* "southern" are only known in the Otago Region from several tributary streams of the Von River South Branch, and detectability has declined over the last two decades (Jack 2015).

Of the 12 Regionally Vulnerable freshwater fish taxa, six taxa share an equivalent Nationally Vulnerable status, while six taxa were assessed nationally as At Risk (Table 1.1). The six Regionally Vulnerable taxa with equivalent national status were *G. anomalus*, *G. eldoni*, *G. maculatus*, *G. pullus*, *Galaxias* "Pomahaka", and *Galaxias* "species D". In contrast, the other six Regionally Vulnerable taxa – *Cheimarrichthys fosteri*, *G. argenteus*, *G. fasciatus*, *G. gollumoides*, *G. vulgaris*, and *Galaxias* aff. *paucispondylus* "Southland" – hold a more elevated conservation status regionally than nationally, reflecting their greater conservation concern within the Region.

Regionally At Risk freshwater fish taxa

In the Otago Region four freshwater fish species were assigned a Regionally At Risk category (Table 1.1). Two were Regionally Declining and two were Regionally Naturally Uncommon. The Regionally Declining taxa in Otago were *G. brevipinnis* and *G. depressiceps*. For *G. brevipinnis* in Otago, the potential for different population trends were noted for diadromous and potadromous (i.e., migratory freshwater-resident) populations. This taxon meets the Partial Decline Qualifier as it is considered to be declining over most of its range, including diadromous populations within the Otago Region and beyond, but different population trends are likely in Otago's lakes and surrounding tributaries (e.g., Lake Mahinerangi, Whakatipu Waimāori/Lake Wakatipu, Lake Wānaka, Te Wairere/Lake Dunstan, Lake Roxburgh). Since 2017, the known area of occupancy for *G. depressiceps* increased from ≤100ha to 100–1000ha (Dunn 2025a; Dunn 2025k; Dunn & O'Brien 2022). Additionally, restoration efforts for *G. depressiceps* in Akatore Creek (Jack et al. 2023), and tributaries of Waihemo / Shag River (Otago Regional Council 2025c) were being initiated or taking effect during this time.

The Regionally Naturally Uncommon taxa were *Gobiomorphus hubbsi* and *G. huttoni*. In Otago, these fishes had area of occupancy of ≤ 1,000ha and population trends that were Stable ± 10%.

Regionally Not Threatened freshwater fish taxa

Four freshwater fish taxa in Otago were Regionally Not Threatened: *G. breviceps*, *G. cotidianus*, *R. retiaria*, and *A. forsteri* (Table 1.1). Of the Regionally Not Threatened taxa only *G. breviceps* had a lower conservation status regionally than nationally, reflecting greater conservation concern elsewhere, i.e., Regionally Not Threatened cf. to Nationally Naturally Uncommon. In Otago, this taxon has a stable population and exceeds the regional scaling threshold for area of occupancy (i.e., > 1,000 ha, Dunn 2025a). There is no evidence for predicted or ongoing decline for the Otago population, and *G. breviceps* are well-distributed in suitable habitat types in the Region. All other Regionally Not Threatened taxa had the equivalent national status.

Regionally Introduced and Naturalised freshwater fish taxa

In Otago, seven freshwater fish species were identified as Regionally Introduced and Naturalised (Table 1.1). These are taxa that have become naturalised in the wild after being deliberately or accidentally introduced in Aotearoa New Zealand by human agency. Introductions of exotic fish have occurred in Otago since the late 1860s, including for sports fish. All seven Regionally Introduced and Naturalised taxa in Otago have secure populations overseas. While some of these taxa are recorded in discrete catchments or sub-catchments in the Otago Region (e.g., *Tinca tinca*), others are widespread in Otago's freshwater environment (e.g., *Salmo trutta*).

Regionally Introduced, Not Established freshwater fish taxa

This category includes freshwater fish taxa observed where: 1) a release is documented, but a self-sustaining population has not yet established in the wild; or 2) where a deliberate introduction is documented and published records indicate the species bred (or probably bred), but it is no longer extant. *Ctenopharyngodon idella* and *Salmo salar* were identified as Regionally Introduced, Not Established (Table 1.2).

Ctenopharyngodon idella have been documented as deliberately introduced into the wild in Otago for aquatic weed control, but there is no evidence of a self-sustaining population establishing. The Ministry for Primary Industries – Manatū Ahu Matua (MPI) and Department of Conservation – Te Papa Atawhai (DOC) both have statutory roles for approving the release of *C. idella*; DOC for releases to new locations and MPI for locations where *C. idella* already exist. *Ctenopharyngodon idella* release has been permitted in an artificial pond by DOC near Lake Hayes/Waiwhakaata although subsequent unauthorised releases in the Otago Region and more broadly across the country are being investigated (Phoenix Hale pers. comm. 2025, DOC). Although Otago is unlikely to currently have the environmental conditions necessary for *C. idella* to successfully breed in the wild, this likelihood is not impossible and ecological consequences are potentially dire (Hofstra et al. 2014).

Although *S. salar* are not recorded in the Otago Region in the New Zealand Freshwater Fish Database, deliberate introductions and established wild populations are documented in the Otago Region from 1868 onwards. Establishment was not successful, with the taxon now considered extirpated from the Otago Region and nationally either extinct or declining towards extinction while restricted to the Waiau catchment in the Southland Region (Jayde Couper, pers. comm. 2026, Fish and Game; Dunn et al. 2025; Stokell 1955).

Select Regional Qualifiers discussion

Qualifiers can provide additional information on a taxon's threat status. Below are explanations of why some regional qualifiers were used for freshwater fish taxa in Otago.

Regional Endemics and National Strongholds

The Otago Region has 11 species assigned the qualifier National Stronghold (Appendix 4), meaning they have > 20% of the national population in Otago. Nine of these taxa are regional endemics, i.e., known to be native and only breed in Otago. The regional endemics are *Galaxias* "Nevis", *Galaxias* "species D", *Galaxias* "Teviot", *Galaxias* aff. *paucispondylus* "Manuherikia", *G. anomalus*, *G. cobitinis*, *G. depressiceps*, *G. eldoni*, and *G. pullus*. Two taxa, *Galaxias* "Pomahaka" and *G. brevipinnis*, have Otago national strongholds and are also found elsewhere. *Galaxias* "Pomahaka" are almost exclusively recorded in the Otago Region but also found in the Southland Region near to the regional boundary shared with Otago. Although *G. brevipinnis* are widely distributed throughout Australia (Victoria, Tasmania, South Australia, New South Wales), and Aotearoa New Zealand (Te Waipounamu / South Island, Te Ika-a-Māui / North Island, Chatham Island / Rēkohu, and sub-Antarctic islands), the Otago Region is a stronghold for the national population. Of the taxa that have National Strongholds in Otago, nine were Regionally Threatened (Regionally Critical = 1; Regionally Endangered = 3; Regionally Vulnerable = 5), and two were Regionally At Risk (Regionally Declining).

Type Locality

The type locality of a nominal taxon refers to the geographical place of capture, collection, or observation on the name-bearing type or specimen. The five taxa with Otago type localities are *G. anomalus*, *G. cobitinis*, *G. depressiceps*, *G. eldoni*, and *G. pullus* (Appendix 5).

Conservation Dependent

Conservation Dependent taxa are those likely to move to a worse conservation status if current management ceases. The term 'management' can include indirect actions that benefit taxa,

such as protection and restoration of spawning habitats, or legislation that controls harvest, or elimination of invasive predator species from targeted river reaches. Of the 17 freshwater fish taxa identified with the Conservation Dependent qualifier in Otago, two were Regionally Data Deficient, 14 were Regionally Threatened, and one was Regionally At Risk. Of the 12 taxa in the Regionally Threatened category with the Conservation Dependent qualifier, two had the Regionally Critical status, three had the Regionally Endangered status, and nine had the Regionally Vulnerable status. For diadromous galaxias fishes (*G. maculatus*, *G. fasciatus*, and *G. argenteus*), the Conservation Dependent qualifier generally related to the protection of their freshwater spawning habitats and regulation of the whitebait fishery (Department of Conservation 2005). For *A. dieffenbachii* and *A. australis*, the Conservation Dependent qualifier related to the management of eel fisheries, including through commercial and amateur fishing regulations. The Conservation Dependent Qualifier was also identified for *G. australis* and eleven freshwater-resident galaxiid species which are benefitting from habitat protection and restoration, and, for some, the removal of invasive predatory fish (Department of Conservation 2003, 2004; Jack 2023; Jack et al. 2023; Otago Regional Council 2025c).

One Location

Six taxa were assigned the qualifier One Location for Otago: *Galaxias* aff. *paucispondylus* “Manuherikia”, *Galaxias* “Teviot”, *G. cobitinis*, *Galaxias* “Nevis”, *N. burrowsius*, and *S. anisodon*. Four of these are endemic to Otago and the One Location qualifier refers to their entire global population existing in one place. *Galaxias* aff. *paucispondylus* “Manuherikia” is recorded only in the Manuherekia / Manuherikia River catchment, upstream from Falls Dam. *Galaxias* “Teviot” is in tributaries of Lake Onslow, tributaries of the Teviot River catchment, and nearby in the very headwaters of the Taiari / Taieri River catchment. *Galaxias* “Nevis” is recorded only in the Nevis River/ Te Papapuni catchment, and *G. cobitinis* is only present in the Kauru River and Kākaunui / Kakanui River catchment. *N. burrowsius* and *S. anisodon* have been assigned the One Location qualifier as in Otago they are only found near the Waitaki River mouth, although their range is mostly in the Canterbury Region.

Summary

This report identifies the freshwater fish species recorded in the Otago Region since human arrival. An expert panel then applied a consistent framework to assign the conservation status, trends, and qualifiers to these taxa at the regional scale.

Information on regional freshwater fish populations is crucial for management. It allows regional councils and others to implement national legislation and direction, identify important habitats, inform consenting processes, prioritise targeted restoration efforts, and monitor the long-term effectiveness of conservation interventions. Benefits gained by assessing risk of extinction at the regional scale, complementary to national assessments, include:

- improved knowledge of the status of taxa across the region;
- direction for local government and community groups to prioritise conservation actions that can work in synergy with or provide additionality to the work of DOC;
- an improved ability to protect taxa through regulatory processes; and
- improved national conservation assessments of species through greater local input.

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Appendix 1: Process for determining the regional threat status of taxa

Process 1: Determination of regional threat status

Identify and record taxa on the relevant New Zealand Threat Classification System (NZTCS) list that have not been observed in the region

↓

Identify Nationally Threatened taxa that breed or are resident for more than half of their life cycle in the region and assign a Regional Conservation status (see Process 2)

↓

Identify Non-resident native taxa in the NZTCS and assess Regionally Non-resident status

Process 2: Determination of strongholds and Regionally Not Threatened species

Is the region a stronghold for the taxa (i.e., >20% of the national population present)?

↓ **N**

Does the region hold more than 2000 mature individuals or does the taxon occupy more than 1000 ha (10 km^2)?

↓ **Y**

N ↓

Y ↓

Is the population ±10% stable or increasing?

↓ **Y**

N →

Assign Regional Conservation Status by applying the NZTCS criteria to the regional population

Assign Regional Conservation Status of Regionally Not Threatened

Appendix 2: List of Regional Qualifiers for Regional Conservation Threat Assessments

Qualifiers from Crisp et al. (2026) provide context to the threat category and status of taxa.

Code	Qualifier	Description
BNS	Benchmarked Against National Status	The regional data for population size / area of occupancy and trend indicate that the taxon has a less threatened conservation status than its national status.
CInt	Conservation Introduction	Establishment of a taxon for the purposes of conservation outside its recorded distribution but within an appropriate habitat and ecogeographical area. Two types of Conservation Introductions are recognised: a) Assisted migration is the intentional movement and release of an organism outside its indigenous range to avoid extinction of populations of the focal species, and b) Ecological replacement is the intentional movement and release of organism outside its indigenous range to perform a specific ecological function.
FR	Former Resident	Breeding population (existed for more than 50 years) extirpated from the region but continues to arrive as a regional vagrant or migrant.
IN	Introduced Native	The taxon was introduced to the region, though is not known to have previously occurred in it.
IR	Indigenous Range Limit	The inferred range (extending in any direction) of the taxon in pre-human times meets its natural limit in the region. The range limit can be north/south and/or east/west, depending on the regional council boundaries.
NR	Natural Range	The known range (extending in any direction) of the taxon meets it natural limit in the region. The range limit can be north/south and/or east/west, depending on the regional council boundaries.
NStr	National Stronghold	More than 20% of the national population breeds or is resident for more than half the taxon's life cycle in the region.
PR	Population Reinforcement	Translocations from other regions have been carried out to boost the population numbers of the taxon.
RC	Regional Coloniser	Taxa that have arrived in the region without human assistance and have been successfully breeding in the wild since 1950.
RE	Regional Endemic	Taxa known to breed only in the region.
RM	Regional Migrant	A minimum of 15 individuals of a New Zealand native taxon are known to visit the region as part of their normal life cycle, but do not breed in the region.
RN	Reintroduction	Taxa that have been reintroduced to the region after having previously gone extinct there.
RR	Range Restricted	To be Range Restricted, a taxon must be naturally confined to a specific substrate, habitat, or geographical area less than the regional threshold areas (e.g., 1000 ha for the Otago Region), see Table 2.1 Crisp et al. (2022).
RV	Regional Vagrant	Aotearoa New Zealand native taxa that have sporadic or transitory occurrences in the region with fewer than 15 individuals visiting per annum.
TL	Type Localities	The type locality of the taxon is within the region (ignore if the taxon is or has ever been regionally extinct).

Continued next page

Regional qualifiers continued

Code	Qualifier	Description
TLH	Holotype	A holotype is the one specimen on which a species name is based.
TLI	Isotype	An isotype is a duplicate specimen of the holotype.
TLL	Lectotype	A lectotype is a specimen later selected to serve as the single type specimen for species originally described from a set of syntypes. In zoology, a lectotype is a kind of name-bearing type.
TLN	Neotype	A neotype is a specimen later selected to serve as the single type specimen when an original holotype has been lost or destroyed or where the original author never cited a specimen.
TLS	Syntype	A syntype is any one of two or more specimens that is listed in a species description where no holotype was designated.

Appendix 3: List of National Qualifiers from the New Zealand Threat Classification System

National qualifiers from Rolfe et al. (2022) provide context to the threat category and status of taxa.

Code	Qualifier	Description
Assessment Process Qualifier		
DPR	Data Poor: Recognition	A taxon is given the Data Poor: Recognition qualifier when confidence in the assessment is low because of difficulties in determining the identity of the taxon in the field and/or laboratory. Taxa with this qualifier will also often be given the qualifiers Data Poor: Size and Data Poor: Trend, in which case they are most likely to be Data Deficient.
DPS	Data Poor: Size	The Data Poor: Size qualifier indicates that confidence in the assessment is low because of a lack of data on population size.
DPT	Data Poor: Trend	The Data Poor: Trend qualifier indicates that confidence in the assessment is low because of a lack of data on population trend.
DE	Designated	A taxon is given the Designated qualifier when the expert panel has assigned it to what they consider to be the most appropriate status without full application of the criteria. For example, a commercial fish stock that is being fished down to the biomass maximum sustainable yield (BMSY) may meet the criteria for Declining but could be designated as Not Threatened if the expert panel believes that this better describes its risk of extinction.
Biological Attribute Qualifier		
IE	Island Endemic	The Island Endemic qualifier is given to a taxon whose natural distribution is restricted to one island archipelago (e.g., the Auckland Islands) and is not found on the North or South Islands of New Zealand or Stewart Island/Rakiura. A taxon cannot be given this qualifier if it is Secure Overseas (SO, SO? or S?O) or Threatened Overseas (TO, TO? or T?O).
NS	Natural State	A taxon is given the Natural State qualifier if it has a stable or increasing population that is presumed to be in a natural condition (i.e., it has not experienced a historical human-induced decline). This qualifier is equivalent to the 'natural' population state value in the NZTCS database.
RR	Range Restricted	A taxon that is naturally confined to a specific substrate or habitat or a geographic area of less than 100,000 ha (1000 km^2) is given the Range Restricted qualifier. This is assessed by taking into account the area of habitat that is occupied by each sub-population and summing these areas where there is more than one sub-population. Examples of such taxa include Chatham Island forget-me-not (*Myosotidium hortensia*) and Auckland Island snipe (*Coenocorypha aucklandica aucklandica*). This qualifier can apply to any Threatened or At Risk taxon. However, it is redundant if a taxon is confined to one location.
Sp	Biologically Sparse	The Biologically Sparse qualifier is used when a taxon naturally consists of small and widely scattered sub-populations. It can apply to any Threatened or At Risk taxon.

Continued next page

National qualifiers continued

Code	Qualifier	Description
Pressure Management Qualifier		
CD	Conservation Dependent	A taxon that is likely to move to a worse conservation status over the longer of the next 10 years or three generations (maximum 100 years) if current management ceases is given the Conservation Dependent qualifier. The term 'management' can include indirect actions that benefit taxa, such as island biosecurity. A taxon is only considered conservation dependent if cessation of the management would result in a worse conservation status, and the influence of the benefits of management on the total population must be considered before using this qualifier. The benefit of managing a single sub-population may not be adequate to trigger this qualifier but may trigger Partial Decline. Furthermore, taxa that are qualified as Conservation Dependent may also be given the Partial Decline qualifier if only one or a few sub-populations have benefitted from management.
CI	Climate Impact	The taxon is adversely affected by long-term climate trends and/or extreme climatic events. The following questions provide a guide to using the CI Qualifier: Is the taxon adversely affected by long-term changes in the climate, such as an increase in average temperature or sea-level rise? If NO = no Qualifier but needs monitoring and periodic re-evaluation because projected changes to the average climate and sea-level rise may adversely impact the taxon (including via changes to the distribution and prevalence of pests, weeds, and predators) in the future. If YES = CI Qualifier Is the taxon adversely affected by extreme climate events, such as a drought, storm, or heatwave? If No = no Qualifier but needs monitoring and periodic re-evaluation because projected changes to the climate are likely to increase the frequency and/or severity of these events in the future. If YES = CI Qualifier Use of the Climate Impact Qualifier would indicate the need for more in-depth research, ongoing monitoring of climate impacts, and potentially a climate change adaptation plan for the taxon. See NZTCS manual 2022 Appendix 2 for additional questions that can be used to analyse climate impacts (Rolfe et al. 2022)
CR	Conservation Research Needed	A taxon is given the Conservation Research Needed qualifier if the causes of its decline and/or solutions for its recovery are poorly understood and research is required

Continued next page

National qualifiers continued

Code	Qualifier	Description
PF	Population Fragmentation	The Population Fragmentation qualifier is used where gene flow between sub-populations is hampered as a direct or indirect result of human activity. It should be noted that naturally disjunct populations are not considered to be fragmented
RF	Recruitment Failure	The Recruitment Failure qualifier is used where the age structure of the current population of a taxon is such that a catastrophic decline is likely in the future. It should be noted that a failure to produce new progeny or the failure of progeny to reach maturity can be masked by apparently healthy populations of mature specimens.
Population Trend Qualifier		
EF	Extreme Fluctuations	A taxon that has an increased threat of extinction due to extreme unnatural population fluctuations or natural fluctuations overlaying human-induced declines is given the Extreme Fluctuations qualifier. When ranking taxa with extreme fluctuations, the lowest estimated number of mature individuals should be used for determining population size, as a precautionary measure. However, annual population fluctuations that are a natural function of a taxon's life cycle should not be considered.
EW	Extinct in the Wild	A taxon that is known only in captivity or cultivation or has been reintroduced to the wild but is not self-sustaining is given the Extinct in the Wild qualifier. Assessment of a reintroduced population should be considered only when it is self-sustaining, which requires both of the following criteria to have been fulfilled: It is expanding or has reached a stable state through natural replenishment and at least half the breeding adults are products of the natural replenishment; and it has been at least 10 years since reintroduction.
Inc	Increasing	The Increasing qualifier is used when a taxon has an ongoing or forecast increase of > 10% in the total population, taken over the longer of the next 10 years or three generations (maximum 100 years). Note that this qualifier is redundant for taxa ranked as Recovering
PD	Partial Decline	A taxon that is declining over most of its range but has one or more secure populations (such as on offshore islands) is given the Partial Decline qualifier. An example of a Partial Decline taxon is North Island kākā (*Nestor meridionalis septentrionalis*), which is declining towards a small, stable population. The Relict qualifier may be appropriate when the population has stabilised.
PE	Possibly Extinct	A taxon that has not been observed for more than 50 years but for which there is insufficient evidence to support declaring it extinct is given the Possibly Extinct qualifier. This qualifier may apply to several Data Deficient and Nationally Critical taxa.

Continued next page

National qualifiers continued

Code	Qualifier	Description
Population State Qualifier		
NO	Naturalised Overseas	A taxon that is endemic to New Zealand but has been introduced (deliberately or accidentally) by human agency to another country and has naturalised there is given the Naturalised Overseas qualifier. An example of such a taxon is *Olearia traversiorum* in the Republic of Ireland.
OL	One Location	The One Location qualifier is used where a taxon is found at one location (geographically or ecologically distinct area) in New Zealand that is less than 100 000 ha (1000 km2), so a single event (e.g., a predator irruption or fire) could easily affect all individuals of the taxon. Examples of such taxa include L'Esperance Rock groundsel (*Senecio esperensis*) and Open Bay Island leech (*Hirudobdella antipodum*). This qualifier can apply to all Threatened, At Risk, Non-resident Native – Coloniser and Non-resident Native – Migrant taxa, regardless of whether their restricted distributions in New Zealand are natural or human induced. Resident native taxa that have restricted distributions but for which it is unlikely that all sub-populations would be threatened by a single event (e.g., because water channels within an archipelago are larger than known terrestrial predator swimming distances) should be qualified as Range Restricted.
Rel	Relict	The Relict qualifier is given to a taxon whose population has declined since human arrival to less than 10% of its former range but has stabilised. The range of a relictual taxon takes into account the area currently occupied as a ratio of the taxon's former extent. Reintroduced and self-sustaining populations within or outside the former known range of a taxon should be considered when determining whether a taxon is relictual. This definition is modified from the definition of the At Risk – Relict category provided in Townsend et al. (2008). The main difference is that trend is no longer included in the qualifier definition, allowing the qualifier to be applied to any taxon that has experienced severe range contraction, regardless of whether that contraction continues or has been arrested. This qualifier may replace the Partial Decline qualifier once a taxon's population has stabilised within a reduced area.
SO	Secure Overseas	The Secure Overseas qualifier is used when a taxon is secure in the parts of its natural range outside New Zealand.
SO?	Secure Overseas?	Use of the Secure Overseas? qualifier indicates that it is uncertain whether a taxon of the same name that is secure in the parts of its natural range outside New Zealand is conspecific with the New Zealand taxon. An example of such a taxon is the bidibidi *Acaena minor* var. *antarctica*
S?O	Secure? Overseas	Use of the Secure? Overseas qualifier indicates that it is uncertain whether the taxon is secure in the parts of its natural range outside New Zealand. An example of such a taxon is the New Zealand bull kelp *Durvillaea antarctica*.
TO	Threatened Overseas	The Threatened Overseas qualifier is used when the taxon is threatened in the parts of its natural range outside New Zealand.
TO?	Threatened Overseas?	Use of the Threatened Overseas? qualifier indicates that it is uncertain whether a taxon of the same name that is threatened in the parts of its natural range outside New Zealand is conspecific with the New Zealand taxon.

Continued next page

National qualifiers continued

Code	Qualifier	Description
T?O	Threatened? Overseas	Use of the Threatened? Overseas qualifier indicates that it is uncertain whether the taxon is threatened in the parts of its natural range outside New Zealand. An example of such a taxon is the aquatic beetle *Gyrinus convexiusculus*.

Appendix 4: Freshwater fishes that are Regional Endemics or have National Strongholds in the Otago Region

Name and Authority	Common Name	Regional Endemic	National Stronghold
Galaxias "Nevis"	Nevis galaxias (Nevis River)	Regional Endemic	National Stronghold
Galaxias "Pomahaka"	Pomahaka galaxias (Pomahaka River)		National Stronghold
Galaxias "species D"	Clutha flathead galaxias (Clutha River)	Regional Endemic	National Stronghold
Galaxias "Teviot"	Teviot flathead galaxias (Teviot River)	Regional Endemic	National Stronghold
Galaxias aff. *paucispondylus* "Manuherikia"	alpine galaxias (Manuherikia River)	Regional Endemic	National Stronghold
Galaxias anomalus Stokell, 1959	central Otago roundhead galaxias	Regional Endemic	National Stronghold
Galaxias brevipinnis Günther, 1866	koaro		National Stronghold
Galaxias cobitinis McDowall & Waters, 2002	lowland longjaw galaxias (Kakanui River)	Regional Endemic	National Stronghold
Galaxias depressiceps McDowall & Wallis, 1996	Taieri flathead galaxias	Regional Endemic	National Stronghold
Galaxias eldoni McDowall, 1997	Eldon's galaxias	Regional Endemic	National Stronghold
Galaxias pullus McDowall, 1997	dusky galaxias	Regional Endemic	National Stronghold

Appendix 5: Freshwater fish species with type localities in the Otago Region

Type localities as described by Roberts et al. 2015.

Name and Authority	Common Name	Locations
Galaxias anomalus Stokell, 1959	central Otago roundhead galaxias	Holotype: NMNZ P.002776. The outlet of a spring which is drained by a ditch crossing the Ophir-Omakau Road a few chains northwest of the Ophir Hotel, central Otago, New Zealand (45°06.13' S, 169°36.30' E). Type locality redefined by McDowall & Wallis (1996).
Galaxias cobitinis McDowall & Waters, 2002	lowland longjaw galaxias (Kakanui River)	Holotype: NMNZ P.037567. Kauru River, tributary of the Kakanui River at road bridge, North Otago, New Zealand [45°04.80' S, 170°47.68' E].
Galaxias depressiceps McDowall & Wallis, 1996	Taieri flathead galaxias	Holotype: NMNZ P.031802. Healy Creek, where it crosses Danseys Pass Road, tributary of Kye Burn, Taieri River system, Otago, New Zealand (44°58.12' S, 170°19.60' E).
Galaxias eldoni McDowall, 1997	Eldon's galaxias	Holotype: NMNZ P.033177. Smugglers Creek, tributary of Traquair Burn, Taieri River system, South Island, New Zealand (45°49.62' S, 170°12.917' E).
Galaxias pullus McDowall, 1997	dusky galaxias	Holotype: NMNZ P.033175. Stream draining Munro Dam, tributary of Waipori River, Taieri River system, South Island, New Zealand (45°53.7' S, 170°00.47' E).

Conservation status of freshwater fishes in Otago



Appendix 6: Map of Territorial Authorities and Coastal Marine Area in the Otago Region.

Otago has five Territorial Authorities: Central Otago District, Clutha District, Dunedin City, Queenstown Lakes District and Waitaki District (Otago part only). A provisional Coastal Marine Area is also shown. See Appendix 7 for map of Freshwater Management Units in Otago.



Appendix 7: Map of Freshwater Management Units in the Otago Region.

The inland area of the Otago Region has been divided into five Freshwater Management Units (FMUs): Clutha Mata-au, Catlins, Dunedin & Coast, North Otago, and Taiari. The Clutha Mata-au FMU has been further subdivided into five rohe (areas): Upper Lakes, Dunstan, Manuherekia, Roxburgh and Lower Clutha. A provisional Coastal Marine Area is also shown. See Appendix 6 for map of Territorial Authorities and Coastal Marine Area in Otago.



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Otago Regional Council

9.5. Lake Wānaka Sediment Core Study

Prepared for:	Council
Report No.	S&R2625
Activity:	Science
Author:	Hugo Borges, Senior Scientist – Lakes
Endorsed by:	Tom Dyer (General Manager Science and Resilience)
Date:	18 November 2026
Portfolio Leads:	Cr Kelliher and Cr Robertson, Science and Resilience

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PURPOSE

[1] To inform Councillors of the objectives, methods and principal findings of the final Lake Wānaka sediment core study commissioned by Otago Regional Council with support from Ministry for the Environment (MfE, now part of MCERT).

EXECUTIVE SUMMARY

[2] In mid 2025 Otago Regional Council (ORC) and MfE commissioned a study of lakebed sediments to investigate how environmental conditions and ecological communities in Lake Wānaka have changed over approximately 1,000 years. This was a key workstream in the Deep Lakes Technical Advisory Group proposal to help put recent lake conditions in context.

[3] Lakebed sediment cores from Roys Bay and Glendhu Bay were recovered and analysed.

[4] The study provides evidence of substantial changes in the biological communities of both bays since human arrival, with the most pronounced changes occurring in the late twentieth and early twenty-first centuries.

[5] The two bays changed at different times and in different ways. Roys Bay shows particularly marked biological change since approximately 1980, including a marked increase in *Lindavia intermedia*, the non-native diatom associated with lake snow. At Glendhu Bay, biological changes since approximately 2000 coincided with increased sediment and trace-metal inputs, patterns that are consistent with increasing catchment pressures.

[6] Recent biological changes coincide with higher rates of sediment accumulation and increased delivery of lead and cadmium to the sediments, alongside diatom changes consistent with increasing nutrient availability. Together these patterns are consistent with increasing catchment pressures. However, the report cannot distinguish the effects of particular activities such as urban development, farming, or other human influences.

[7] The study adds a historical baseline that is not available from routine monitoring alone and provides important context for the lake condition observed today. It shows that

changes in the lake's ecology have occurred over centuries, but that the pace of change at these two sites increased considerably in recent decades. Because only two bays were sampled, the authors caution against assuming the same timing or mechanisms apply across the whole lake. They note further targeted studies, including additional sediment analyses and sampling in other locations, would be required to more confidently understand causes and wider patterns.

RECOMMENDATION

That the Council:

1) ***Notes*** *this report.*

BACKGROUND

[8] Lake Wānaka is currently classified as microtrophic, meaning that it has very low nutrient concentrations and generally clear water. Recent monitoring has identified increasing chlorophyll-a concentrations (an indicator of algae). Regular monitoring and lake users have also highlighted the emergence of lake snow, coincident with changes in the surrounding catchment and increasing development and tourism pressure.

[9] Routine water-quality monitoring covers only a short period relative to the lake's history. ORC, with support from MfE, commissioned this study to provide a much longer historical perspective, and place observed trends and conditions in longer historical context.

[10] Researchers collected sediment cores in November 2025 from Roys Bay (14 m water depth) and Glendhu Bay (62 m; Figure 1). Lakebed sediment accumulates in layers over time, preserving traces of past vegetation, organisms and environmental conditions. The researchers examined pollen and charcoal, metals, sediment characteristics, microscopic algae called diatoms, sedimentary DNA and an indirect measure of historical chlorophyll-a.

DISCUSSION

[11] The study aimed to reconstruct historical water quality and ecology during the period of human occupation, test whether biological communities changed over roughly the past 150 years, and investigate whether sediment layers recorded major earthquakes. The cores span approximately 1,000 years of sediment accumulation, allowing researchers to compare conditions before and after major periods of human settlement and catchment change.

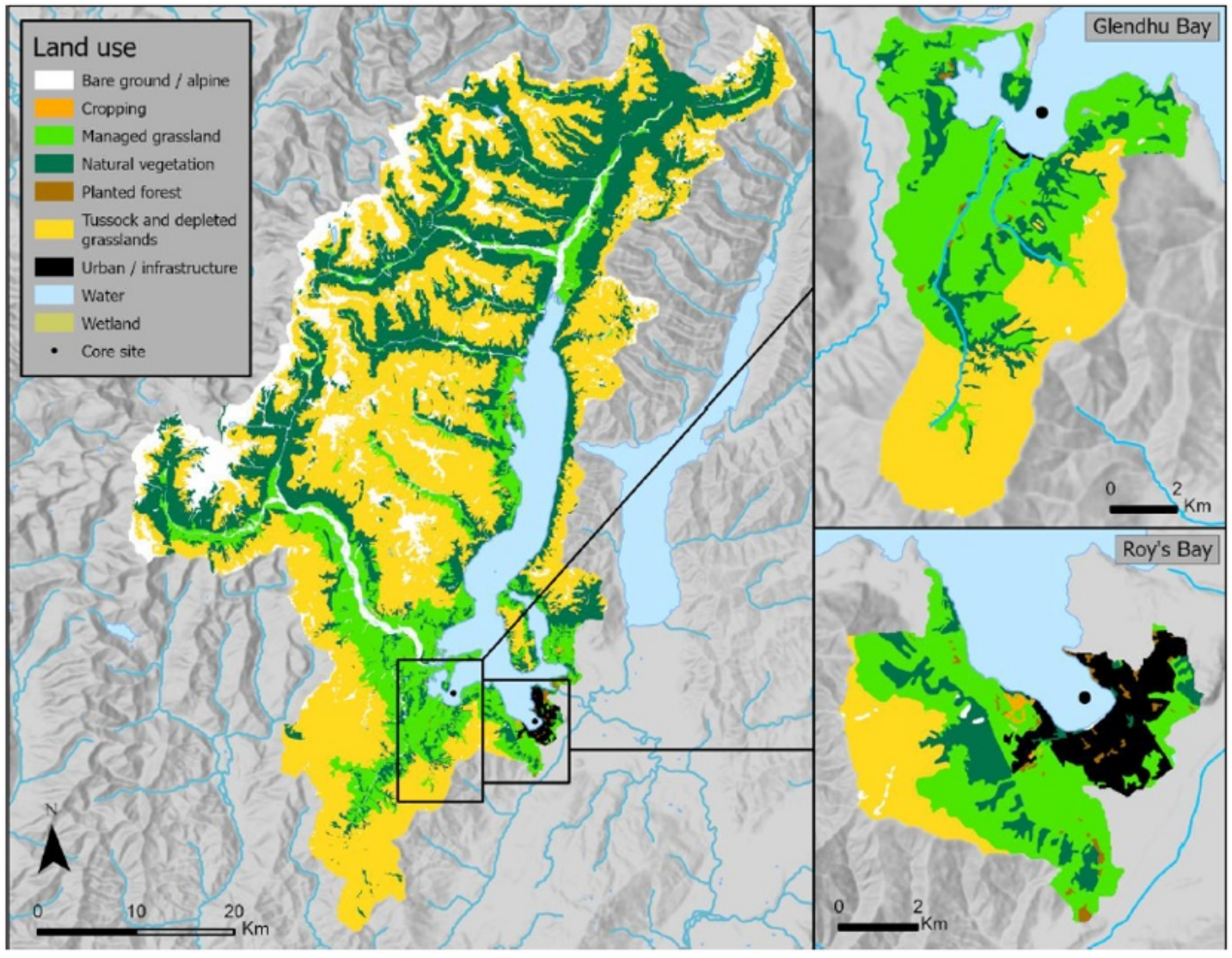


Figure 1 – Locations of the Glendhu Bay and Roys Bay sediment core sampling sites and the surrounding catchment land use around Lake Wānaka.

[12] The following paragraphs summarise the key findings of the study.

[13] **Natural differences between the bays.** Even before human settlement (c. 1300), Roys Bay and Glendhu Bay supported different biological communities. This indicates that local water movement, habitat and catchment conditions influenced each bay independently. Glendhu Bay also contains many distinct layers of sediment delivered during high-runoff events, whereas Roys Bay has a more continuous record of fine sediment settling.

[14] **Changes following human arrival.** In both bays, pollen and charcoal record major changes in surrounding vegetation after Māori arrival, including increased burning, expansion of bracken fern and declines in woody vegetation. The lake's biological communities also changed in Roys Bay during this period, but comparable changes were not clearly identified in Glendhu Bay. The authors emphasise that the ecological effects of early human activity may have varied across the lake.

[15] **Changes following European settlement.** After approximately 1850, the catchment underwent further changes, including pastoral development and later urban growth and other land-use pressures. In Roys Bay, biological change was evident relatively early in the European period and coincided with increased sediment and charcoal deposition. Diatom communities shifted from species associated with very low nutrient conditions towards species associated with slightly more productive water and changes in shallow-water habitat. Changes at Glendhu Bay were initially more gradual.

[16] **The strongest changes occurred in recent decades.** Across both bays, the cores revealed marked changes in communities of diatoms, bacteria and other microscopic organisms during the late twentieth and early twenty-first centuries. These findings indicate substantial reorganisation of ecological communities, but do not necessarily mean that every aspect of lake health changed in the same way.

[17] **Roys Bay since approximately 1980.** The study found major changes in biological communities, including a marked rise in the amount of *Lindavia intermedia* deposited in sediments. This non-native diatom is associated with "lake snow", a sticky material observed in the upper Clutha lakes. Its increase occurred alongside higher sediment-based chlorophyll-a signals and a decline in some bottom-dwelling diatoms. The authors suggest *Lindavia* may be contributing to ecological change, but do not establish that it is the sole cause. The report also notes that ecological change appears to have begun before the first confirmed occurrence of *Lindavia* intermedia in the sediment record, making it unlikely that Lindavia initiated the broader ecological shift, although it may have intensified subsequent changes. Importantly, the recent biological shifts did not closely track increases in sediment accumulation or the measured lead and cadmium inputs, indicating that in-lake processes or other unmeasured factors may be important.

[18] **Earthquake evidence.** Neither core contained a diagnostic sediment deposit caused directly by an earthquake. A period of enhanced sediment delivery at Glendhu Bay could be consistent with a delayed catchment response to the 1717 Alpine Fault earthquake, but the link is provisional and alternative explanations remain possible. Deeper lake cores would be needed to look for records of earthquakes in the lake sediments.

PLAIN LANGUAGE SUMMARY

[19] The study authors have provided the following summary of the findings to put the results in broader context:

> ***Lake Wānaka: Evidence of accelerating ecological change***
>
> *This study provides the first unequivocal evidence that the ecology and water quality of Roys and Glendhu Bays in Lake Wānaka have changed substantially since human settlement, with the rate of change accelerating markedly in recent decades.*
>
> *Commissioned by Otago Regional Council, with support from MfE, the study used lake sediments to reconstruct 1,000 years of ecological change, providing a long-term perspective unavailable from routine monitoring, which began only in 2016. Microscopic fossils, environmental DNA and high-resolution imaging reveal that ecological change began following Māori settlement, particularly in Roys Bay, and intensified after European settlement in the mid-1800s.*
>
> *Most importantly, rates of ecological change have accelerated, with the most rapid changes occurring during the last two decades. This pattern is evident in both bays and across multiple groups of organisms, from algae and bacteria to larger aquatic species.*
>
> *Although the causes remain uncertain, some recent changes, particularly in Glendhu Bay, are consistent with increasing catchment pressures. A critical question is whether the lake is experiencing gradual change or entering a period of more rapid ecological decline, and which management actions could alter this trajectory.*

[20] Additional material will be developed and available on the ORC website and at relevant forums to communicate the techniques, findings, limitations, and implications of the study.

SUMMARY OF CONSIDERATIONS

Community Outcomes

This work aligns with the Environment community outcome of ORC's 2024–2034 Long-Term Plan, supporting a healthy environment, thriving ecosystems and biodiversity.

The study contributes to this outcome by improving understanding of the historical water quality and ecological condition of Lake Wānaka over approximately the past 1,000 years. The findings provide valuable scientific evidence to support ORC's freshwater monitoring and management responsibilities, particularly by establishing historical baseline conditions against which recent and future environmental changes can be assessed.

Councillor Priority Actions

This study supports priority action SR01, *'Review and align science programmes with community and catchment needs, ensuring outputs are accessible, relevant, and support decision-making. Clearly articulate how statutory and discretionary activities contribute to core environmental outcomes and identify any gaps in capability or coverage and how these will be addressed',* by providing accessible and relevant outputs which support decision-making.

Alignment with Central Government Legislation

The study supports ORC's responsibilities under the Resource Management Act 1991, particularly its functions relating to the monitoring and management of freshwater resources.
The research is also relevant to the objectives of the National Policy Statement for Freshwater Management 2020, which provides direction for managing freshwater ecosystems and maintaining or improving freshwater health.

Alignment with Otago Regional Council Internal Policy

The project supports ORC's Strategic Directions 2024–2034, particularly its focus on protecting and enhancing the environment and maintaining healthy freshwater ecosystems.
The findings contribute to ORC's scientific understanding of Lake Wānaka and may inform future monitoring priorities and freshwater management activities.

Financial Considerations

The Lake Wānaka sediment core study was supported through funding from the Ministry for the Environment (now Ministry of Cities, Environment, Regions and Transport), and Otago Regional Council.

ORC contributed $96,500 towards the $275,000 project cost, together with approximately $5,000 of staff time providing project coordination and support.

Legal Compliance/Risk

There is a low legal and compliance risk. This report is for noting only and does not commit Council to any decision, service change or spending. The findings apply only to the two bays sampled, do not identify a single confirmed cause and do not attribute the changes to any

particular activity or party. As the report will be publicly available, the limits of the findings should be stated plainly wherever it is quoted.

Reputational Risk
The Wanaka community has expressed concerns about changing water quality. This study which highlights recent changes to the lake may increase scrutiny on ORC to undertake further work or action.

There is some reputational risk. The report links recent ecological change to lake snow and increasing catchment pressure, but it cannot identify a single cause and covers only two bays. The community may therefore expect action, or may be frustrated that the report does not provide definitive information. This will be managed through the planned media release, clear messaging on what the study does and does not show, and offers to present the results to the community and other interested parties.

Climate Resilience
The effect of this study on climate resilience has not been assessed.

Carbon Emissions
The effect of this study on carbon emissions has not been assessed

He Mahi Rau Rika: Significance, Engagement and Māori Participation Policy
This paper does not seek a decision from Council. The issue is of high important to mana whenua and the output of the study will be shared as set out below.

Engagement with Mana Whenua

Engagement with mana whenua commenced in May 2025 during the planning phase of the Lake Wānaka sediment core project. ORC's Science team worked with the Iwi Partnerships and Engagement team to develop an engagement approach, recognising the cultural significance of Lake Wānaka and the importance of providing opportunities for mana whenua to contribute to the project.

Engagement was progressed through Aukaha and Te Ao Mārama Inc. (TAMI), with project information shared and opportunities provided to discuss the proposed research and identify any cultural considerations.

The final research findings will be shared with Aukaha and TAMI, and mana whenua representatives will be invited to a future presentation of the study by the research team, providing an opportunity to hear the findings and discuss the results directly with the researchers.

Stakeholder Engagement

The study was undertaken by a multidisciplinary research team led by Lincoln University, with contributions from Victoria University of Wellington, Earth Sciences New Zealand, the University of Otago, the University of Waikato, Cawthron Institute and Northern Arizona University.

Communications

The final report provides substantial new scientific information about the environmental history of Lake Wānaka, including evidence of ecological changes over approximately the past 1,000 years and an acceleration in the rate of change during recent decades.

A media release is planned to accompany this paper, and the report will be available on the ORC website.

Offers will be made to present the results to WAI Wānaka, QLDC, and other interested parties.

Additional material will be developed and available on the ORC website and at relevant forums to communicate the techniques, findings, and implications of the study.

NEXT STEPS

[21] Following receipt by Council, the report can be used as a source of historical evidence when interpreting ongoing monitoring results.

[22] The cores have been archived and available for future work. Additional student research is being undertaken on the cores beyond the scope of this project.

[23] The work has shown the valuable historic record that can be interpreted from lake cores, and similar studies may be explored for other lakes in Otago.

ATTACHMENTS

1. LUW W 032026 Sediment Core Lake Wanaka FINA L 141026 [**9.5.1** - 104 pages]

LINCOLN UNIVERSITY
TE WHARE WĀNAKA O AORAKI

A multi-proxy reconstruction of historical water quality and ecological change in Lake Wānaka



LINCOLN UNIVERSITY
TE WHARE WĀNAKA O AORAKI

A multi-proxy reconstruction of historical water quality and ecological change in Lake Wānaka

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Prepared for Otago Regional Council

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Executive Summary

Lake Wānaka is one of Aotearoa New Zealand's iconic freshwater lakes, supporting a range of environmental, cultural, social, and recreational values. However, concerns have increased in the last decade about possible rising chlorophyll-a concentrations, the appearance of lake snow caused by the invasive diatom *Lindavia intermedia*, urban growth, land-use intensification, and other pressures within the catchment. Because routine monitoring spans only a small fraction of the timescales over which environmental change occurs, this study used lake sediments to reconstruct ecological and water-quality change over the past millennium.

Sediment cores spanning approximately 1,000 years were collected from Roys Bay and Glendhu Bay and analysed using a multi-proxy palaeolimnological approach. Biological, chemical, and physical indicators preserved within the sediments were used to reconstruct past catchment conditions, water quality, and ecological communities. These included pollen (to reconstruct vegetation change within the catchment), charcoal (as evidence of past burning), trace metals (as indicators of urbanisation, agricultural activity, and catchment disturbance), diatoms (microscopic algae that are highly sensitive indicators of water quality and nutrient conditions), hyperspectral scanning as a proxy for historical chlorophyll-a, and sedimentary environmental DNA (sedDNA) targeting bacteria, plants, and microeukaryotes, a diverse group of microscopic organisms including algae, fungi, protists, and small animals.

The sediment records reveal substantial changes in biological communities and environmental indicators since human arrival. These records provide evidence of ecological change, although the specific drivers are less certain. The timing and magnitude of change differed between Roys Bay and Glendhu Bay, indicating that different parts of the lake have not responded uniformly to environmental pressures.

Prior to human settlement, the two bays supported distinct biological communities. These differences were evident across multiple biological indicators and indicate that natural variation in hydrology, catchment characteristics, sediment inputs, and habitat structure influenced ecological conditions within the lake long before human impacts occurred. The sediment records also reveal important differences between the two sites. In particular, the Glendhu Bay core contained numerous event layers representing periods of enhanced terrestrial sediment input, highlighting the strong connection between this part of the lake and processes occurring within the surrounding catchment.

Evidence of major landscape transformation following Māori arrival was recorded in both sediment cores through increased charcoal deposition, expansion of bracken fern (*Pteridium esculentum*), an indicator of landscape disturbance, and declines in woody vegetation. However, only Roys Bay displayed clear evidence of associated ecological change within the lake itself. Multiple biological indicators showed shifts during the Māori period, whereas comparable changes were largely absent from Glendhu Bay. These patterns indicate that ecological responses differed between the two bays. One possible explanation is that the effects of early human activity were spatially variable, although other factors may also have contributed to the

contrasting responses observed. Ecological change became increasingly apparent following European settlement. In Roys Bay, biological changes began relatively early and coincided with increases in sediment accumulation and charcoal deposition. These sedimentary indicators are consistent with increased catchment disturbance and sediment delivery during this period. Diatom communities shifted away from taxa associated with very low nutrient conditions towards species indicative of modest increases in nutrient availability and changes in nearshore habitat conditions. In contrast, ecological change in Glendhu Bay was initially more gradual. Diatom records indicate subtle increases in nutrient availability, while several biological indicators remained relatively stable until the late twentieth century.

The most substantial changes in biological communities and environmental indicators occurred during the late twentieth and early twenty-first centuries. These changes are interpreted as evidence of significant ecological reorganisation. Marked changes were detected across bacterial, eukaryotic, and diatom communities in both bays, indicating widespread ecosystem change. The timing of these recent changes differed between sites, while the drivers remain less certain.

In Roys Bay, major biological shifts accelerated after approximately 1980 CE. These changes were not closely associated with contemporaneous increases in sediment accumulation, lead flux, or cadmium flux. This suggests that the recent ecological changes observed in Roys Bay cannot be readily explained by the catchment indicators examined in this study and may reflect in-lake processes or other factors that were not directly measured. One of the most prominent recent ecological changes was the marked increase in accumulation rates of *Lindavia intermedia*. This increase coincided with rising chlorophyll-a concentrations and declining benthic and benthic/epiphytic diatom accumulation rates, suggesting that this species may be causing ecological changes in Roys Bay.

In Glendhu Bay, recent ecological change shows a stronger association with catchment processes. Accelerated biological change since approximately 2000 CE coincides with increases in sediment accumulation, lead flux, and cadmium flux, together with diatom assemblage changes that indicate increasing nutrient availability. These patterns are consistent with increasing catchment pressures. However, the available evidence does not allow individual drivers, such as land-use intensification, development, or other human activities, to be distinguished.

Overall, the sediment records demonstrate that ecological change in Roys Bay and Glendhu Bay in Lake Wānaka is not only a recent phenomenon. Instead, ecosystem responses began following human settlement and have continued through successive phases of catchment modification. However, the rate of change has accelerated markedly during recent decades. The results emphasise the importance of considering both catchment influences and in-lake processes when managing the future health of Lake Wānaka and highlight the value of long-term environmental records for placing contemporary ecological change in context.

Introduction

Lake Wānaka is a large, deep glacial lake situated in inland Otago, Te Waipounamu / South Island, Aotearoa New Zealand, at the eastern margin of the Southern Alps. Together with the neighbouring Lakes Wakatipu and Hawea, it forms part of a network of deep oligotrophic lakes occupying glacially carved basins within the upper Clutha/Mata-Au catchment. The lake has a surface area of approximately 180 km^2, a maximum depth of 311 m, a catchment area of approximately 2,590 km^2, and a water residence time of 5–6 years (Bayer 2013). The catchment is dominated by mountainous terrain, with steep slopes, extensive alpine environments, braided river systems, and broad glacial valleys. Major inflows include the Makarora and Matukituki rivers, while outflow occurs via the Clutha / Mata-Au River. The large fetch and exposed valley orientations result in strong wind forcing, and the lake typically develops thermal stratification from November to June, with thermoclines commonly occurring between 20 and 40 m depth (Bayer 2013). Lake Wānaka is classified as microtrophic, characterised by low nutrient concentrations, low phytoplankton biomass, and high-water clarity (lawa.org.nz).

The long water residence time and relatively low nutrient inputs have contributed to the high-water quality over much of the lake's recorded history. However, the lake and its catchment have experienced substantial environmental change since human arrival. Understanding the timing, magnitude, and causes of these changes is important for guiding future management.

Human occupation and environmental change in the Lake Wānaka region

Māori first arrived in southern Aotearoa New Zealand during the late thirteenth century (Wilmshurst et al. 2008, Perry et al. 2012), with palaeoecological evidence indicating that the Lake Wānaka catchment was occupied by approximately 1300–1350 CE (McWethy et al. 2014). Sediment records from nearby Diamond Lake further document human presence through faecal biomarkers and extensive burning during this period, coinciding with widespread forest clearance and the rapid transformation of the landscape from podocarp-dominated forest to shrubland and grassland (Argiriadis et al. 2018). These changes occurred within only a few generations of initial settlement and represent one of the most rapid examples of human-driven landscape transformation known from Aotearoa New Zealand. Human occupancy appears to have declined following the initial burning period (Argiriadis et al. 2018), although Māori continued to use the Wānaka area for food gathering, travel, and seasonal occupation over subsequent centuries (Tau & Anderson 2008).

The arrival of Europeans in the mid-nineteenth century initiated a second major phase of environmental change. European surveyors first entered the region during the 1850s,

followed rapidly by pastoral development, timber extraction, and later tourism (Angus 1988, Upper Clutha History Society n.d.). Extensive sheep grazing altered vegetation throughout the catchment, while the introduction of rabbits, mustelids, trout, deer, and numerous other non-native species fundamentally changed terrestrial and aquatic ecosystems. Population growth remained relatively modest for much of the twentieth century, but Wānaka has undergone rapid urban expansion during recent decades, accompanied by increasing tourism, infrastructure development, land-use intensification, and recreational pressures. These changes have heightened concerns about nutrient enrichment, invasive species, increased sediment inputs, and the long-term ecological integrity and water quality of Lake Wānaka.

In addition to the broad phases of Māori and European settlement, several well-documented environmental pressures have affected the Lake Wānaka catchment during the last 170 years (Schallenberg & Eng 2025). These include gold mining during the 1860s-1870s, widespread pastoral farming and rabbit outbreaks in the late nineteenth century, the introduction of aerial topdressing and agricultural intensification after the 1940s, increasing tourism and urban development from the 1960s onwards, and rapid residential growth since the 1990s. The catchment has also experienced biological invasions, including the establishment of *Lagarosiphon major* during the 1970s and the recent emergence of lake snow associated with the non-native diatom *Lindavia intermedia*. In addition, periodic floods and earthquakes have the potential to influence sediment delivery and water quality (Schallenberg & Eng 2025).

Recent changes in water quality

Recent monitoring indicates that Lake Wānaka remains a microtrophic (lawa.org.nz). However, analysis of monthly monitoring data collected between 2016 and 2021 showed a significant increase in chlorophyll-a concentrations in Lake Wānaka, with similar trends observed in Lakes Wakatipu and Hāwea (Schallenberg et al. 2022). Although chlorophyll-a concentrations remain low by national standards, the increase suggests rising phytoplankton biomass and a potential shift in lake productivity. Over the same period, the invasive diatom *Lindavia intermedia*, responsible for the phenomenon known as lake snow, became increasingly prominent in the upper Clutha lakes, raising concerns about changes to lake ecosystem structure and function (Schallenberg et al. 2022). Because routine monitoring records only extend back a few decades, it remains difficult to determine whether these recent increasing trends in chlorophyll-a fall within the range of natural variability or represent the early stages of longer-term ecological change.

Paleolimnology as a tool for understanding environmental change

Paleolimnology is the study of environmental change using biological, chemical, and physical indicators preserved in lake sediments (Cohen 2003). Because sediments accumulate progressively through time, they provide a natural archive of past conditions

within lakes and their catchments. Unlike conventional monitoring programmes, which in Aotearoa New Zealand generally extend back only years to decades, sediment records can preserve environmental information spanning centuries to millennia (Short et al. 2022, Thomson-Laing et al. 2024)

Lake sediments can be used to reconstruct historical water quality, ecosystem structure, catchment disturbance, climate variability, and human impacts. Paleolimnological approaches are particularly valuable in regions such as Lake Wānaka, where modern monitoring records are relatively short compared with the timescales over which environmental change occurs. By establishing pre-human and pre-European baseline conditions, sediment records provide an important approach for interpreting contemporary ecological trends and assessing whether recent changes are unprecedented.

This study uses a multi-proxy paleolimnological approach to reconstruct past environmental conditions in Lake Wānaka and its catchment. Multiple physical, chemical and biological indicators preserved in lake sediments were analysed to provide information on changes in catchment processes, water quality, lake productivity, ecosystem structure, and human impacts through time. Particular emphasis is placed on sedimentary environmental DNA (sedDNA). SedDNA refers to genetic material preserved within lake sediments following the deposition of cells, tissues, pollen, spores, and other biological remains (Capo et al. 2021). Advances in molecular techniques now allow DNA fragments from past organisms to be identified and used to reconstruct historical biological communities. Compared with traditional fossil indicators, sedDNA can provide a more comprehensive view of biodiversity and can detect a wide range of organisms that leave few or no identifiable morphological remains. In this study, sedDNA analyses target bacteria, microeukaryotes, and terrestrial and aquatic plants. These data provide unique insights into long-term ecological change and allow shifts in lake and catchment biodiversity to be examined alongside physical and geochemical indicators.

Study aims and report layout

The Otago Regional Council (ORC) commissioned this study to improve understanding of the historical water quality and ecological condition of Lake Wānaka. In the absence of long-term monitoring records, paleolimnological techniques were used to reconstruct past environmental conditions from lake sediments and establish baseline conditions against which contemporary changes can be assessed.

The aims of this study were to:

1. Reconstruct the historical water quality and ecological condition of Lake Wānaka throughout the period of human occupation.

2. Determine whether biological communities have undergone measurable changes over the past ~150 years.
3. Investigate whether lake sediments preserve evidence of major earthquakes and their associated impacts on the lake and its catchment.

This report is structured to maximise accessibility for readers without a background in paleolimnology. A concise overview of each analytical approach is provided in the **Methods**, highlighting the environmental information that can be inferred from each proxy. Detailed methods, including laboratory procedures, and analytical techniques, are presented in the appendices.

The **Results and Interpretation** section summarises the findings from each commissioned analysis and evaluates their implications for historical changes in lake and catchment condition. Where a proxy was considered unsuitable or provided limited information for the study cores, the data are included in the appendices for completeness. The first part of this section presents the full sediment record, followed by a synthesis of the key biological and geochemical changes that have occurred since European settlement (approximately 1850 CE).

The **Synthesis and Recommendations** section integrates evidence from multiple proxies to address the study objectives and develop a comprehensive understanding of long-term environmental change in Lake Wānaka. The report concludes with recommendations for future investigations to improve understanding of ecological and water-quality change in Lake Wānaka and to support similar assessments in other lakes across the Otago region.

Methods

Sampling locations and methods

Two sediment cores were collected from locations in Glendhu Bay (lake depth = 62 m) and Roys Bay (lake depth = 14 m) in Lake Wānaka in November 2025 (Figure 1). The cores were collected using a Mackereth coring system fitted with a 6 m long, 5 cm diameter core barrel. All core barrels were pre-sterilised with 2% bleach prior to coring. Following collection, the cores were transported at 4°C to the University of Otago (Dunedin) and Earth Sciences New Zealand (Lower Hutt, Wellington).

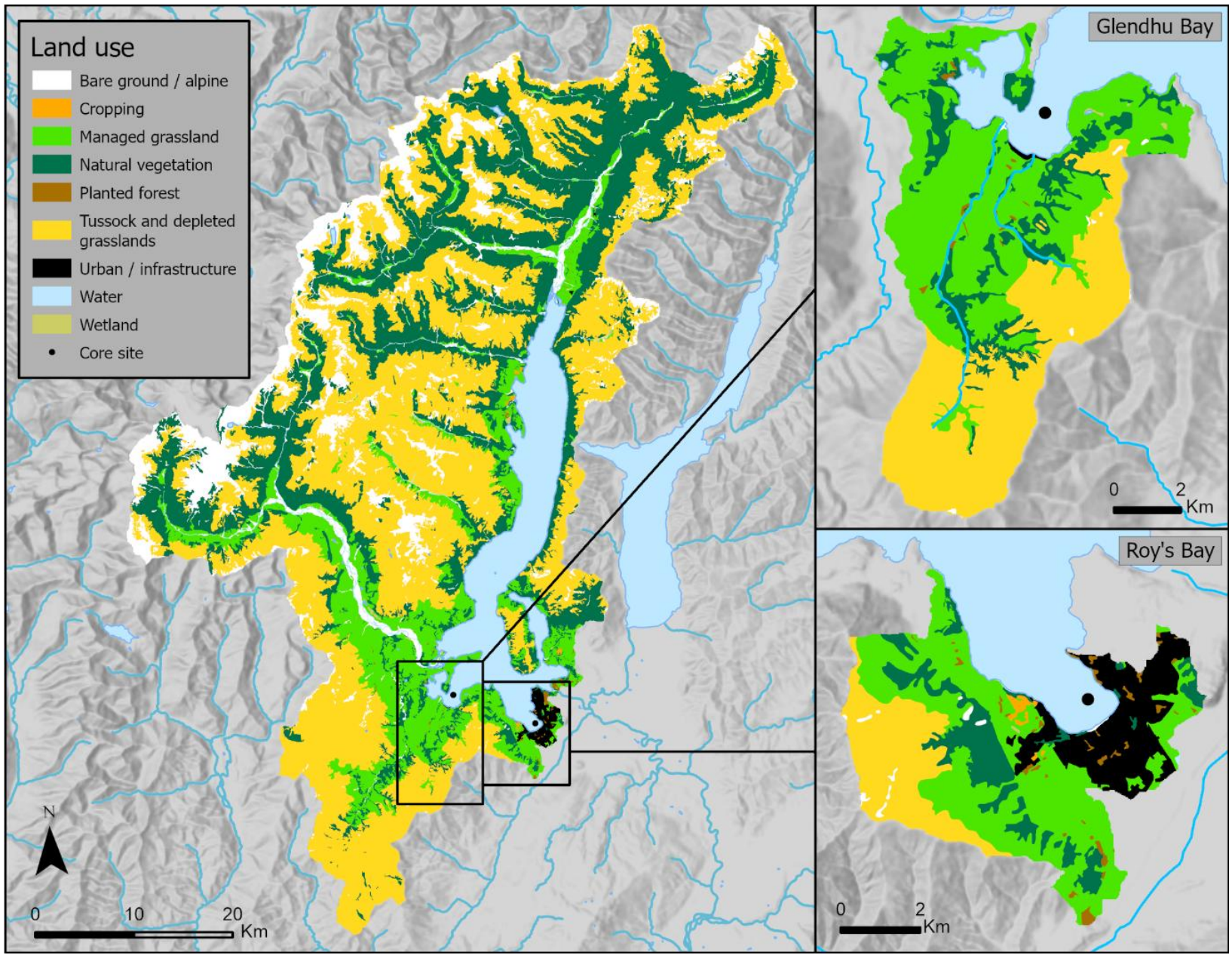


Figure 1. Locations of the Glendhu Bay and Roys Bay sediment core sampling sites and the surrounding catchment land use around Lake Wānaka.

Each core was split longitudinally into two halves. One half of each core was retained for non-destructive analyses. All cores were described for sediment stratigraphy, imaged, and analysed using computed tomography (CT) scanning. In addition, the cores stored at University of Otago were analysed using ITRAX X-ray fluorescence scanning, while the cores stored at Earth Sciences New Zealand were analysed using hyperspectral imaging.

The remaining half of the core stored at Earth Sciences New Zealand was subsampled for sedDNA, chronological analyses, pollen, charcoal, and trace metal analyses. Sampling intervals are provided in Appendix 1. The remaining half of the core stored at the University of Otago was subsampled for grain size analysis.

Care was taken when subsampling the Glendhu Bay core because it contains multiple rainfall-derived event layers. These layers represent rapid depositional events in which terrestrial sediments are transported into the lake following periods of high runoff. As a result, they are more likely to contain predominantly terrestrial material and may not accurately reflect the in-lake biological communities or environmental conditions at the time of deposition. These event layers were avoided during subsampling to minimise the influence of allochthonous material and ensure that the analysed sediments provided a more reliable record of in-lake environmental change.

Analysis

Table 1 provides an overview of the analyses undertaken on the sediment core and how the resulting data can be interpreted. Detailed methods are provided in Appendix 2.

Table 1. Description of the information provided by each proxy / method used to analyse sediment cores in this report. Samples from selected depths over a period of ~1000 years were analysed unless indicated otherwise.

Proxy (method)	Information provided
Age model (chronology)	Provides dates associated with each layer of the sediment core. In this study this is determined using ^{210}Lead analysis and pollen data.
Pollen and charcoal	Indicates changes in catchment / region, and in lake vegetation and provides high-level data that can be used to assess the timing of different human occupation periods. The presence of charcoal can be used to provide evidence of burning in the catchment / region.
Computed tomography (CT) (Entire core is scanned)	Scans of the sediment core, providing high-resolution measurements of sediment density and internal sedimentary structures throughout the core.
iTrax scanning (Entire core is scanned)	Indications of shifts in lake geochemistry, productivity and catchment erosion. In this report, we have selected: - Titanium (Ti) relative concentrations normalised to incoherence (Inc) as a proxy for increased detrital input and fine-grained material.
Grain size	Used to characterise sediment texture and identify event layers associated with increased runoff, flooding, or erosion within the catchment. In this study, grain-size

	data were used primarily to identify rainfall-related event deposits.
Metals Metal analyses were restricted to sediment deposited during the European settlement period, together with sediments from the early Māori period to provide a pre-European baseline (sediment younger than c. 1772 CE in Roys Bay and c. 1798 CE in Glendhu Bay). The primary aim was to assess anthropogenic impacts on Lake Wānaka by comparing metal deposition following European settlement with baseline conditions that pre-dated major catchment modification.	**Antimony:** A proxy for industrial and atmospheric pollution, often associated with combustion processes and vehicle-related emissions. **Arsenic:** A proxy for both natural geochemical inputs (e.g., bedrock weathering) and anthropogenic sources such as agriculture and mining. **Cadmium:** A proxy for fertiliser application on land surrounding the lake. Cadmium occurs naturally as an impurity in phosphate rock and was present in superphosphate fertilisers widely used in Aotearoa New Zealand until lower-cadmium phosphate sources were introduced during the 1990s. **Copper:** A proxy for anthropogenic inputs, in this case related to urban or agricultural runoff, as well as catchment disturbance. **Lead:** A proxy for increases in population or urbanisation close to a lake. Lead is commonly sourced from atmospheric deposition of leaded petrol, which was phased out in Aotearoa New Zealand in 1996. **Mercury:** A proxy for industrial activity and atmospheric pollution, often derived from coal combustion and long-range atmospheric transport. **Zinc:** A proxy for urban runoff, industry, and catchment disturbance. Often associated with vehicle emissions, tyres, galvanised materials, and industrial activity. **Flux:** The metal data are presented as a "flux" (mg cm^{-2} yr^{-1}). This represents the amount of a particular metal deposited onto a unit area of the lakebed each year. Flux is calculated by combining the concentration of the metal in the sediment with the mass accumulation rate (MAR). Unlike concentration alone, which can be influenced by changes in sediment composition or dilution, flux provides a measure of the actual rate at which metals were delivered to and buried in the sediment over time. Higher flux values indicate greater inputs of the metal to the lake during that period. Other data presented alongside the metal flux includes: **Mass accumulation rate (MAR)** (g cm^{-2} yr^{-1}) which is the amount of dry sediment that accumulated on a unit area of the lakebed each year. It combines information on sedimentation rate and dry density, allowing changes in the rate of sediment deposition through time to be quantified. Higher MAR values indicate periods when

	more sediment was deposited, while lower values indicate slower sediment accumulation.
Hyperspectral scanning (Entire core is scanned)	A proxy for chlorophyll-a concentrations. In this study the data is presented as a flux.
Diatoms	Microscopic algae whose species composition and biomass reflect changes in water quality, nutrient concentrations, water depth, light availability, and other environmental conditions.
Sedimentary DNA (sedDNA)	**Metabarcoding:** Uses DNA preserved in sediments to identify the organisms that were present at different times, allowing reconstruction of past biological communities and changes in ecosystem composition through time. Specific genetic markers (assays) can be selected to target particular groups of organisms, providing information on different components of the ecosystem. In this study, metabarcoding assays used were: • **Bacteria** (16S ribosomal RNA gene) • **Microeukaryotes** (18S ribosomal RNA gene and cytochrome c oxidase subunit I gene) • **Terrestrial and aquatic plants** (transfer RNA-Leu gene [trnL] and ribulose-1,5-bisphosphate carboxylase/oxygenase large subunit gene [rbcL]) • **Vertebrates** (12S rRNA gene) – Targets vertebrate DNA, including fish, mammals, and birds. All samples were analysed using this marker; however, the recovery of informative vertebrate sequences was limited, and the data were not suitable for further ecological interpretation and are not presented in this report. **Digital PCR (dPCR):** A highly sensitive molecular technique that enables absolute quantification of specific DNA targets. In this study, dPCR was used to quantify cyanobacteria using a cyanobacteria-specific 16S rRNA gene assay. Data were only obtained for the Roys Bay core because the original sediment weights used for DNA extraction were unavailable for the Glendhu Bay core. The data are presented as a "flux" (copies cm^{-2} yr^{-1}). This represents the amount of the gene deposited onto a unit area of the lakebed each year. Flux was calculated as described for trace metals.

Delineation of human occupation eras and terminology in this report

Pteridium esculentum (bracken fern) is widely used in Aotearoa New Zealand palaeoecological studies as a chronological indicator of early Māori activity because it is both a marker of landscape disturbance and a traditional food resource (McGlone & Wilmshurst, 1999; McWethy et al. 2010; Newnham et al. 2018). The appearance and increase of *P. esculentum* in sediment records, particularly when associated with elevated charcoal concentrations, are commonly interpreted as evidence of human disturbance and burning.

Pinus spp. and other non-native taxa, including sheep's sorrel (*Rumex acetosella*), were introduced following European colonisation and are therefore used as indicators of European presence and land-use change within the landscape.

Based on these indicators, three periods were identified in the sediment records and used throughout this study: pre-human (>84 cm at Roys Bay; >118.5 cm at Glendhu Bay), Māori settlement (23-84 cm at Roys Bay; 28-118.5 cm at Glendhu Bay), and post-European settlement (0-23 cm at Roys Bay; 0-28 cm at Glendhu Bay). Integration of the pollen records with previously published age-depth models (Bunbury et al., 2022) indicates that the transition to the Māori settlement period occurred at approximately 1310 CE, while the onset of the post-European settlement period occurred at approximately 1860 CE. Further details are provided in the Results and Interpretation section.

The term "evidence of Māori activity and settlement" (hereafter referred to as Māori) is used to indicate intervals characterised by proxy evidence commonly associated with Māori land use, including increased charcoal accumulation and the expansion of *Pteridium esculentum*. This terminology recognises that these ecological indicators do not provide definitive evidence for the timing or extent of Māori occupation. Other sources of evidence, particularly oral histories and archaeological records, may indicate different settlement chronologies, and some observed ecological changes may also reflect natural processes rather than solely human activity.

Results and Interpretation

Sediment core descriptions and chronology

The sediment sequences recovered from Glendhu Bay and Roys Bay record markedly different depositional environments (records of how and where sediment was deposited).

The Roys Bay core is dominated by massive to faintly laminated, fine-grained olive-grey sediment (Figure 2). The CT imagery shows relatively subtle variations in sediment density and internal structure and, importantly, lacks the numerous discrete event deposits observed at Glendhu Bay. Sedimentation at Roys Bay therefore appears to have been dominated by relatively continuous settling of fine suspended material rather than repeated discrete episodes of terrestrial sediment deposition during events.

In contrast, the Glendhu Bay core is composed of light grey fine-grained background sediment interrupted by numerous discrete event deposits. These deposits range from thin beds to units several centimetres thick (Figure 3). They are characterised by sharp basal contacts (abrupt boundaries between one sediment layer and the layer beneath it) and textures that fine upwards from dark grey fine sands to light grey fine silts (Appendix 3 - Figure A4). The grading of these event deposits suggests they are formed by hyperpycnal flows (sediment-laden floodwaters that were dense enough to sink and flow along the lake floor) that evolve from the influent streams of the Glendhu catchment during elevated runoff events when stream discharge and suspended sediment concentrations are high. Event deposits occur throughout the sequence but are particularly prominent between 14–20 cm and 35–59 cm depth. Their abundance indicates that sediment accumulation in Glendhu Bay is strongly influenced by episodic delivery of terrestrial sediment from the surrounding catchment. The contrasting sedimentology of the two sites indicates substantially stronger coupling between catchment sediment-generating processes and deposition at Glendhu Bay than at Roys Bay.

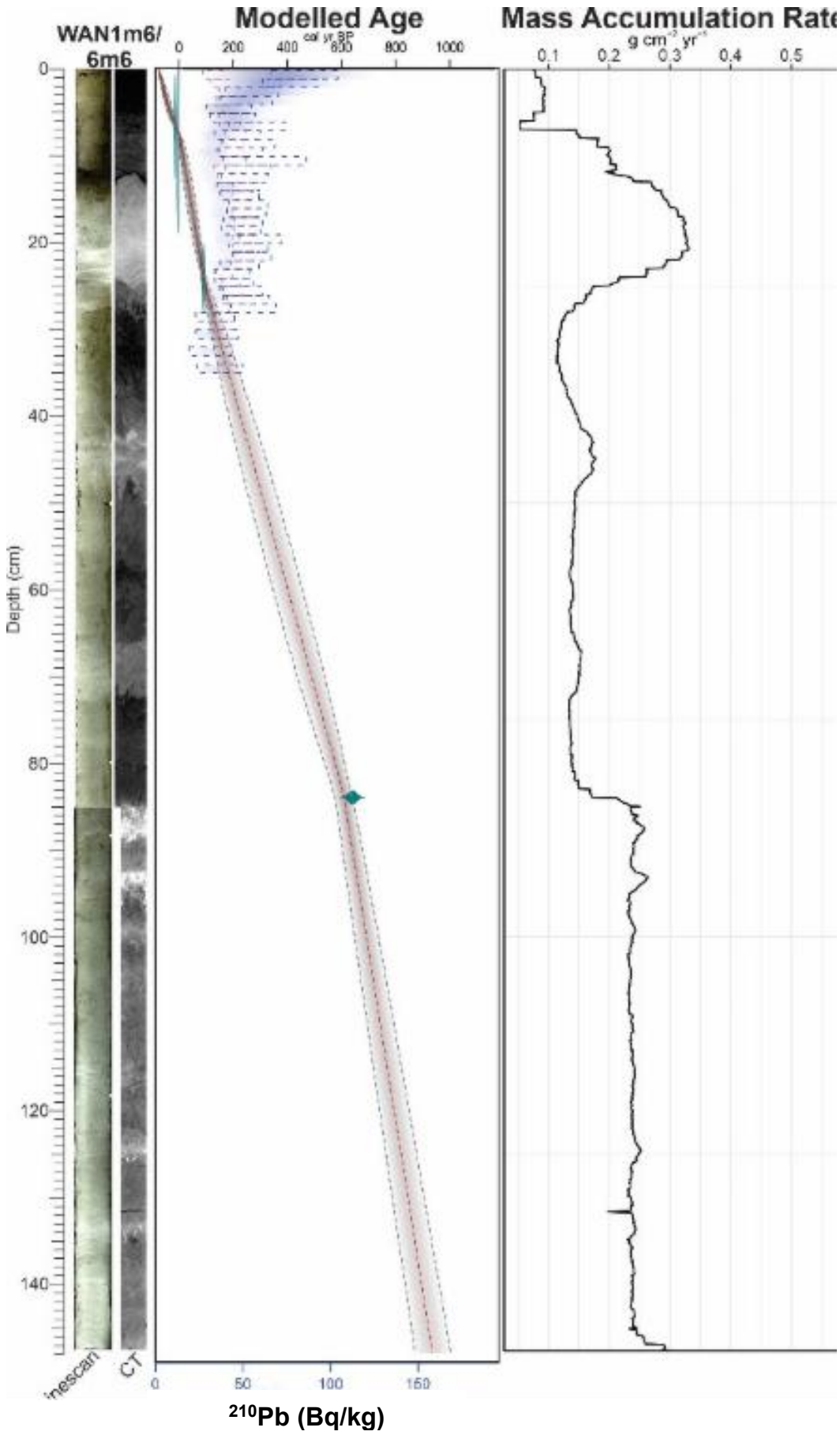


Figure 2. Roys Bay sediment core chronology and mass accumulation rate. Linescan and computed tomography (CT) images shown alongside the age-depth model and reconstructed mass accumulation rate (MAR). The age model is constrained by excess ^{210}Lead activity in the upper core and pollen biostratigraphic age markers at greater depth. The red dashed line shows the modelled median age-depth relationship and grey dashed lines indicate the associated 95% uncertainty envelope. The teal symbols indicate chronological constraints from ^{137}Cesium and pollen biostratigraphy. MAR (g cm^{-2} yr^{-1}) was calculated from the modelled sedimentation rate and sediment dry density. The relatively homogeneous sedimentology and absence of prominent event beds result in a comparatively continuous MAR record.

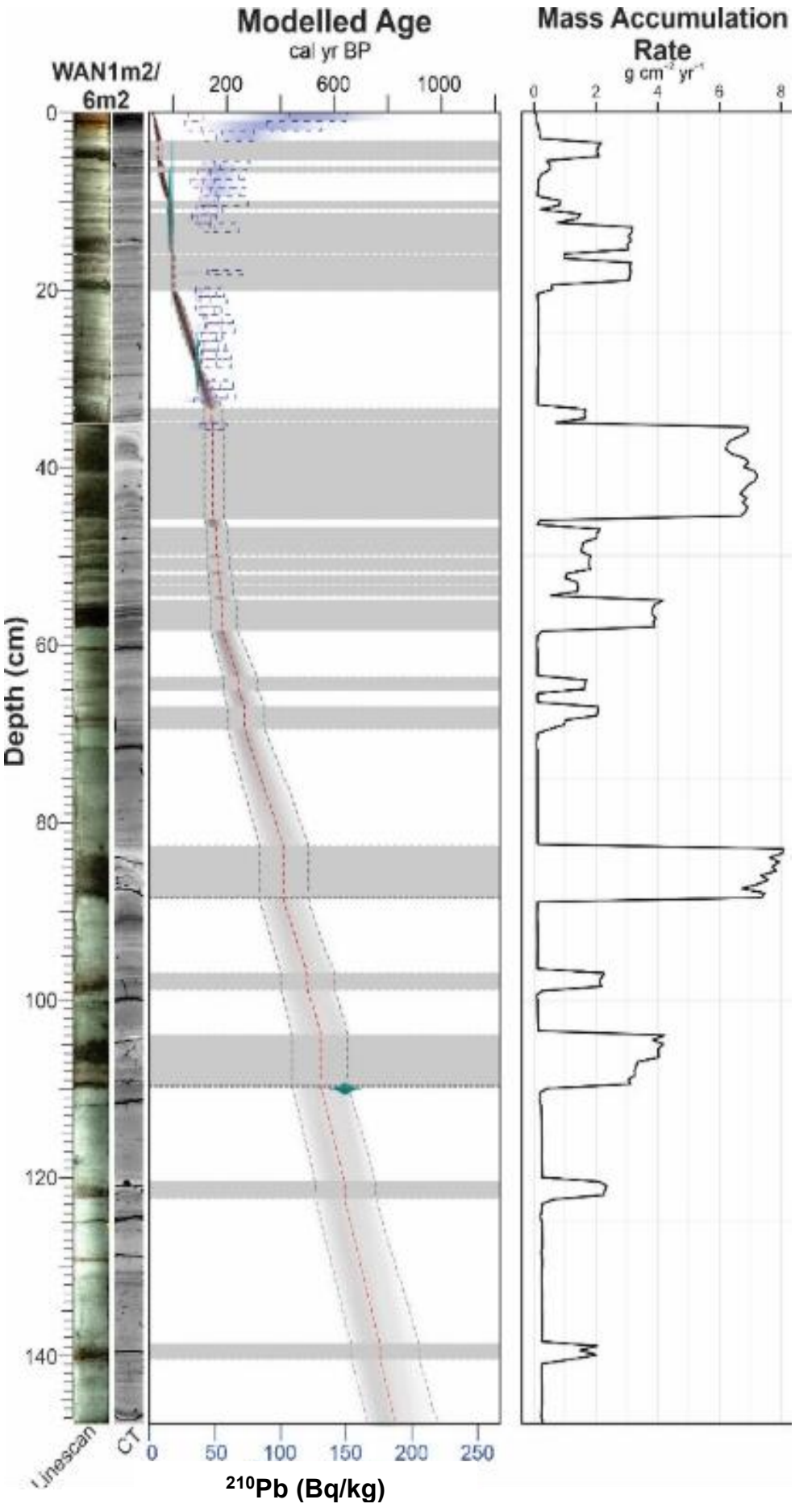


Figure 3. Glendhu Bay sediment core chronology and mass accumulation rate. Linescan and computed tomography (CT) images shown alongside the age-depth model and reconstructed mass accumulation rate (MAR). Grey shaded intervals identify rapidly deposited event beds recognised from core sedimentology and CT imagery; these intervals were treated as short-duration depositional events in the age model. The chronology is constrained by excess ^{210}Lead activity in the upper core and pollen biostratigraphic age markers at greater depth. The red dashed line shows the modelled median age-depth relationship, grey dashed lines indicate the associated 95% uncertainty envelope. The teal symbols indicate chronological constraints from ^{137}Cesium and pollen biostratigraphy. MAR (g cm^{-2} yr^{-1}) was calculated from modelled sedimentation rate and sediment dry density. Large MAR peaks coincide with the thick event deposits and therefore represent short-lived episodes of rapid sediment accumulation rather than sustained changes in background sediment supply.

Chronologies for both cores were developed using excess ^{210}Lead activity and ^{137}Cesium in the upper sediments together with pollen biostratigraphy. As noted above, changes in charcoal and *Pteridium esculentum* (bracken fern) were used to identify the transition associated with Māori activity at approximately 1310±15 CE, while the appearance of introduced pollen taxa was used to constrain the onset of European influence at approximately 1860±3 CE.

Chronological uncertainty increases below the interval directly constrained by ^{210}Lead. For example, in Roys Bay the 95% highest probability density function range increases from 22 years during the ^{210}Lead constrained interval to 87 years for the rest of the core, while in the Glendhu Bay cores the uncertainty increases from 22 years to 87 years. No radiocarbon ages were obtained from either core, meaning that deeper sections of the chronology depend principally on interpolation and extrapolation between the available ^{210}Lead and pollen-derived chronological constraints. The modelled ages of the lower portions of both cores, and particularly their basal ages, should therefore be regarded as approximate rather than tightly constrained estimates

The contrasting depositional environments are also clearly expressed in the mass accumulation rate (MAR) records. At Glendhu Bay, the largest MAR values coincide with phases of event deposits. The most notable of these initiated just before European settlement, reaching peaks of approximately 7–8 g cm^{-2} yr^{-1}, while a younger phase initiated at ~1950 CE, peaking a 2–4 g cm^{-2} yr^{-1}. These phases represent relatively short-lived pulses of rapid terrestrial sediment deposition during sequential events, probably indicating either an increase in the amount of sediment available for transport during high runoff due to catchment erosion or changes in the routing of major streams into Glendhu Bay. In contrast, accumulation within the intervening background sediment is substantially lower, generally <0.5 g cm^{-2} yr^{-1}. The Glendhu sequence records a slow, steady build-up of sediment over time, interrupted by occasional events that deposited much larger amounts of sediment in a short period.

Roys Bay displays a substantially smoother MAR record because discrete event deposition is absent. Background MAR is relatively low through much of the pre-human and Māori intervals before increasing markedly around the transition into the European period. MAR reaches approximately 0.3–0.35 g cm^{-2} yr^{-1} during the late nineteenth to early twentieth century, coincident with major changes in catchment vegetation and land use associated with European settlement. This increase is consistent with enhanced erosion and fine-sediment delivery following vegetation clearance and the development of pastoral land use. MAR subsequently declines and remains comparatively stable through much of the later twentieth-century and recent record, providing little evidence for a comparable sustained increase in sediment accumulation during the period of most rapid recent urban development.

Overall, the two records demonstrate strong spatial differences in the way catchment disturbance is transferred to Lake Wānaka. Roys Bay preserves a comparatively continuous sedimentary record in which changes in MAR can be related more directly to longer-term changes in catchment sediment supply. In contrast, Glendhu Bay is an event-dominated depositional environment in which terrestrial sediment delivery is concentrated into discrete, high-magnitude pulses superimposed on much lower background accumulation. The records therefore suggest that the sedimentary response to human land-use change has not been spatially uniform across Lake Wānaka and needs to be interpreted within the different catchment and depositional settings of the two bays.

Vegetation change – evidence from the pollen record

Pollen and charcoal were analysed to provide records of past vegetation change, catchment disturbance, and human activity. Pollen preserved in lake sediments can be used to reconstruct changes in local and regional vegetation, including forest clearance and the appearance of introduced species associated with human occupation. Charcoal provides evidence of past fire activity and land clearance within the catchment and wider region. However, both pollen and charcoal can be transported by wind and water and vary in their dispersal and production (pollen), meaning that sediment records may reflect regional as well as local environmental signals (McWethy et al. 2014) and should viewed to represent broad vegetation spatial patterns and composition and not directly reflect vegetation biomass.

Pre-human period (~ pre 1350 CE)

Both Glendhu Bay and Roys Bay display broadly similar vegetation patterns during the pre-human period (
Figure **4**Figure 5; Appendix 4, Figures A5 and A6). Tree pollen dominated the assemblages (Roys Bay: ~80%; Glendhu Bay: ~60%), with major components derived from beech and podocarp forest taxa, including *Lophozonia* (silver beech), *Fuscospora* (red, black, mountain, hard beech), *Podocarpus* spp. (podocarps), *Prumnopitys taxifolia* (Mataī), and *Dacrydium cupressinum* (rimu). Shrub taxa, mainly *Phyllocladus* (Celery pine), *Coprosma*, *Plagianthus* (Ribbonwood), and Asteraceae (Daisy family) comprised approximately 30% of the assemblages, with consistent representation of *Muehlenbeckia*, *Myrsine*, and Rosaceae. Herbaceous taxa accounted for only 5–10% of the pollen sum and were dominated by Poaceae (Grass). Wetland and aquatic taxa included Cyperaceae (sedges), *Isoetes* (a macrophyte), together with the algae *Pediastrum* and *Botryococcus*. Fern spores were very low in abundance. Charcoal particles were consistently present at low concentrations throughout this interval, indicating intermittent natural fires (
Figure **4**Figure 5; Appendix 4, Figures A5 and A6).

Overall, the pollen assemblages suggest a heterogeneous landscape composed of beech–podocarp forest, shrubland, grassland, and wetland communities prior to human

arrival. Previous studies have suggested that the lowland basin floors of Central Otago were dominated by short-statured woodland and shrubland containing taxa such as *Plagianthus regius*, *Coprosma*, *Myrsine*, and *Olearia* (Wood & Walker, 2008), while *Phyllocladus* and *Lophozonia* likely originated from local montane forests (Thorburn, 1974). The absence of supporting macrofossil evidence has led to suggestions that much of the podocarp pollen signal was derived from more distant forests in the humid western regions or eastern coastal districts (McGlone & Wood, 2019). The persistent but very low abundance of tree fern (*Cyathea smithii*) further supports the interpretation that forest cover in dry Central Otago was spatially restricted, probably being confined to sheltered gullies and stream margins where local moisture availability was higher (McGlone et al. 1995).

This relatively stable vegetation pattern changed abruptly following Māori arrival.

Māori period (~1350 CE to 1850 CE)

Both sites record an abrupt decline in tree and shrub taxa during the Māori period. This pattern is particularly pronounced at Roys Bay, although *Lophozonia* shows a less marked reduction (

Figure **4**Figure 5; Appendix 4, Figures A5 and A6). In contrast, *Fuscospora* maintained consistent representation throughout this interval and, together with *Lophozonia*, became the dominant remaining forest component in the Roys Bay catchment. Most shrub taxa also declined markedly, while *Coriaria* emerged and remained consistently present thereafter. These changes were accompanied by a substantial expansion of *Pteridium esculentum* and Poaceae at both sites, indicating a shift from woody vegetation to fernland and grassland. Wetland communities also changed, with *Isoetes* replacing *Pediastrum* and *Botryococcus* as the dominant aquatic taxon. Charcoal concentrations increased markedly, reaching nearly three times those of the pre-human period (
Figure **4**Figure 5; Appendix 4, Figures A5 and A6).

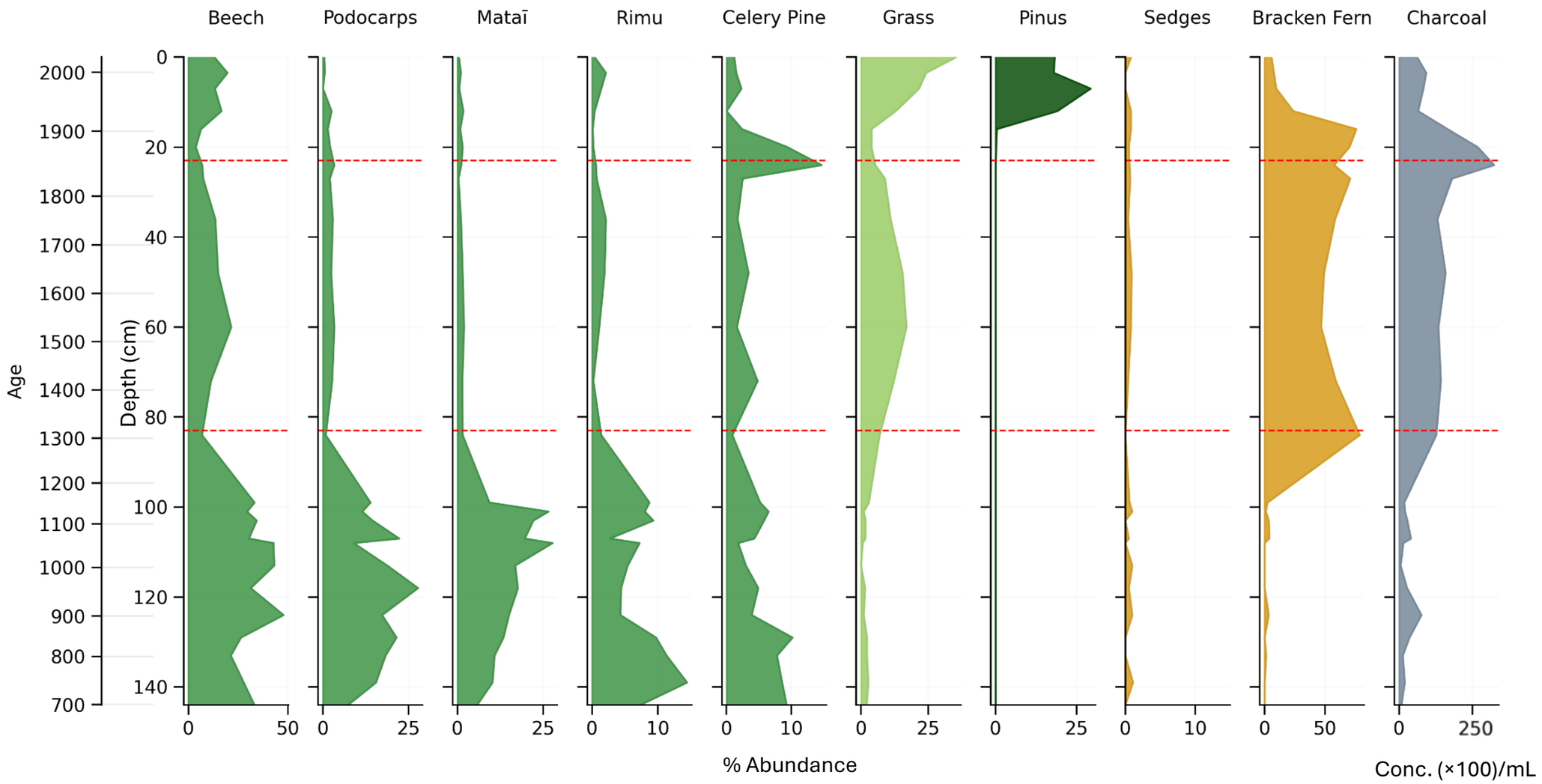


Figure 4. Summary percentage pollen diagram showing the relative abundance of selected common taxa from Roys Bay, Lake Wānaka. See Appendix 4 Figure A5 for a detailed diagram. Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals).

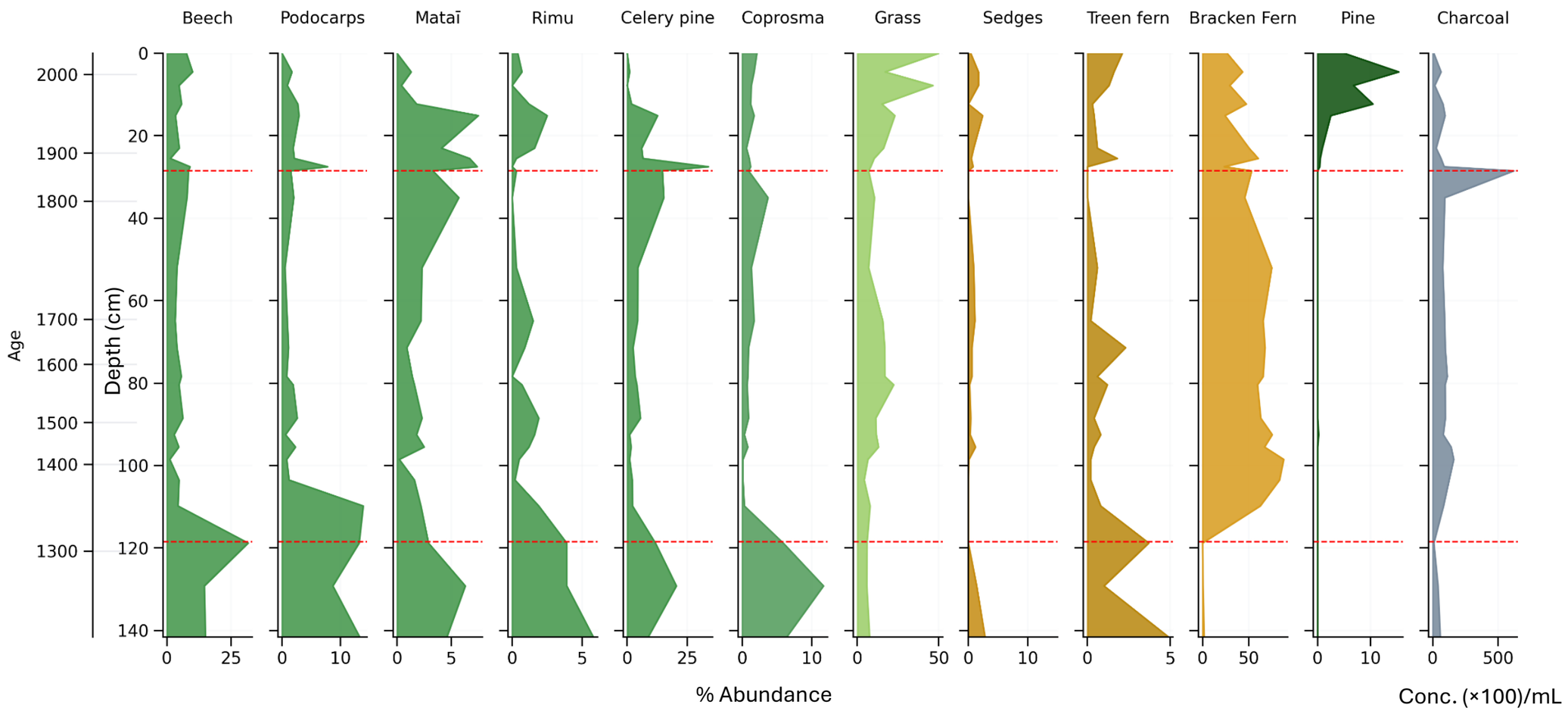


Figure 5. Summary percentage pollen diagram showing the relative abundance of selected common taxa from Glendhu Bay, Lake Wānaka. See Appendix 4 Figure A6 for a detailed diagram. Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals.

These vegetation changes are consistent with pollen records from elsewhere in Central Otago, including Lake Hayes (Thorburn, 1974), Lake Diamond (McWethy et al. 2009), and regional syntheses by McGlone et al. (1995). The timing also agrees closely with evidence for early human settlement in inland Otago. Substantial increases in human-sourced faecal sterol fluxes at Lake Kirkpatrick (c. 1345–1365 CE) and Lake Diamond (c. 1310–1380 CE) have been interpreted as evidence of human occupation (Argiriadis et al. 2018). Roys Bay most closely resembles the Nokomai Ecological District, where repeated anthropogenic burning removed most lowland and montane forests, leaving isolated *Fuscospora*-dominated forest remnants (McGlone et al. 1995). Given the dry climate and fire-prone shrubland vegetation of the region, it is likely that Māori fires frequently escaped control and spread across extensive areas of scrub and forest.

Among these vegetation changes, the response of podocarp taxa is particularly noteworthy. If the podocarp pollen signal had been derived predominantly from distant western forests, as previously proposed, such a synchronous decline would be less expected because West Coast podocarp forests were comparatively less affected by Māori burning. Instead, these data suggest the former local presence of scattered conifer forest remnants within the Wānaka region, although part of the podocarp pollen signal was probably transported from eastern coastal forests. This interpretation is supported by a pronounced peak in retene, a biomarker produced during the combustion of conifer wood, in sediments from nearby Lake Kirkpatrick at approximately 1350 CE, indicating abundant coniferous fuel during the initial burning phase (Argiriadis et al. 2018). Taken together, these observations suggest that inland Otago may have supported more tall woody vegetation than implied by the limited historical and macrofossil record (McGlone et al. 1995; McGlone & Wood, 2019). Although the Wānaka basin was probably less frequently occupied than major Māori settlement areas, even relatively small human populations could have profoundly transformed these fire-sensitive landscapes through repeated burning.

A second major vegetation transition occurred following European settlement.

European period (post ~1850 CE)

The European period is marked by the first appearance of the pasture indicators, particularly exotic *Rumex acetosella* (Sheep's sorrel), *Taraxacum* (Dandelion), and Poaceae (

Figure **4**Figure 5; Appendix 4 Figures A5 and A6). This transition coincides with a substantial increase in charcoal concentrations, representing the highest values recorded in the sequence, although this peak was relatively short-lived at Glendhu Bay. It was followed by the appearance and expansion of exotic tree taxa, including tree taxa, including *Salix* (Willow), *Pinus* (Pine), and *Corylus* (Hazel). At both sites, *Fuscospora* and *Lophozonia* remained relatively stable compared with the preceding Māori period, likely representing their stable presence in the upper catchments. However, Glendhu Bay

shows a slight recovery of podocarp taxa, including *Dacrydium cupressinum*, *Prumnopitys taxifolia*, *Dacrycarpus dacrydioides* (Kahikatea), and *Podocarpus* spp., together with a modest increase in fern diversity. Wetland vegetation continued to be dominated by *Isoetes* (

Figure **4**Figure 5; Appendix 4 Figures A5 and A6). These changes closely resemble those recorded at Lake Diamond and Lake Hayes and have been attributed to widespread burning associated with European pastoral expansion during the late 1850s and early 1860s (Thorburn, 1974; McWethy et al. 2009). Elsewhere in the central South Island, early European burning similarly produced a brief resurgence of bracken before its replacement by exotic grassland (McGlone et al. 2005). Historical accounts describe extensive burning of native scrub to create grazing land prior to and during the Otago gold rush (Knudson, 1968, as cited in Thorburn, 1974). Rapid-growing exotic trees such as *Salix* were subsequently planted to provide timber and fuel in landscapes that had already been largely depleted of native woody vegetation (Thorburn, 1974).

One interesting feature of the European period is the slight recovery of podocarp taxa, which is also evident in the pollen record from nearby Lake Diamond (Li, unpublished data). Buchanan (1868, cited in Thorburn, 1974) observed that parts of Otago were becoming "reclothed with bush" during the early years of European settlement. Following the decline of Māori use of inland Otago after the depletion of accessible pounamu resources (Knudson, 1968, as cited in Thorburn, 1974), reduced burning pressure may have allowed remnant woody vegetation to regenerate in sheltered gullies and other fire-protected habitats. This interpretation is further supported by biomarker evidence from Lake Diamond, where the absence of a nineteenth-century increase in faecal sterols suggests limited pastoral activity and relatively low human pressure within the catchment (Argiriadis et al. 2018). Together, these observations suggest that reduced burning and limited catchment disturbance created a brief window for the partial recovery of native woody vegetation in parts of the inland Otago landscape.

Mass accumulation rates, trace metals and ITRAX

Trace metals (antimony, arsenic, cadmium, copper, lead, mercury, and zinc) were analysed in the sediment core to reconstruct past changes in contaminant inputs and catchment activity, as these elements act as proxies for anthropogenic pressures such as agriculture, urbanisation and catchment disturbance (Table 1). Metal concentrations were converted to flux (mg cm^{-2} yr^{-1}) by combining concentration data with mass accumulation rates (MAR), allowing the actual rate of metal delivery and burial in the lake sediments to be quantified through time. Unlike concentration data alone, flux accounts for variations in sediment accumulation and therefore provides a more robust measure of temporal changes in metal loading, with higher flux values indicating greater metal inputs to the lake during a given period.

Roys Bay

Mass accumulation rates (MAR) remained relatively low prior to approximately 1865 CE (HDPF range 1858 to 1874 CE) before increasing through the late nineteenth and early twentieth centuries (Figure 6). The timing of this increase coincides with European settlement of the region and corresponds closely with the marked increase in charcoal concentrations observed in the pollen record (Figure 4) suggesting enhanced catchment disturbance and burning following land-use change.

All trace elements exhibited temporal patterns similar to MAR. Antimony, arsenic, cadmium, copper, lead, mercury and zinc fluxes generally increased during periods of elevated sediment accumulation and declined during intervals of lower sediment delivery. Although some fluctuations were evident throughout the record, none of the trace elements displayed an abrupt or sustained increase that would indicate substantial anthropogenic enrichment independent of changes in sediment accumulation. Instead, the close correspondence between elemental fluxes and MAR suggests that variations in trace-element deposition were primarily controlled by changes in sediment delivery to the lake.

The relatively weak trace-metal response is somewhat surprising given the well-documented effects of twentieth-century urbanisation on lake sediment records elsewhere (e.g., Wang et al. 2024). However, population growth in Wānaka remained modest for much of the period represented by the sediment core (Table 2**Table 2**). Historical estimates suggest that the township population remained below approximately 2,000 people until the late 1970s and below 4,000 people until the 1990s. Increased population growth occurred only during the last few decades, with the population increasing from approximately 5,000 in 2006 to more than 11,000 by 2023. Consequently, much of the sediment record represents a period when local anthropogenic pressures were relatively low. This limited population size may explain the absence of a strong trace-metal contamination signal despite evidence for increased sediment delivery following land-use change.

Table 2. Population estimates for Wānaka from 1901 to 2023. Values prior to the 1980s are historical estimates because the Wānaka urban area was not consistently defined in early New Zealand censuses. Census values from 1986 onwards are from Statistics New Zealand.

Year	Population	Inc. in population
1901	~450	-
1911	~500	50
1921	~650	150
1936	~800	150
1945	~900	100
1956	~1,100	200
1966	~1,350	250
1976	~1,700	350
1986	~2,300	600
1996	~3,500	1,200
2006	5,037	1,537
2013	6,987	1,950
2018	8,890	1,903
2023	11,550	2660

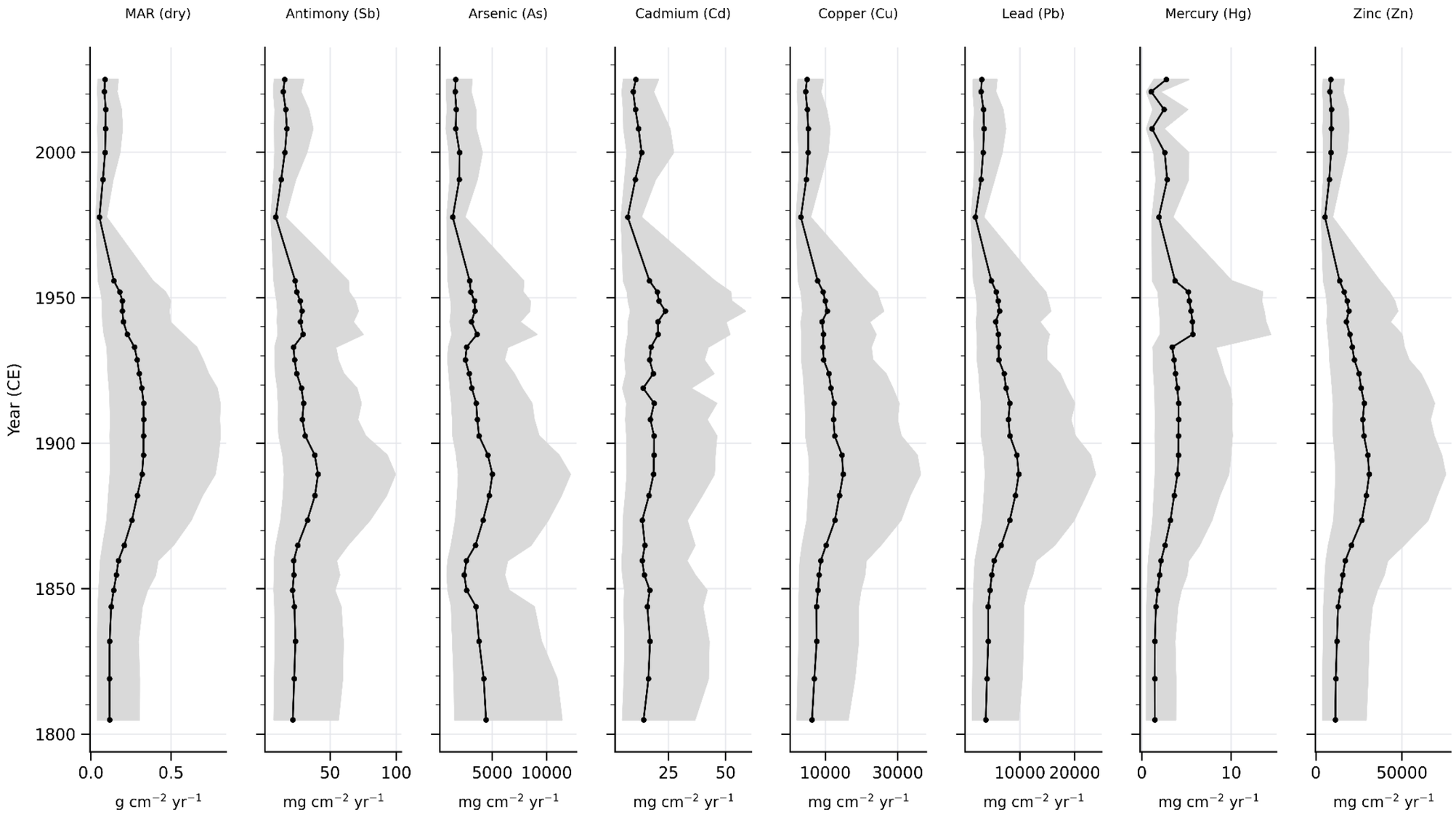


Figure 6. Sedimentary mass accumulation rate (MAR) and trace-element accumulation from Roys Bay, Lake Wānaka, plotted against age (CE). Solid black lines represent median values, and grey envelopes indicate the minimum–maximum range using the uncertainty in MAR as derived from the age model.

Glendhu Bay

Mass accumulation rates varied throughout the sediment record but generally increased during the twentieth century relative to the nineteenth century. This increase was accompanied by parallel increases in the accumulation rates of all trace metals, indicating that sediment delivery was a primary control on trace-metal fluxes to the lake (Figure 7). Unlike Roys Bay, several trace elements exhibited greater temporal variability. Arsenic showed particularly large fluctuations and reached its highest accumulation rates in recent sediments. Copper, lead and zinc also varied substantially and generally increased during periods of elevated MAR after approximately 2000 CE.

The stronger variability observed at Glendhu likely reflects catchment characteristics. The catchment is larger than that of Roys Bay and receives inflows from Fern Burn and Alpha Burn. The close correspondence between mass accumulation rates and trace-metal accumulation suggests that variations in sediment delivery were an important control on trace-metal fluxes. Increased erosion and transport of fine-grained sediment from the catchment likely enhanced the delivery of trace elements to the lake, although the specific sources of individual metals cannot be determined from the available data.

Cadmium is of particular interest because phosphate fertilisers historically used in Aotearoa New Zealand contained cadmium as an impurity. Consequently, cadmium accumulation in lake sediments has often been interpreted as evidence of agricultural development and superphosphate fertiliser use. The increase in cadmium flux observed in recent sediments from Glendhu Bay is consistent with enhanced catchment-derived inputs and may partly reflect agricultural activities within the catchment (Queenstown Lakes District Council, 2018; Glendhu Bay Trustees Ltd., 2019). However, because cadmium increased alongside several other trace metals and periods of elevated sediment accumulation, the available data do not allow specific source attribution. Similar, and in some cases much more pronounced, increases in cadmium accumulation associated with agricultural intensification have been reported in other paleolimnological studies from Aotearoa New Zealand. However, the largest increases typically occurred between approximately 1920 and 1950 CE, coinciding with the widespread expansion of pastoral farming and the adoption of aerial topdressing, which substantially increased superphosphate fertiliser use (e.g., Wheeler et al. 2024).

Arsenic reached its highest accumulation rates in the most recent sediments. Unlike cadmium, the source of this arsenic enrichment is not clear. Potential mechanisms include changes in catchment-derived sediment inputs, mobilisation of naturally occurring arsenic from catchment materials, or changes in sediment delivery pathways. Given the absence of a clear corresponding anthropogenic source, the arsenic signal should be interpreted cautiously and is best regarded as evidence of changing trace-element inputs rather than a diagnostic indicator of a specific activity or land-use change.

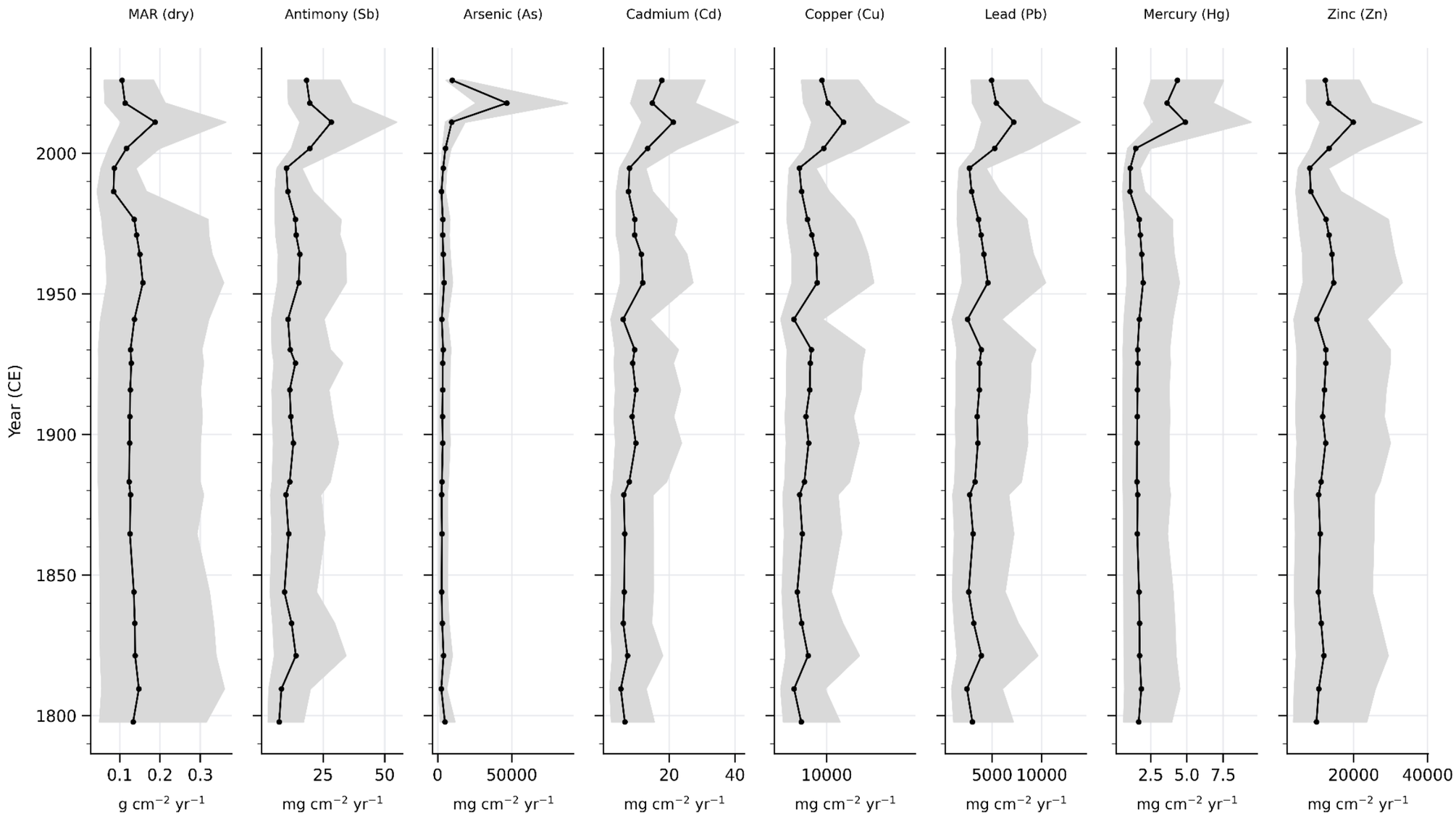


Figure 7. Sedimentary mass accumulation rate (MAR) and trace-element accumulation from Glendhu Bay, Lake Wānaka, plotted against age (CE). Solid black lines represent median values, and grey envelopes indicate the minimum–maximum range using the uncertainty in MAR as derived from the age model.

The Ti:Inc ITRAX data yielded broadly similar patterns to the MAR data. Given that we consider the MAR analysis to be more robust, the ITRAX data are provided in Appendix 5 for completeness but are not interpreted further.

Hyperspectral

Hyperspectral reflectance measurements at 660 nm and 670 nm were used to calculate the Relative Absorption Band Depth (RABD660/670) index, which is associated with chlorophyll-a and its degradation products preserved within sediments. This index is commonly used as a proxy for chlorophyll-bearing organic matter and past biological production (Butz et al. 2017; Schneider et al. 2018).

In this study, the RABD660/670 index was converted to a sedimentary chlorophyll-a proxy concentration ($\mu g\ g^{-1}$) using a calibration derived from a comparison of surface sediment samples from 29 glacial lakes in Aotearoa New Zealand, where chlorophyll-a was measured using both hyperspectral scanning and high-performance liquid chromatography (Yackulic, McKay and Vandergoes, unpublished data). Chlorophyll-a concentrations were subsequently converted to flux values ($mg\ cm^{-}2\ yr^{-1}$; see Appendix 2).

Interpretation of this proxy should be undertaken with caution. The hyperspectral signal cannot distinguish between chlorophyll-a originating from aquatic production within the lake and chlorophyll associated with terrestrial vegetation transported into the lake catchment. For example, flood-derived sediments may contain chlorophyll-bearing plant material, including leaves and other organic debris. Similarly, chlorophyll preserved within lake sediments may be derived from a mixture of phytoplankton, benthic algae, and aquatic macrophytes. The proxy may also be influenced by sedimentological and geochemical properties that affect spectral reflectance. For example, the upper approximately 1.5 cm of the Glendhu Bay core could not be interpreted due to oxidation of the sediment surface, which altered the hyperspectral signal.

The Roys Bay record indicates a notable increase in chlorophyll-a flux after approximately 1350 CE, followed by relatively stable values until around 1850 CE (Figure 8). Chlorophyll-a flux values then declined before increasing rapidly during the mid-twentieth century, with a pronounced rise beginning around 1950 CE. Following this peak, chlorophyll flux decreased temporarily before increasing again towards the sediment surface.

Event layers were removed from the Glendhu Bay record prior to plotting. Chlorophyll flux remained relatively stable until approximately 1700 CE, after which values declined. Despite some minor fluctuations, chlorophyll-a flux remained generally stable through the nineteenth and twentieth centuries (Figure 9). Interpretation of the uppermost part of the record is limited because the oxidised surface sediment could not be analysed. Consequently, the record stops at approximately 2011 CE (HDPF range 2004-2017).

As discussed above, there are several important limitations associated with hyperspectral-derived chlorophyll reconstructions. In addition, the uncertainties associated with both the age-depth model and the regression equation used to convert hyperspectral measurements to chlorophyll flux have been propagated through the analysis, resulting in relatively large uncertainty envelopes around the reconstructed values (Figure 8 and 9).

Given the importance of determining whether algal production has increased, particularly in the last 50 to 100 years, we strongly recommend undertaking sediment pigment analysis on the cores. Pigment analyses provide a more robust and quantitative assessment of historical algal abundance and can also provide information on changes in the composition of algal communities (Leavitt and Hodgson 2002). This would help distinguish whether recent changes in the hyperspectral chlorophyll-a proxy reflect greater aquatic productivity, shifts in algal assemblages, increased macrophyte abundance, or enhanced terrestrial organic matter inputs. Diatoms can often be associated with different lake habitats (e.g., pelagic, benthic, and epiphytic environments). To aid interpretation of the Roys Bay chlorophyll-a record, diatom concentrations and biovolume flux were estimated for the post-European period. These results are presented in the Diatom section below. However, it is important to note that diatoms represent only one, albeit important, component of the lake's primary producer community.

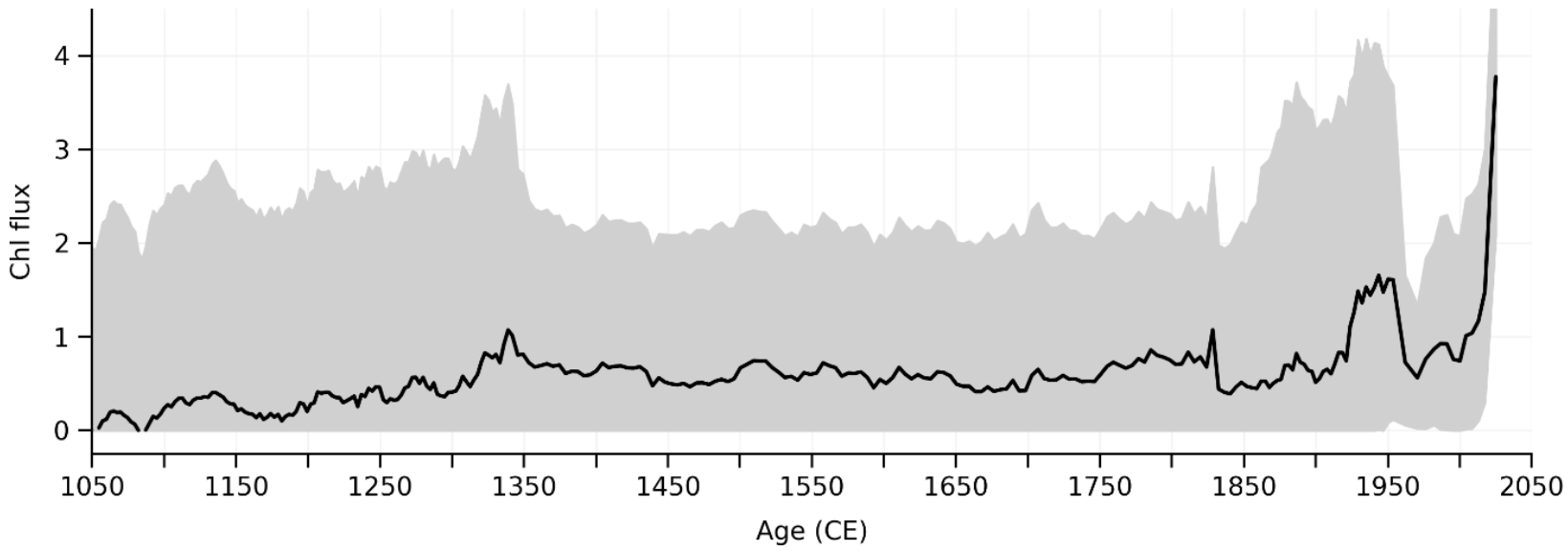


Figure 8. Hyperspectral-derived chlorophyll-a flux (mg cm^{-2} yr^{-1}) for the Roys Bay sediment core. The solid black line represents the median reconstructed values, while the grey envelope indicates the full uncertainty range (minimum to maximum values) derived from propagation of uncertainties associated with the age-depth model and the regression equation used to convert hyperspectral measurements to chlorophyll-a.

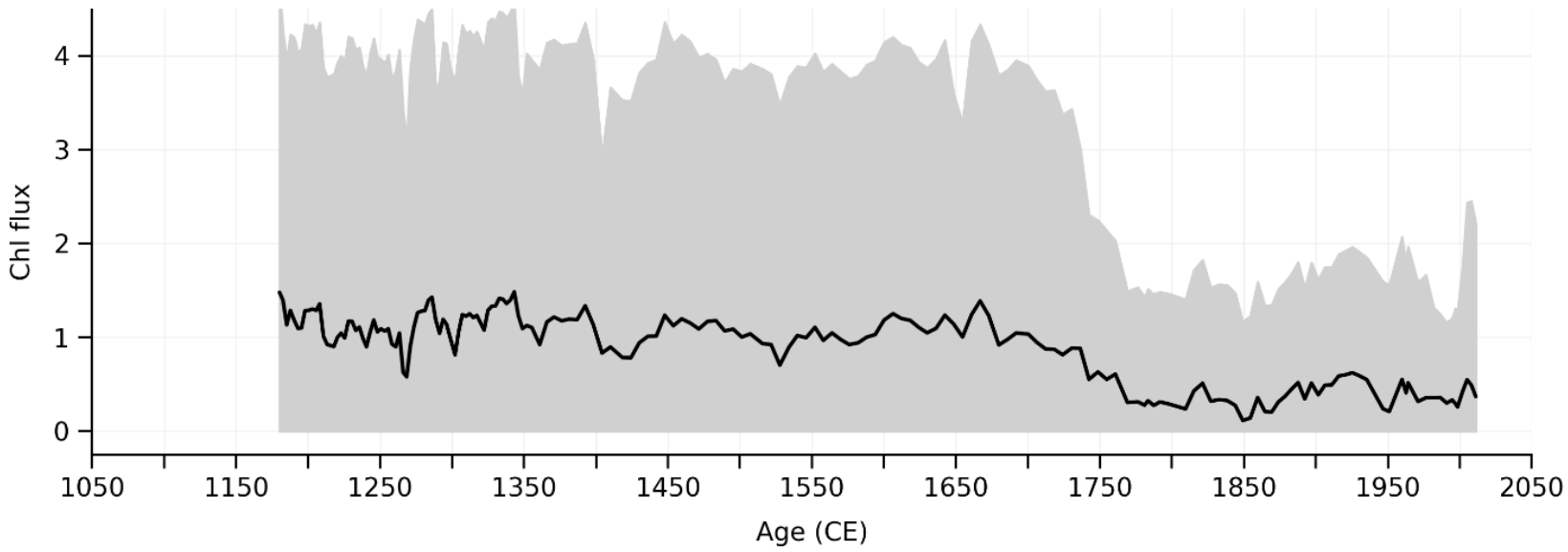


Figure 9. Hyperspectral-derived chlorophyll-a flux (mg cm^{-2} yr^{-1}) for the Glendhu sediment core. The solid black line represents the median reconstructed values, while the grey envelope indicates the full uncertainty range (minimum to maximum values) derived from propagation of uncertainties associated with the age-depth model and the regression equation used to convert hyperspectral measurements to chlorophyll-a. Signals measured during event layers were removed for plotting.

Diatoms

Diatoms were analysed because they are highly sensitive indicators of environmental conditions and respond rapidly to changes in water quality, nutrient availability, habitat conditions, and catchment disturbance. The siliceous cell walls of diatoms are well preserved in lake sediments, allowing past ecosystem conditions to be reconstructed from changes in diatom species composition through time (Dixit et al. 1992).

Roys Bay

Prior to human arrival, the diatom community of Roys Bay was dominated by small fragilarioid taxa (Figure 10). These species have broad ecological tolerances and although they inhabit both benthic and pelagic habitats, they are more generally associated with benthic environments. The centric, planktonic species *Discostella stelligera,* and the benthic species *Karayevia clevei* and *Achnanthidium minutissimum* were also important in the pre-human diatom assemblage. *Karayevia clevei* and *Achnanthidium minutissimum* are tolerant of turbulent systems such as would be found in shallow habitats or those close to the shoreline, and *Karayevia clevei* is tolerant of low nutrient concentrations. *Discostella stelligera* is widespread and has been associated with oligotrophic, clear water systems. Taxa associated with soils and moist habitat were present in low abundance (<2% relative abundance) throughout the period prior to human arrival, which may indicate the presence of marginal or wetland habitats around the bay.

Following Māori arrival, the relative abundance of *Karayevia clevei* declined and the community became dominated by *Discostella stelligera*, and *Achnanthidium minutissimum* (Figure 10). Taxa associated with moist habitats increased in abundance in the samples following Māori arrival (from ~ 2 to 3.8% relative abundance), largely driven by benthic species *Diploneis elliptica*. The abundance of small fragilarioid taxa decreased yet their relative abundance remained between 17 – 25% of the community. Across this era, the relative abundances of small fragilarioid taxa and *Discostella stelligera* remained relatively stable. The relative abundance of benthic/epiphytic species *Achnanthidium minutissimum,* benthic/epiphytic mesotrophic taxon *Achnanthidium* cf. *macrocephalum,* and benthic/epiphytic meso-eutrophic taxa *Cocconeis* cf. *placentula* increased over this period, which may indicate changes in the littoral environment, including development or expansion of marginal wetland or macrophyte habitats and associated increases in substrate availability, and/or changes in light availability favouring benthic growth, and/or an increase in nutrient availability.

The transition from the Māori era to the post-European era in Roys Bay was marked by an initial increase in the relative abundance of *Discostella stelligera* accompanied by declines in *Achnanthidium minutissimum* and small fragilarioid taxa (Figure 11). At the same time, *Karayevia clevei* exhibited a spike in relative abundance and *Achnanthidium* cf. *macrocephalum* increased in abundance. The biovolume of *Discostella stelligera* over this period remained relatively stable despite its initial marked increase (data not shown). Thus, this likely reflects declines in benthic taxa that happened at the same time rather than an increase in pelagic productivity. Following c. 1860 CE horizon, the Roys Bay diatom community underwent a more substantial shift. *Discostella stelligera* declined rapidly, while the benthic/epiphytic and meso-eutrophic *Cocconeis* cf. *placentula*, the epiphytic *Achnanthidium minutissimum,* and the benthic *Brachysira* cf. *vitrea*, a taxon associated with mesotrophic lakes in Aotearoa New Zealand, increased in abundance. The increasing contribution of benthic and epiphytic taxa is consistent with changes to the littoral environment and potentially indicate increasing contribution of epiphytic habitats and/or increased water clarity and light availability. This was followed by a brief incursion of *Asterionella formosa* and the appearance of *Fragilaria crotonensis* and *Lindavia intermedia*. *Lindavia intermedia* is the species responsible for lake snow. Trace levels of *L. intermedia* were detected in sediment corresponding to an age of c. 1980 CE (HDPF range 1970-1990). However, CT scan imagery at this depth indicated potential bioturbation by kākahi, and the identification is therefore considered uncertain. Consistent and more reliable occurrences of *Lindavia intermedia* were first recorded in sediment dated to c. 1999 CE (HDPF range 1989-2008). At the same time, increases in the abundance of *Diploneis elliptica* (included in terrestrial species), a species associated with moist habitats, and *Eunotia incisa* which is commonly epiphytic and associated with small lakes and ponds, and moist habitats, occur.

Asterionella formosa is an introduced species and thus its occurrence is the result of dispersal. However, *Asterionella formosa* is sensitive to nutrient concentrations and is considered an indicator of critical nitrogen loads, above which there is ecological effect, in oligotrophic lakes (Porter & Johnson, 2007; Saros et al. 2005). Thus, it likely also indicates increased nitrogen loading to the bay. Furthermore, the coincident appearance of *Fragilaria crotonensis* indicates increasing nutrient concentrations. *Fragilaria crotonensis* has been found to be primarily limited by phosphorus in some lakes in Aotearoa New Zealand, but is more commonly associated with nitrogen loading in large oligotrophic lakes elsewhere. With the increases in the abundance of epiphytic/benthic and moist habitat species (Figure 11), these changes suggest potential interacting increases in nutrient availability and availability of benthic and epiphytic habitats either due to expansion of macrophyte or marginal wetland habitat, or increased light availability.

To aid interpretation of the Roys Bay chlorophyll-a record (Figure 8), diatom biovolume accumulation rates were estimated for the post-European period. Post about 1900 CE, benthic and benthic/epiphytic taxa dominated diatom biomass (Figure 12), potentially reflecting changes in benthic habitat availability, light conditions, or macrophyte communities. However, from approximately the 1990s onwards, pelagic diatom accumulation rates increased markedly, driven almost entirely by *Lindavia intermedia* (Figure 12). This increase occurred concurrently with declines in benthic and benthic/epiphytic diatom fluxes, indicating a shift in the dominant source of diatom production within Roys Bay. The expansion of *Lindavia intermedia* closely aligns with the recent increase in sediment chlorophyll-a concentrations, providing further evidence that the establishment of this non-native species may be substantially altering the ecology and primary production dynamics of Roys Bay, shifting diatom production from predominantly benthic/epiphytic to increasingly pelagic habitats.

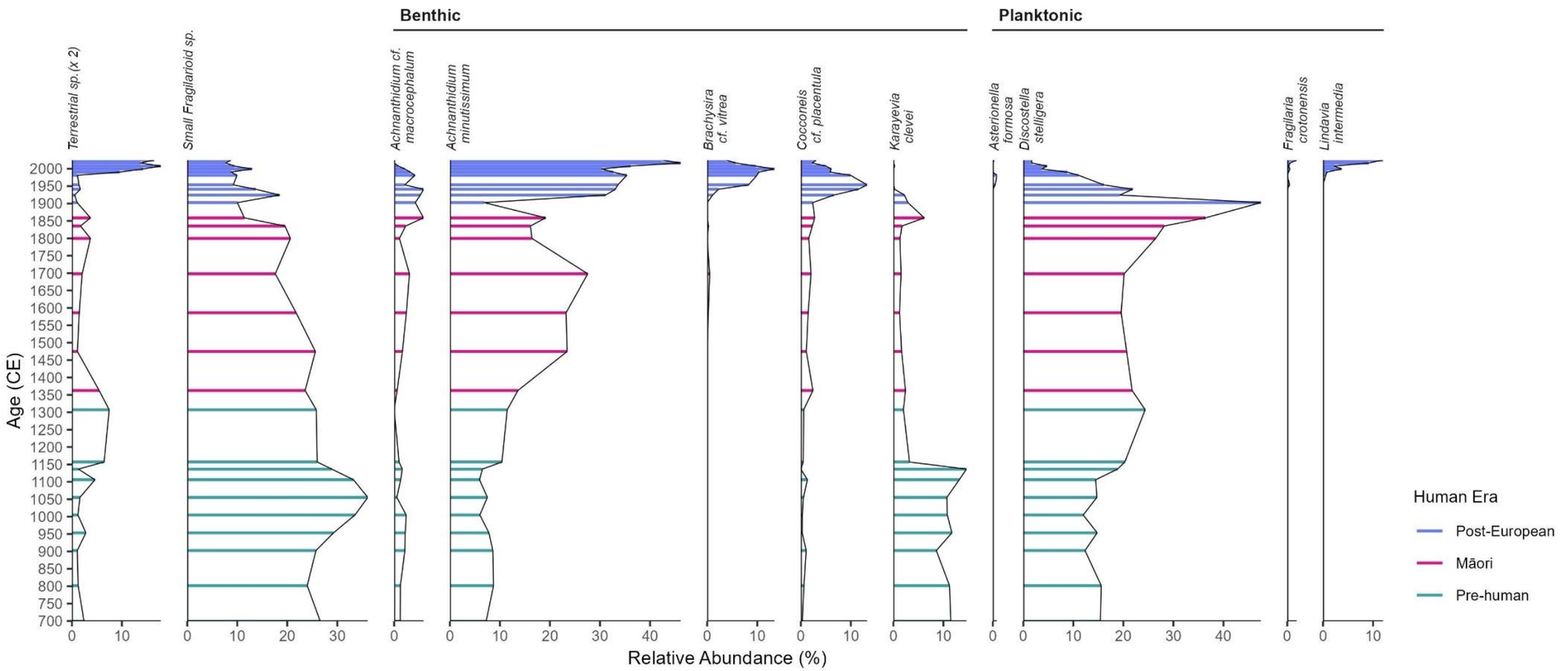


Figure 10. Stratigraphy of the Roys Bay diatom community assemblage. Data are expressed in relative abundance. Benthic and Planktonic taxa shown are present in ≥ 5% relative abundance in at least one sample. The taxa *Asterionella formosa* and *Fragilaria crotonensis* are included, despite not meeting the 5% threshold, as they are considered important indicator taxa. For visualisation purposes, taxa associated with soils and moist habitats have been summed and their abundance multiplied by 2 ("Terrestrial sp. (x 2)"), and small Fragilarioid species have been grouped ("Small Fragilarioid sp."). Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals.

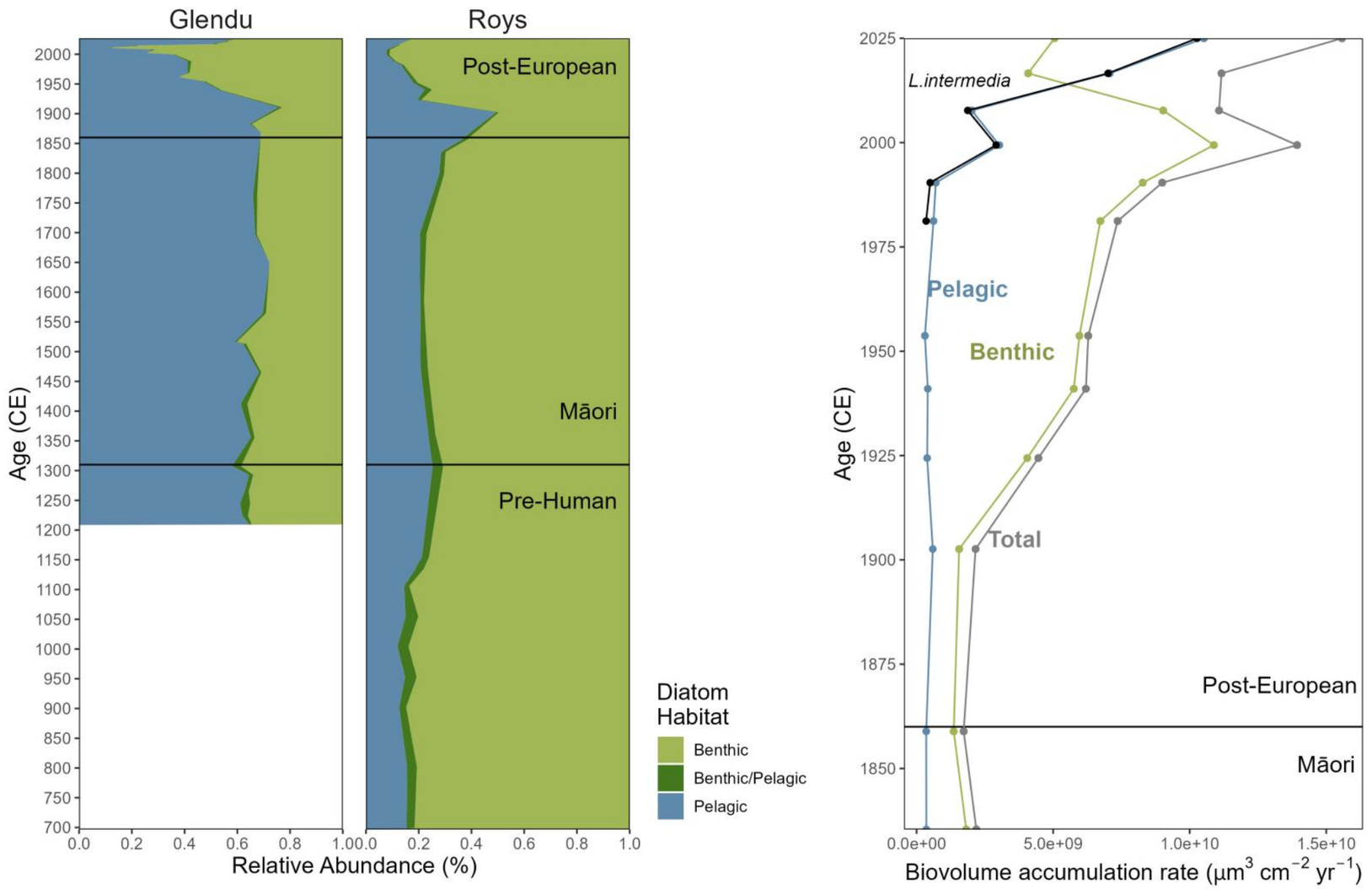


Figure 11. (Left) Relative abundance of habitat guilds of diatom communities in Roys and Glendhu Bay. (Right) Temporal changes in diatom biovolume accumulation rates in the Roys Bay core for total diatoms, major habitat guilds, and *Lindavia intermedia*.

Glendhu Bay

Prior to human arrival, the diatom community of Glendhu Bay was dominated by the centric, planktonic species *Discostella stelligera*, which exceeded 50% relative abundance in all samples (Figure 12). This species is widespread in lakes in Aotearoa New Zealand and appears tolerant of a broad range of conditions nationally, although internationally, it has been associated with oligotrophic, clear water systems. Small, araphid taxa were also important in the pre-human diatom assemblage. The most abundant of these species were *Staurosira construens, Pseudostaurosira brevistriata,* and *Staurosirella pinnata*. Globally, these species occur across a broad trophic gradient. However, *Pseudostaurosira brevistriata* is frequently associated with cool, oligotrophic, glacial, and alpine systems and in Aotearoa New Zealand, *Staurosirella*. *pinnata* has been recorded to be more abundant in deep, clear water lakes. Although these species inhabit both benthic and pelagic habitats, they are more generally associated with benthic environments. Another notable benthic/epiphytic species present in high abundance (6 – 13% relative abundance), prior to human arrival is *Achnanthidium minutissimum*. *Achnanthidium minutissimum* has been recorded over a broad trophic gradient and environmental conditions and is thus not strongly indicative of limnological conditions (Figure 12).

The most substantial change in the community occurred after European arrival to present. Immediately following European arrival, species such as planktonic *Discostella stelligera* and *Stephanodiscus noveazeelandiae* and benthic/epiphytic *Achnanthidium minutissimum* decline (Figure 12). Simultaneously, mesotrophic taxa including *Achnanthidium* cf. *macrocephalum* and *Fragilaria capucina* increase.

Further increases in the abundance of *Achnanthidium* cf. *macrocephalum* and *Brachysira* cf. *vitrea* may indicate increased water clarity and/or expansion of benthic and epiphytic habitats (Figure 11), while declines in *Discostella stelligera* and the introduction of *Asterionella formosa* indicate possible increases in nutrient concentrations. Another incursion of soil/moist habitat species, and a subsequent rapid increase in *Fragilaria crotonensis* suggest further catchment disturbance and increased nutrient concentrations. In the uppermost sediments, *Lindavia intermedia* is the dominant taxon, with its first occurrence recorded in sediments dated to 2008 CE (HDPF range 2000-2014).

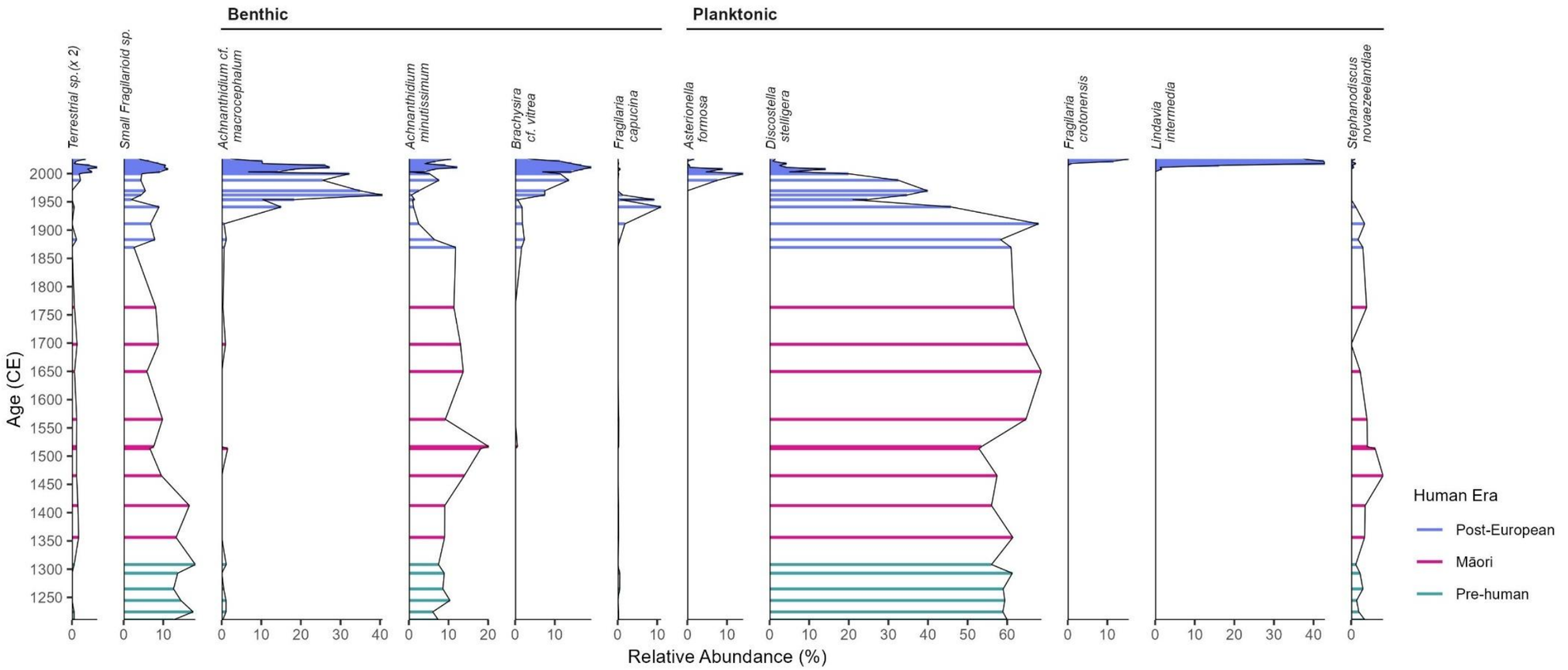


Figure 12. Stratigraphy of the Glendhu Bay diatom community assemblage. Data are expressed in relative abundance. Benthic and Planktonic taxa shown are present in ≥ 5% relative abundance in at least one sample. For visualisation, taxa associated with soils and moist habitats have been summed and their abundance multiplied by 2 ("Terrestrial sp. (x 2)"), and small Fragilarioid species have been grouped ("Small Fragilariod sp."). Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals).

Environmental sedimentary DNA

Sedimentary environmental DNA (sedDNA) has become a powerful tool for reconstructing past biological communities from lake sediments (Capo et al. 2021). DNA preserved within sediments can provide records of organisms that lived in or around a lake hundreds to thousands of years ago. For example, in Aotearoa New Zealand, sedDNA has successfully reconstructed historical fish communities in Lake Waihau (Gisborne; Thomson-Laing et al. 2024) and documented historical kākahi populations and the introduction of European perch in Lake Pounui (Wairarapa; Thomson-Laing et al. 2023).

However, sedDNA is not equally informative in all lakes or for all groups of organisms. DNA preservation is influenced by factors such as microbial degradation, sediment chemistry and mineral composition, meaning that the success of detecting taxa varies between lakes. For example, Thomson-Laing et al. (2025) consistently detected kākahi DNA in only three of nine lakes in Aotearoa New Zealand lakes, despite contemporary populations being present in several others. Consequently, the absence of detectable DNA should not necessarily be interpreted as the historical absence of a species.

Because the abundances of different amplicon sequence variant (ASV; a unique DNA sequence that represents a distinct genetic type similar to a molecular taxon), are affected by multiple biological and methodological factors, small shifts in relative abundance or number of reads should be treated with caution and not over-interpreted as changes in population size or ecological importance. Instead, greater emphasis is placed on the appearance, disappearance, large shifts and broad trends of taxa through time. Lake sediments also contain DNA from both aquatic organisms and terrestrial organisms transported from the surrounding catchment. Distinguishing between these aquatic and terrestrial signals is therefore an important consideration when interpreting sedDNA records.

Additionally, several other sources of uncertainty should be considered when interpreting sedDNA records. Different taxa can vary in the rate at which their DNA degrades and is preserved within sediments, and primer sets may preferentially amplify some groups over others. The detection of rare taxa can also be influenced by stochastic processes during DNA extraction, amplification and sequencing. Furthermore, taxonomic resolution varies among organism groups and reference databases, meaning some taxa can only be identified to coarse taxonomic levels. For microbial communities, it is also possible that some DNA signals reflect organisms living within deeper sediments at the time of sampling rather than exclusively representing past communities preserved within the sediment record.

These uncertainties are considered when interpreting the results and are one reason why interpretations are based primarily on large, consistent trends through time rather than

minor fluctuations. Importantly, the major conclusions are supported by multiple independent lines of evidence, including sedimentary DNA, hyperspectral data, pollen, charcoal, and geochemical proxies. The convergence of these independent indicators provides greater confidence in the timing and direction of inferred environmental changes than would be possible from any single proxy alone.

To maximise the ecological information recovered, in this study we analysed multiple genetic markers targeting different groups of organisms. Plant communities were characterised using the chloroplast markers *trnL* and *rbcL*, while bacterial and eukaryotic communities were assessed using the 16S rRNA, 18S rRNA and COI markers. Microbial communities are often among the most sensitive indicators of environmental change because they respond rapidly to changes in nutrient status and other environmental drivers (e.g., Gregersen et al. 2022).

We also applied a vertebrate-specific marker (12S rRNA) to target fish, birds, mammals and amphibians. Based on previous studies, we expected fish DNA to be difficult to detect in Lake Wānaka because of its large water volume relative to fish biomass but anticipated recovering DNA from birds and introduced mammals (e.g., deer and sheep) because of substantial catchment inputs. Instead, the vertebrate marker yielded sparse and inconsistent results, with only a few mammal detections that could not be interpreted confidently. As a result, the vertebrate data are not presented in this report. Similar outcomes have been observed in several other Aotearoa New Zealand lakes (unpublished data), suggesting that DNA preservation and recovery are influenced by lake-specific characteristics, potentially including catchment geology and sediment properties.

The following sections present the results for each genetic marker, with each providing complementary information on past changes in the biological communities of Lake Wānaka and its surrounding catchment.

In addition to characterising biological communities using sedDNA, we also used a more quantitative technique known as digital PCR (Table 1) to explore how cyanobacterial abundance changes through time. However, interpretation of the dPCR results proved challenging due to variability in the record and uncertainties regarding the relationship between gene copy number and cyanobacterial biomass. Consequently, these data are reported in Appendix 6 and are not discussed further in the main report.

Plant sedimentary DNA

To provide an ecological interpretation of the plant sedDNA data, each ASV was assigned to one of three habitat categories: aquatic, wetland, or terrestrial. Habitat assignment was not always straightforward because many plant taxa occupy ecotonal environments (e.g., lake margins), and the taxonomic resolution achieved for some ASVs was insufficient to confidently distinguish species with different habitat preferences. In these

cases, habitat classifications were based on expert judgement using the most likely ecological affinity of the assigned taxon. While some uncertainty is unavoidable, we do not believe that these classifications influenced the overall patterns observed.

For both plant markers *(rbcL* and *trnL*), terrestrial taxa comprised the vast majority of the recovered DNA throughout the sediment records (Figure 13 and Figure 15). This result is expected because Lake Wānaka receives substantial terrestrial DNA from its large catchment via river inflows, surface runoff, and erosion, resulting in a strong allochthonous plant DNA signal within the sediments. Given that pollen analysis focuses on understanding catchment vegetation change, whereas this section of the report is concerned primarily with within-lake ecological change, the terrestrial component of the sedDNA signal is not explored further here. However, a recent comparison of sedDNA and pollen records from a North Island lake (Li et al. 2026) demonstrated that these approaches provide complementary information, together providing a more nuanced understanding of catchment vegetation dynamics and broader environmental change.

For the *rbcL* gene, aquatic taxa comprised approximately 10–25% of the assemblage at Glendhu Bay and 20–50% at Roys Bay (Figure 13). Wetland taxa generally accounted for less than 10% of the assemblage at both sites. Given the substantial aquatic DNA signal recovered, we examined the aquatic component in greater detail (Figure 14). Across both bays, aquatic assemblages were dominated by chlorophytes (green algae), although the relative contribution of other taxa varied through time. At Roys Bay, several intervals, particularly after c. 1940 CE, were characterised by increased representation of charophytes (*Chara* and *Nitella*), whereas Glendhu Bay exhibited a stronger and more consistent chlorophyte signal. Submerged macrophytes, including *Isoetes*, *Potamogeton*, and *Myriophyllum*, were detected throughout much of the record, indicating the long-term presence of aquatic vegetation in Lake Wānaka.

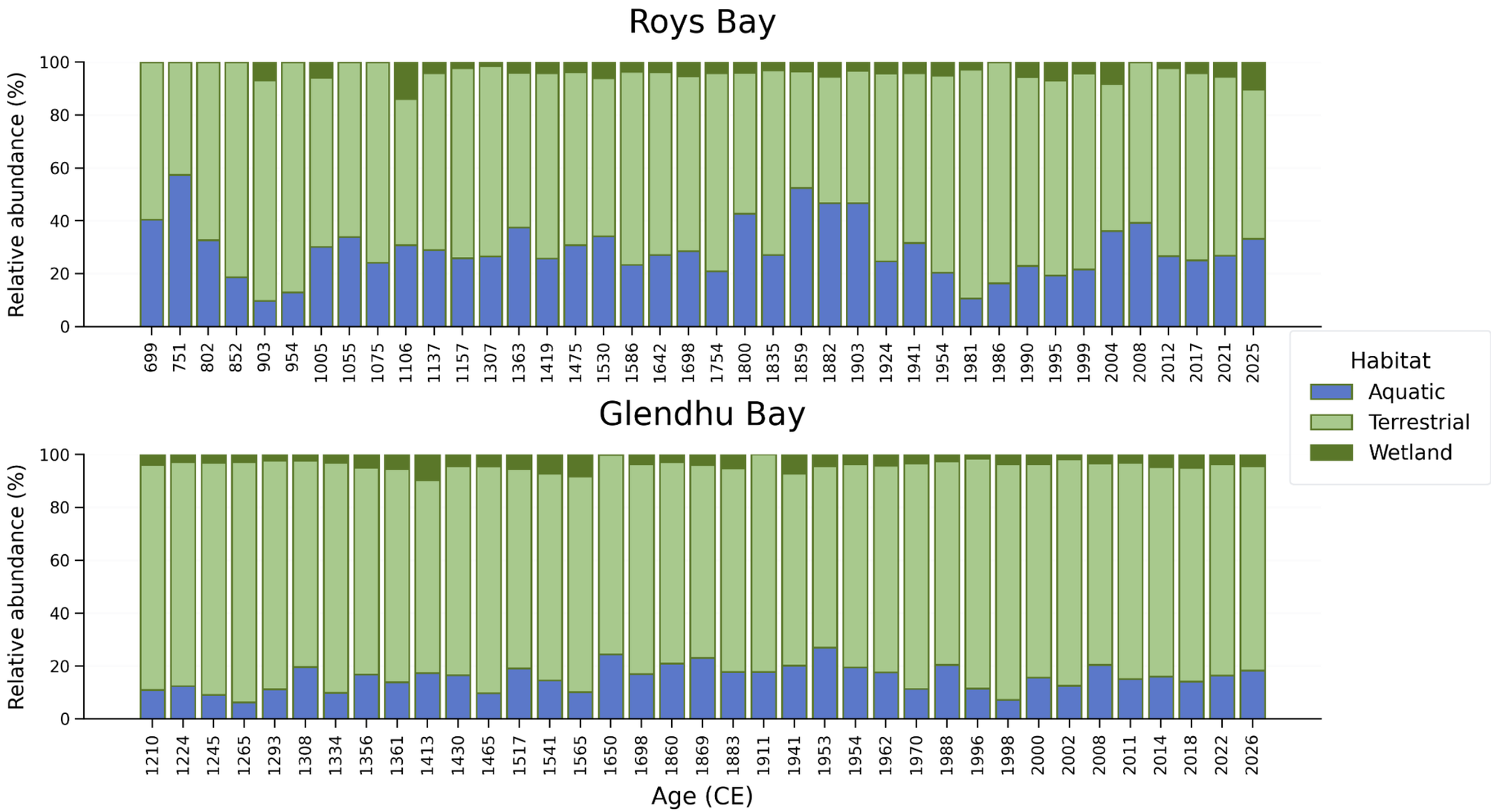


Figure 13 . Relative abundance (%) of aquatic, wetland, and terrestrial plant ASVs identified using the *rbcL* gene in sediment cores from Glendhu Bay and Roys Bay, Lake Wānaka. Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals).

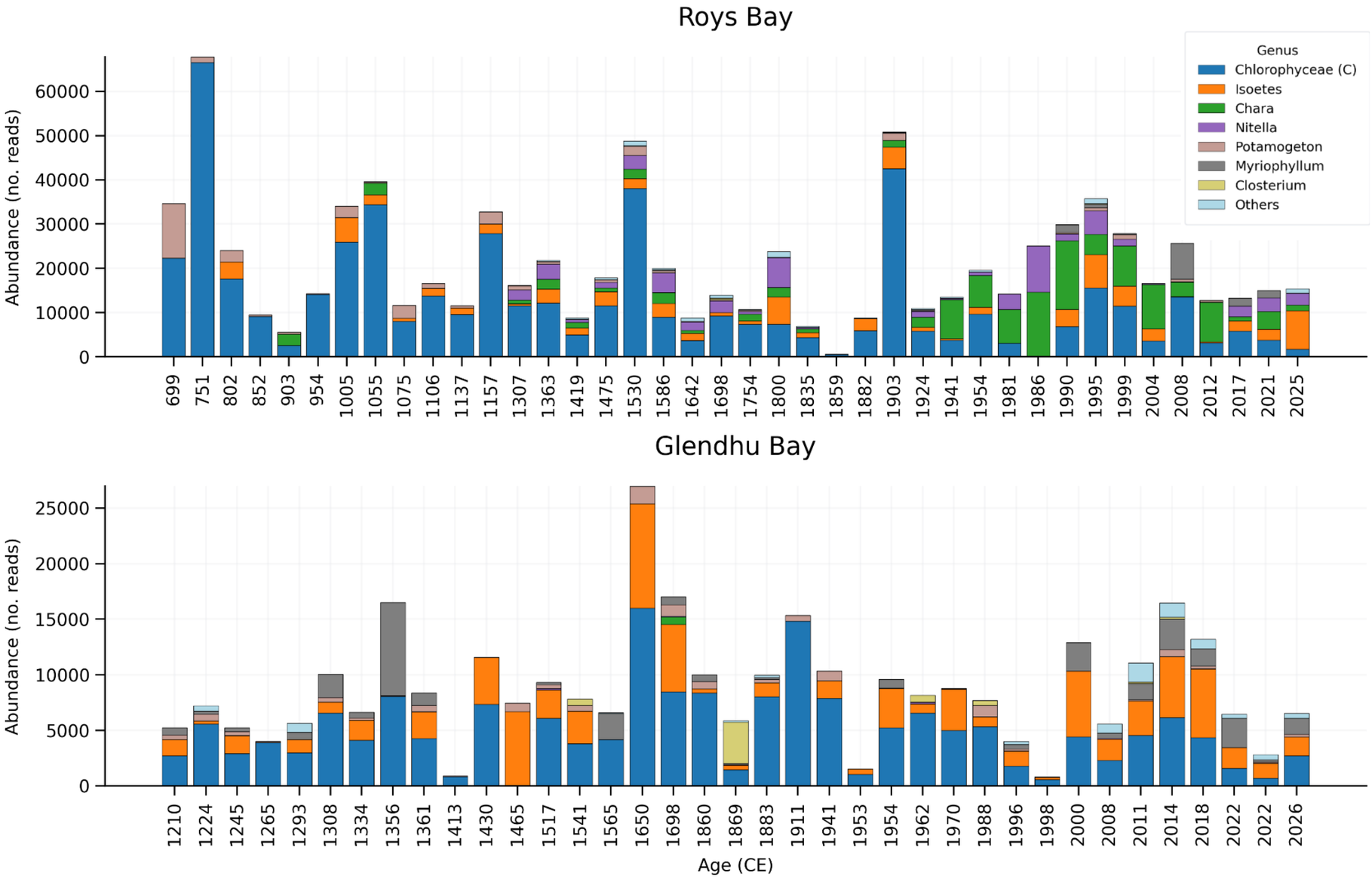


Figure 14. Temporal changes in the abundance (number of reads) of aquatic taxa detected using the *rbcL* gene in sediment cores from Glendhu Bay and Roys Bay, Lake Wānaka. Bars show read abundances for major aquatic taxonomic groups through time. Taxa are shown at the genus level unless otherwise indicated in brackets (C = class). Only the seven most abundant taxa are displayed; all remaining taxa are grouped as "Others". Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals).

For the *trnL* gene, aquatic and wetland taxa formed only a minor component of the assemblage at Glendhu Bay, where aquatic taxa generally accounted for less than 5% of reads and wetland taxa rarely exceeded 15% (Figure 15). Roys Bay displayed a stronger aquatic and wetland signal, with aquatic taxa reaching up to ~45% of the assemblage and wetland taxa contributing as much as ~50% in some intervals, particularly between c. 1950 and 1990 CE.

Because of the marked increase in wetland taxa observed at Roys Bay with the *TrnL* gene, we explored the composition of the wetland assemblage in greater detail (Figure 16). The major shift occurred after approximately c.1924 CE (HDPF range 1908-1937 CE) and was driven almost entirely by a substantial increase in members of the Phrymaceae (lopseed) family. Phrymaceae is a small family of flowering plants comprising 12 described species in Aotearoa New Zealand, four of which are introduced, and includes several species that occur naturally in wetland habitats. However, the taxonomic resolution of the *trnL* marker does not allow identification to species level, preventing determination of whether the DNA originated from native or introduced taxa. Based on the timing of this increase, coincident with European settlement and widespread land-use change in the Lake Wānaka catchment, it is more likely that this signal reflects a response to catchment modification and vegetation change rather than a substantial increase in wetland extent.

Given the relatively strong aquatic signal recovered from Roys Bay, we explored the composition of the aquatic assemblage in greater detail (Figure 17). Aquatic taxa were dominated throughout the record by Haloragaceae, a family that includes several aquatic macrophytes such as *Myriophyllum*. Two samples, dated to approximately 1859 CE (HDPF range 1853 – 1865 CE) and 1882 CE (HDPF range 1869 -1896 CE), differed from this pattern, with reduced aquatic abundance and increased representation of Araliaceae, with the signal attributed to pennywort (*Hydrocotyle*) species. The reason for this shift is uncertain but may reflect localised sediment inputs associated with early European settlement and catchment disturbance rather than a major ecological change within the lake. Because both native and introduced pennywort species occur in Aotearoa New Zealand, and taxonomic resolution is limited to family level, it is not possible to determine which taxa contributed to this signal.

Another notable change was the appearance of Plantaginaceae after approximately 1903 CE (HDPF range 1887 - 1919 CE), with the signal largely attributed to water-starworts (Figure 17). As both native and introduced species occur within this group, it is not possible to determine the taxa responsible. However, given the timing of the increase, this signal likely reflects European settlement and associated catchment modification rather than a change in lake conditions.

Interestingly we were unable to detect *Lagarosiphon* DNA in the sediment core. This is a non-natiev macrophyte that is of high interested and the target for a control programme particularly in Glendhu Bay. There is currently no reference sequence for this taxon in the *trnL* database. It is also likely that the taxonomic resolution of the *rbcL* marker was insufficient to confidently identify *Lagarosiphon*. There are several sequences assigned at the order level to this taxa. If *Lagarosiphon* is of specific interest, we would recommend using a targeted assay specifically designed to detect this taxon.

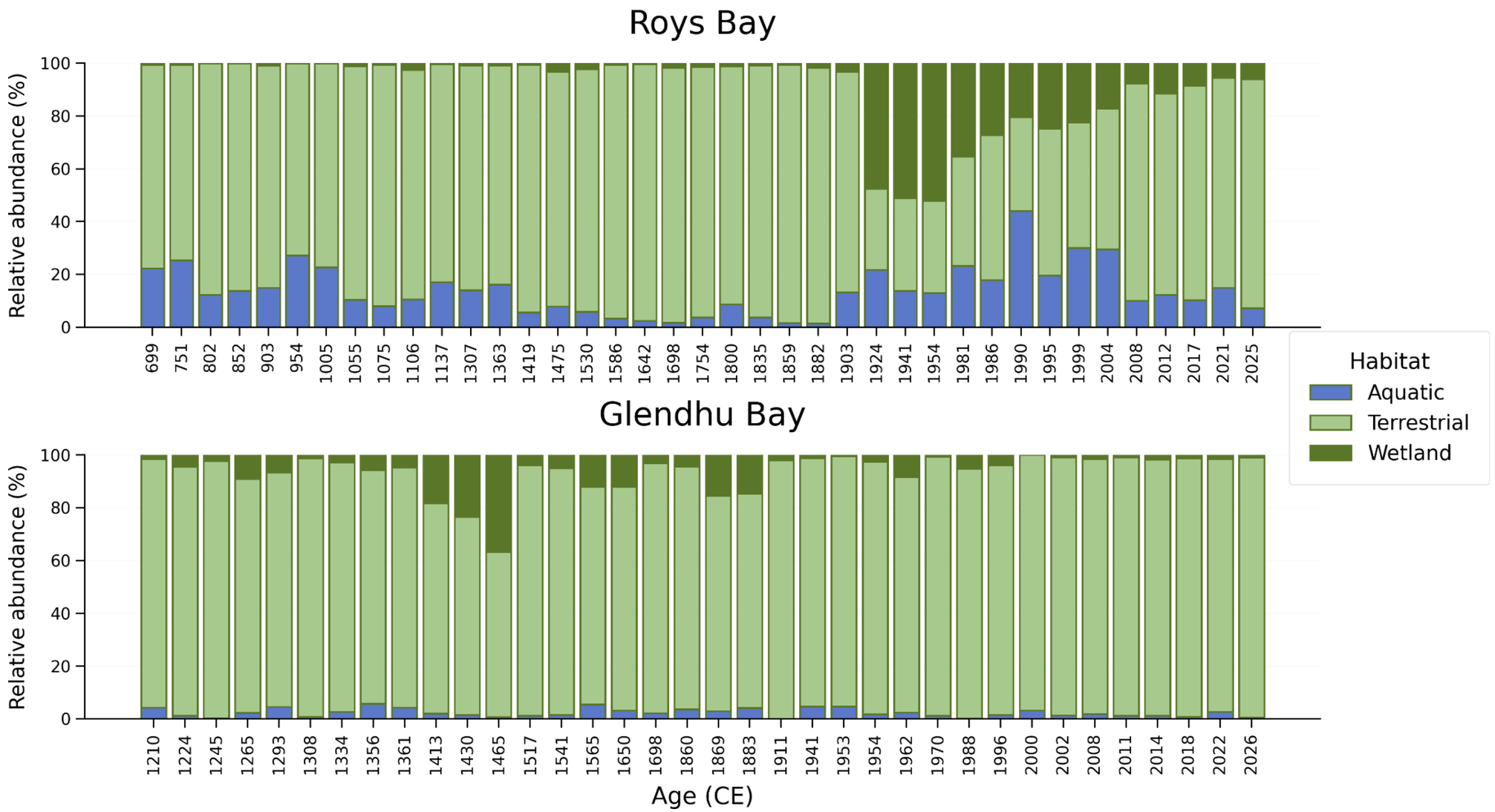


Figure 15. Relative abundance (%) of aquatic, wetland, and terrestrial plant ASVs identified using the *TrnL* gene in sediment cores from Glendhu Bay and Roys Bay, Lake Wānaka. Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals).

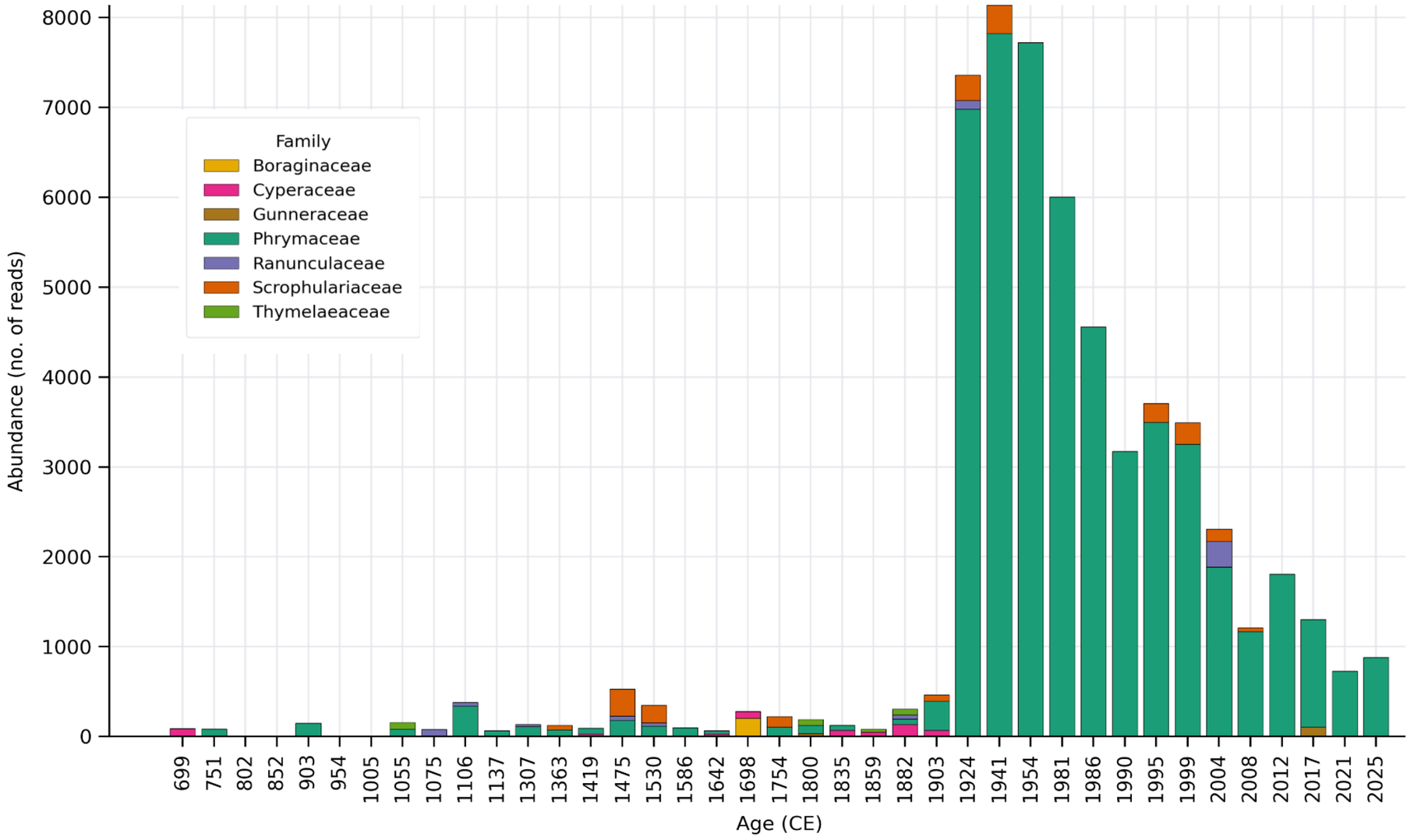


Figure 16. Temporal changes in abundance (number of reads) of wetland taxa detected using the *TrnL* gene in sediment cores from Roys Bay, Lake Wānaka. Bars show read abundances for major aquatic taxonomic groups through time. Taxa are shown at the Family level. Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals).

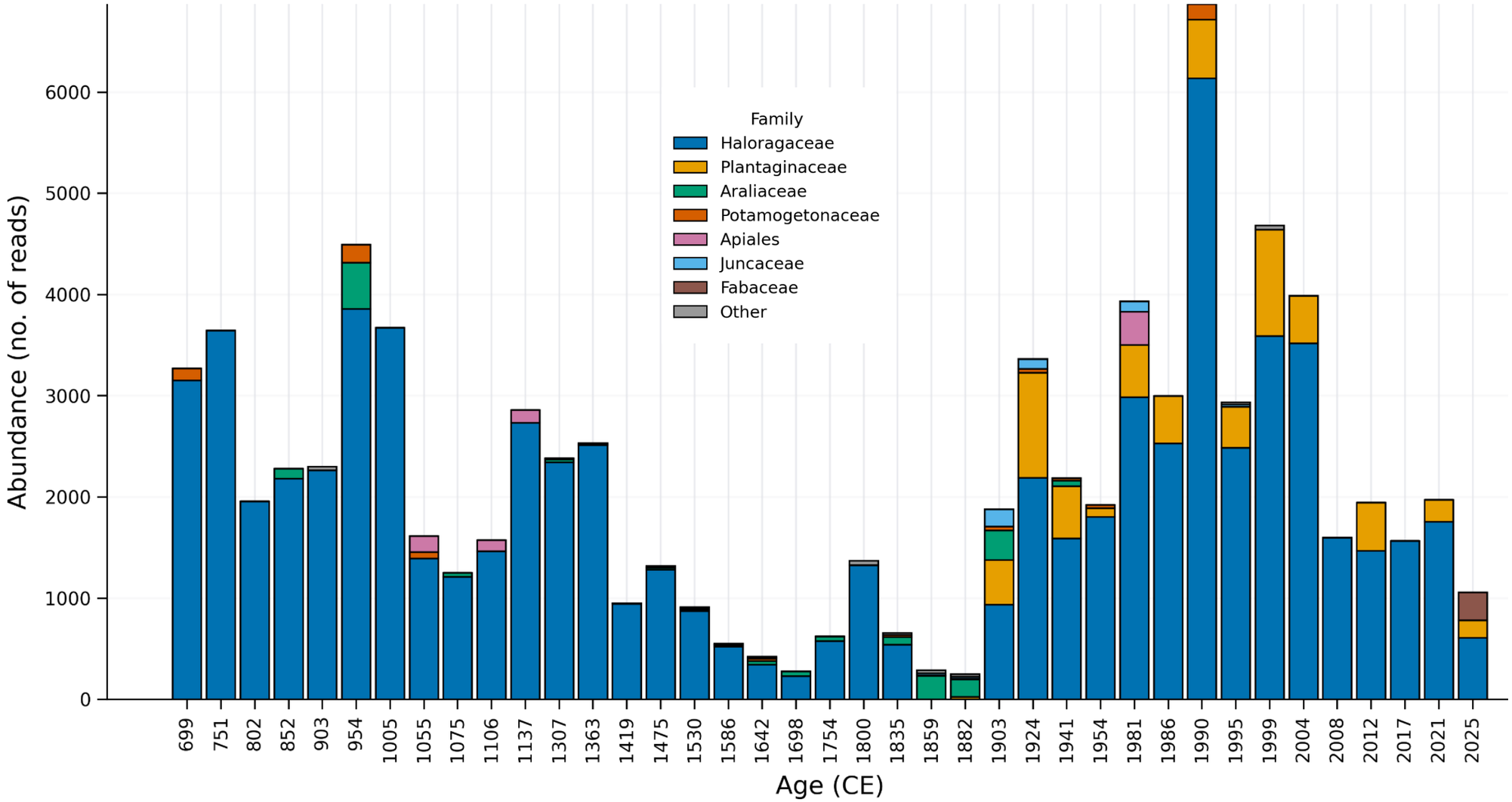


Figure 17. Temporal changes in abundance (number of reads) of aquatic taxa detected using the *rbcL* gene in sediment cores from Roys Bay, Lake Wānaka. Bars show read abundances for major aquatic taxonomic groups through time. Taxa are shown at the genus level unless otherwise indicated in brackets (C = class). Only the seven most abundant taxa are displayed; all remaining taxa are grouped as "Others". Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals).

Bacterial data – 16S rRNA gene

The first plots shown are Principal Coordinates Analysis (PCoA) ordinations, a method used to visualise similarities and differences among biological communities, in this case bacterial communities. Each point represents a sample from a sediment core layer, and the distance between points reflects how different the bacterial communities are from one another. Samples that plot close together contain more similar bacterial communities, whereas samples that are further apart are more distinct. The first two PCoA axes represent the major patterns of variation within the dataset.

At Roys Bay, the PCoA shows a pronounced shift in bacterial community composition between the pre-human and Māori periods (Figure 18). Samples deposited during the Māori period occupy an intermediate position between the pre-human and European clusters, suggesting stepwise changes in lake microbial communities associated with successive phases of human activity. In contrast, Glendhu Bay displays much greater overlap between pre-human and Māori-aged samples, indicating relatively little change in bacterial community composition following Māori settlement (Figure 18).

The contrasting Māori-period responses between the two sites are particularly interesting because they are not mirrored in the pollen records, where both sites show broadly similar evidence for forest disturbance, increases in charcoal, and expansion of *Pteridium esculentum* (bracken fern). The stronger response at Roys Bay may reflect more intensive local human activity, as this area would have been relatively accessible along the lake margin. In contrast, Glendhu Bay receives inflows from major tributaries, including Fern Burn and Alpha Burn, potentially integrating signals from a larger and less intensively used catchment. Alternatively, the muted Māori-period signal at Glendhu Bay may relate to the site's disturbance history. The sediment stratigraphy contains multiple event deposits interpreted as flood-derived sediment inputs, which may have repeatedly disrupted bacterial communities or increased terrestrial contributions to the sediment record. Because bacterial 16S rRNA data cannot readily distinguish between terrestrial and aquatic sources, these explanations cannot currently be separated.

When samples from both bays are analysed together using PCoA (Figure 19), the pre-human samples form distinct and relatively distant clusters. This separation indicates that, prior to human disturbance, the bacterial communities in Roys Bay and Glendhu Bay were substantially different. These differences likely reflect local environmental conditions, such as variation in flood-derived sediment inputs and lake characteristics that cannot be evaluated from the present dataset, including mixing regimes or the extent of macrophyte cover.

A notable feature of the ordination is that three Roys Bay samples from the early European period plot closer to the Glendhu Bay samples than to other Roys Bay samples from the same period. This is particularly evident for the c. 1882 CE sample (HDPF range 1869-1896 CE). The convergence of bacterial community composition coincides with a

period of increased terrestrial sediment input into Roys Bay (Figure 6). This pattern may indicate a stronger influence of terrestrial-derived bacteria, although as noted above the current data do not allow this possibility to be distinguished from changes in the aquatic bacterial community driven by increased sediment inputs. Regardless of the mechanism, Roys Bay samples deposited after c. 1954 CE (HDPF range 1952-1956 CE) once again form a relatively tight and distinct cluster, indicating the development of a bacterial community composition that differs from that observed in Glendhu Bay.

As noted above, the post-European samples from Roys Bay do not clearly separate from the Māori-period samples until approximately c. 1954 CE (HDPF range 1952-1956 CE). Thereafter, the samples follow a progressive trajectory through ordination space rather than forming a single discrete cluster, suggesting continued ecological change throughout the twentieth century and into the present. The clustering of the most recent samples may indicate a degree of stabilisation in community composition.

In contrast, Glendhu Bay exhibits a pronounced shift in bacterial community composition during the European period, with European-aged samples forming a distinct cluster separated from both Māori and pre-human communities. This transition appears to have occurred earlier than in Roys Bay, with European-associated bacterial communities established by approximately 1860 CE (HDPF range 1854-1866 CE). A further notable feature of the Glendhu Bay record is the separation of samples younger than c. 2014 CE (HDPF range 2009-2019 CE), suggesting a recent change in bacterial community composition.

These shifts coincide with the period of widespread catchment modification and pastoral development across the Upper Clutha during the late 1850s and 1860s. Historical records indicate that large pastoral runs, including what later became Glendhu Station, were established shortly after the Crown opened the region to pastoral leasing (Upper Clutha History Society, n.d.). The earlier bacterial community response observed in Glendhu Bay may therefore reflect a stronger connection between this site and catchment-wide land-use change.

The apparent shift in bacterial community composition after c. 2014 CE (HDPF 2009 – 2019 CE at Glendhu Bay may reflect recent environmental changes within the catchment and nearshore lake environment. One possible influence is the ongoing management of the invasive aquatic weed *Lagarosiphon major*, which has been actively controlled in Glendhu Bay through herbicide application, diver removal, and benthic matting programmes (Girvan 2025). Glendhu Station has also been the focus of increasing development activity during recent decades (Queenstown Lakes District Council 2018, Glendhu Bay Trustees Ltd 2019), although the timing of this development appears somewhat later than the observed bacterial community shift, suggesting it is unlikely to be the primary driver.

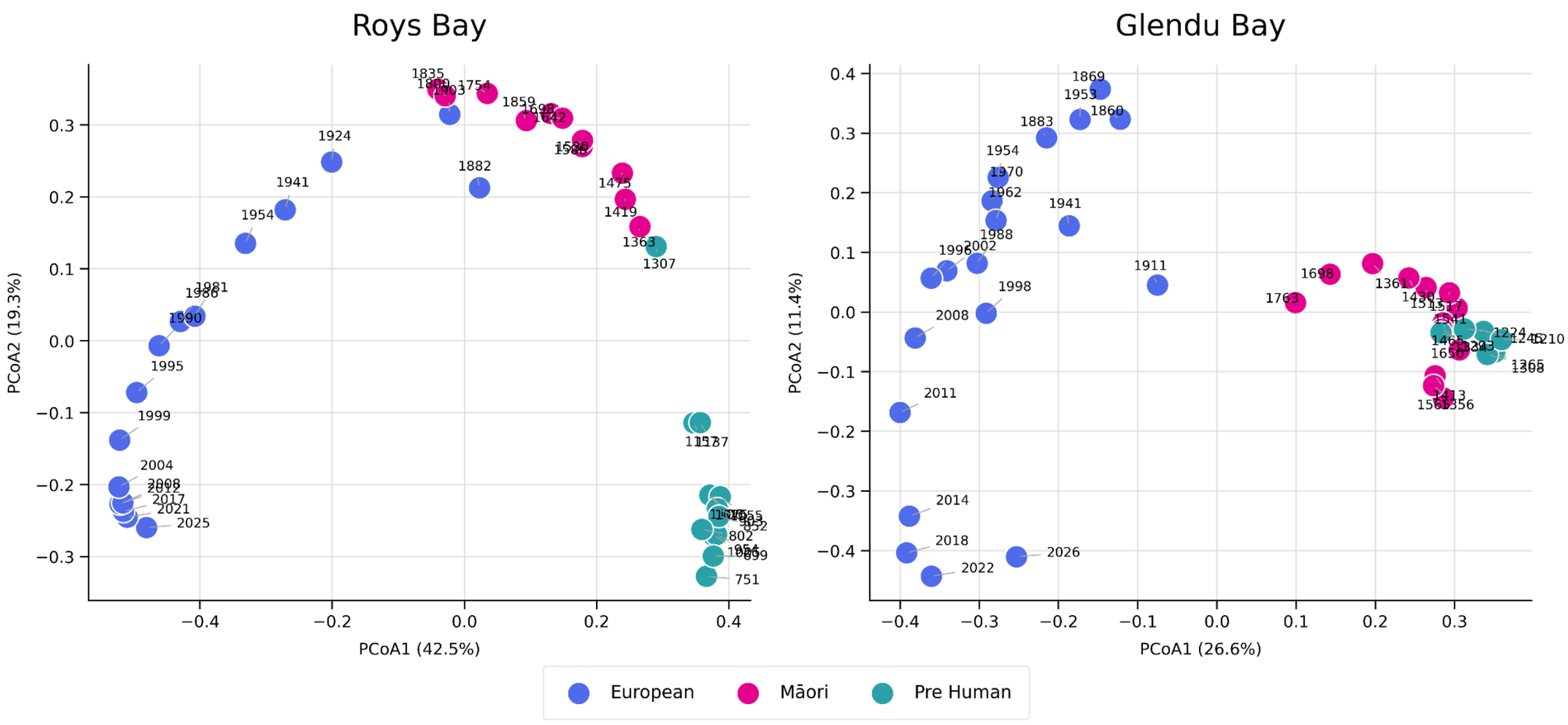


Figure 18. Principal Coordinates Analysis (PCoA) ordinations bacterial communities derived from the 16S rRNA gene metabarcoding for Roys and Glendhu Bays, Lake Wānaka. Ordinations were calculated using Hellinger-transformed relative abundance data. Labels show median estimates derived from the age model (CE). Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals).

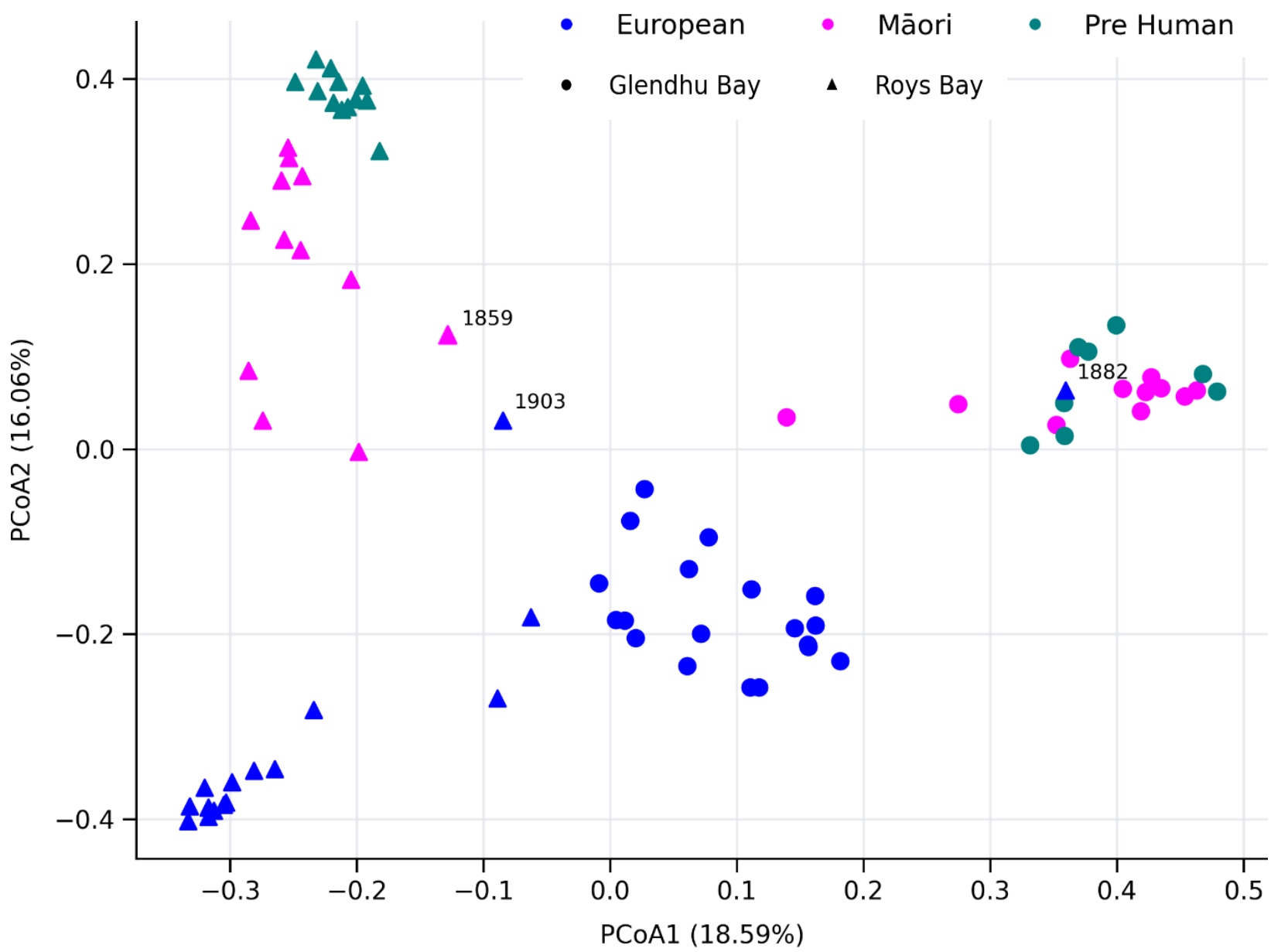


Figure 19. Principal Coordinates Analysis (PCoA) ordinations bacterial communities derived from the 16S rRNA gene metabarcoding for Roys and Glendhu Bays, Lake Wānaka combined. Ordinations were calculated using Hellinger-transformed relative abundance data. The three labels show median estimates derived from the age model (CE). Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals).

Overall, these patterns are broadly consistent with bacterial sedDNA records from other lakes across Aotearoa New Zealand, which commonly show substantial microbial community reorganisation following human arrival and subsequent European land-use intensification (e.g., Wheeler et al. 2024).

To assess the magnitude and timing of changes in bacterial community composition through time, Principal Response Curves (PRCs) were constructed using the bacterial sedDNA data. PRCs are a statistical technique that simplifies complex community composition data, containing information from many taxa, into a single response curve that can be plotted through time. This approach makes it easier to identify the magnitude and timing of ecological change within a community.

For the bacterial sedDNA data, the PRCs reinforced the patterns observed in the PCoA (Figure 20 and 21). At Roys Bay, the PRC indicated gradual community change during the pre-human and Māori periods, followed by more rapid shifts after approximately 1900 CE. In contrast, Glendhu Bay showed little change during the pre-human and Māori periods,

gradual change following European settlement, and a marked acceleration in community change beginning in the late twentieth century. A more detailed examination and interpretation of post-1850 CE community changes are provided in the following section of this report. In general, the broad patterns identified in the bacterial sedDNA data were also evident in the other sedDNA markers and in the diatom record, suggesting a coherent ecosystem response across multiple biological indicators (Figure 20 and 21).

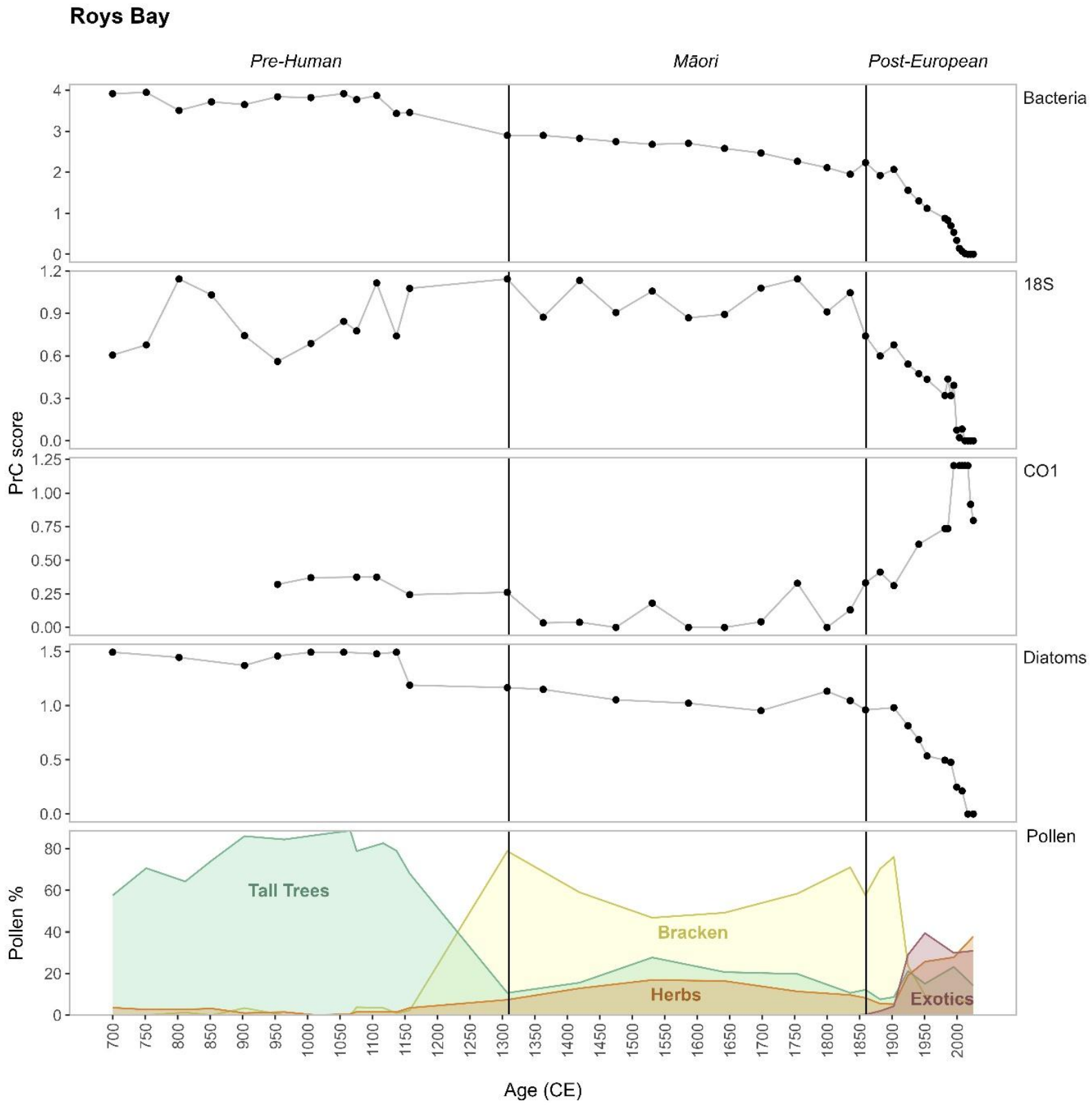


Figure 20. Principal Response Curves (PRCs) for bacterial communities (16S rRNA gene), eukaryotes (18S rRNA and COI genes), and diatom metabarcoding data from Roys Bay, Lake Wānaka. Also shown are the percentages of selected dryland pollen groups, including bracken fern (*Pteridium*), grasses and other herbs (herbs), tall native trees (tall trees), and exotic trees (exotics). Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% highest-density probability intervals). The black vertical lines delimit the transitions between the pre-human and Māori periods (left line) and the Māori and post-European periods (right line).

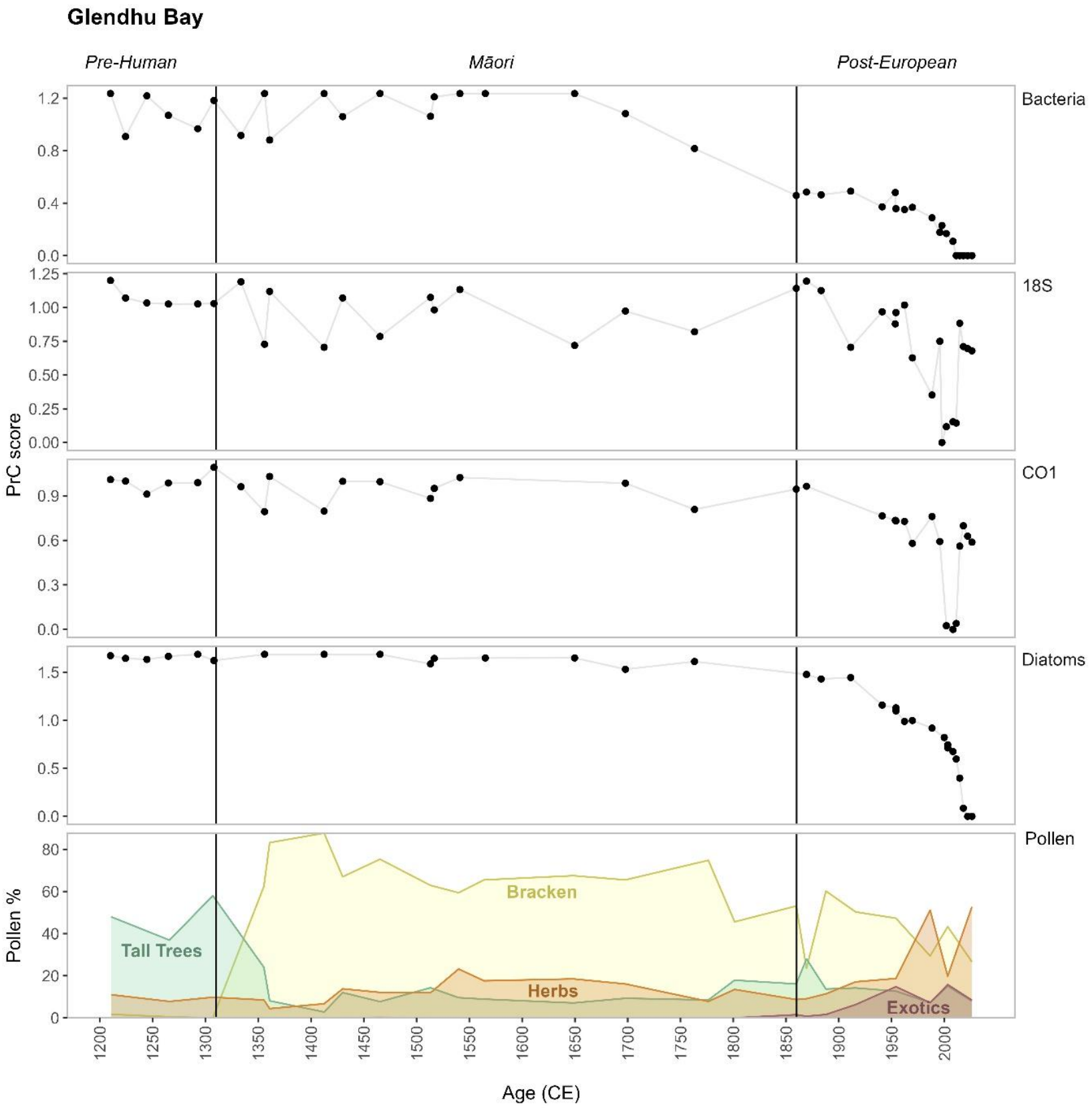


Figure 21. Principal Response Curves (PRCs) for bacterial communities (16S rRNA gene), eukaryotes (18S rRNA and COI genes), and diatom metabarcoding data from Glendhu Bay, Lake Wānaka. Also shown are the percentages of selected dryland pollen groups, including bracken fern (*Pteridium*), grasses and other herbs (herbs), tall native trees (tall trees), and exotic trees (exotics). Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% highest-density probability intervals). The black vertical lines delimit the transitions between the pre-human and Māori periods (left line) and the Māori and post-European periods (right line).

Microeukaryotes – 18S rRNA gene

A total of 37 phyla were detected in the sediment samples (Appendix 7), encompassing a broad range of primary producers, decomposers, consumers, predators, and parasites. The assemblages were dominated by green algae and land plants (Chlorophyta and Streptophyta), protists (particularly Cercozoa and Myzozoa), fungi (primarily Ascomycota), and aquatic invertebrates including flatworms (Platyhelminthes), roundworms (Nematoda), rotifers, arthropods, and bryozoans.

The Roys Bay PCoA showed a clear separation among the prehuman, Māori, and European samples, indicating a directional change in community composition through time (Figure 22). In contrast, the Glendhu Bay PCoA showed considerable overlap among samples from these periods, suggesting more gradual shifts in community composition. The European samples generally occurred at lower PCoA1 values than the older samples, indicating a change in community structure following European settlement (c. 1860 CE). Recent samples also tended to cluster together, with a notable compositional shift occurring after approximately 2014 CE (2009 to 2019 CE). To further investigate the drivers of these patterns, changes in community composition were examined at both the phylum and genus levels.

At the phylum level, there were substantial temporal shifts in community composition in the Roys and Glendhu Bay samples, although the timing and magnitude of these changes differed between sites (Figure 23 and Figure 24). Roys Bay exhibited greater variability through time, with periods of Chlorophyta dominance between ~1350 and 1450 CE, Streptophyta dominance between ~1500 and 1900 CE, and a major expansion of Cercozoa (single-celled protists) between approximately 1998 and 2011 CE. In Glendhu Bay, assemblages prior to approximately 1800 CE were dominated by Streptophyta and Platyhelminthes, with several intervals between ~1050 and 1800 CE where Platyhelminthes comprised 40-60% of the community. From the late nineteenth century onwards, Streptophyta became increasingly dominant, followed by a marked increase in Cercozoa during the mid to late twentieth century (~1950-2000 CE).

A consistent trend across both bays was the recent increase in Nematoda. In Roys Bay, nematodes expanded rapidly after approximately 2000 CE and became the dominant phylum in the most recent sample (2026 CE). Genus/species-level analysis indicated that this increase was largely driven by *Ethmolaimus* (Appendix 8). *Ethmolaimus are* free-living benthic freshwater nematodes commonly associated with lake sediments. As benthic nematodes are important consumers of bacteria and other microorganisms, and increases may indicate enhanced importance of sediment-associated microbial food web (Ferris 2026a).

In Glendhu Bay, nematodes remained a relatively minor component throughout most of the record but increased in the uppermost sediment sample, where the predatory genus *Ironus* dominated (Appendix 9). *Ironus* is a genus of free-living predatory nematodes

commonly found in freshwater sediments. Its presence may indicate the establishment of meiofaunal communities capable of supporting higher trophic levels within the sediment food web (Ferris 2026b). Given that this increase was observed in only a single sample, it should be interpreted with caution. As noted earlier, patterns identified in individual samples may reflect short-term variability or analytical uncertainty, and greater confidence should be placed on trends that are consistent across multiple consecutive samples.

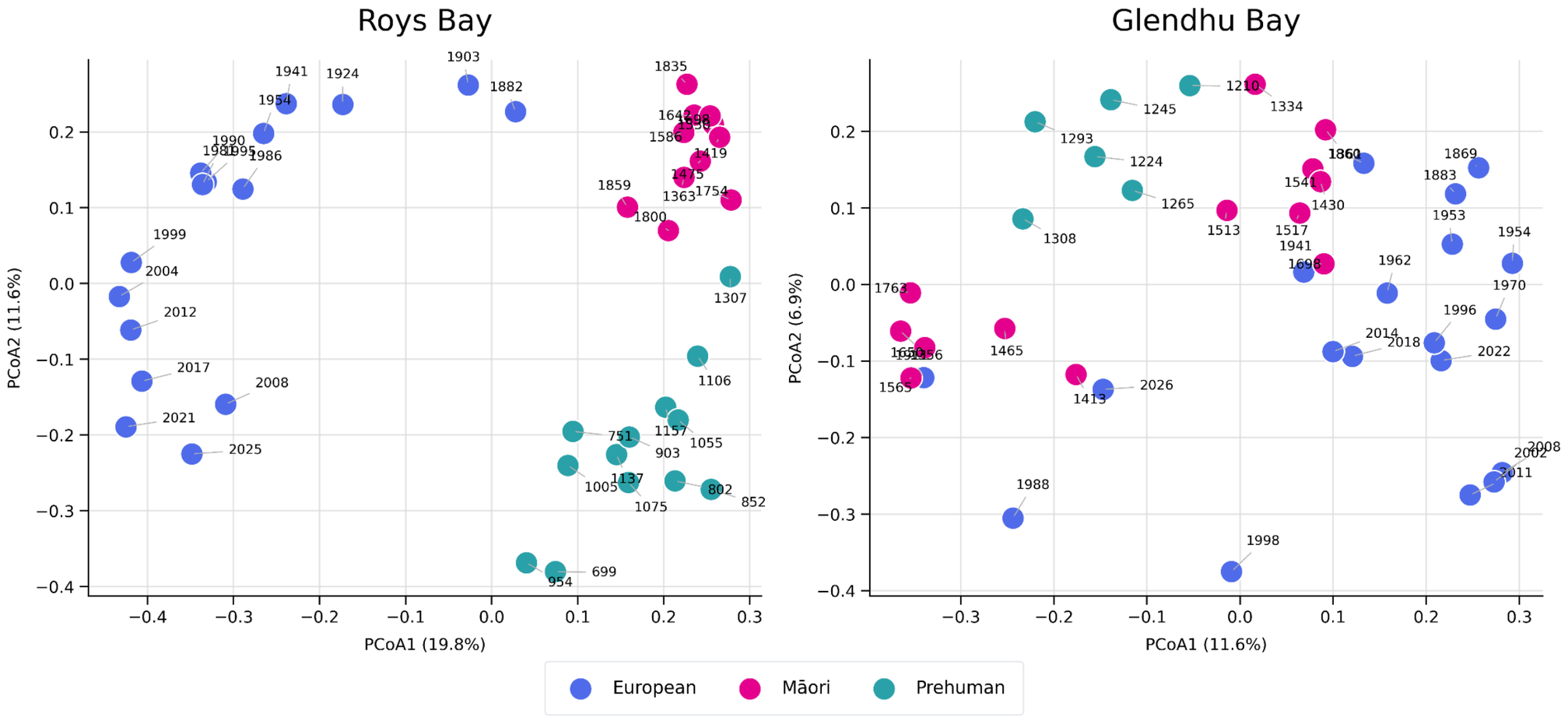


Figure 22. Principal Coordinates Analysis (PCoA) ordinations microeukaryote communities derived from the 18S rRNA gene metabarcoding for Roys and Glendhu Bays, Lake Wānaka. Labels show median estimates derived from the age model (CE). Ordinations were calculated using Hellinger-transformed relative abundance data. Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals).

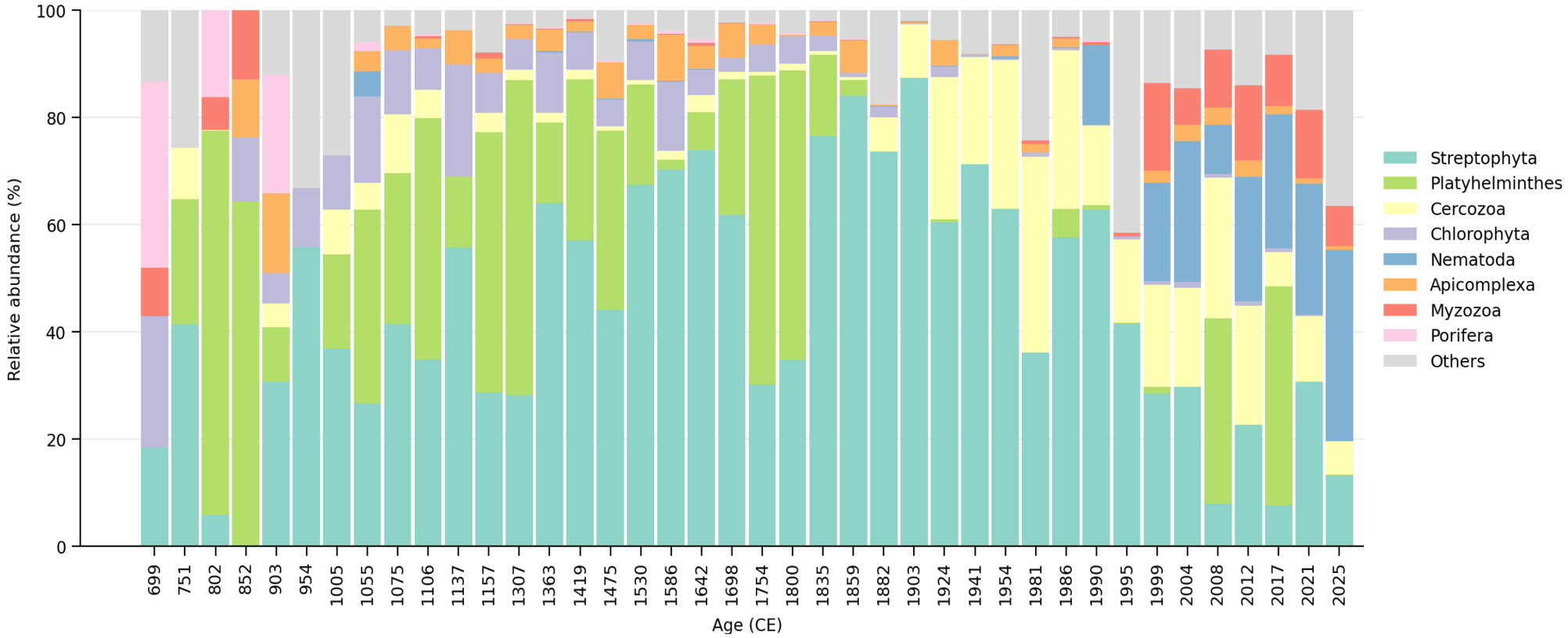


Figure 23. Relative abundance (%) of microeukaryote phyla in sediment cores from Roys Bay, Lake Wānaka. Only the top eight most abundant phyla are shown. Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals).

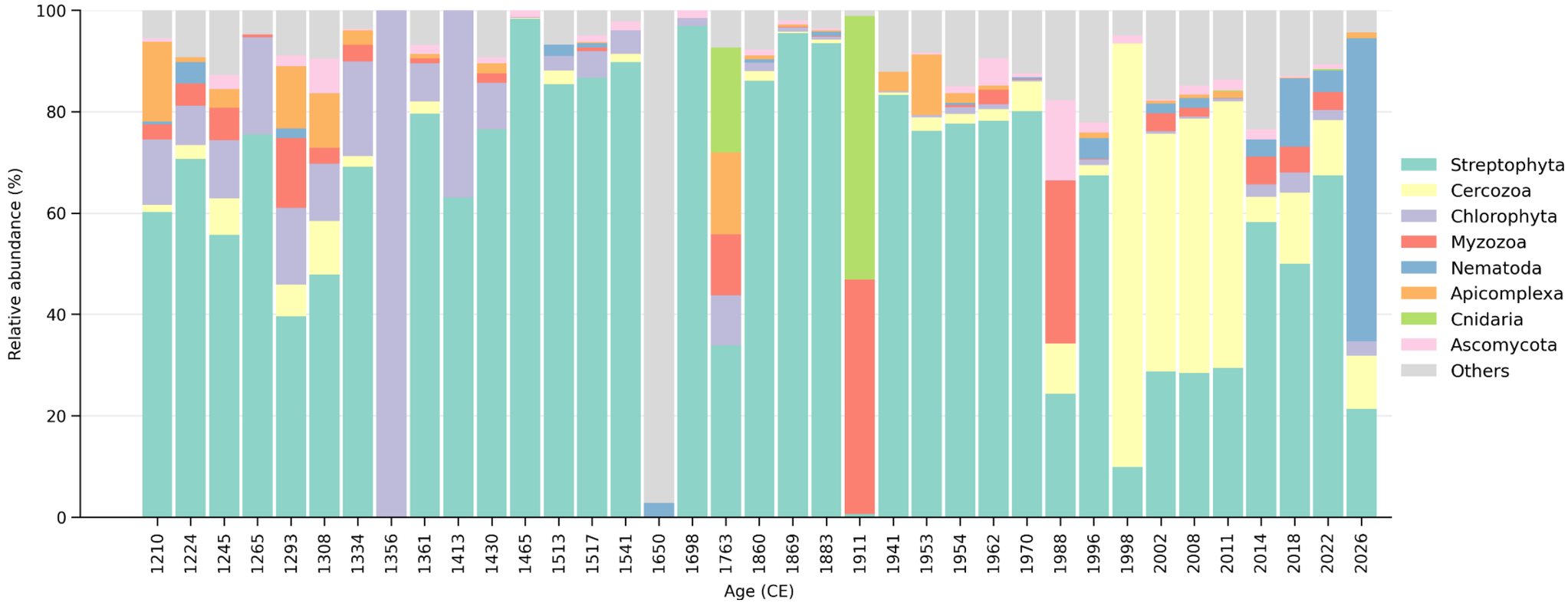


Figure 24. Relative abundance (%) of microeukaryote phyla in sediment cores from Glendhu Bay, Lake Wānaka. Only the top eight most abundant phyla are shown. Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals).

Cercozoa also underwent major changes. In Glendhu Bay, Cercozoa were largely represented by the genus *Sandona*, which increased from low abundance before ~1880 CE to become a major component of the assemblage between approximately 1950 and 1995 CE before declining slightly in the most recent sediments (Appendix 9). S*andona* is a bacterivorous cercozoan protist that forms part of benthic microbial food webs (Howe et al. 2011). Increases in its abundance may indicate enhanced microbial activity and greater availability of bacterial prey within sediment habitats. In Roys Bay, Cercozoa showed an even stronger response, becoming dominant between approximately 1998 and 2011 CE, although this increase was driven primarily by unidentified genera. The concurrent rise of Cercozoa and Nematoda in both bays during the twentieth and early twenty-first centuries suggests a substantial reorganisation of benthic microbial food webs.

The PRCs for the 18S rRNA gene broadly reinforced the patterns observed in the PCoA (Figure 20). Roys Bay showed relatively stable community composition during the pre-human and Māori periods followed by an increasingly rapid shift after European settlement, particularly during the twentieth century. Glendhu Bay exhibited more gradual change through time, with the largest shifts occurring in the most recent samples.

Microeukaryotes – CO1 gene

A total of 29 phyla were detected in the sediment samples (Appendix 10), with assemblages primarily comprising algae, fungi, protists, and aquatic invertebrates.

The Roys Bay PCoA showed a clear directional change in COI community composition through time, with European samples separated from pre-Figure 25). In human and Māori samples, and the most recent samples forming a distinct cluster (

Figure **25**). In contrast, Glendhu Bay showed substantial overlap among the pre-human, Māori, and older European samples, although recent European samples were more clearly separated, indicating an acceleration in community change during the late twentieth and early twenty-first centuries.

At the phylum level, both sites showed substantial temporal variation in community composition. Roys Bay transitioned from communities dominated by Bacillariophyta (diatoms), Ochrophyta (golden-brown algae and related algae) and Chlorophyta before the twentieth century to Arthropoda (insects) dominance in recent decades (Figure 26). Further examination of the arthropod assemblages in Roys Bay showed a substantial increase in Diptera (true flies) during the twentieth century, becoming the dominant arthropod group in recent sediments. This may reflect increased nutrient availability and organic matter accumulation (Appendix 11; Figure A12).

Glendhu Bay exhibited greater fluctuations through time, with alternating dominance of Ascomycota (sac fungi), Bacillariophyta, Ochrophyta and Oomycota (water moulds), including a pronounced Oomycota expansion between ~1998 and 2011 CE (Figure 27). Recent Glendhu Bay assemblages were more evenly distributed among several major phyla.

The PRCs for the COI gene also showed patterns similar to those observed in the PCoA (Figure 20 and 21). At Roys Bay, relatively little change occurred during the pre-human and Māori periods, followed by accelerating community change after European settlement and particularly during the late twentieth century. In contrast, Glendhu Bay showed comparatively modest change for most of the record, with more pronounced shifts occurring in recent decades (Figure 20 and 21).

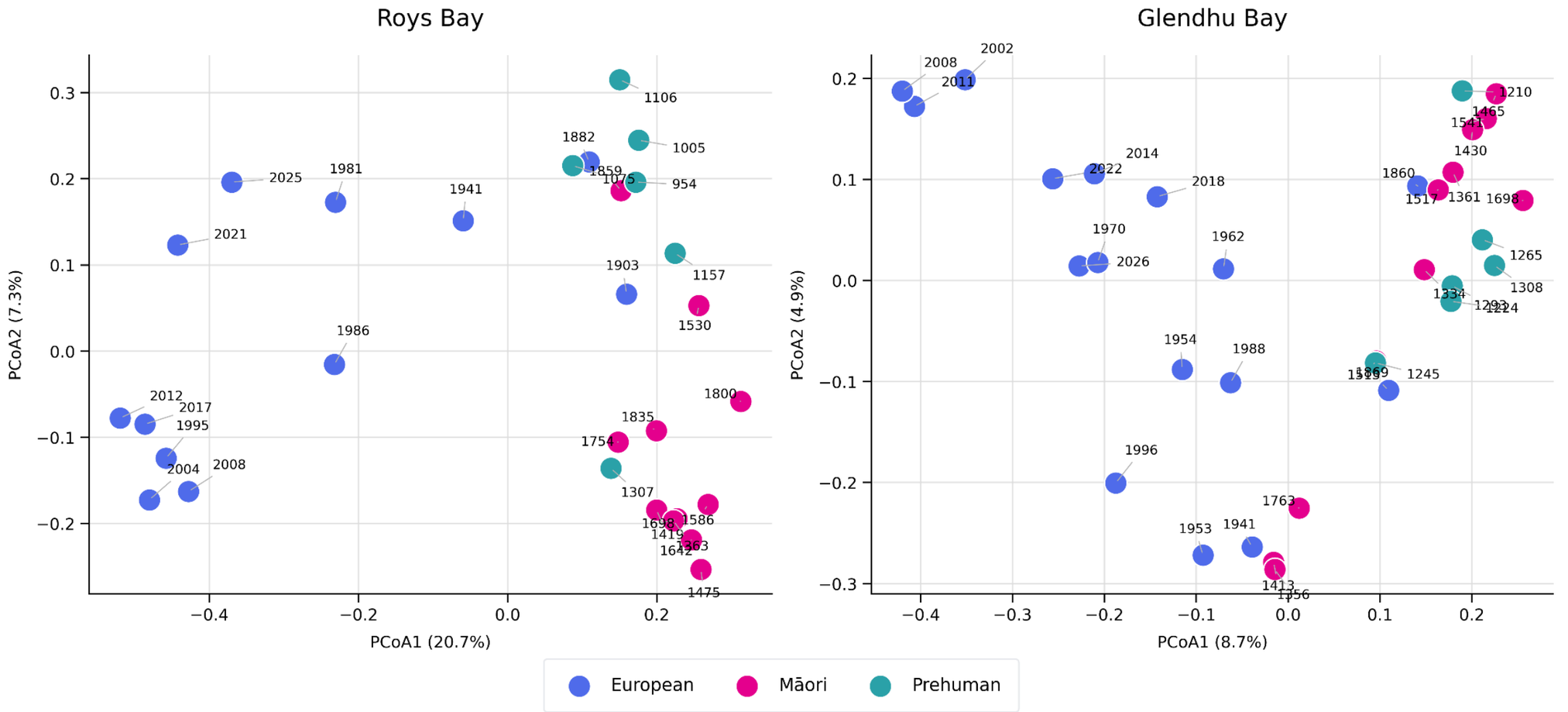


Figure 25. Principal Coordinates Analysis (PCoA) ordinations microeukaryote communities derived from the cytochrome c oxidase subunit I (COI) gene metabarcoding for Roys and Glendhu Bays, Lake Wānaka. Labels show median estimates derived from the age model (CE). Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals).

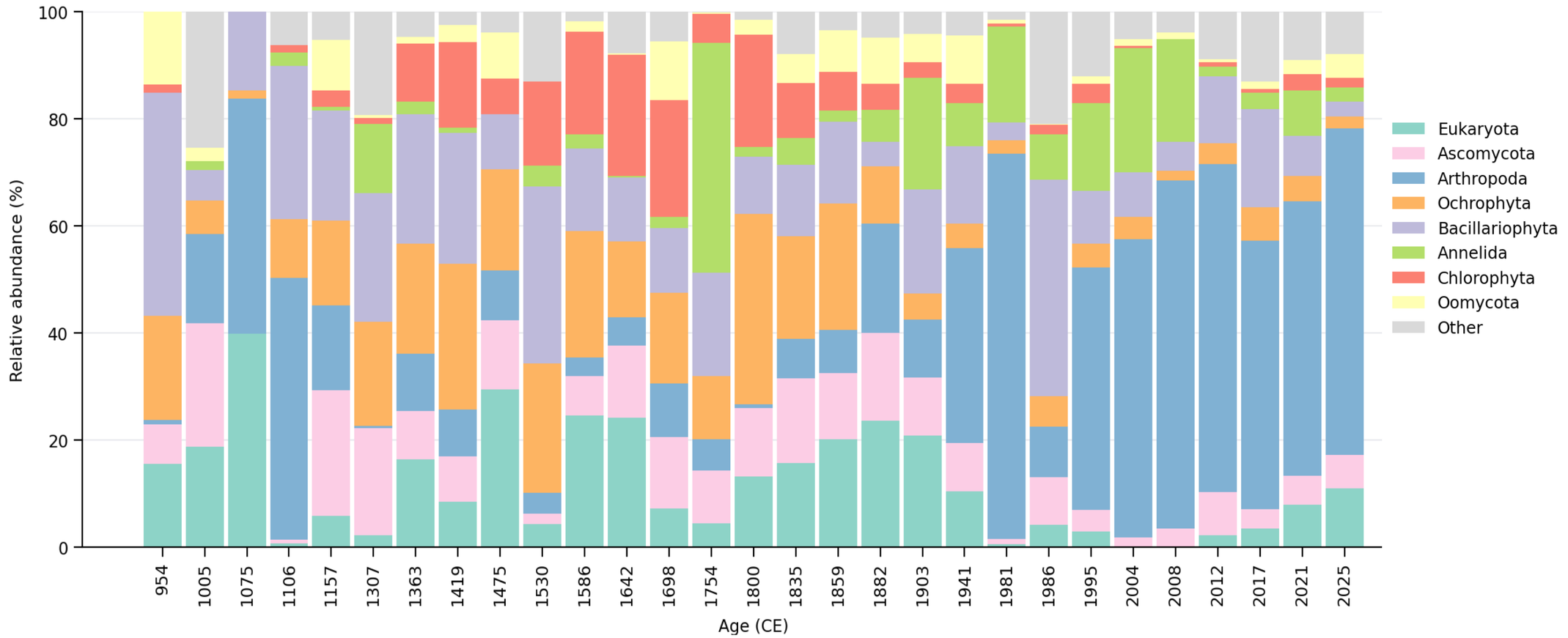


Figure 26. Relative abundance (%) of eukaryote phyla in sediment cores from Roys Bay, Lake Wānaka. Only the top seven most abundant phyla are shown. Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals).

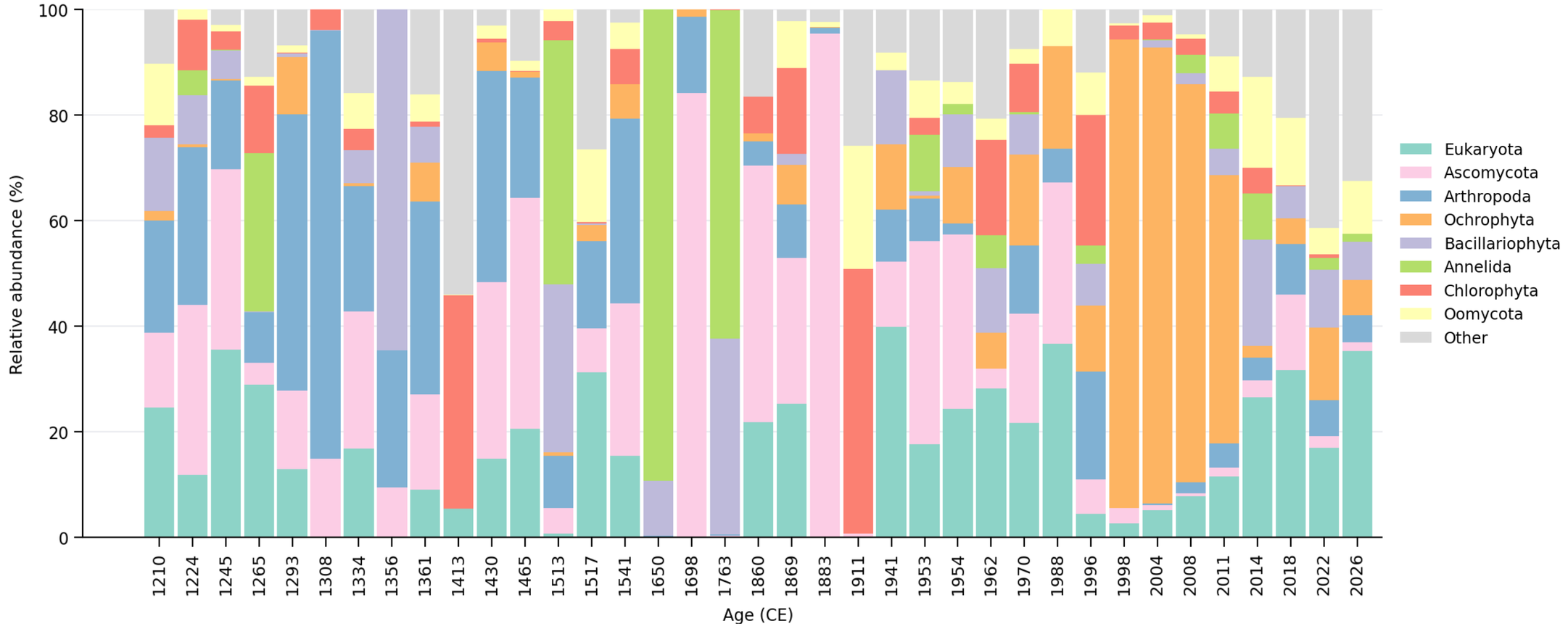


Figure 27. Relative abundance (%) of eukaryote phyla in sediment cores from Glendhu Bay, Lake Wānaka. Only the top seven most abundant phyla are shown. Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals). Samples from 1911 and 1883 CE are included in this plot but were excluded from other multivariate analyses due to their low total read counts.

Post-1850 CE changes and potential drivers

A key question raised by ORC was whether Lake Wānaka has undergone significant ecological change since European settlement. To investigate this, we focused on sediments deposited after ~1850 CE and compared changes in biological communities inferred from 16S rRNA (bacteria), 18S rRNA and COI (eukaryotes), and diatom records with hyperspectral chlorophyll-a flux and three potential environmental drivers: mass accumulation rate (MAR), lead flux, and cadmium flux (Figures 28 and 29). MAR represents the rate at which sediment is deposited and preserved on the lakebed and is commonly used as an indicator of catchment-derived sediment inputs resulting from erosion in lakes like Wānaka, where sedimentation is dominated by terrestrial material from land clearance, flooding, or other disturbances. Lead flux was used as a broad indicator of urbanisation and human activity within the catchment, while cadmium flux was used as an indicator of agricultural activity, reflecting the widespread use of phosphate fertilisers that contain trace amounts of cadmium.

Roys Bay

The Roys Bay record indicates two major phases of ecological change following European settlement (Figure 28).

Phase 1: Catchment disturbance and increased sediment delivery (~1860-1950 CE)

- MAR increased markedly from approximately 1860 CE, suggesting an increase in sediment delivery to the lake.
- This increase coincided with a rise in charcoal accumulation (Figure 4), indicating enhanced burning and catchment disturbance during the early post-settlement period.
- In contrast, lead and cadmium fluxes remained relatively stable, suggesting that the increased sediment delivery was more likely associated with land clearance and erosion than with agricultural or urban contaminant inputs.
- All biological proxies began to diverge during this period, indicating a lake-wide ecological response to catchment modification.
- Towards the end of this time period, chlorophyll-a flux increased, potentially reflecting increased nutrient availability associated with enhanced sediment inputs.
- The diatom community underwent substantial reorganisation after ~1850 CE (Figure 10). Oligotrophic planktonic taxa declined and were replaced by species associated with benthic and epiphytic habitats and more mesotrophic conditions, suggesting increasing nutrient availability and greater development of littoral and macrophyte habitats.

- The subsequent appearance of additional planktonic diatom taxa associated with more productive conditions suggests gradual ecological change and increasing nutrient availability.
- COI data show a marked increase in Diptera (true flies) during the twentieth century, eventually becoming the dominant arthropod group. This pattern is consistent with increased organic matter accumulation and enhanced productivity in lake sediments.

Phase 2: Rapid contemporary ecological change (~1980 CE-present)

- Around 1980 CE, all four biological proxies exhibited a more abrupt and almost synchronous shift.
- The 18S rRNA record shows a strong recent expansion of nematodes, particularly *Ethmolaimus*, a benthic taxa that feeds on microorganisms. This increase may indicate a growing importance of sediment-associated microbial food webs.
- Following c. 2000 CE, chlorophyll-a flux increased strongly, reaching its highest values in the uppermost sediments.
- This increase coincided with changes in both diatom and COI assemblages, suggesting a broad reorganisation of primary producer and consumer communities.
- The timing of these changes predates the first confirmed occurrence of *Lindavia intermedia* (lake snow) in 1999 CE (HDPF range: 1989 to 2008 CE), making it unlikely that the species initiated the observed ecological shift. However, its proliferation recent years represents a substantial change in the planktonic diatom community and may account for at least some of the increase in chlorophyll-a flux. Additional evidence comes from diatom accumulation rates, which show that the expansion of *Lindavia intermedia* coincided with declining benthic and benthic/epiphytic diatom production and a shift towards pelagic dominance. As *Lindavia intermedia* produces extracellular polymeric substances ("lake snow"), its proliferation may alter organic matter dynamics, carbon cycling, sedimentation processes, and microbial habitats within the lake (Novis et al. 2017). Nevertheless, the extent to which *Lindavia intermedia* has contributed to the broader ecological changes observed in Roys Bay remains uncertain.
- The earlier ecological transition is more plausibly linked to other drivers, such as increasing urbanisation within the Wānaka catchment and associated changes in nutrient inputs, although the relative importance of these factors requires further investigation.

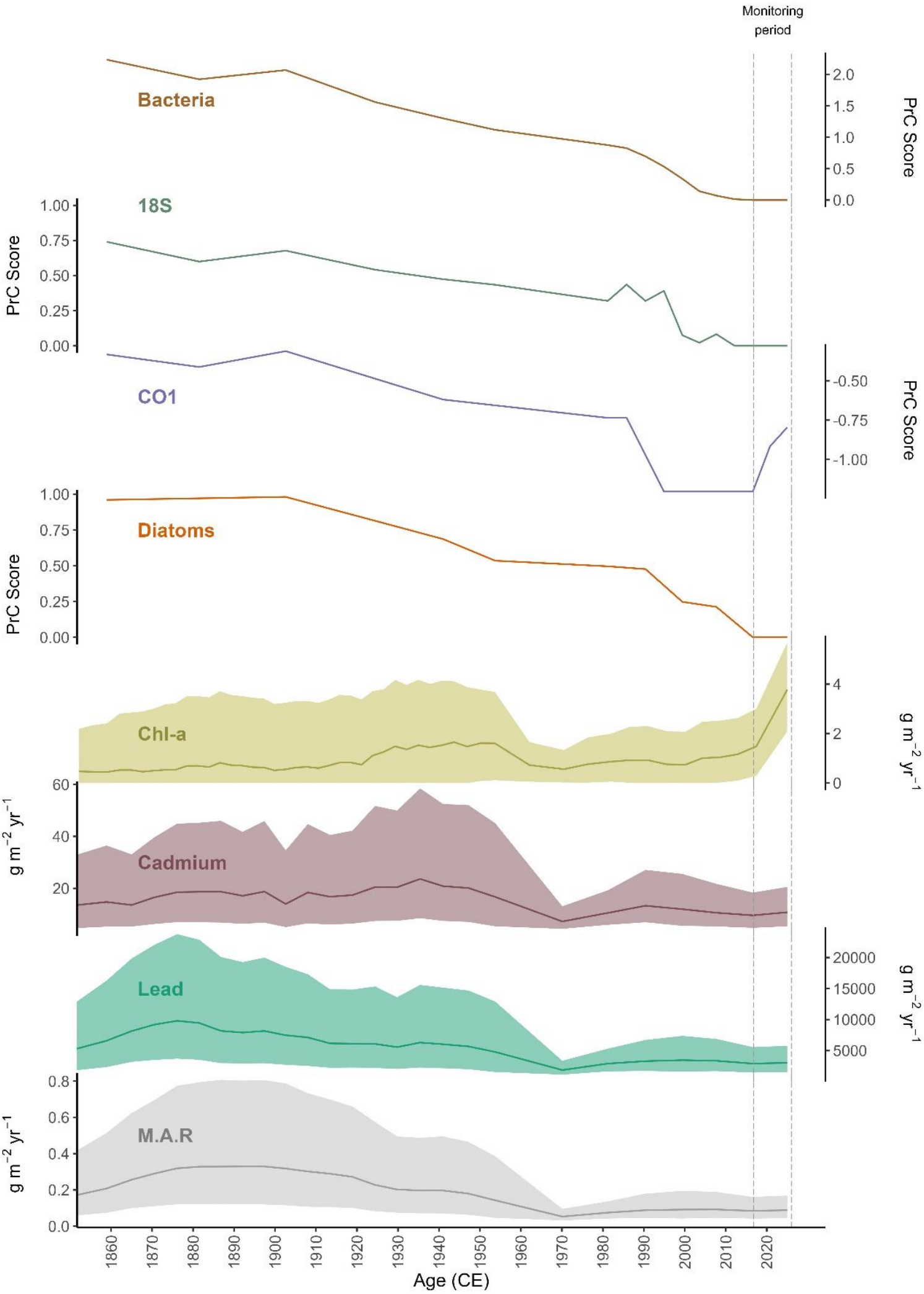


Figure 28. Temporal changes in principal response curve (PRC) scores derived from bacterial (16S rRNA), eukaryotic and metazoan (18S rRNA), and diatom assemblages in Roys Bay, Lake Wānaka, plotted alongside reconstructed chlorophyll-a (Chl-a) flux, cadmium flux, lead flux (mg cm^{-2} yr^{-1}), and mass accumulation rate (MAR; g cm^{-2} yr^{-1}) from ~1850 CE to present. For chlorophyll-a, cadmium, lead, and MAR, solid lines represent median values, and shaded envelopes indicate uncertainty ranges derived from the age-depth model and proxy-specific calculations (see Methods). Ages shown are median estimates from the age model. Dashed vertical line shows the start of consistent water quality monitoring.

Glendhu Bay

The Glendhu Bay sediment sequence contains multiple event layers, reflecting repeated episodes of increased sediment delivery to the lake. These event layers were avoided during sediment core sub-sampling to ensure that the reconstructed records primarily reflect in-lake ecological change rather than the direct effects of disturbance events. Nevertheless, it is important to acknowledge that repeated catchment disturbances, even when episodic, are likely to have influenced lake communities over time. Such disturbances may have caused short-term ecological impacts and favoured taxa that are better able to resist, recover from, or exploit periodic increases in sediment inputs.

The Glendhu Bay record indicates two phases of ecological change following European settlement.

Phase 1: Gradual ecological change (~1850-2000 CE)

- MAR, lead flux, and cadmium flux remained relatively stable throughout most of the post-European settlement period, indicating limited changes in sediment delivery, urbanisation, or agricultural inputs (Figure 29). However, as noted above this pattern should be interpreted in the context of the numerous event deposits preserved within the core, which demonstrate that episodic catchment disturbances continued to occur throughout this period.
- Bacterial (16S rRNA) and diatom communities also remained relatively stable until approximately 1990 CE.
- Greater variability was observed in the 18S rRNA and COI records; however, these proxies can be strongly influenced by changes in the abundance of individual large-bodied taxa, making long-term trends more difficult to interpret.
- Despite the relative stability of the environmental indicators, all biological proxies began to change rapidly during the 1990s.
- These changes occurred prior to major increases in MAR, lead, or cadmium flux, indicating that factors other than catchment land-use change were likely responsible for initiating this ecological transition.
- The diatom record provides evidence for progressive nutrient increases during this period. Following ~1840 CE, declines in taxa associated with oligotrophic conditions and increasing abundance of taxa characteristic of mesotrophic and littoral habitats indicate a gradual shift towards more productive conditions within the lake (Figure 11).

Phase 2: Accelerated ecological change (~2000 CE-present)

- Following approximately 2000 CE, cadmium, lead, and MAR flux all increased, indicating enhanced catchment-derived sediment and trace-element inputs. While these changes are consistent with increasing human influence within the catchment, the available data do not allow specific source attribution.
- These environmental changes corresponded with marked shifts in the 18S rRNA and COI communities and a weaker, but still evident, response in the bacterial community. The timing of these biological changes is centred around 2014 CE (HDPF range 2009-2019 CE).
- Since approximately 2017 CE, the diatom community has undergone further change, characterised by a rapid increase in nutrient-associated planktonic taxa. This pattern may indicate subtle increases in nutrient availability and productivity relative to earlier conditions.
- *Lindavia intermedia* was first detected in sediments dated to 2008 CE (HDPF range: 2001-2014 CE). Its appearance coincides with recent ecosystem change and may has contributed to shifts in planktonic communities, although its ecological impact on the wider ecology of the lake remains unknown.
- Additional pressures may have arisen from ongoing management of the invasive aquatic weed *Lagarosiphon*, including herbicide application, diver removal, and benthic matting programmes, as well as increasing residential and tourism-related development within the Glendhu Bay catchment.

Overall, the Glendhu Bay record suggests that ecological change began before clear evidence of increased catchment disturbance was recorded in the sediments, implying that other environmental drivers initiated the first major biological shifts. However, the acceleration of biological change after ~2000 CE coincided with increasing MAR and trace-metal fluxes, as well as shifts towards nutrient-associated diatom taxa, indicating a growing influence of catchment-derived inputs and associated environmental change on lake ecosystem structure and function.

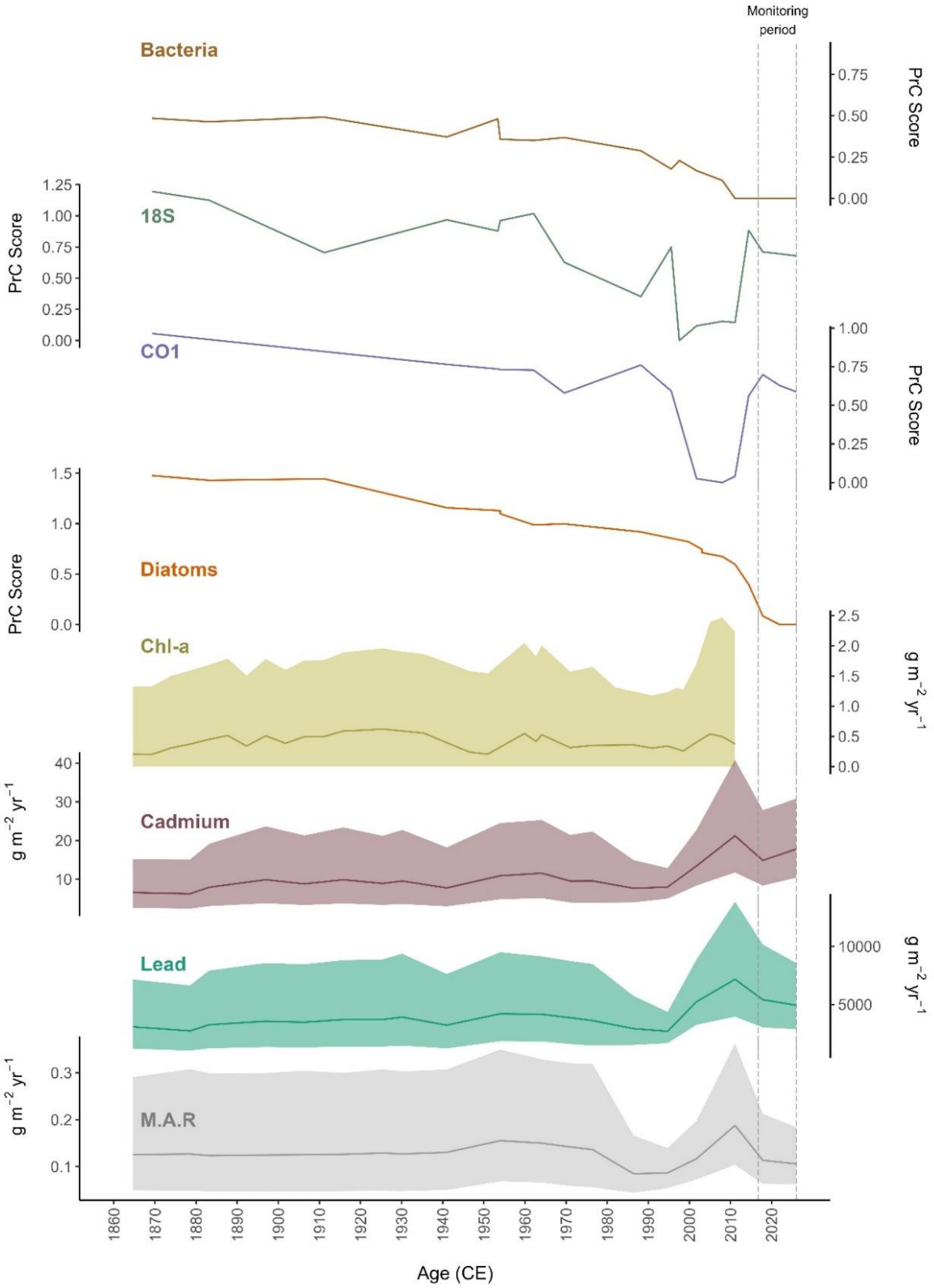


Figure 29. Temporal changes in principal response curve (PRC) scores derived from bacterial (16S rRNA), eukaryotic and metazoan (18S rRNA), and diatom assemblages in Glendhu Bay, Lake Wānaka, plotted alongside reconstructed chlorophyll-a (Chl-a) flux, cadmium flux, lead flux (mg cm^{-2} yr^{-1}), and mass accumulation rate (MAR; g cm^{-2} yr^{-1}), from ~1850 CE to present. For Chl-a, cadmium, lead, and MAR, solid lines represent median values, and shaded envelopes indicate uncertainty ranges derived from the age-depth model and proxy-specific calculations (see Methods). Ages shown are median estimates from the age model. Dashed vertical line shows the start of consistent water quality monitoring.

Earthquake records

Sediment cores from some lakes can provide natural archives of past earthquakes because strong ground shaking can trigger subaqueous slope failures and increase sediment delivery from surrounding catchments, leaving distinctive deposits in the sediment record. These deposits can be dated to reconstruct the timing, frequency and relative intensity of prehistoric earthquakes, extending earthquake histories well beyond instrumental and written records (Howarth et al. 2012). This approach has been successfully applied in Aotearoa New Zealand, particularly to lakes adjacent to the Alpine Fault, where sediment records have been used to reconstruct the recurrence and rupture history of large earthquakes (Howarth et al. 2021).

No unequivocal co-seismic earthquake deposits were identified in the sediment cores collected from Roys Bay or Glendhu Bay. This is not unexpected because these relatively shallow embayment's lack the steep subaqueous slopes that commonly fail during strong seismic shaking and generate diagnostic event deposits. In addition, the absence of such deposits may also reflect the coring locations themselves, which were not situated within local depositional basins. As a result, any sediment gravity flows generated by subaqueous landsliding are likely to have bypassed the core sites rather than being deposited and preserved there.

However, the chronology from Glendhu Bay provides some evidence that the pronounced pre-European sediment pulse from 59 cm to 35 cm, an increase in sediment accumulation, may be related to the landscape response to the 1717 CE Mw ~8.2 Alpine Fault earthquake. The onset of this sediment pulse has a 95% age range of 1705–1795 CE, which includes the 1717 earthquake. It is therefore plausible that earthquake-triggered landsliding increased sediment availability within the catchment and initiated a sediment cascade that subsequently delivered elevated sediment loads to Glendhu Bay. Despite this substantial increase in sediment delivery, there is little evidence for a corresponding ecological response in the lake record, suggesting that the ecological impacts of this disturbance were limited compared with those associated with later anthropogenic changes.

This interpretation remains provisional because the Glendhu cores do not preserve an independent co-seismic marker that can directly link the onset of increased sedimentation to the 1717 CE earthquake. Other processes, including changes in the drainage configuration or sediment delivery pathways of the major inflows to Glendhu Bay, could potentially produce a similar response. Testing the earthquake-cascade hypothesis would require sediment cores from the deeper basins of Lake Wānaka, where earthquake-triggered subaqueous deposits are more likely to be both generated and preserved. Identification and dating of a co-seismic deposit associated with the 1717 CE earthquake would provide an independent chronological marker against which the onset

of the Glendhu sediment pulse could be tested. Such work was beyond the scope of this study and would require specialised equipment capable of recovering sediment cores from deep-water environments.

Synthesis and recommendations

The sediment records from Roys Bay and Glendhu Bay provide strong evidence that biological communities in these parts of Lake Wānaka have undergone substantial change since human arrival. However, the timing, magnitude, and likely drivers of change differed between the two embayment's, highlighting the importance of local environmental setting within this large and morphologically complex lake. While the two cores represent contrasting depositional environments and capture common regional drivers, they do not necessarily reflect the full spatial variability of Lake Wānaka. Consequently, the records are interpreted as evidence of environmental change in Roys Bay and Glendhu Bay, with broader lake-wide inferences made cautiously.

The two bays supported distinct biological communities prior to human settlement, indicating that natural differences in catchment characteristics, hydrology, and habitat structure were already important drivers of ecological variation. These differences appear to have influenced how each bay responded to subsequent human activities.

Roys Bay showed evidence of ecological change during the Māori settlement period, with shifts recorded consistently across multiple biological proxies. Comparable changes were not evident in Glendhu Bay, suggesting that the ecological effects of early human activity were spatially variable within the lake.

Following European settlement, ecological change became increasingly apparent in both bays, although the trajectories differed. These changes occurred during a period of substantial catchment modification that included pastoral development, gold mining, rabbit outbreaks, vegetation change, and later agricultural intensification and tourism development, all of which have the potential to influence sediment delivery, nutrient cycling, and aquatic habitats (Schallenberg and Eng 2025). In Roys Bay, changes began relatively early (c. 1903 HDPF 1887 to 1919) and coincided with increased sediment accumulation and charcoal deposition, indicating a response to catchment disturbance and enhanced sediment delivery. Diatom assemblages shifted from communities associated with oligotrophic conditions towards taxa characteristic of slightly more productive and littoral habitats, suggesting increasing nutrient availability and changes in nearshore habitat structure. In contrast, Glendhu Bay exhibited a more gradual ecological transition, with some evidence from the diatom community for subtle nutrient enrichment.

The most pronounced ecological reorganisation occurred during the late twentieth and early twenty-first centuries. Marked shifts were recorded across bacterial (16S rRNA), eukaryotic (18S rRNA, COI), and diatom assemblages in both bays. However, the drivers

of these changes appear to differ between sites. In Roys Bay, major biological changes after approximately 1980 CE are not clearly associated with changes in MAR, lead, or cadmium flux, suggesting that in-lake processes have become increasingly important. One of the most prominent recent changes was the marked increase in accumulation rates of the diatom *Lindavia intermedia*. This increase coincided with rising chlorophyll-a in the sediment core and declining benthic and benthic/epiphytic diatom accumulation rates, suggesting that this species may be contributing to recent ecological changes in Roys Bay.

In Glendhu Bay, there is stronger evidence that recent ecological change has been influenced by catchment processes. Accelerated biological change since approximately 2000 CE broadly coincides with increases in MAR, lead, and cadmium flux, as well as shifts towards diatom taxa associated with greater nutrient availability. These patterns are consistent with increasing catchment pressures, including land-use intensification, development, and other human activities within the catchment.

Overall, the records demonstrate that Lake Wānaka has not responded uniformly to human disturbance. Instead, ecological change has occurred at different times, through different mechanisms, and at different rates across the lake. The findings highlight the importance of both catchment influences and in-lake processes in shaping ecosystem trajectories and suggest that contemporary ecological change is part of a longer-term process that began following human settlement but has accelerated markedly over recent decades.

Recommendations for further studies

1. Improve understanding of recent ecological change within Lake Wānaka and other lakes in the upper Clutha catchment

Undertake high-resolution pigment analyses of post-1850 CE sediments from Roys Bay and Glendhu Bay to better characterise changes in lake productivity, algal community composition following human settlement. Pigment records would provide an independent assessment of changes in primary production and complement the biological proxies examined in this study.

Comparable palaeolimnological investigations should also be extended to other locations within Lake Wānaka[1] and to other large lakes within the upper Clutha

[1] As part of the field programme associated with this project, a short sediment core was also recovered from a bay at the Makarora end of Lake Wānaka. Preliminary pollen analyses indicate that the upper metre of this core was deposited entirely during the post-European settlement period. However, the sequence contains frequent event deposits derived from the Makarora River, making it challenging to isolate intervals that reflect in-lake ecological processes rather than terrestrial sediment inputs. Further investigation of this site may nevertheless prove valuable.

catchment to determine whether the patterns observed in this study are site-specific or reflect broader regional trends. A network of sites spanning a gradient of catchment pressures, from relatively low-impact systems such as Lake Hāwea to more urbanised environments such as Frankton Arm (Lake Whakatipu), would provide valuable context for interpreting recent ecological change. Where the primary objective is to identify the timing and magnitude of recent ecological change, investigations could focus on sediments deposited since approximately 1850 CE. This approach would substantially reduce analytical costs and avoid many of the logistical challenges associated with recovering and analysing longer sediment sequences.

2. Improve understanding of benthic food webs and ecosystem functioning in Roys Bay and Glendhu Bay

Recent ecological change identified in this study is characterised by substantial shifts in microbial, meiofaunal, invertebrate, and diatom communities. However, the implications of these changes for benthic food-web structure, trophic interactions, and ecosystem functioning remain poorly understood. Further work is needed to determine how observed changes in community composition have influenced ecological processes and the flow of energy and nutrients through lake ecosystems.

A combination of contemporary ecological surveys, stable isotope analyses, fatty acid biomarkers, and targeted molecular approaches could be used to characterise food-web structure and identify links between primary producers, microbial communities, meiofauna, and higher trophic levels. Such studies would help determine whether the biological reorganisation observed in Roys Bay and Glendhu Bay represents a fundamental change in ecosystem functioning or primarily reflects shifts in species composition. Understanding these relationships would also improve interpretation of sedimentary DNA records and help identify the mechanisms underlying recent ecological change.

3. Develop a better understanding of the drivers and functional consequences of recent ecological change

Encourage studies aimed at identifying the causes of recent ecological change within Roys Bay and across Lake Wānaka more broadly. Potential drivers include catchment urbanisation, changes in nutrient loading, shifts in hydrology, climate variability, and species introductions. Although this study identifies the timing and nature of major ecological transitions, the relative importance of these potential drivers remains uncertain.

One promising approach would be the application of metagenomic analyses to selected sediment intervals representing key periods of ecological change. These techniques can identify genes and metabolic pathways associated with nutrient cycling, organic matter decomposition, primary production, and other ecosystem processes. Combined with contemporary monitoring data, such analyses would provide insights into functional

ecosystem change and improve understanding of the mechanisms driving biological reorganisation within Lake Wānaka.

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Appendices

Appendix 1. Sampling depths

Roys Bay

Sample Name	Depth (cm)	eDNA	Pollen	Diatoms
WAN1m6	0.0	1	1	1
WAN1m6	0.5	1		
WAN1m6	1.0	1		1
WAN1m6	1.5	1		
WAN1m6	2.0	1		1
WAN1m6	2.5	1		
WAN1m6	3.0	1	1	1
WAN1m6	3.5	1		
WAN1m6	4.0	1		1
WAN1m6	4.5	1		
WAN1m6	5.0	1		1
WAN1m6	6.5		1	
WAN1m6	7.0	1		1
WAN1m6	9.0	1		1
WAN1m6	12.0	1	1	1
WAN1m6	16.0	1	1	1
WAN1m6	20.0	1	1	1
WAN1m6	24.0	1	1	1
WAN1m6	27.0	1	1	1
WAN1m6	31.0	1		1
WAN1m6	36.0	1	1	
WAN1m6	42.0	1		1
WAN1m6	48.0	1	1	
WAN1m6	54.0	1		1
WAN1m6	60.0	1	1	
WAN1m6	66.0	1		1
WAN1m6	72.0	1	1	
WAN1m6	78.0	1		1
WAN1m6	84.0	1	1	1
WAN6m6_0-1.5m	99.0	1	1	1
WAN6m6_0-1.5m	101.0	1	1	
WAN6m6_0-1.5m	104.0	1	1	1
WAN6m6_0-1.5m	107.0	1	1	
WAN6m6_0-1.5m	109.0	1	1	1
WAN6m6_0-1.5m	114.0	1	1	1
WAN6m6_0-1.5m	119.0	1	1	1
WAN6m6_0-1.5m	124.0	1	1	1
WAN6m6_0-1.5m	129.0	1	1	
WAN6m6_0-1.5m	134.0	1	1	1
WAN6m6_0-1.5m	139.0	1	1	
WAN6m6_0-1.5m	144.0	1	1	1

Glendhu Bay

Core	Depth (cm)	eDNA	Pollen	Diatoms
WAN1m2	0.0	1	1	1
WAN1m2	0.5	1		1
WAN1m2	1.0	1		1
WAN1m2	1.5	1		1
WAN1m2	2.0	1		1
WAN1m2	2.5	1		1
WAN1m2	3.2	1		
WAN1m2	5.8	1		1
WAN1m2	6.3	1		
WAN1m2	6.8	1		
WAN1m2	7.8	1	1	1
WAN1m2	9.6	1		
WAN1m2	10.6	1		
WAN1m2	12.3	1	1	1
WAN1m2	15.1	1	1	
WAN1m2	20.0	1		1
WAN1m2	23.0	1	1	1
WAN1m2	25.5		1	
WAN1m2	26.0	1		1
WAN1m2	27.5	1	1	1
WAN1m2	28.5	1	1	
WAN6m2_0-1.5m	52.0	1	1	1
WAN6m2_0-1.5m	58.0	1		1
WAN6m2_0-1.5m	64.9	1	1	1
WAN6m2_0-1.5m	71.4	1	1	1
WAN6m2_0-1.5m	78.4	1	1	1
WAN6m2_0-1.5m	80.4	1	1	
WAN6m2_0-1.5m	82.4	1		1
WAN6m2_0-1.5m	88.5	1	1	1
WAN6m2_0-1.5m	92.5	1	1	1
WAN6m2_0-1.5m	95.5	1	1	
WAN6m2_0-1.5m	98.5	1	1	1
WAN6m2_0-1.5m	103.5	1	1	
WAN6m2_0-1.5m	109.8	1	1	1
WAN6m2_0-1.5m	113.8	1		
WAN6m2_0-1.5m	118.8	1	1	1
WAN6m2_0-1.5m	123.7	1		1
WAN6m2_0-1.5m	129.2	1	1	1
WAN6m2_0-1.5m	133.2	1		1
WAN6m2_0-1.5m	137.2	1		1
WAN6m2_0-1.5m	141.6	1	1	1

Appendix 2. Detailed methodology

Site Selection

Core sites were selected using the bathymetric map to identify relatively flat areas within Roys Bay, where sediments may record the impacts of Wānaka township, and within Glendhu Bay, which represents a more rural setting. Once these broad areas had been identified, a Compressed High-Intensity Radar Pulse (CHIRP) survey was undertaken to map the lake floor and image sediment structures extending approximately 10-20 m below the lakebed.

This technique was used to identify relatively flat areas of the lakebed suitable for coring, while avoiding slopes that may be susceptible to mass movement and areas containing rock outcrops. Selecting coring locations under these conditions maximises the likelihood of recovering a continuous and undisturbed sediment record that can be used to evaluate environmental change over time.

Figures A1 representative CHIRP profiles from Glendhu Bay. The Glendhu Bay profile extends from a rock outcrop into the bay and illustrates the sediment structure beneath the lake floor at the selected coring location.

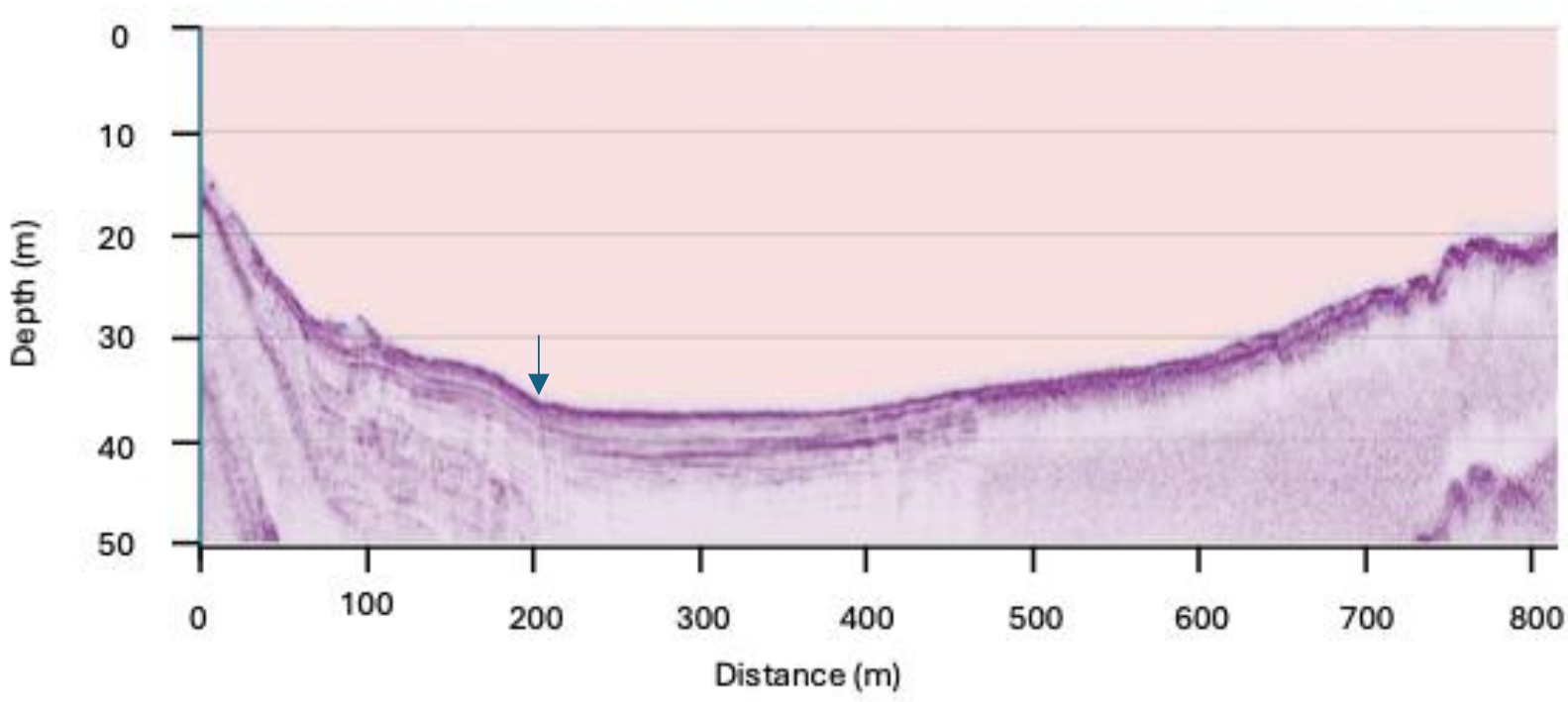


Figure A1. CHIRP profile across Glendhu Bay from west to east, showing a steep bedrock slope on the left side of the profile and more gently sloping moraine deposits draped with sediments on the right side. The optimal coring location is at approximately 200 m along the transect (arrow), at a water depth of approximately 37 m, where the sediment sequence is thick and exhibits planar, continuous bedding. The planar-bedded sediments observed between approximately 200, and 450 m abruptly disappear from the CHIRP record, most likely due to gas trapped within the sediments attenuating the acoustic signal and limiting its penetration into the underlying deposits.

Sediment core chronology and flux calculations

To determine sediment ages, 2 cm thick samples were collected from each core for ^{210}Lead, ^{226}Radium and ^{137}Cesium analysis. Samples were frozen at −80°C overnight and subsequently freeze-dried for at least 24 hours using a FreeZone 6 L Benchtop Freeze Dry System. The dried samples were homogenised using a mortar and pestle prior to radionuclide analysis. Activities of ^{210}Lead, ^{226}Radium and ^{137}Cesium were determined by gamma spectrometry at the Institute of Public Health and Forensic Science (PHF Science), Christchurch, New Zealand. Activities were reported in Bq kg^{-1}, with uncertainties expressed as 95% confidence intervals. Excess ^{210}Lead for each depth was then calculated.

Independent age markers to constrain the age–depth models were derived from anthropogenic radionuclides and pollen biostratigraphy. ^{137}Cesium activities were used to provide independent chronological constraints on the recent sediment record. The down core ^{137}Cesium profiles were examined for the onset of detectable atmospheric fallout associated with nuclear weapons testing, assigned an age of 1953 ± 3, and for the ^{137}Cesium fallout maximum associated with peak atmospheric nuclear testing in the early 1960s, assigned an age of 1964 ± 4. Additional chronological control was obtained from pollen analysis to identify the transition from pre-European to European land use, and pre-human to evidence of Māori settlement. The first appearance of exotic pollen taxa, particularly *Pinus* spp. and *Rumex acetosella*, which provide a stratigraphic marker for European settlement and associated vegetation change in the Lake Wānaka catchment were prescribed a date of 1854 to 1866 CE to align with when Pembroke was initially settled. Evidence of initial settlement by Māori was constrained using increases in charcoal and *Pteridium esculentum* pollen, which we prescribed an age of 1280 to 1340 CE based on regional pollen and archaeological records (Bunbury et al., 2022).

Age–depth models were developed using the Bayesian 'rplum' package (Aquino-Lopex et al., 2018; Appendix 2: Figure A2 and A3). RPlum combines measured ^{210}Lead and ^{226}Radium activities with independent chronological information and prior distributions describing sedimentation and ^{210}Pb behaviour to estimate sediment ages and their uncertainties. Independent constraints provided by ^{137}Cesium fallout horizons and pollen isochrons were incorporated as age normally distributed probability distributions. Sedimentary event deposits, where identified, were treated as instantaneous deposits and excluded from the calculation of background sediment accumulation rates. Both cores were modelled in 1-cm sections. Sedimentation time (years required to accumulate 1 cm of sediment) was assigned a gamma prior with a shape of 1.5 and a mean of 10 yr cm^{-1} for Glendhu Bay and 5 yr cm^{-1} for Roys Bay. These broad priors allow substantial variation in accumulation rates. A beta prior controlled the persistence, or "memory", of sedimentation times between adjacent sections, with means of 0.4 and 0.5 for Glendhu Bay and Roys Bay, respectively, and a strength of 10 for both. Higher memory favours smoother changes in accumulation rate, while the strength controls the

concentration around the prior mean. Both models used gamma priors for unsupported ^{210}Pb influx (mean 50 Bq m^{-2} yr^{-1}; shape 2) and supported ^{210}Pb activity (mean 10 Bq kg^{-1}; shape 5). These constrain the external supply and background activity of ^{210}Pb, respectively, while incorporating uncertainty in both into the chronology. The minimum distinguishable unsupported-activity parameter (Al) was 0.1. Dating measurements update these priors to produce posterior age distributions, with priors exerting greater influence where chronological constraints are weak. The resulting age–depth models were used to estimate the timing and uncertainty of changes in sediment accumulation within the Lake Wānaka cores.

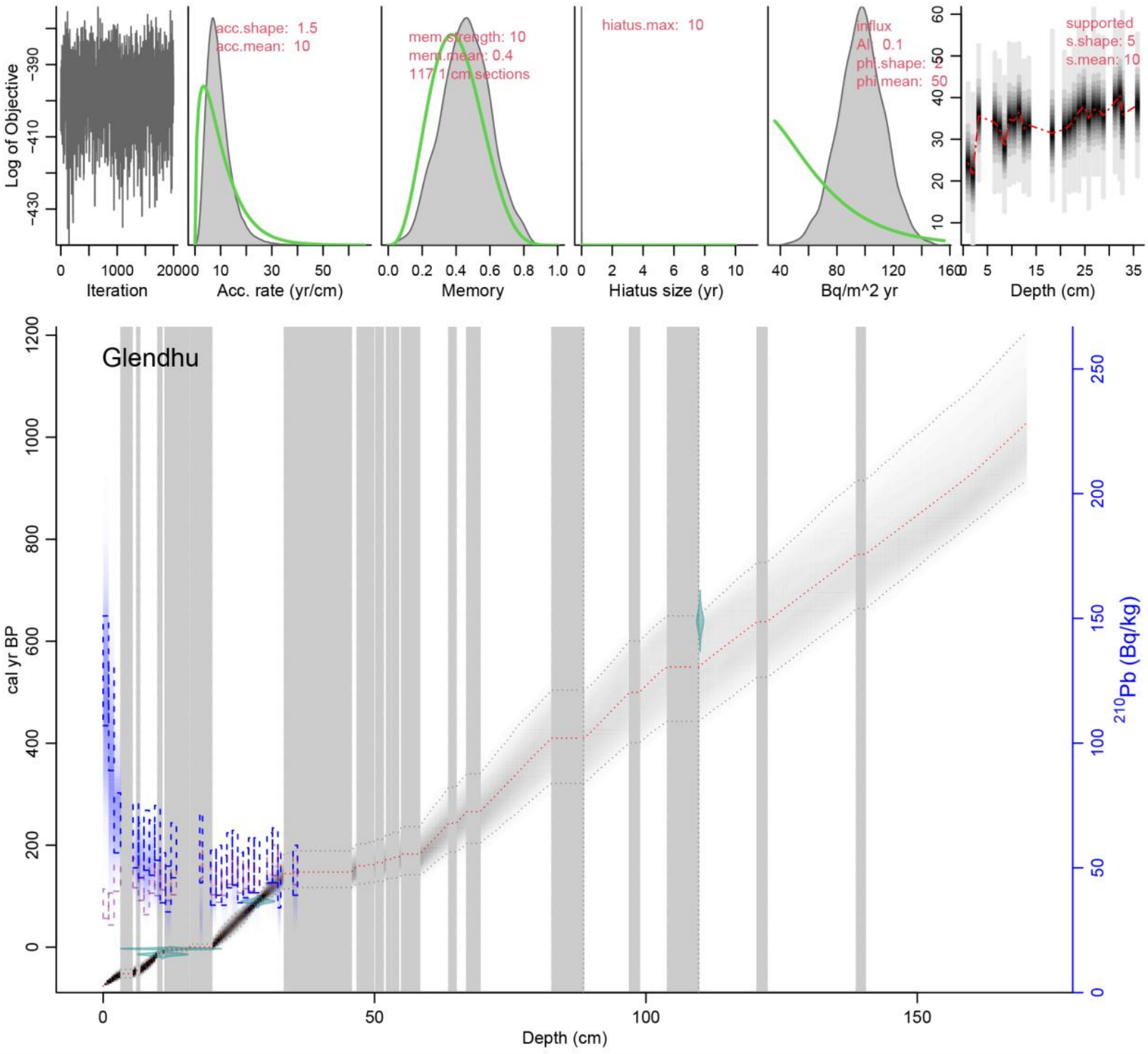


Figure A2. Bayesian age–depth model for the Glendhu Bay sediment core, Lake Wānaka, generated using RPlum. In the lower panel, greyscale shading shows posterior age probability, with darker shading indicating higher probability; the red dotted line marks the mean age and grey dotted lines delimit the 95% credible interval. Ages are expressed as calendar years before 1950 CE (cal yr BP). Teal distributions show additional chronological constraints. Blue rectangles show measured ^{210}Pb activities and their 95% uncertainty ranges, blue shading shows modelled activities, and purple outlines indicate supported ^{210}Pb activity (right-hand axis). Grey vertical bands mark event deposits treated as instantaneous sediment accumulation; these intervals were removed before age modelling and reinserted into the final age–depth model. Upper panels show, from left to right, the Markov chain Monte Carlo trace, sedimentation time (yr cm^{-1}), accumulation memory, unsupported ^{210}Pb influx, and supported ^{210}Pb activity with depth. Green curves show priors and grey distributions show posteriors; red annotations give model settings.

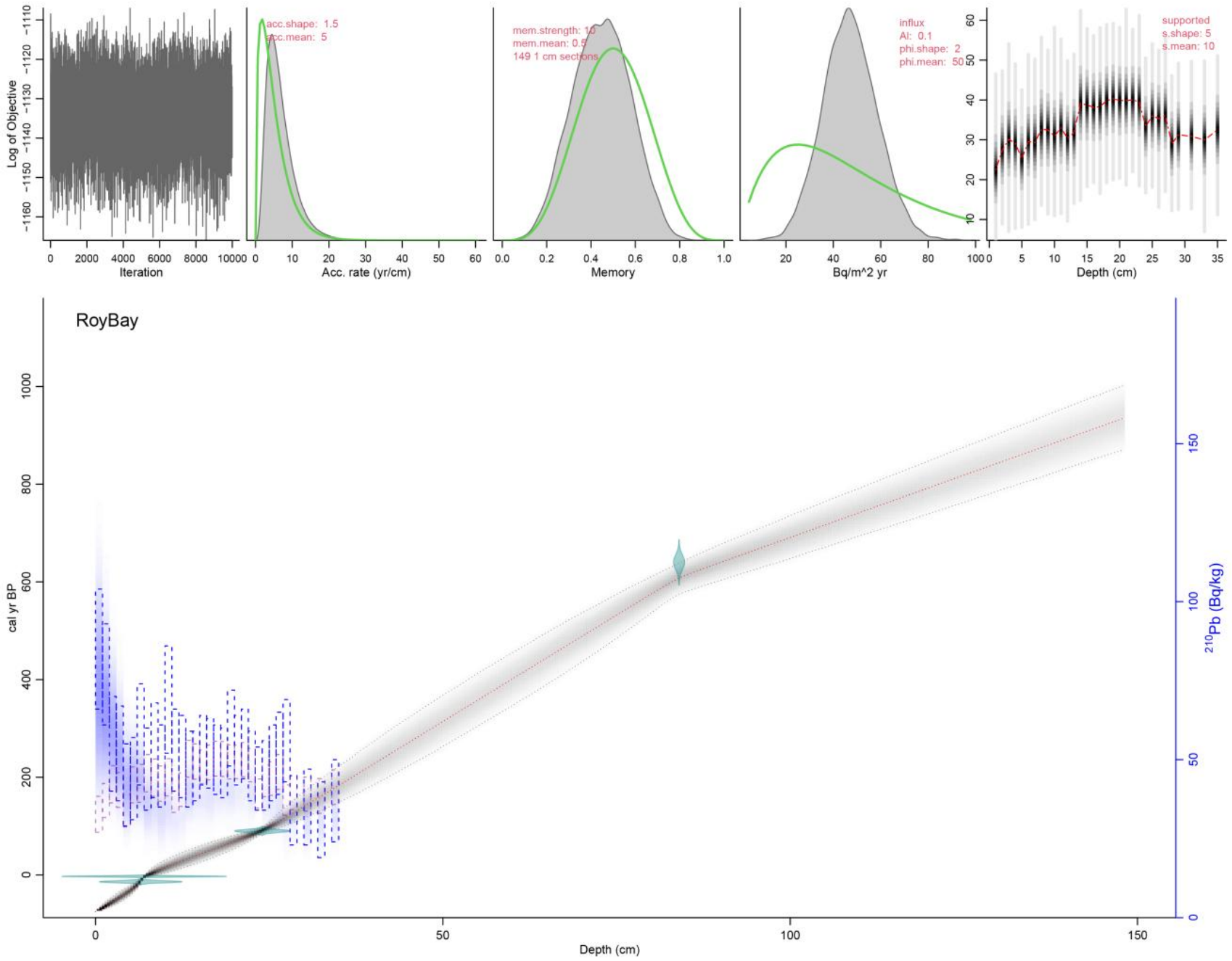


Figure A3. Bayesian age–depth model for the Roys Bay sediment core, Lake Wānaka, generated using RPlum. In the lower panel, greyscale shading shows posterior age probability, with darker shading indicating higher probability; the red dotted line marks the mean age, and grey dotted lines delimit the 95% credible interval. Ages are expressed as calendar years before 1950 CE (cal yr BP). Teal distributions show additional chronological constraints. Blue rectangles show measured ^{210}Pb activities and their 95% uncertainty ranges, blue shading shows modelled activities, and purple outlines indicate supported ^{210}Pb activity (right-hand axis). Upper panels show, from left to right, the Markov chain Monte Carlo trace, sedimentation time (yr cm^{-1}), accumulation memory, unsupported ^{210}Pb influx, and supported ^{210}Pb activity with depth. Green curves show priors and grey distributions show posteriors; red annotations give model settings.

Pollen analysis

Pollen was identified through microscopy following the methods described in Short et al. (2022). In brief, pollen was extracted from 0.5-2 cm^3 of sediment using standard laboratory procedures, including treatment with 10% hot hydrochloric acid, acetolysis, and sieving through a 6 µm mesh. Exotic Lycopodium tablets were added to each sample to allow calculation of pollen concentrations. Pollen and spore types were identified using standard reference texts and Aotearoa New Zealand reference collections.

Data are reported as the relative frequency based on a minimum pollen sum of 150 grains. This sum includes pollen from all dryland plants, encompassing trees, shrubs,

herbaceous plants, and non-native taxa. Bracken fern (*Pteridium esculentum*) is included in the dryland pollen sum because, in post-disturbance landscapes, its functional morphology is more similar to shrubs than to ferns, and dense stands are ecologically equivalent to shrubland (McGlone et al. 2005). Pollen from other groups, wetland plants, aquatic plants, ferns, tree ferns, and non-palynomorph particles, was excluded from the dryland sum, but their relative abundances were calculated as a proportion of the dryland pollen plus the respective group.

Itrax scanning

Downcore major and trace elemental abundances were measured at 1 mm intervals using a Cox Analytics Itrax µXRF Core Scanner at the University of Otago Repository for Core Analysis (Dunedin, New Zealand). The top 1–2 mm of the sediment core surface was scraped and removed prior to scanning to minimise potential surface contamination. Samples were scanned with a molybdenum X-ray tube set at 30 kV, 55 mA, and 10 s integration time. While multiple elements were analysed, only titanium (Ti) relative to incoherence (Inc) is given in this report where we use it as a proxy for detrital input and fine sediment (Davies et al. 2015).

Trace metals

The subsamples were dried, passed through a 2 mm sieve, and analysed for antimony (Sb), arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), mercury (Hg), and zinc (Zn) by acid digestion followed by inductively coupled plasma mass spectrometry (ICP-MS) at ALS Laboratories (Hamilton). Method reporting limits (mg kg^{-1} dry weight) were 0.025 for Sb, 0.125 for As, 0.005 for Cd, 0.075 for Cu, 0.25 for Pb, 0.025 for Hg, and 0.05 for Zn.

Mass accumulation rates (MAR) were calculated from the age-depth models and used to convert elemental concentrations to fluxes, thereby accounting for changes in sedimentation rates and sediment density through time.

Hyperspectral imaging scanning

The cores were scanned using a Hyperspectral Core Scanner equipped with a Specim sCMOS-CL-50-V10E-SCB camera working in the visual to near-infrared range (400–1000 nm). Measurements were captured with a spectral resolution of 1.3 nm and a spatial resolution of 41 µm. This study analysed spectral data using RABD660–670, an index which is correlated with the sedimentary pigment chlorophyll-a and its degradation products (Butz et al., 2017; Schneider et al., 2018). In this study, the RABD660/670 index was converted to a sedimentary chlorophyll-a proxy concentration (µg g^{-1}) using a calibration derived from a comparison of surface sediment samples from 29 glacial lakes in Aotearoa New Zealand, where chlorophyll-a was measured using both hyperspectral scanning and high-performance liquid chromatography (Yackulic, McKay and Vandergoes, unpublished data). Chlorophyll-a increases non-linearly with RABD660-

670, and its variance increases with concentration. We therefore regressed chlorophyll-a^0.75 on (RABD660-670 − 1). The intercept was fixed at zero, so no absorption trough means no chlorophyll-a:

Chlorophyll-a (μg g^{-1}) = [111.2 × (RABD660;670 − 1)]^(1/0.75)

The slope is 111.2 ± 9.3 (1σ; 95% CI 92–130; $p < 10^{-11}$). The regression explains 84% of the variance in transformed chlorophyll-a (residual standard error 17.2, 28 d.f.; R^2 = 0.64 in μg g^{-1}). In leave-one-out cross-validation, R^2 = 0.58, the RMSEP is 96 μg g^{-1} and the median absolute prediction error is 11 μg g^{-1}. Predictions typically fall within a factor of ~1.9 of measured values.

The chlorophyll-a data was converted to flux (μg cm^{-2} yr^{-1}) following the methods used for trace metals.

Diatom analysis

Samples were treated with 10% hydrochloric acid and 20% hydrogen peroxide to remove carbonates and organic matter (Smol et al. 2001). Diatom slurries were permanently mounted on slides using Naphrax. At least 300 valves per sample were counted and identified to the highest possible taxonomic resolution (Foged, 1979; Krammer & Lange-Bertalot, 1986; Cassie, 1989), and species habitat preferences were determined following Round et al. (1990). Counting and identification were performed at 1,000× magnification under a microscope with differential interference contrast.

To further explore reasons for shifts in Chlorophyll-a at Roys Bay, 12 post 1830 CE samples were assessed for concentrations. In these samples diatom concentration was determined using the microsphere method (Batterbee & Kneen, 1982). Diatom taxa biovolumes were then determined from published databases (Kremer at al. 2014, Novis et al. 2017, Gregersen 2020, Laplace-Treyture et al. 2021) and literature and measurements made during enumeration. Diatom accumulation rates were calculated by multiplying diatom concentration (valves g^{-1}) by sediment mass accumulation rate (g cm^{-2} yr^{-1}). Taxon-specific accumulation rates were calculated by multiplying total diatom accumulation by the relative abundance of each taxon. Biovolume accumulation was calculated at the taxon level by multiplying taxon-specific accumulation rates (valves cm^{-2} yr^{-1}) by the estimated cell volumes (μm^{-3} $cell^{-1}$).

Environmental DNA analysis

Metabarcoding

All molecular analyses were conducted under strict contamination-control procedures. Each stage of the workflow, including DNA extraction, PCR setup, PCR amplification, and PCR product clean-up, was performed in UV-sterilized laminar-flow cabinets or dedicated UV-sterilized laboratory rooms. DNA was extracted from 3-5 g of sediment

using the alkaline buffer phosphate sediment (ABPS) protocol described by Thomson-Laing et al. (2022).

Six genetic markers targeting vertebrates, eukaryotes, plants, and bacteria were amplified using polymerase chain reaction (PCR) (

Table **3**).

Table 3. Primers used for amplification of metabarcoding.

Marker	Primer	Sequence (5'→3')	Reference
12S (vertebrates)	12SVF-F	TTAGATACCCCACTATGC	Riaz et al. (2011)
	12SVF-R1	TAGAACAGGCTCCTCTAG	
COI (eukaryotes)	mlCOIintF	GGWACWGGWTGAACWGTWTAYCCYCC	Leray et al. (2013)
	jgHCO2198	TANACYTCNGGRTGNCCRAARAAYCA	Geller et al. (2013)
rbcL (plants)	rbcL19b	CTTCTTCAGGTGGAACTCCAG	Bradley et al. (2007)
	rbcLZ1	GTCACCACAAACAGAGACTAAAGCAAGT	
16S rRNA (bacteria)	341F	CCTACGGGNGGCWGC	Herlemann et al. (2011); Klindworth et al. (2013)
	805R	GACTACHVGGGTATCTAATCC	
18S rRNA (eukaryotes)	Uni18SF	AGGGCAAKYCTGGTGCCAGC	Zhan et al. (2013)
	Uni18SR	GRCGGTATCTRATCGYCTT	
trnL (plants)	trnL g	GGGCAATCCTGAGCCAA	Taberlet et al. (2007)
	trnL h	CCATTGAGTCTCTGCACCTATC	

For each marker, duplicate PCRs were performed in 20 µL reaction volumes containing 10 µL MyFi Mix (Bioline, London, UK), 1.5 µL bovine serum albumin (BSA; Invitrogen, 1 mg mL^{-1}), 1 µL of each primer (10 µM), 2 µL DNA template, and molecular-grade water to volume.

For the 12S rRNA, COI, 16S rRNA and 18S rRNA assay, thermal cycling commenced with an initial denaturation step of 95°C for 5 min, followed by 38-40 cycles of 95°C for 30 s, 54°C for 90 s, and 72°C for 90 s, with a final extension at 72°C for 5 min.

For the *trnL* and *rbcL* assays, cycling conditions were identical except that the 38 amplification cycles consisted of 95°C for 30 s, 55°C for 45 s, and 72°C for 45 s.

PCR products were purified using SequalPrep™ Normalization Plates (Applied Biosystems, Foster City, CA, USA) according to the manufacturer's instructions. Purified

amplicons, together with extraction and clean-up blanks, were sequenced on an Illumina MiSeq platform at Sequench Ltd. (Nelson, New Zealand).

Sequence processing and bioinformatic analyses were conducted following the workflows described by Pearman et al. (2020) and Thomson-Laing et al. (2024).

Following bioinformatic processing and prior to analysis, taxonomic assignments from the 18S rRNA and COI sequence datasets were integrated, and taxa were classified according to their primary habitat as aquatic, terrestrial, or unknown. All terrestrial taxa were removed from further analyses. Preliminary analyses indicated that inclusion or exclusion of taxa with unknown habitat affinities had little influence on overall patterns; therefore, these taxa were retained in the dataset. For the plant markers, *trnL* and *rbcL*, taxa were categorised as terrestrial, aquatic, or wetland species using expert judgement.

Cyanobacterial digital PCR

Cyanobacterial 16S rRNA copy numbers were quantified using a digital PCR (dPCR) assay adapted for the Absolute Q™ Digital PCR System. The assay targeted the cyanobacterial 16S rRNA gene using primers CYAN107F (5'-GACGGGTGAGTAACRCGTRRG-3') and CYAN377R_mod (5'-CCATTGCGGAAAATTCCCC-3'; Picard et al. 2022).

Each 10 µL reaction contained 2.5 µL Absolute Q SYBR Green DNA Digital PCR Master Mix (4×), 0.2 µL of each primer (final concentration 200 nM), 2 µL template DNA, and 5.1 µL nuclease-free water. Reactions were prepared as an 8 µL master mix, to which 2 µL of DNA template was added immediately prior to loading.

Digital PCR was performed on the Absolute Q™ system according to the manufacturer's recommendations, and target gene copy numbers were calculated as absolute concentrations from positive partition counts. Negative controls were included to monitor potential contamination throughout the workflow.

Data analysis

Analyses of 16S rRNA, 18S rRNA, and COI metabarcoding data were conducted using Hellinger-transformed relative abundance data. Bray-Curtis dissimilarity matrices were calculated and visualised using Principal Coordinates Analysis (PCoA). Temporal changes in 16S rRNA, 18S rRNA, and COI, and diatom community composition were assessed by fitting principal curves to each dataset using the prcurve function in the R package analogue.

Appendix 3. Grain size example

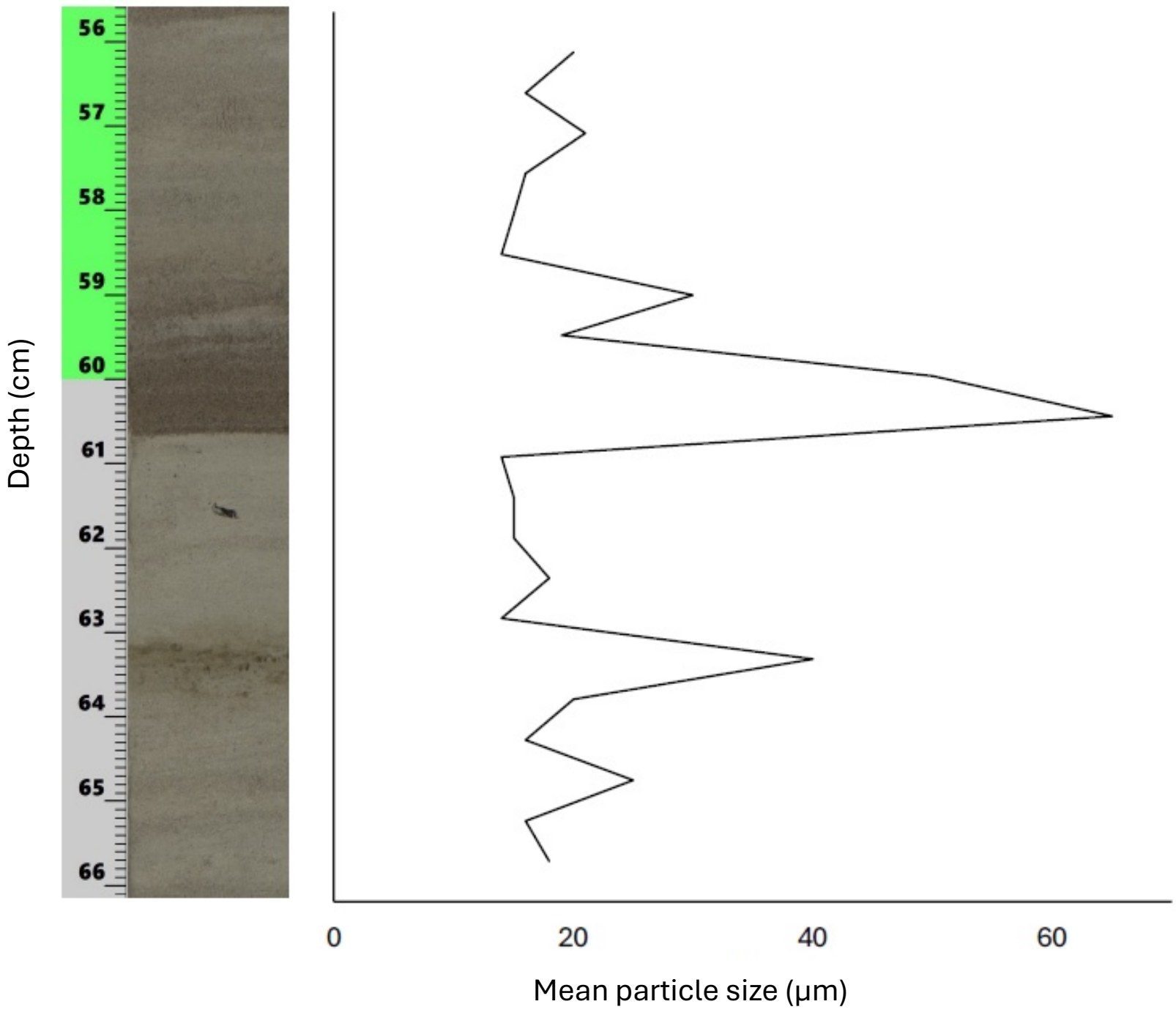


Figure A4. Example of a grain-size profile from the Glendhu Bay, Lake Wānaka sediment core showing mean particle size (µm) through a visually distinct event layer. The event deposit, occurring between approximately 60.7 and 58.8 cm depth, is characterised by an abrupt increase in mean particle size from ~18 µm (medium silt) to ~65 µm (fine sand), indicating the rapid deposition of coarser-grained sediment during a flood event. Above the peak, mean particle size gradually decreases to around 18 µm, with several fluctuations that likely reflect declining flow energy and the waning discharge of floodwaters following the event.

Appendix 4. Detailed pollen diagrams

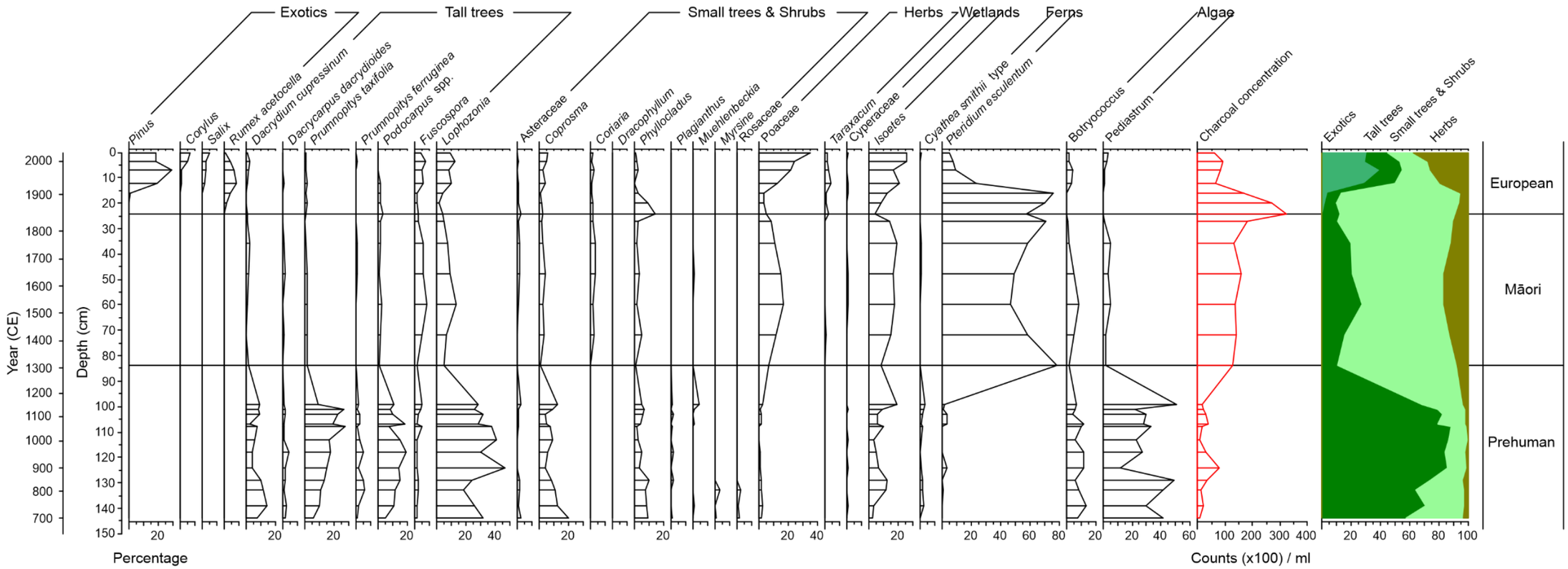


Figure A5. Percentage pollen diagram showing the relative abundance of selected common taxa from Roys Bay, Lake Wānaka, spanning the main stratigraphic sequence.

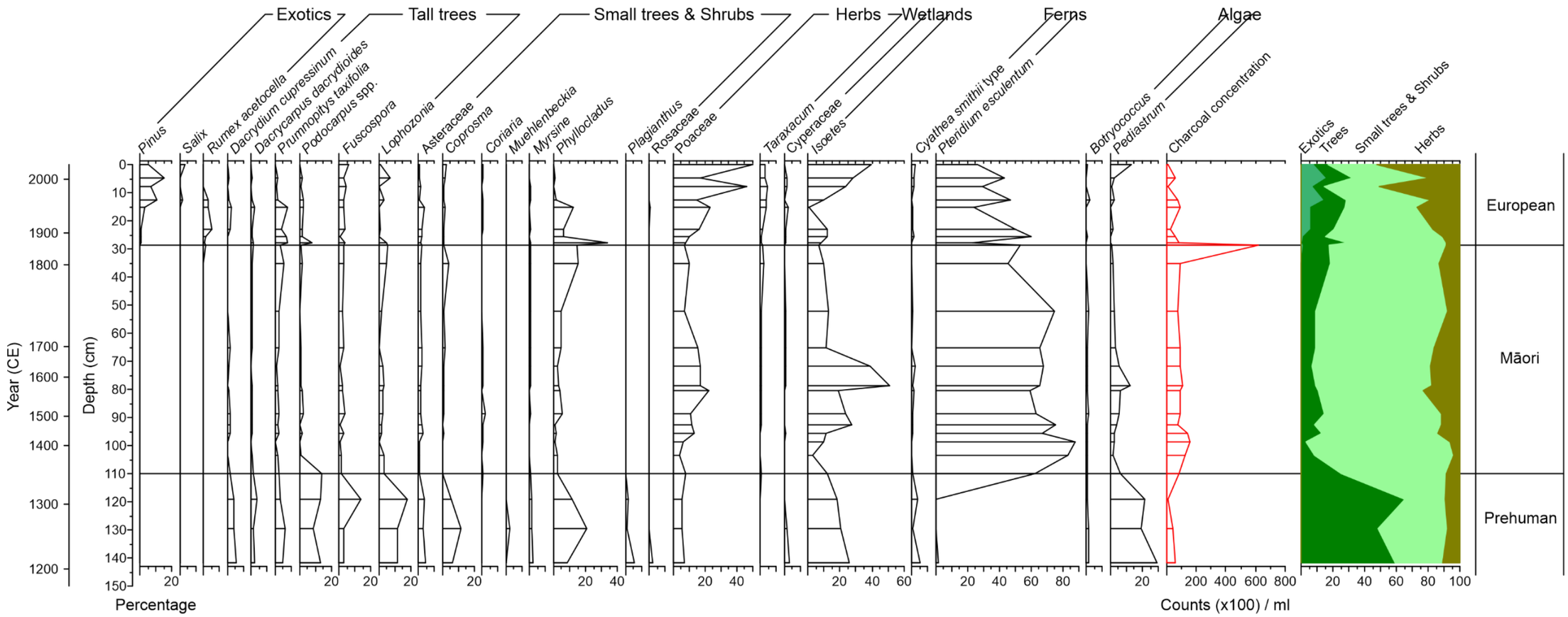


Figure A6. Percentage pollen diagram showing the relative abundance of selected common taxa from Glendhu Bay, Lake Wānaka, spanning the main stratigraphic sequence.

Appendix 5 – ITRAX

The below plot shows the Titanium (Ti) relative concentrations normalised to incoherence (Inc) as a proxy for increased detrital input and fine-grained material.

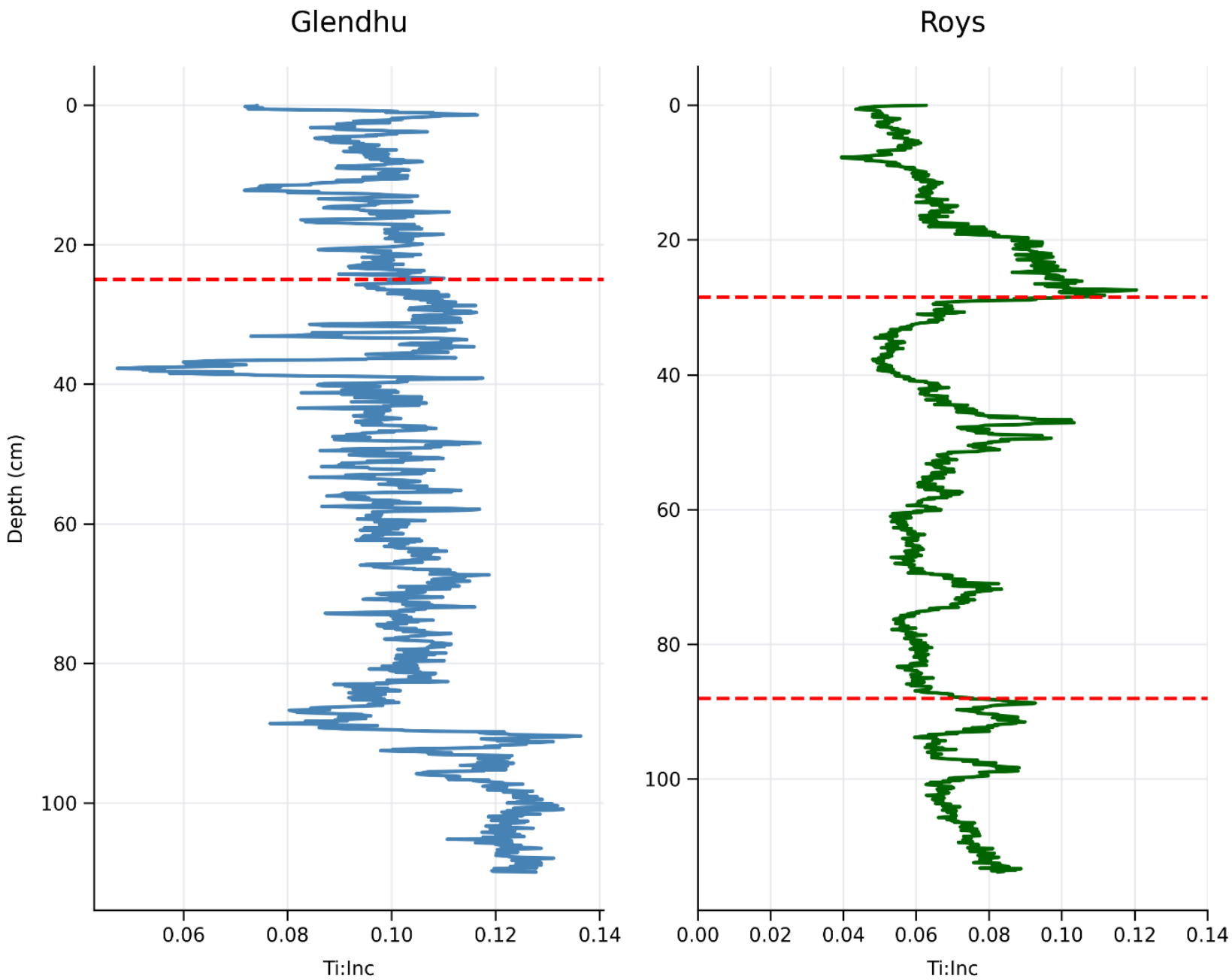


Figure A7. Titanium (Ti) concentrations normalised to incoherent scatter (Inc) for sediment cores from Glendhu Bay and Roys Bay, Lake Wānaka. Ti:Inc is used as a proxy for increased detrital input and the delivery of fine-grained terrestrial material to the lake. Red dashed lines indicate the approximate stratigraphic boundaries associated with major phases of human occupation: the transition from pre-human conditions to Māori occupation, and from Māori to European occupation.

Appendix 6 – Droplet digital PCR for cyanobacteria

In Roys Bay, following a prolonged period of relatively low flux, cyanobacterial DNA abundance increased slightly around 1754 CE (1712 to 1791 CE; Figure A3). This increase did not correspond to an increase in MAR, suggesting that it more likely reflects a change in in-lake cyanobacterial production than a change in sediment delivery. Following a slight decline, maximum values were reached during the late nineteenth to early twentieth centuries. Unlike the earlier increase, this rise broadly coincided with elevated MAR, indicating that catchment-derived inputs may have influenced the observed pattern. Increased erosion and runoff could have enhanced nutrient delivery to the lake, promoting cyanobacterial growth, while simultaneously increasing the accumulation and preservation of cyanobacterial DNA within the sediments. Flux subsequently declined during the twentieth century, although values remained slightly elevated relative to most of the pre-1700 record.

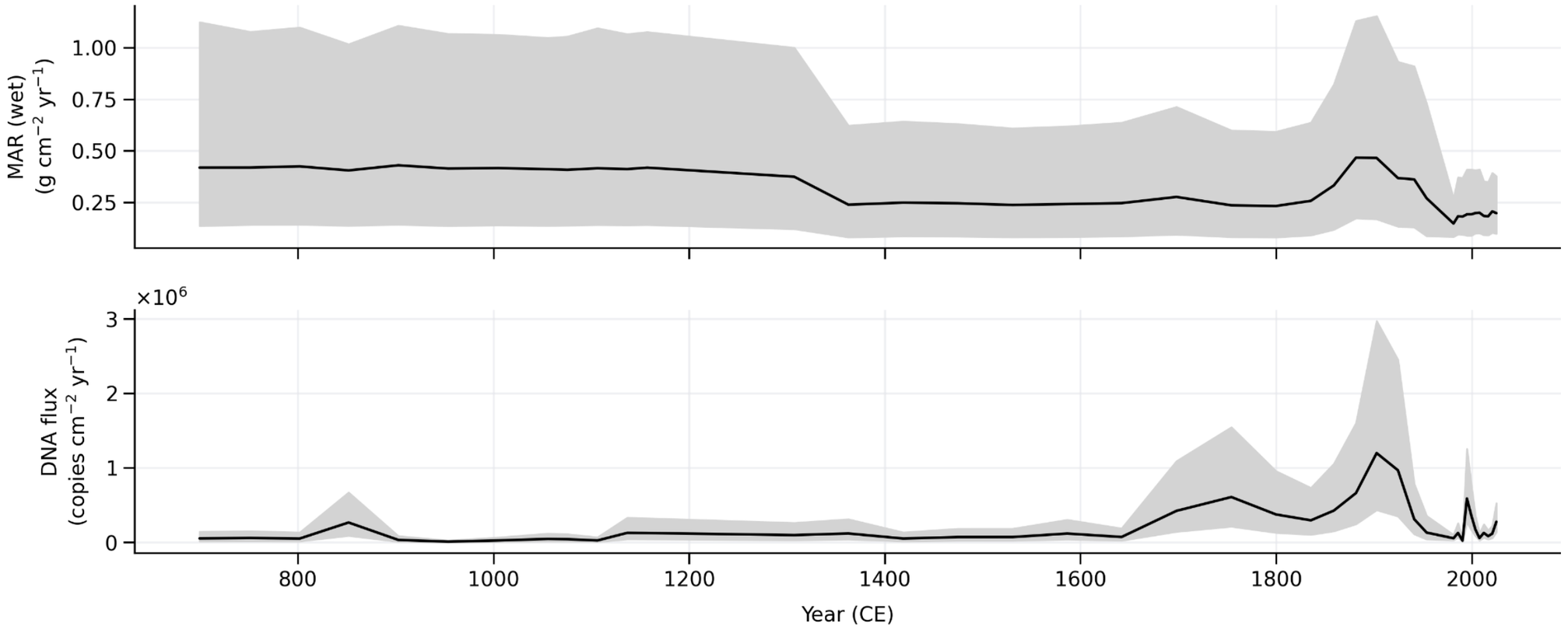


Figure A8. Temporal variation in cyanobacterial DNA flux reconstructed from sedimentary DNA quantified using digital PCR for Roys Bay, Lake Wānaka. Flux estimates (copies cm^{-2} yr^{-1}) were calculated using sediment accumulation rates derived from the age-depth model. Black lines show median estimates and grey shading represents the 95% confidence intervals derived from high-density probability function intervals.

Appendix 7 – Description of phyla detected using the 18S rRNA gene

Taxon	Common name / description
Annelida	**Segmented worms** (earthworms, leeches, aquatic worms)
Apicomplexa	**Apicomplexan parasites** (includes *Plasmodium* malaria parasites; mostly animal parasites)
Apusozoa	**Apusomonads** (protists related to animals and fungi)
Arthropoda	**Arthropods** (insects, crustaceans, spiders, mites, etc.)
Ascomycota	**Sac fungi** (largest fungal group; includes yeasts, moulds, morels, lichens)
Bryozoa	**Moss animals** (colonial aquatic invertebrates)
Cercozoa	**Cercozoans** (amoeba-like protists; many are soil and freshwater microorganisms, including testate amoebae)
Chlorophyta	**Green algae**
Choanoflagellata	**Choanoflagellates** (single-celled relatives of animals; important plankton)
Choanozoa	**Choanozoans** (protists closely related to animals; includes unicellular animal relatives)
Chromeridophyta	**Chromerids** (algae related to corals and apicomplexan parasites)
Chytridiomycota	**Chytrid fungi** (mostly aquatic fungi; important decomposers and parasites of algae/plankton)
Ciliophora	**Ciliates** (single-celled protists covered in cilia; e.g., *Paramecium*-like organisms)
Cnidaria	**Jellyfish, corals, hydroids, sea anemones**
Cryptomycota	**Cryptomycotan fungi / Rozellids** (early diverging fungi-like microorganisms, often parasites)
Cryptophyta	**Cryptophyte algae** (small, flagellated algae common in freshwater and marine systems)
Discosea	**Discosean amoebae** (flat, crawling amoeboid protists)
Endomyxa	**Endomyxan amoebae** (amoeba-like protists, often parasites or decomposers)
Evosea	**Evosean amoebae** (amoeba-like protists including slime mould relatives)
Gastrotricha	**Gastrotrichs** (tiny aquatic “hairy belly” animals)
Haptista	**Haptists** (large group containing haptophytes and related protists)
Heliozoa	**Sun protozoans / heliozoans** (amoeboid protists with radiating axopodia)
Microsporidia	**Microsporidian parasites** (fungal-related microscopic parasites of animals)
Mucoromycota	**Mucor fungi** (early diverging fungi; includes moulds and mycorrhizal fungi)
Myzozoa	**Myzozoans** (protists including dinoflagellates and related groups)
Nematoda	**Roundworms**
Perkinsozoa	**Perkinsid protists** (parasite-like microorganisms, often associated with algae)
Platyhelminthes	**Flatworms** (includes free-living worms and parasitic tapeworms/flukes)
Porifera	**Sponges**
Preaxostyla	**Preaxostylid protists** (mostly anaerobic microscopic flagellates)
Rotifera	**Rotifers** (microscopic aquatic animals, “wheel animals”)
Sanchytriomycota	**Sanchytriid fungi-like parasites** (parasites of algae and plants)
Streptophyta	**Charophyte algae and land plants** (includes green algae closely related to plants; sometimes includes terrestrial plants depending on classification)
Sulcozoa	**Sulcozoan protists** (flagellated amoeba-like microorganisms)
Tardigrada	**Water bears / moss piglets**
Telonemia	**Telonemids** (small planktonic protists)
Tubulinea	**Tubulinid amoebae** (amoeba-like protists, including *Amoeba* relatives)

Appendix 8 – Nematoda abundance from 18S rRNA gene

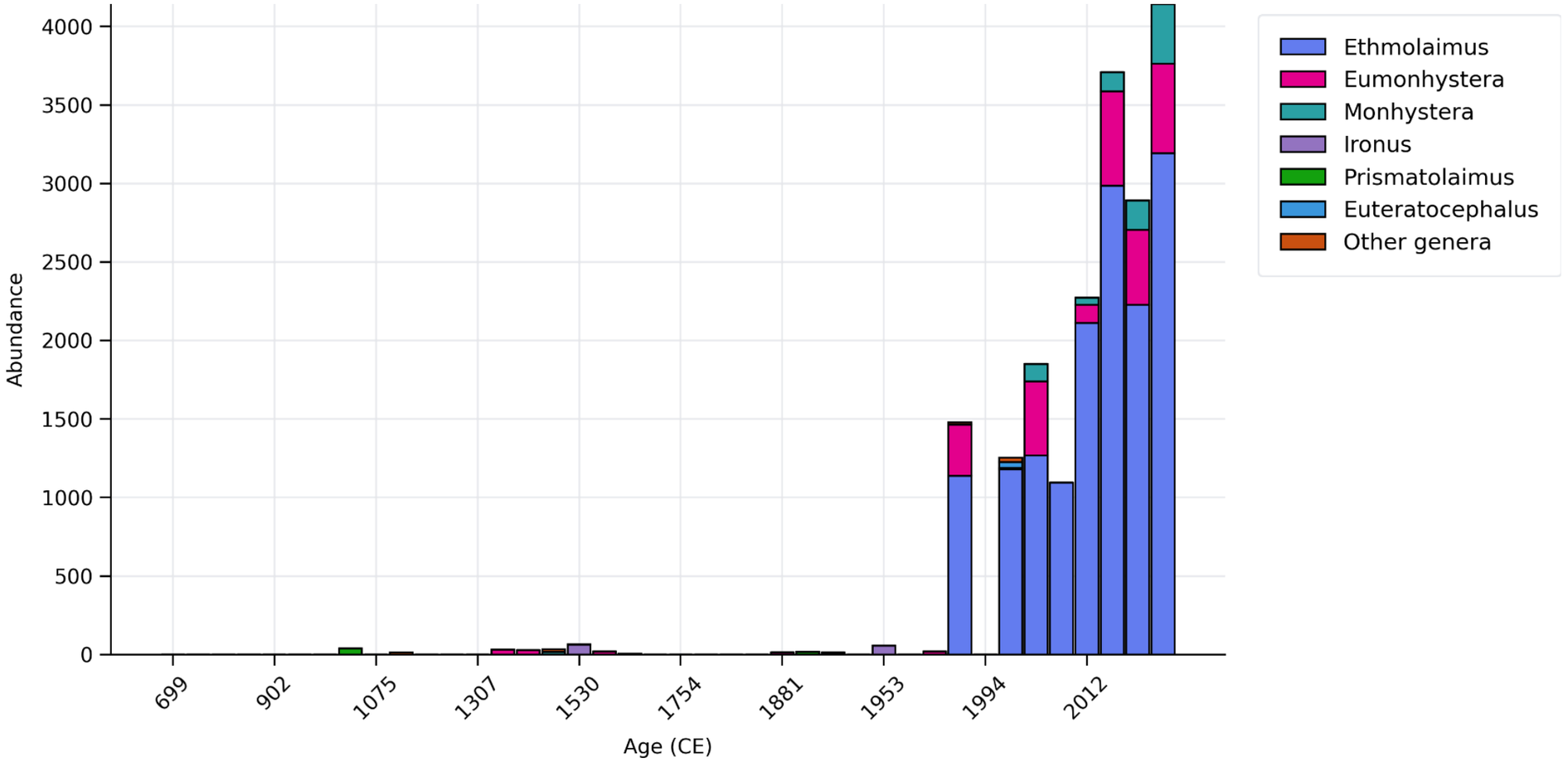


Figure A9. Temporal changes in the abundance (number of reads) of Nematoda detected using the 18S rRNA gene in sediment cores from Roys Bay, Lake Wānaka. Bars show read abundances. Only taxa that were assigned to a specific genera are display all remaining taxa are grouped as "Others". Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals).

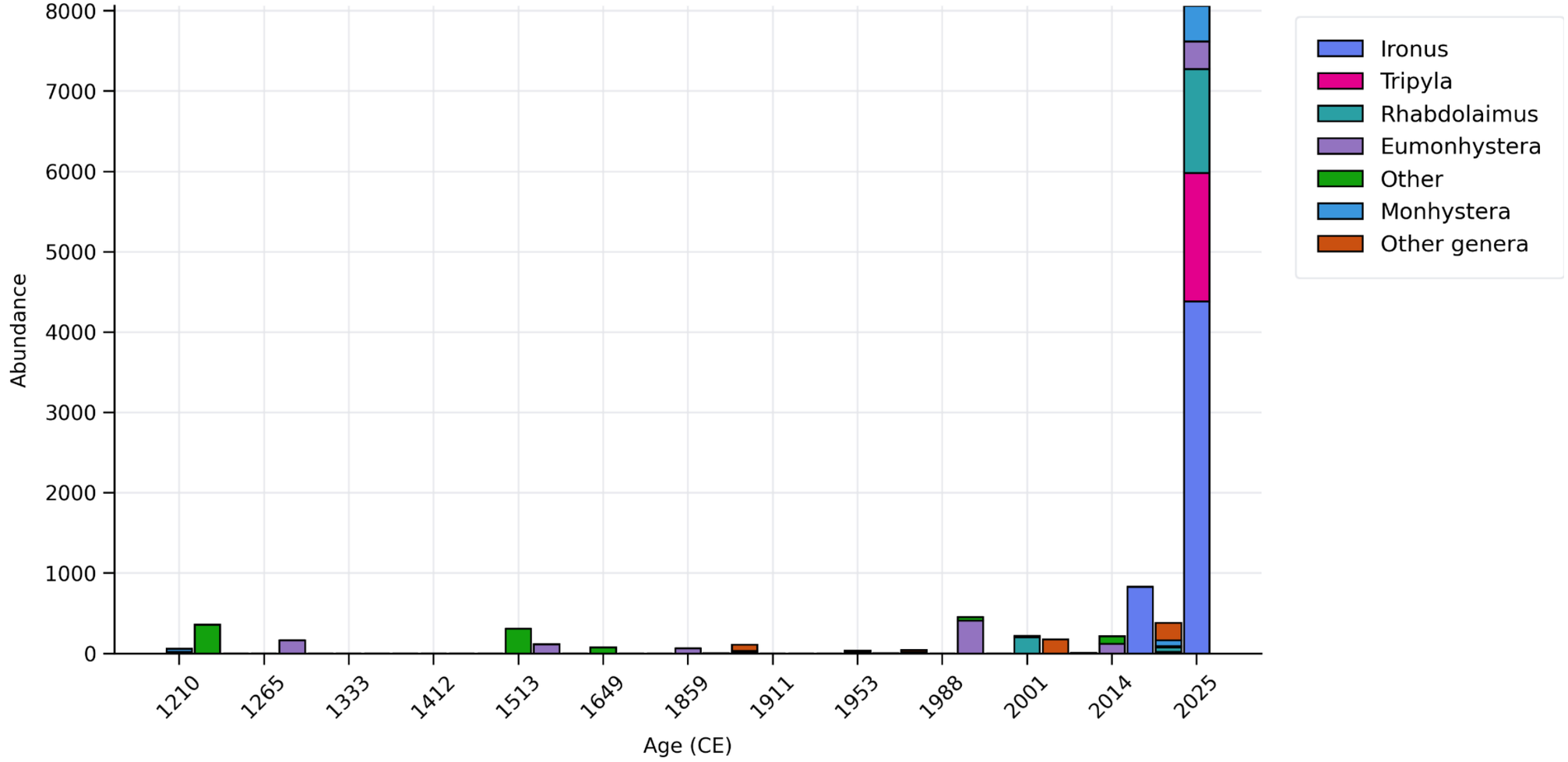


Figure A10. Temporal changes in the abundance (number of reads) of Nematoda detected using the 18S rRNA gene in sediment cores from Glendhu Bay, Lake Wānaka. Bars show read abundances. Only taxa that were assigned to a specific genera are display all remaining taxa are grouped as "Others". Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals).

Appendix 9 – Cercozoa abundance from 18S rRNA gene

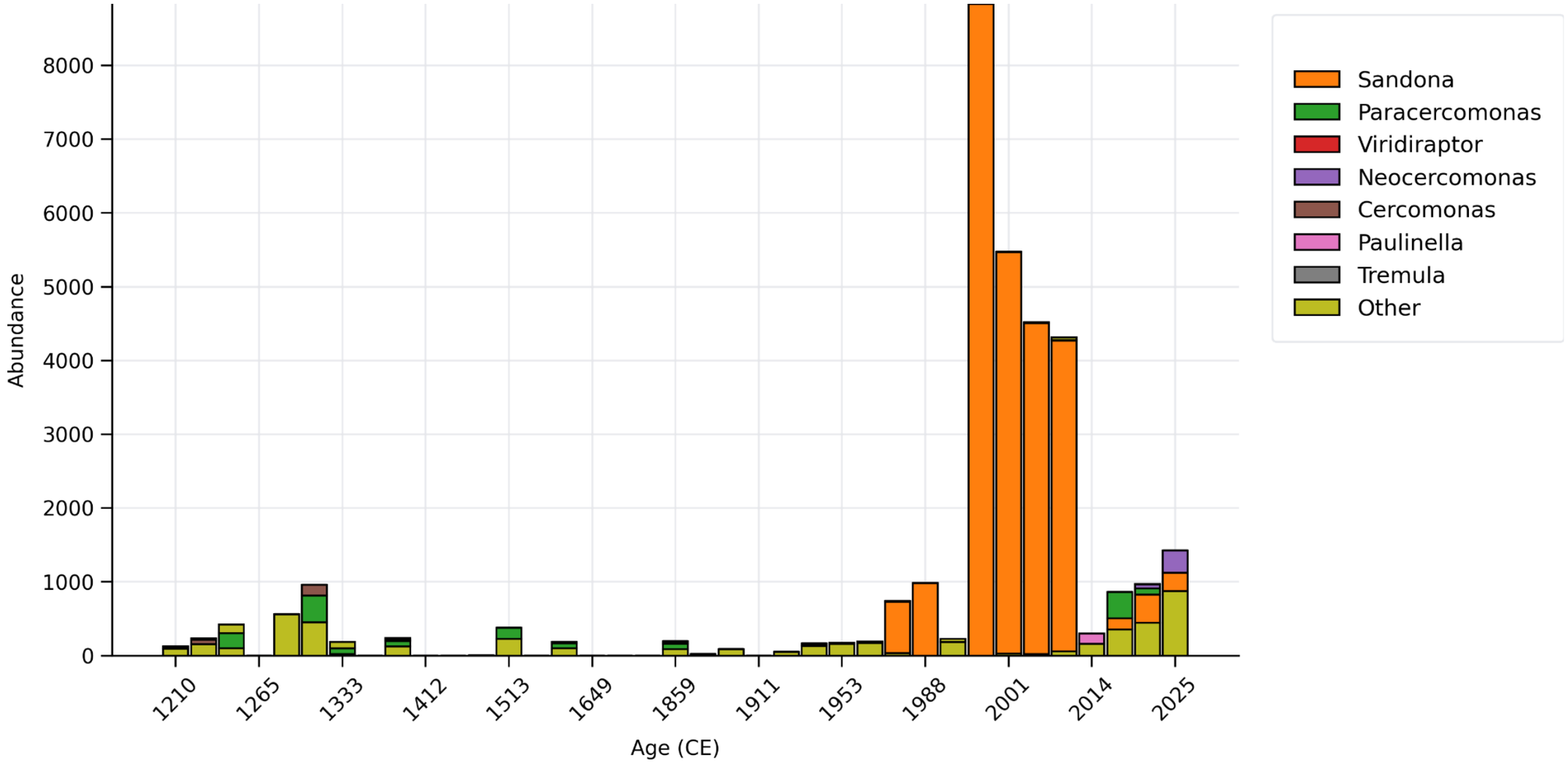


Figure A11. Temporal changes in the abundance (number of reads) of Cercozoa detected using the 18S rRNA gene in sediment cores from Glendhu Bay, Lake Wānaka. Bars show read abundances. Only taxa that were assigned to a specific genera are display all remaining taxa are grouped as "Others". Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% high-density probability function intervals).

Appendix 10 – Description of phyla detected using the CO1 gene

Taxon	Common name / description
Annelida	**Segmented worms** (earthworms, leeches, aquatic worms)
Apusozoa	**Apusomonads** (small flagellated protists related to animals and fungi)
Arthropoda	**Arthropods** (insects, crustaceans, spiders, mites, etc.)
Ascomycota	**Sac fungi** (includes yeasts, moulds, morels, and lichens)
Bacillariophyta	**Diatoms** (silica-walled microscopic algae common in aquatic environments)
Basidiomycota	**Club fungi** (includes mushrooms, puffballs, rusts, and smuts)
Bigyra	**Bigyran protists** (mostly aquatic microorganisms including decomposers and parasites)
Blastocladiomycota	**Blastocladiomycete fungi** (aquatic fungi, often decomposers or parasites)
Chlorophyta	**Green algae**
Choanozoa	**Choanozoans** (protists closely related to animals, including choanoflagellates)
Chytridiomycota	**Chytrid fungi** (mostly aquatic fungi; important decomposers and parasites)
Cnidaria	**Cnidarians** (jellyfish, hydra, corals, and sea anemones)
Cryptophyta	**Cryptomonads** (unicellular algae common in freshwater and marine plankton)
Discoba	**Discobid protists** (diverse single-celled organisms including euglenids)
Discosea	**Discosean amoebae** (amoeba-like protists that move using broad pseudopodia)
Eukaryota	**Eukaryotes** (organisms with complex cells containing a nucleus)
Gastrotricha	**Gastrotrichs** (microscopic aquatic animals found in sediments and biofilms)
Heterolobosea	**Heteroloboseans** (amoeboid and flagellated protists, including *Naegleria*)
Imbricatea	**Imbricate protists** (group containing many scale-bearing flagellates and amoebae)
Malawimonada	**Malawimonads** (rare, flagellated protists thought to represent an early-diverging eukaryote lineage)
Molluscs	**Molluscs** (snails, slugs, mussels, clams, and related animals)
Ochrophyta	**Ochrophytes** (brown algae and diverse microscopic algae including many chrysophytes)
Oomycota	**Water moulds** (fungus-like organisms; many are aquatic decomposers or pathogens)
Platyhel	**Flatworms** (free-living and parasitic worms)
Porifera	**Sponges** (simple filter-feeding aquatic animals)
Rhodophyta	**Red algae**
Streptophyta	**Charophyte algae and land plants** (green plants and their closest algal relatives)
Tardigrada	**Tardigrades** (microscopic "water bears" known for extreme environmental tolerance)

Appendix 11 – Arthropoda abundance from COI gene

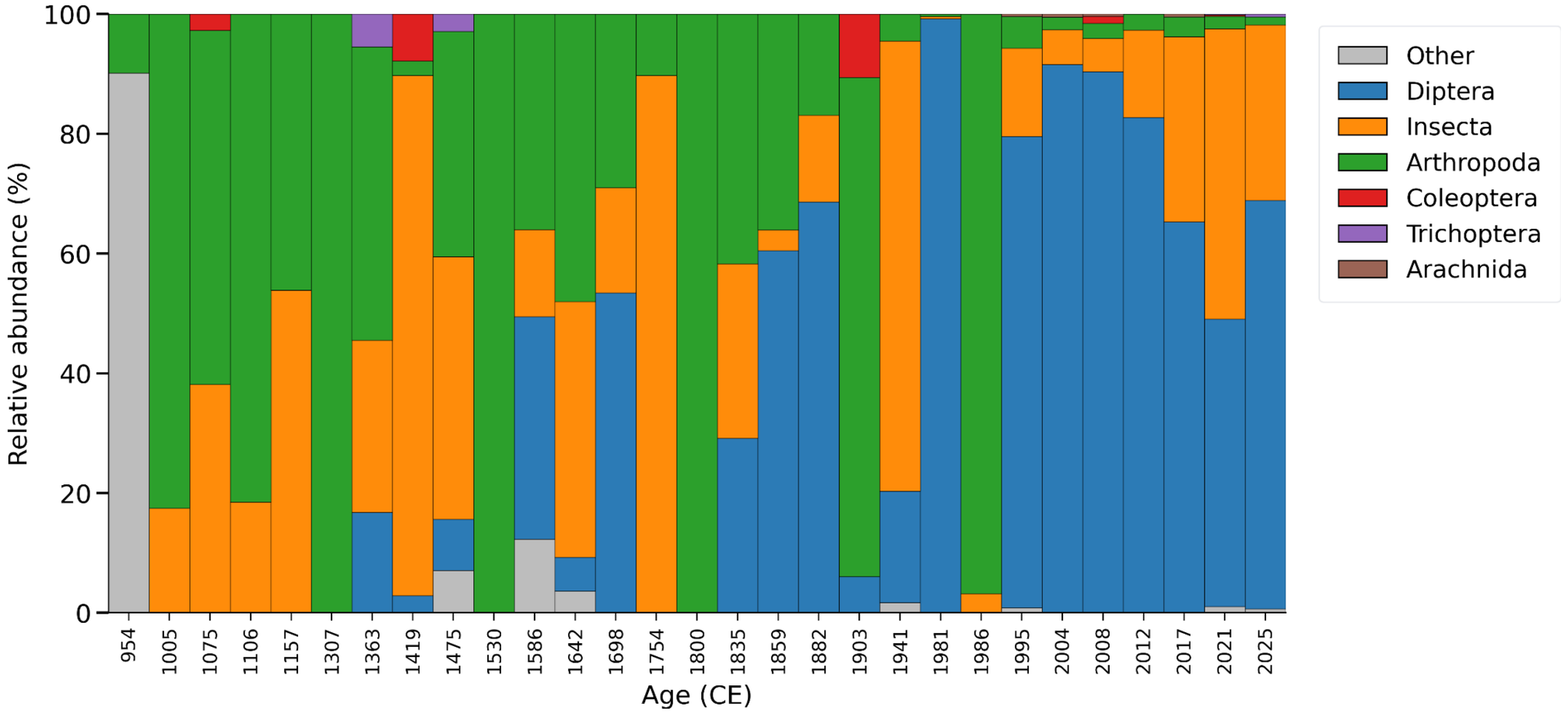


Figure A12. Temporal changes in the relative abundance (%) of arthropod taxa detected using the COI gene in sediment cores from Roys Bay, Lake Wānaka. Taxa are presented at the highest taxonomic resolution achieved for each sequence assignment, resulting in a mixture of taxonomic levels (e.g., phylum, class, and order). Only the seven most abundant taxa are displayed, with all remaining taxa grouped as "Other". Ages shown are median estimates derived from the age model. Age uncertainty is not displayed for clarity (see age-model results for 95% highest-density probability intervals).

9.6. Q1 2026/27 Public Transport Performance Report

Prepared for:	Council
Report No.	TRN2626
Activity:	Public Transport
Author:	Julian Phillips (Implementation Lead, Transport) Gemma Wilson (Senior Operations Analyst – Public Transport)
Endorsed by:	Anita Dawe (General Manager Regional Planning and Transport)
Date:	18 November 2026
Portfolio Leads:	Cr Hollyer and Cr Somerville, Transport

PURPOSE

[1] To update Council on the performance of Public Transport and Total Mobility services for Quarter 1 2026/27, being 1 July 2026 – 30 September 2026.

EXECUTIVE SUMMARY

[2] Dunedin bus patronage for Q1 2026/27 is 873,662 trips – a decrease of 5% from 2025/26.

[3] Dunedin fare revenue for the corresponding period is $1,229,299, an increase of 14%.

[4] Queenstown bus patronage for Q1 2026/27 is 547,079 trips – an increase of 4% from 2025/26.

[5] Queenstown fare revenue for the corresponding period is $1,081,818, an increase of 31%.

[6] Queenstown ferry patronage for Q1 2026/27 is 25,992 trips – an increase of 54% from 2025/26.

[7] Queenstown ferry fare revenue for the corresponding period is $257,106, an increase of 48%.

[8] Across the whole network, 98% of scheduled services were operated (116,513 trips).

[9] 88% of trips departed their start terminus on time, an increase of 2% from 2025/26, and 72% of trips arrived on time, a decrease of 1%.

[10] Total Mobility patronage for Q1 2026/27 is 37,974 trips – down 2.9% from 2025/26.

RECOMMENDATION

That the Council:

1) ***Notes*** *this summary of public transport activity in Otago for Q1 2026/27.*

DISCUSSION – DUNEDIN

[11] This report sets out data for quarter 1 2026/27 in relation to public transport for Bus, Ferry and Total Mobility.

[12] The quarterly patronage, revenue, and fare breakdown for Dunedin is set out in Figure 1 below. Overall, patronage has decreased slightly compared with the previous year, noting that all years since 2022 have set record patronage levels.

[13] The reported decline should be considered in the context of the significant fleet transition undertaken in September, when ticketing equipment was transferred from buses in service to new electric vehicles. During this transition, some passenger trips and fare transactions were not recorded by the ticketing system. This under-recording is likely to account for part of the reported decline in patronage.

[14] Additionally, patronage was likely affected towards the end of the quarter by temporary timetable reductions across a number of services between 11 and 30 September, resulting from operational challenges experienced by the outgoing operator during the transition to new contracts.

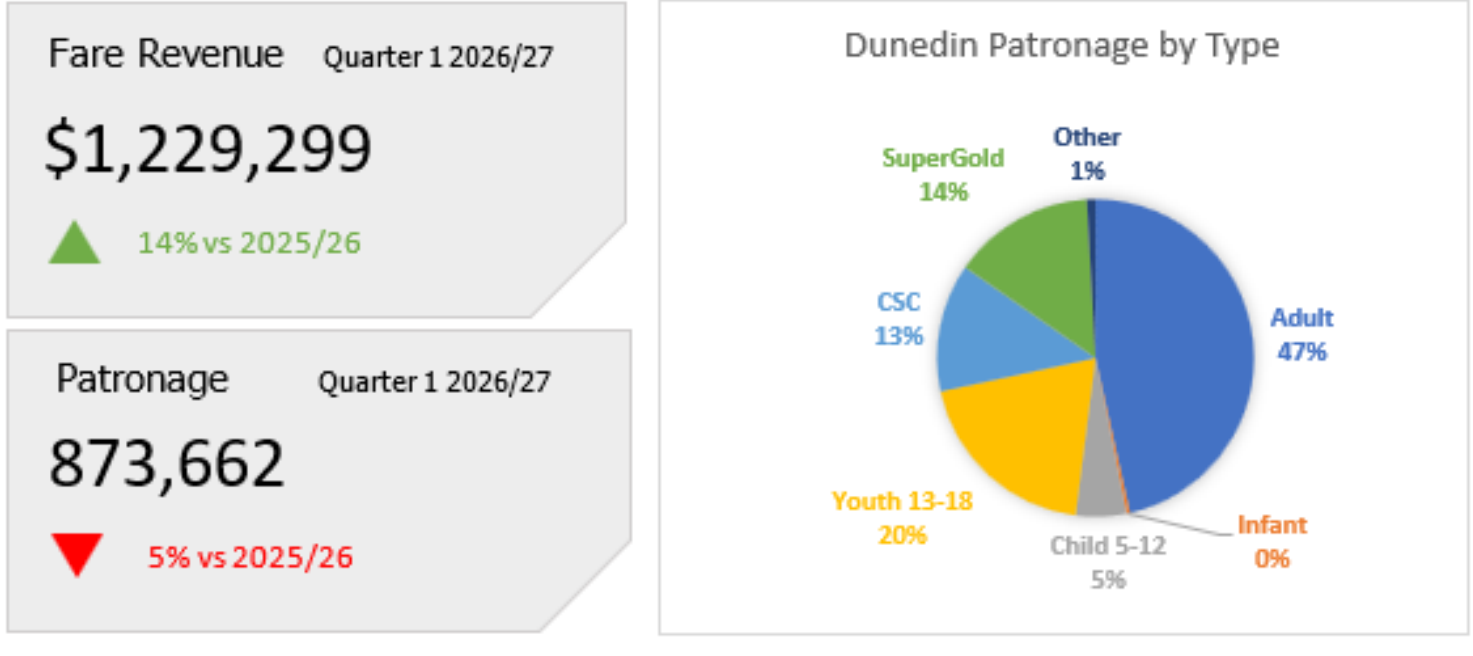


Figure 1: Dunedin Q1 2026/27 Patronage and Revenue

[15] Whilst patronage has decreased, revenue has increased substantively compared to the previous period. This reflects the increase in fares introduced on 30 September 2025 which is the first annual increase in fares for some time. The fare changes were an increase in the adult Bee Card fare from $2 to $2.50, and the reintroduction of child Bee Card fares, at $1.50, as set out in Figure 2 below.

Concession	Prior to 30 September 2025	30 September onwards
Child (5-12)	Free	$1.50
Youth (13-18)	$1.20	$1.50
Adult	$2.00	$2.50
SuperGold (Peak)	$2.00	$2.50
Community Services	$1.00	$1.25

Figure 2: Changes to Bus Fares introduced in September 2025

[16] Monthly and annual patronage from 2017/18 to date is set out in Figure 3.

[17] Despite the decline to date, patronage remains at high levels following several consecutive years of record growth.

Dunedin	July	August	September	October	November	December	January	February	March	April	May	June	Totals
2017/18	176,400	209,028	200,936	191,510	200,606	162,802	164,256	191,055	233,396	178,507	237,131	206,217	2,351,844
2018/19	195,272	235,930	221,438	212,965	223,894	177,520	172,142	213,992	246,593	198,745	245,477	204,362	2,548,330
2019/20	220,652	235,666	230,329	224,285	226,692	182,910	181,525	228,477	175,526	26,802	68,709	197,681	2,199,254
2020/21	293,294	278,162	209,278	224,799	223,263	190,821	160,848	201,611	250,266	195,795	243,550	234,783	2,706,470
2021/22	231,082	144,505	170,397	196,538	223,952	185,219	156,857	190,746	213,639	185,831	246,438	221,895	2,367,099
2022/23	194,544	242,825	229,954	213,011	237,385	189,812	181,899	244,977	291,825	208,030	294,188	268,850	2,797,300
2023/24	256,596	310,050	285,998	293,805	294,909	229,261	224,020	297,223	314,954	286,690	337,078	266,661	3,397,245
2024/25	291,655	323,847	304,480	290,240	296,306	231,031	230,317	305,828	338,983	277,643	333,326	268,904	3,492,560
2025/26	307,820	316,577	297,074	302,647	278,023	226,668	213,151	289,456	352,274	283,776	331,676	303,616	3,502,758
2026/27	**284,991**	**297,133**	**291,538**										**873,662**

Figure 3: Dunedin patronage, 2018/19 to 2026/27

[18] Quarterly patronage is shown in Figure 4 below and Figure 5 presents patronage by concession type.

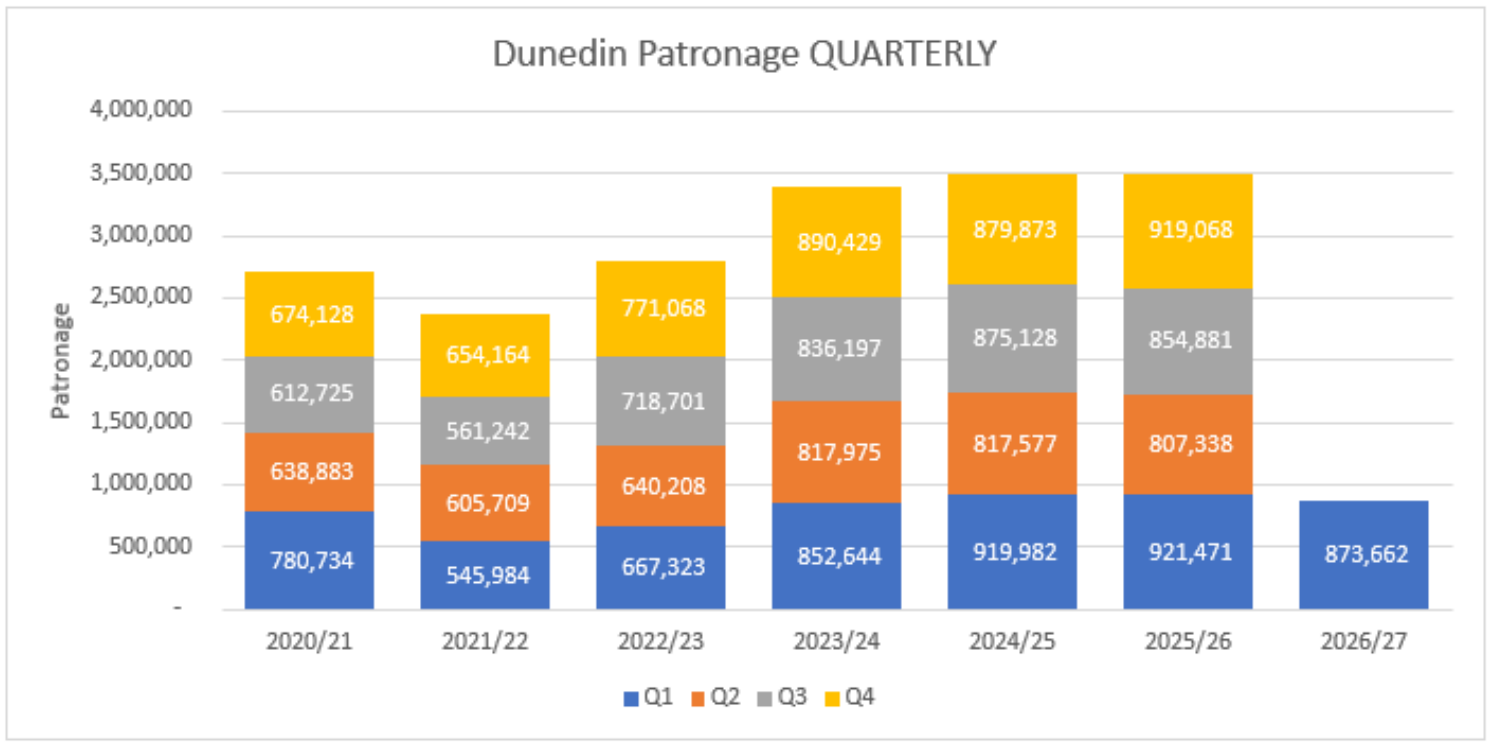


Figure 4: Quarterly Dunedin patronage performance

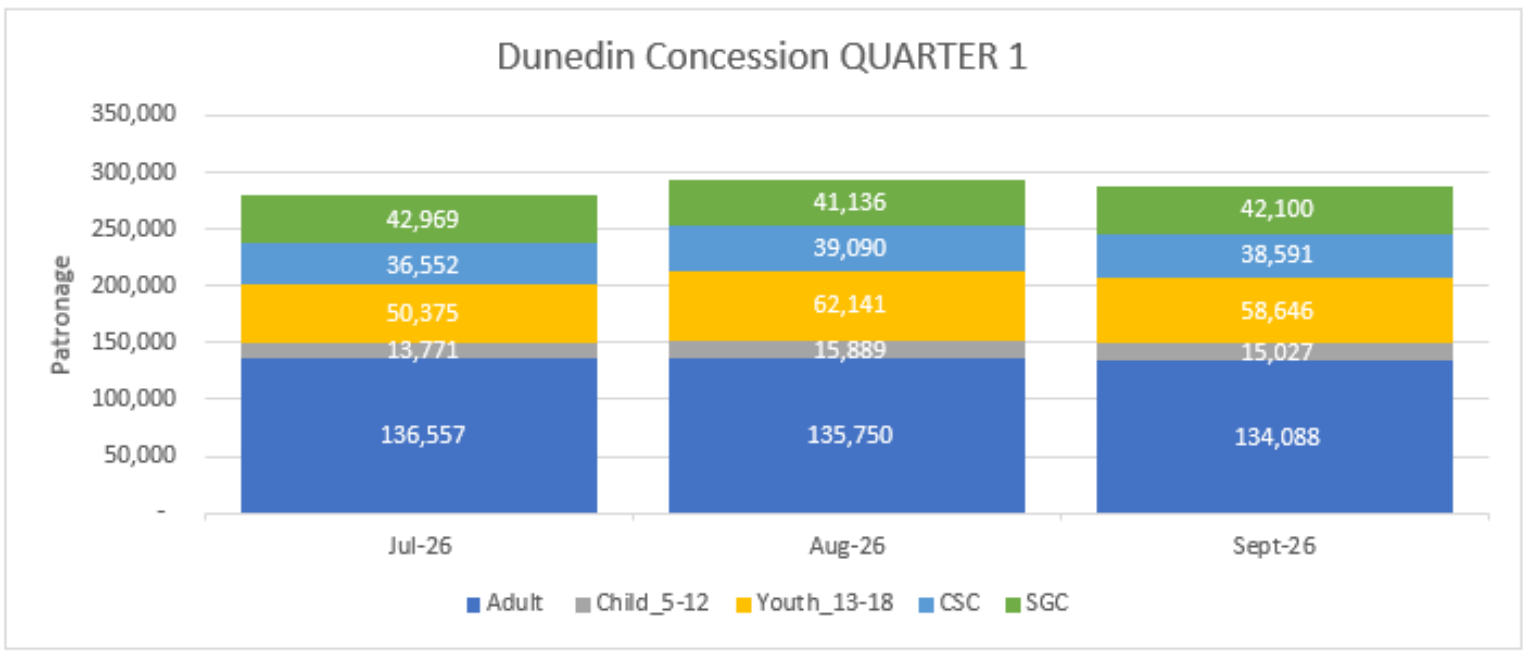


Figure 5: Patronage by concession type

[19] Figure 6 shows the Peak vs Off-Peak patronage, noting an almost equal number of trips across both time periods, with Peak travel accounting for an additional 0.4% of patronage.

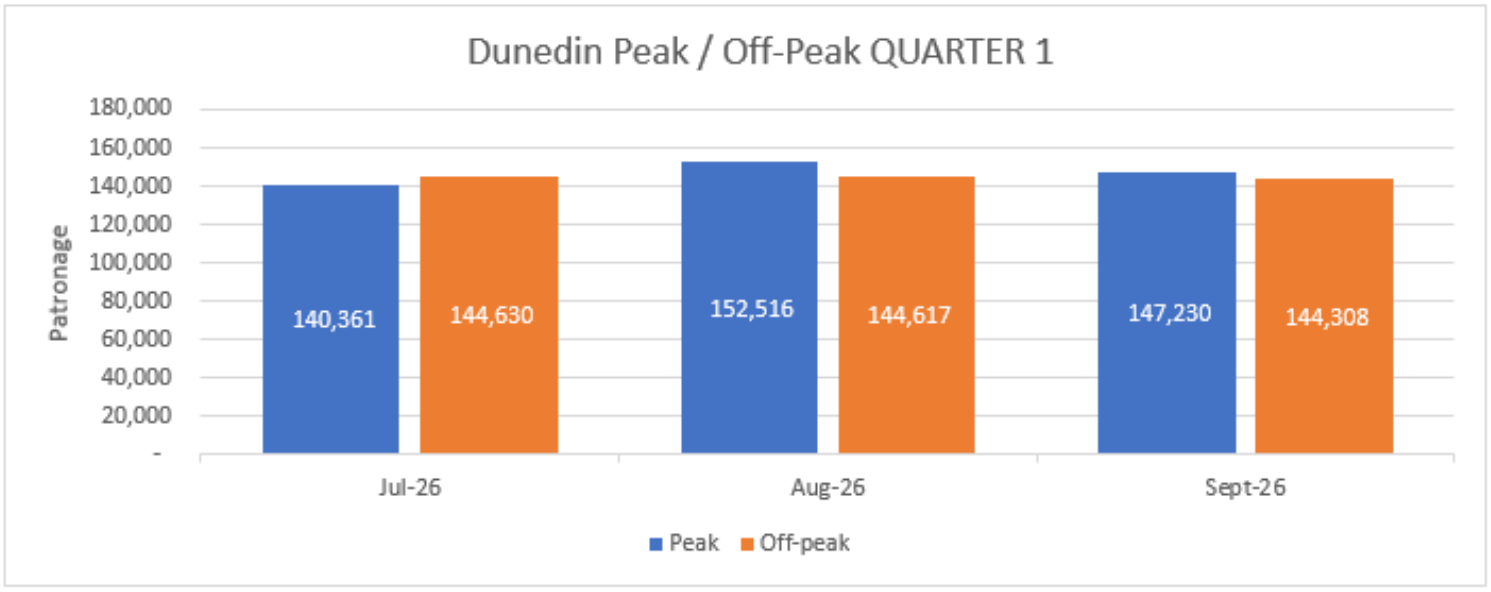


Figure 6: Peak vs Off-Peak patronage split

CHILD & YOUTH PATRONAGE

[20] Figures 7- 14 have been included to respond to the request from Council at the last Public Transport performance report. These are not intended to be included on an ongoing basis, unless specifically directed.

[21] Figure 7 details child concession patronage, being age 5 to 12 years, following the move increase in fares in September 2025, noting a 45% decline for Q1 2026/27 patronage compared to the previous period.

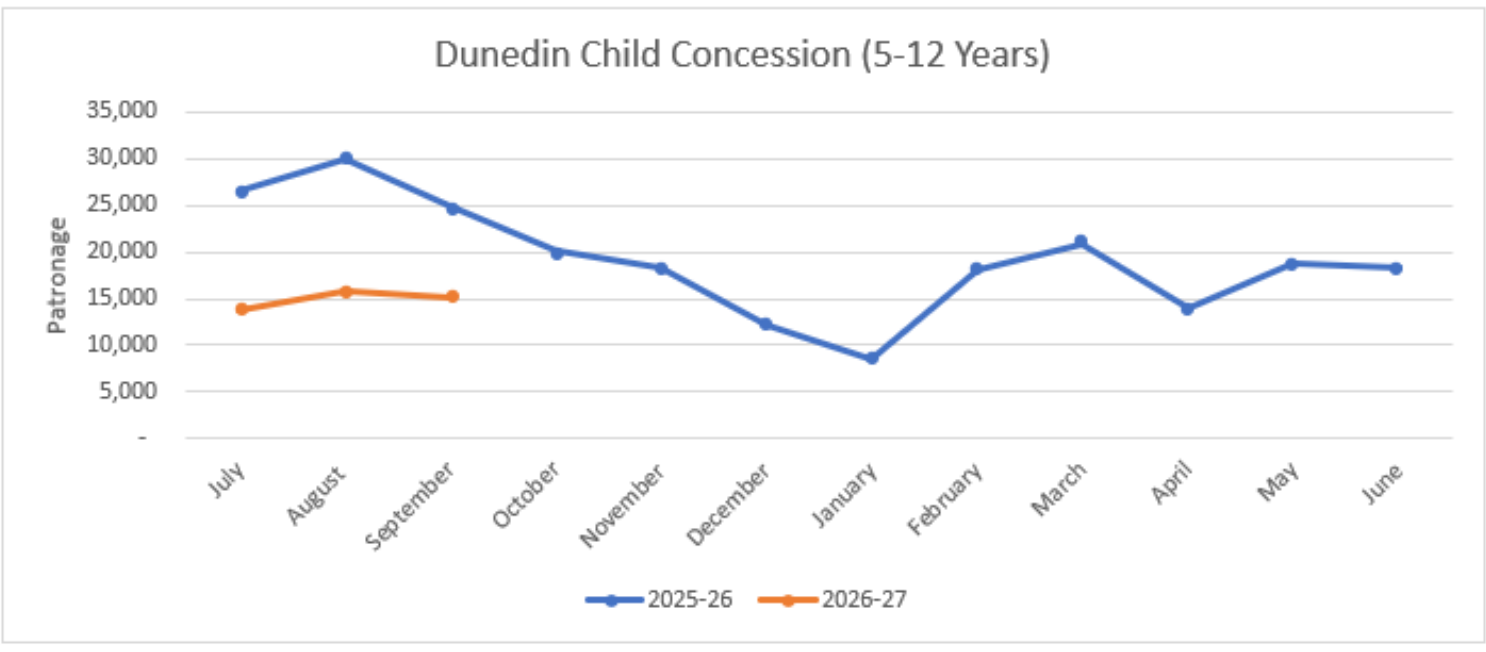


Figure 7: Child concession patronage

[22] Figure 8 shows the spread of child patronage across the day, generally concentrated around school travel times, with strong peaks at 7-8am and 3pm. The busiest hour is 3pm, reflecting students travelling home from school.

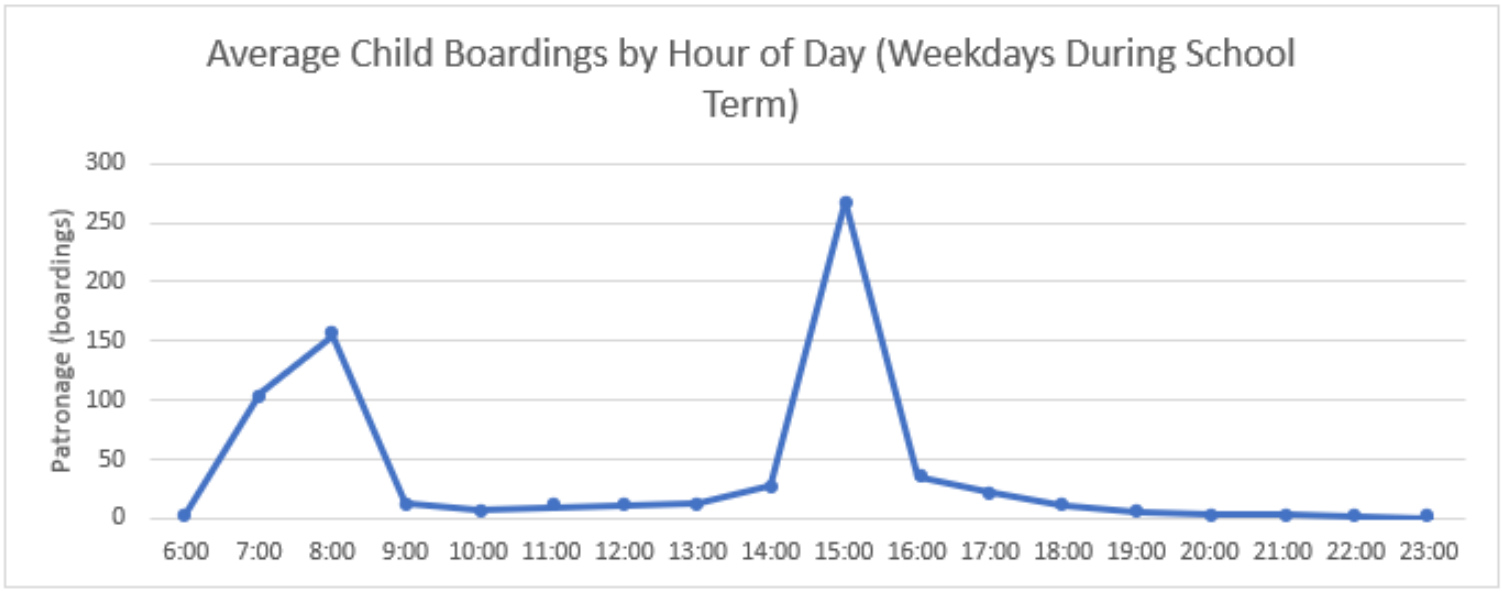


Figure 8: Child concession patronage, time of day

[23] Figure 9 shows child patronage by day of the week, noting significantly lower patronage at weekends.

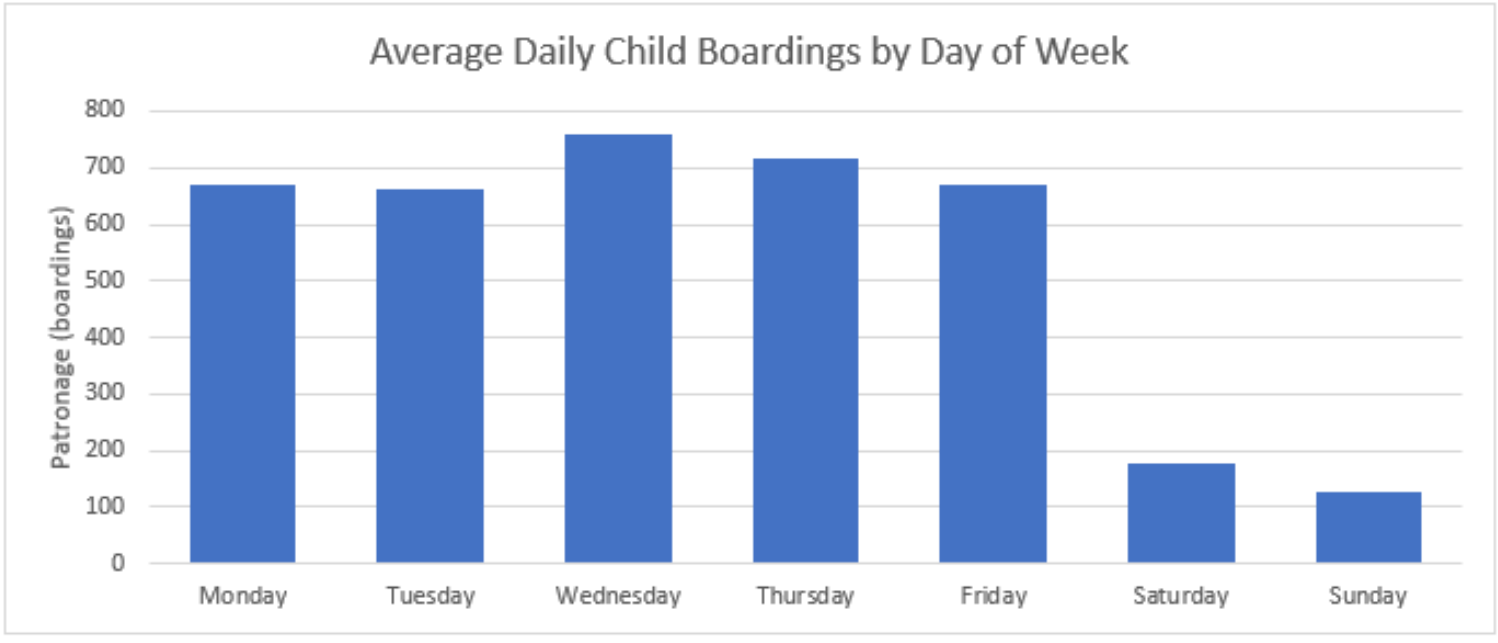


Figure 9: Child concession patronage, day of travel

[24] Figure 10 splits the patronage between school term and school holidays. 69% of all child boardings occur during school term.

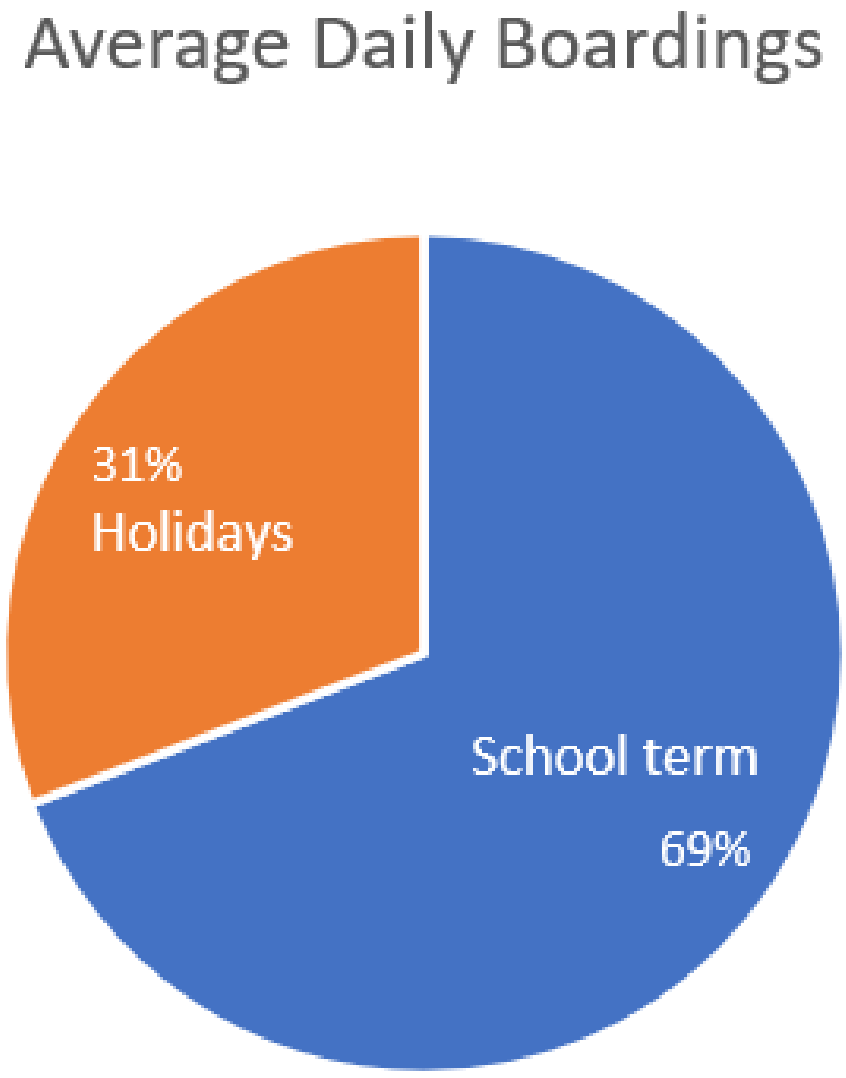


Figure 10: Child concession patronage, school term vs holidays

[25] Figure 11 details youth concession patronage, being age 13 to 18 years, noting a 1% increase in patronage for Q1 2026/27 patronage compared to the previous period.

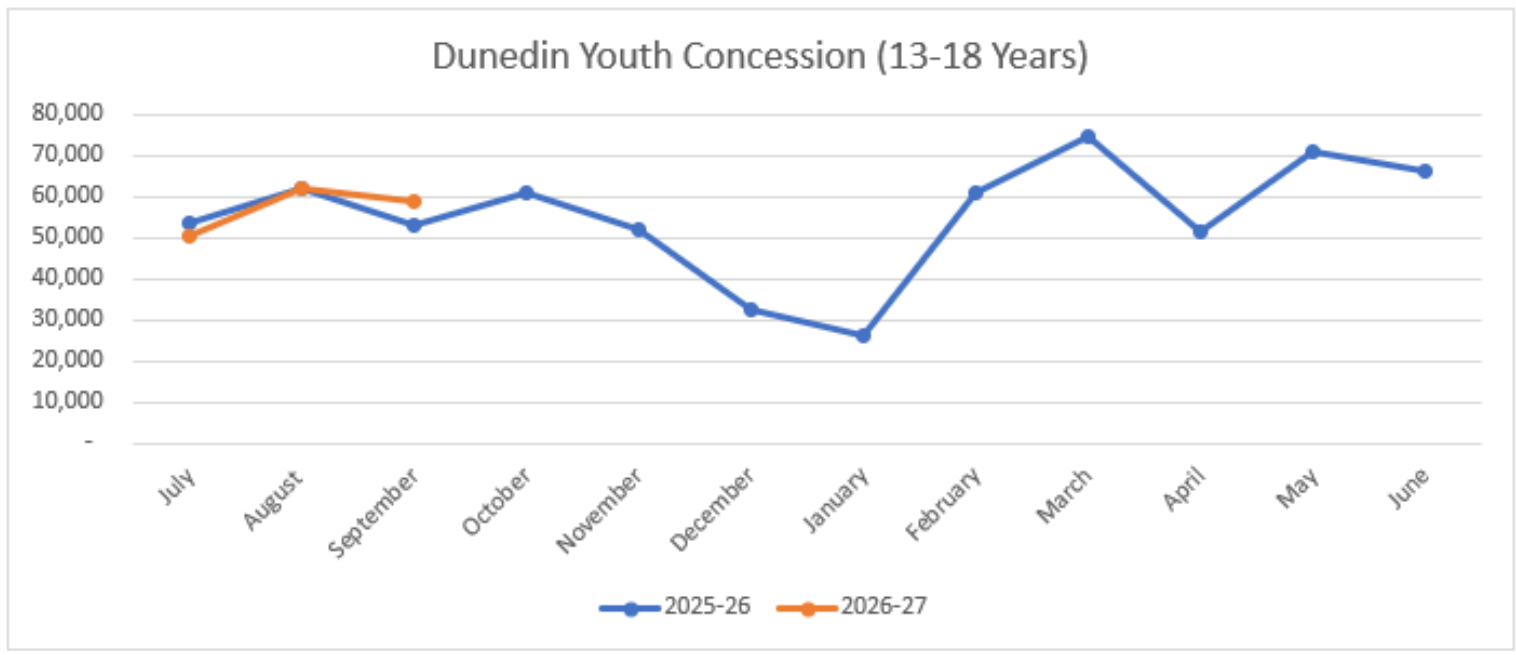


Figure 11: Youth concession patronage

[26] Figure 12 shows the spread of youth patronage across the day, peaking at 8:00am and 3:00pm, reflecting travel to and from school. Demand remains relatively strong through the late afternoon.

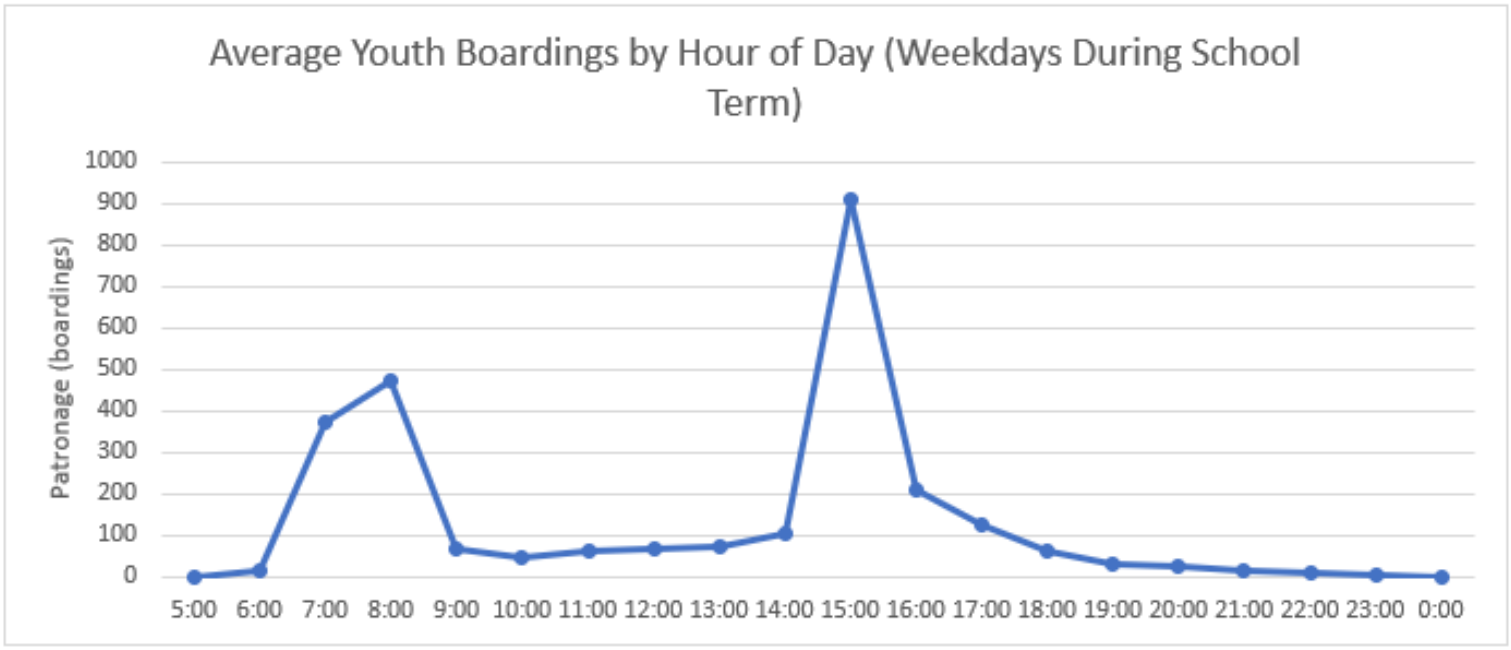


Figure 12: Youth concession patronage, time of day

[27] Figure 13 shows youth patronage by day of the week, noting significantly lower patronage at weekends.

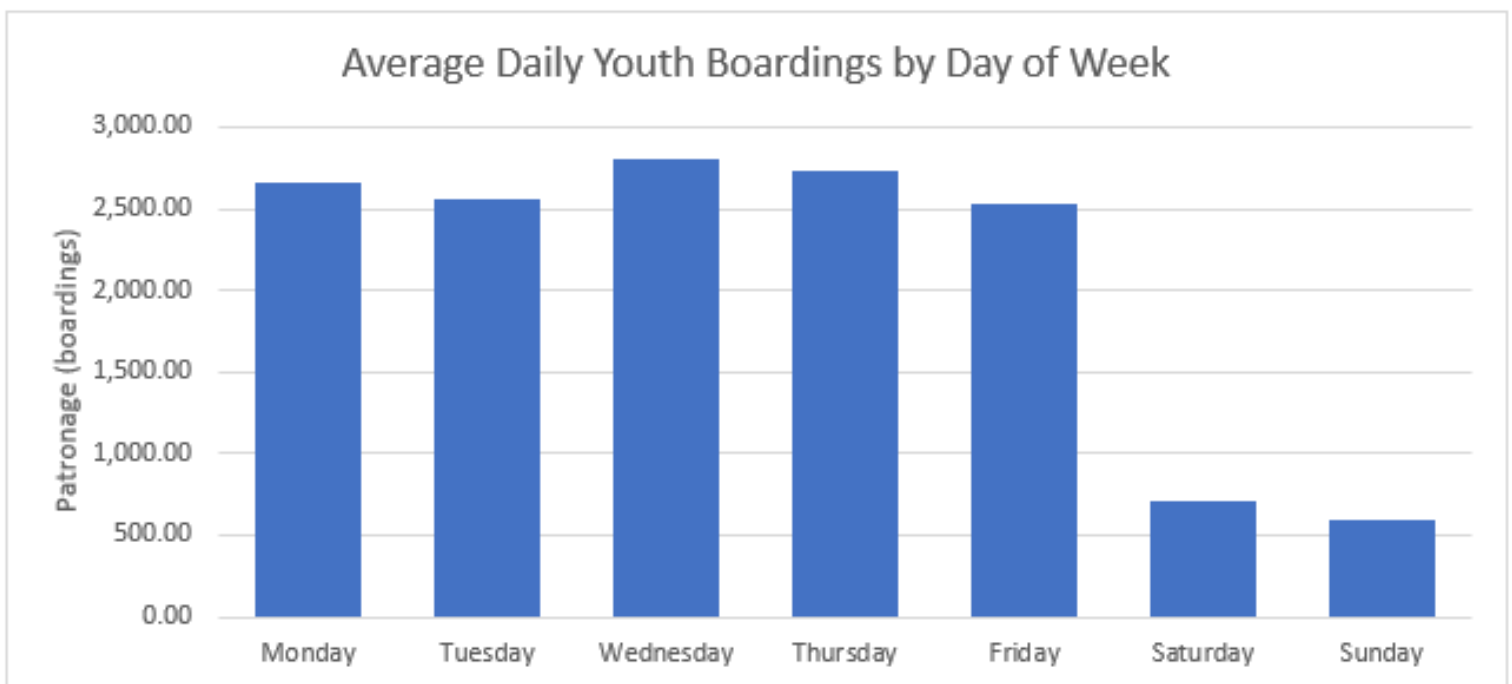


Figure 13: Youth concession patronage, day of travel

[28] Figure 14 splits the patronage between school term weekdays and school holidays. 73% of all youth boardings occur during school term.

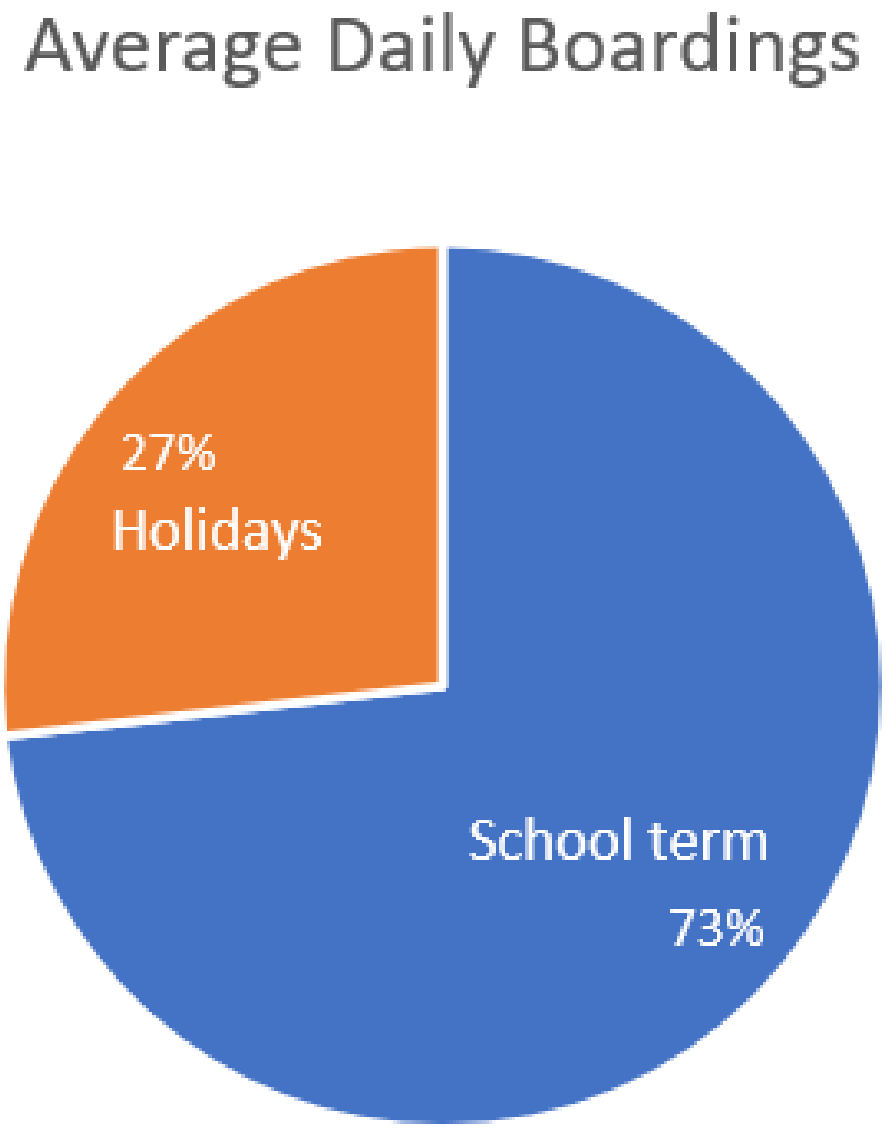


Figure 14: Youth concession patronage, school term vs holidays

[29] In summary, school travel is the primary driver for both child and youth patronage. However, youth passengers continue to use public transport more frequently during school holidays than children, suggesting a broader range of travel purposes beyond education.

DISCUSSION – QUEENSTOWN

[30] The monthly and annual patronage, revenue, and fare breakdown for Queenstown is set out in Figure 15 below. The data shows continued year-on-year growth in patronage, with Q1 2026/27 exceeding the previous period's record growth.

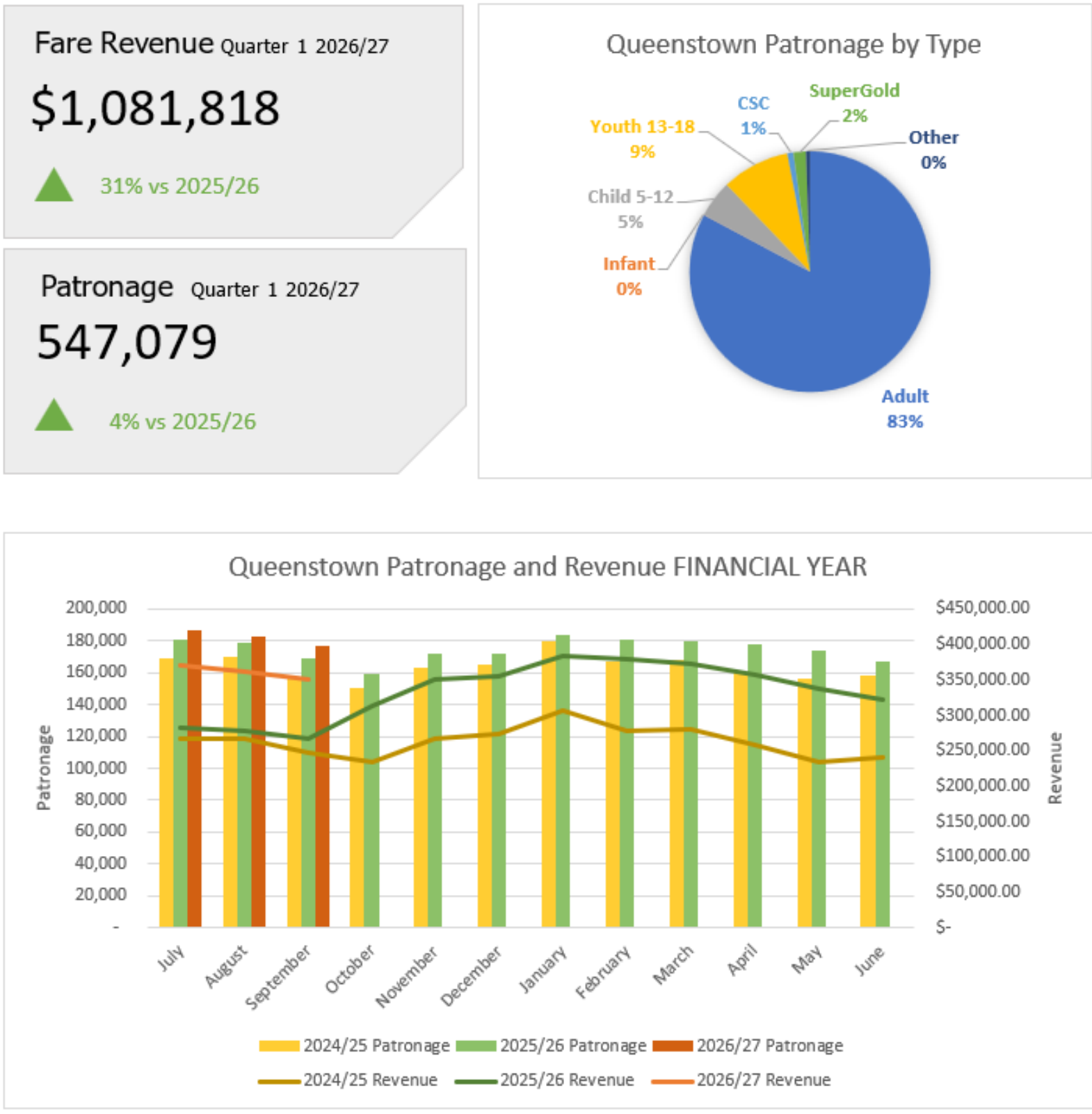


Figure 15: Queenstown Q1 2026/27 Patronage and Revenue

[31] Revenue has lifted significantly compared to the previous period. This reflects the increase in fares introduced on 30th September 2025.

[32] Monthly and annual patronage from 2017/18 to date is set out in Figure 16. Patronage remains at high levels following several consecutive years of record growth.

Queenstown	July	August	September	October	November	December	January	February	March	April	May	June	Totals
2017/18	46,027	40,182	35,157	36,761	37,383	85,454	100,063	98,774	107,971	101,274	98,658	108,268	895,972
2018/19	122,752	117,442	103,974	111,657	125,600	118,997	136,055	129,439	134,084	125,244	118,077	124,736	1,468,057
2019/20	136,766	129,011	121,416	120,662	128,440	128,282	136,985	131,102	90,746	9,919	42,577	73,597	1,249,503
2020/21	100,951	98,102	72,143	73,385	71,464	69,096	68,550	60,717	62,613	65,928	66,863	79,251	889,063
2021/22	95,278	51,010	51,987	66,690	64,895	66,507	69,147	52,471	53,524	68,158	73,786	93,367	806,820
2022/23	100,966	100,668	88,268	91,277	100,579	91,940	89,306	102,118	116,667	118,955	117,645	134,593	1,252,982
2023/24	145,759	155,936	152,621	148,964	163,182	161,886	173,398	170,018	168,881	154,766	148,606	153,183	1,897,200
2024/25	168,957	169,976	157,061	150,977	163,273	165,252	179,781	167,539	168,371	160,052	156,102	158,745	1,966,086
2025/26	180,526	178,780	168,841	159,164	171,621	172,005	184,222	180,531	180,242	177,928	173,853	167,059	2,094,772
2026/27	**186,798**	**183,129**	**177,152**										**547,079**

Figure 16: Queenstown patronage, 2018/19 to 2026/27

[33] Quarterly patronage is shown in Figure 17 below.

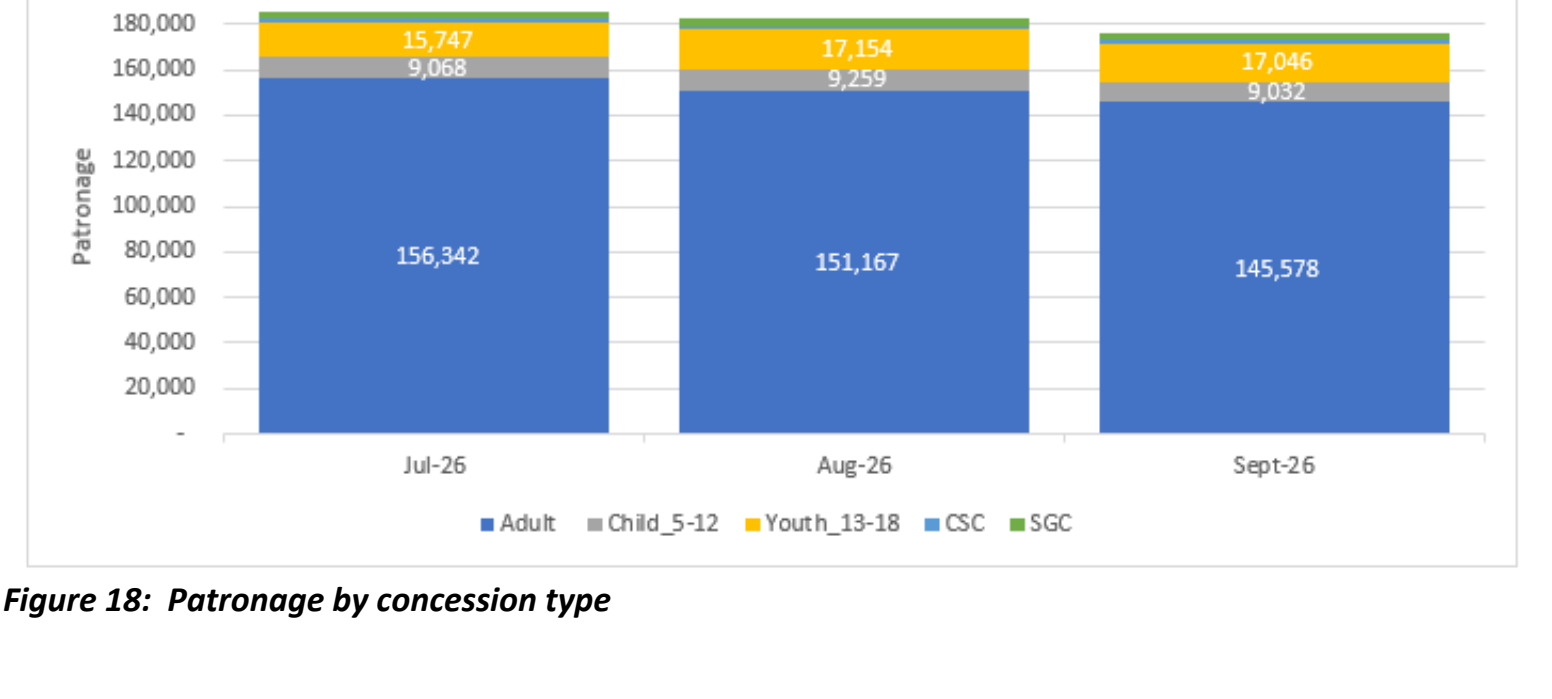


Figure 17: Quarterly Queenstown patronage performance

[34] Figure 18 presents patronage by concession type.



Figure 18: Patronage by concession type

[35] Figure 19 shows the Peak vs Off-Peak patronage, noting a significant contrast Dunedin with 38% of trips taken at peak times and 62% off-peak.

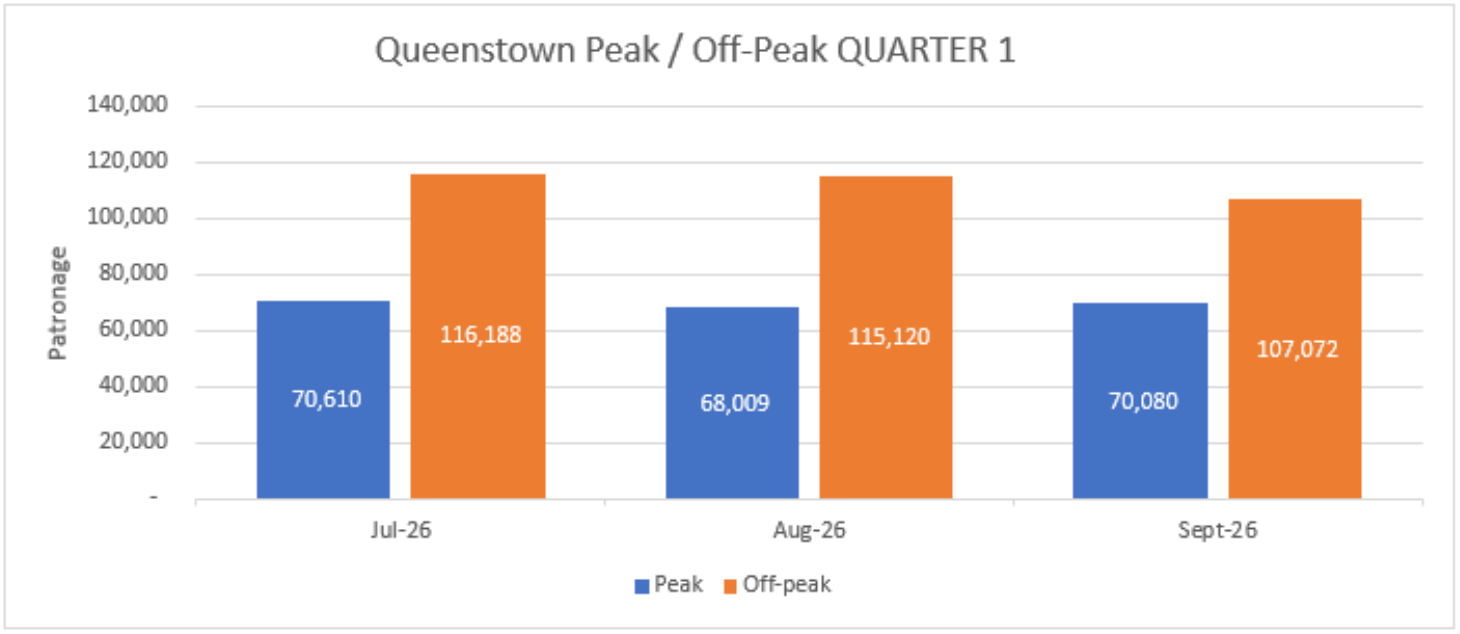


Figure 19: Peak vs Off-Peak patronage split

CHILD & YOUTH PATRONAGE

[36] Figures 20-27 have been included to respond to the request from Council at the last Public Transport performance report. These are not intended to be included on an ongoing basis, unless specifically directed.

[37] Figure 20 details child concession patronage, being age 5 to 12 years, following the move increase in fares in September 2025, noting a 36% decline for Q1 2026/27 patronage compared to the previous period.

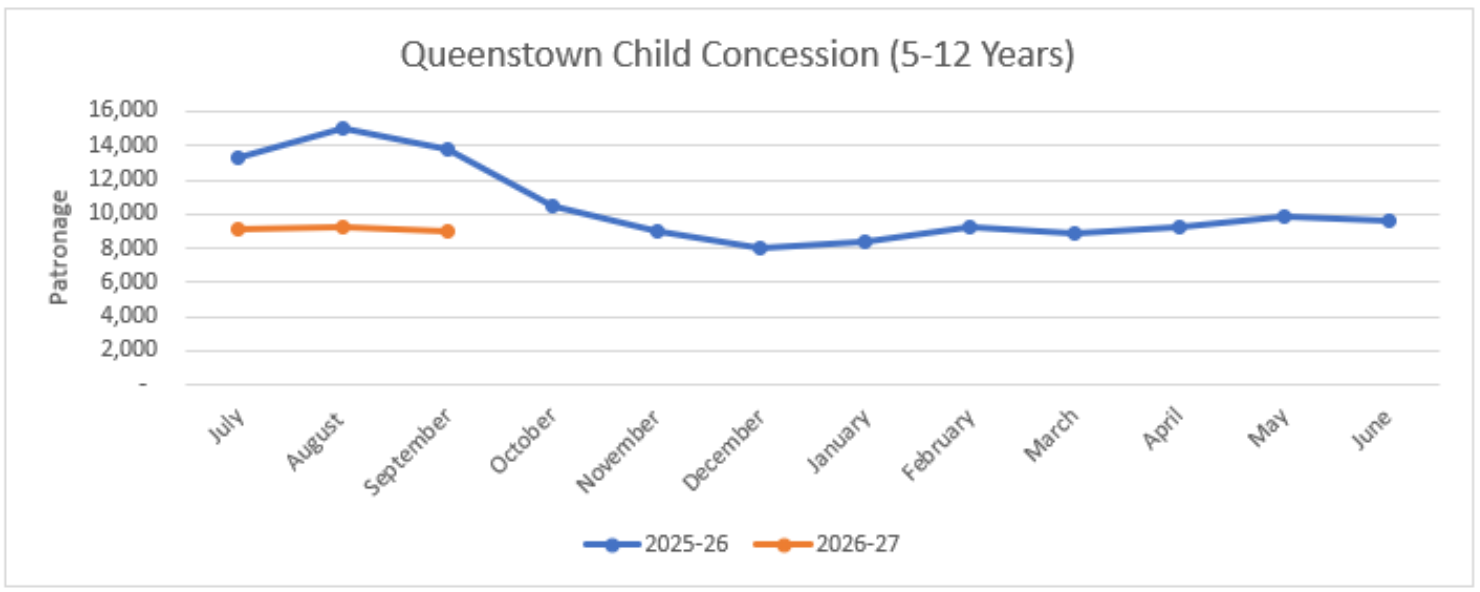


Figure 20: Child concession patronage

[38] Figure 21 shows the spread of child patronage across the day, peaking at 8:00am and 3:00pm, reflecting travel to and from school. Demand remains relatively low outside school travel periods.

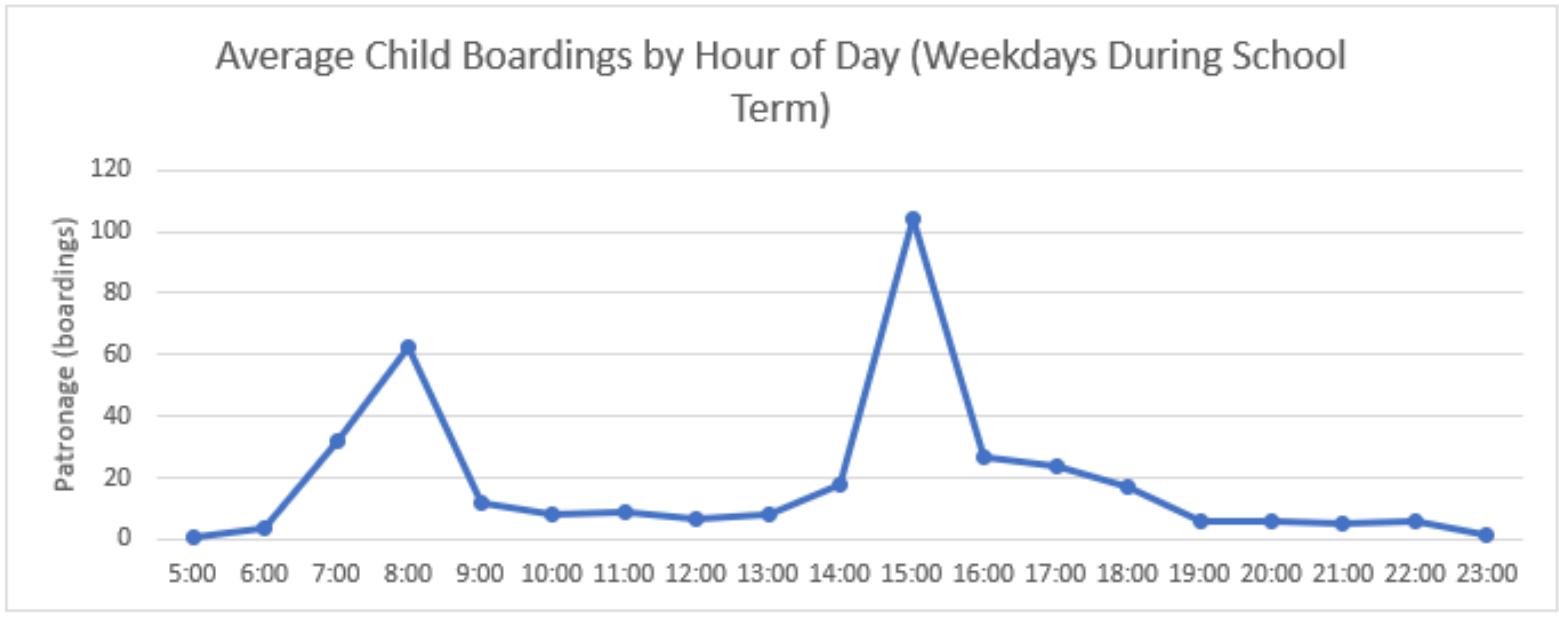


Figure 21: Child concession patronage, time of day

[39] Figure 22 shows child patronage by day of the week, noting lower patronage at weekends, although at a significantly higher proportion of trips than Dunedin.

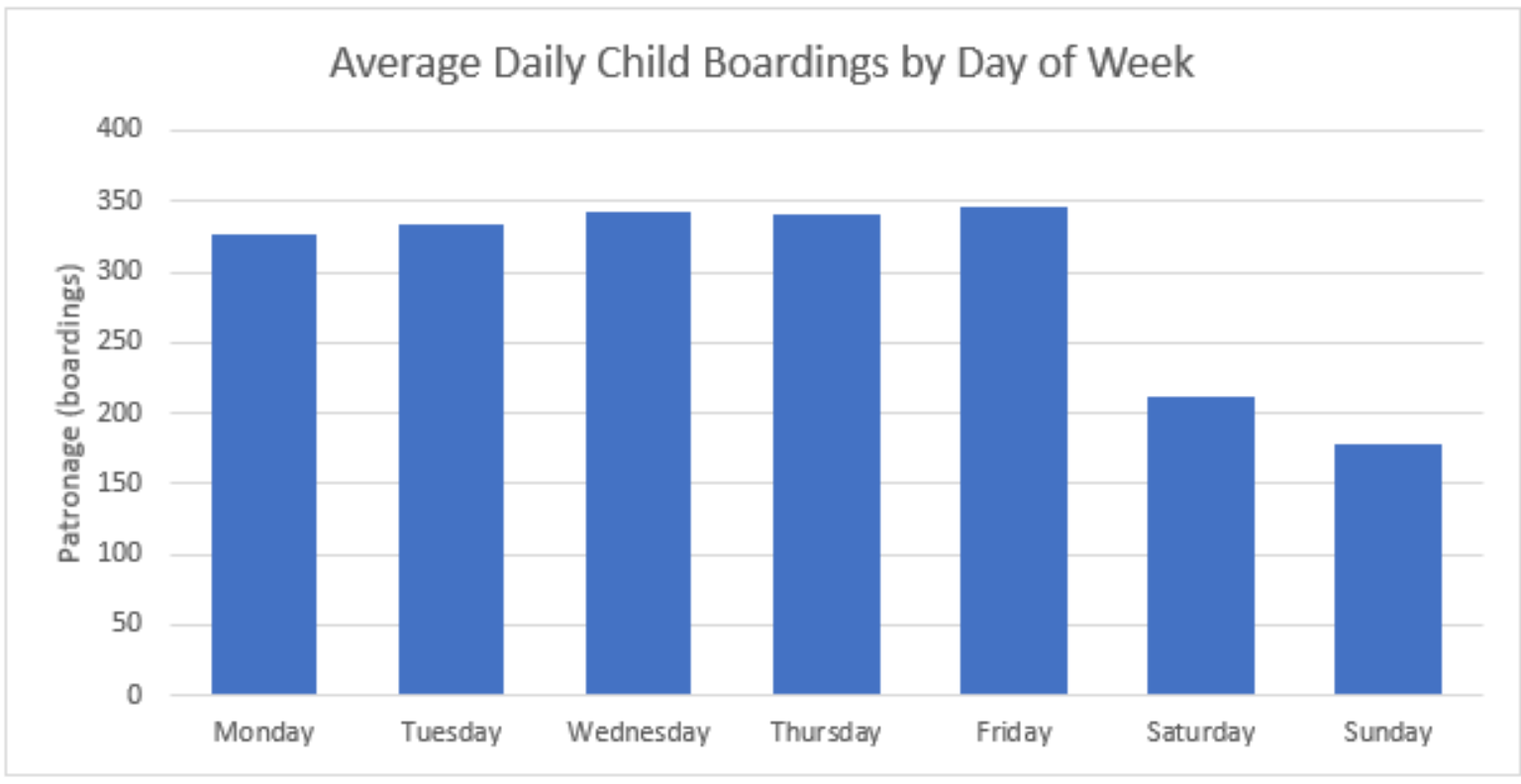


Figure 22: Child concession patronage, day of travel

[40] Figure 23 splits the patronage between school term and school holidays. 59% of all child boardings occur during school term. Whilst child patronage is higher during school term than school holidays, the difference is less pronounced than in Dunedin, demonstrating a greater proportion of non-school travel in the Queenstown network.

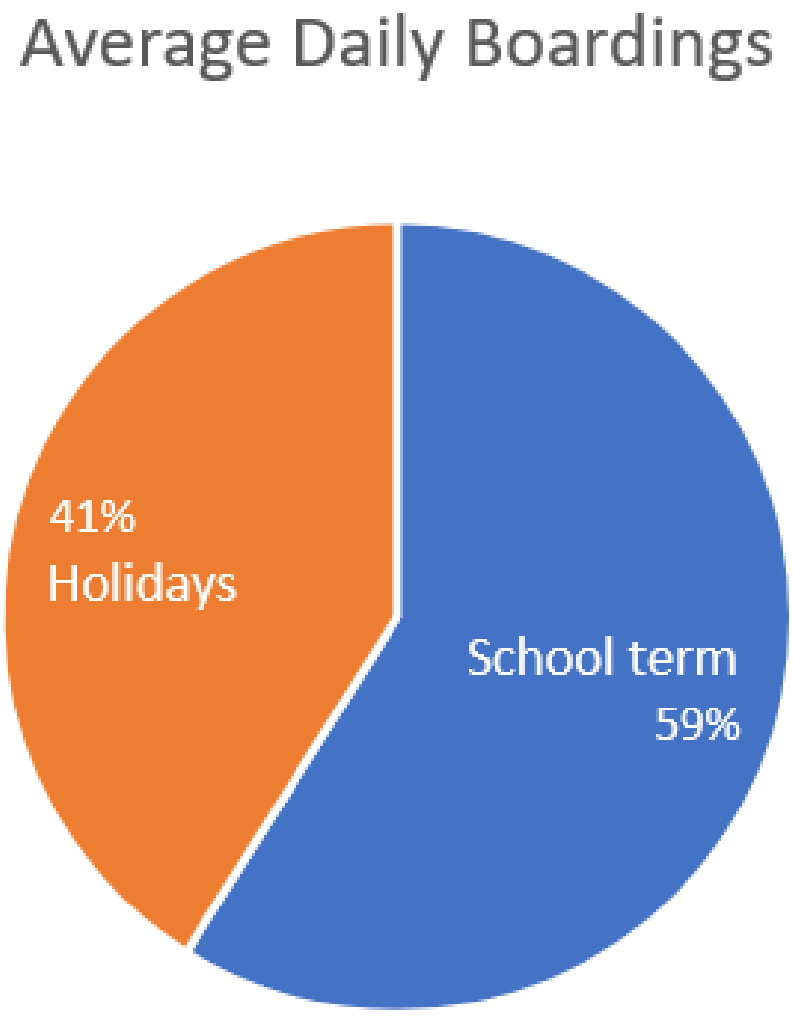


Figure 23: Child concession patronage, school term vs holidays

[41] Compared with the Dunedin child market, Queenstown child patronage shows

a. A smaller disparity between school term and school holiday patronage.
b. Stronger off-peak and holiday usage.

[42] Figure 24 details youth concession patronage, being age 13 to 18 years, noting a 45% increase in patronage for Q1 2026/27 patronage compared to the previous period.

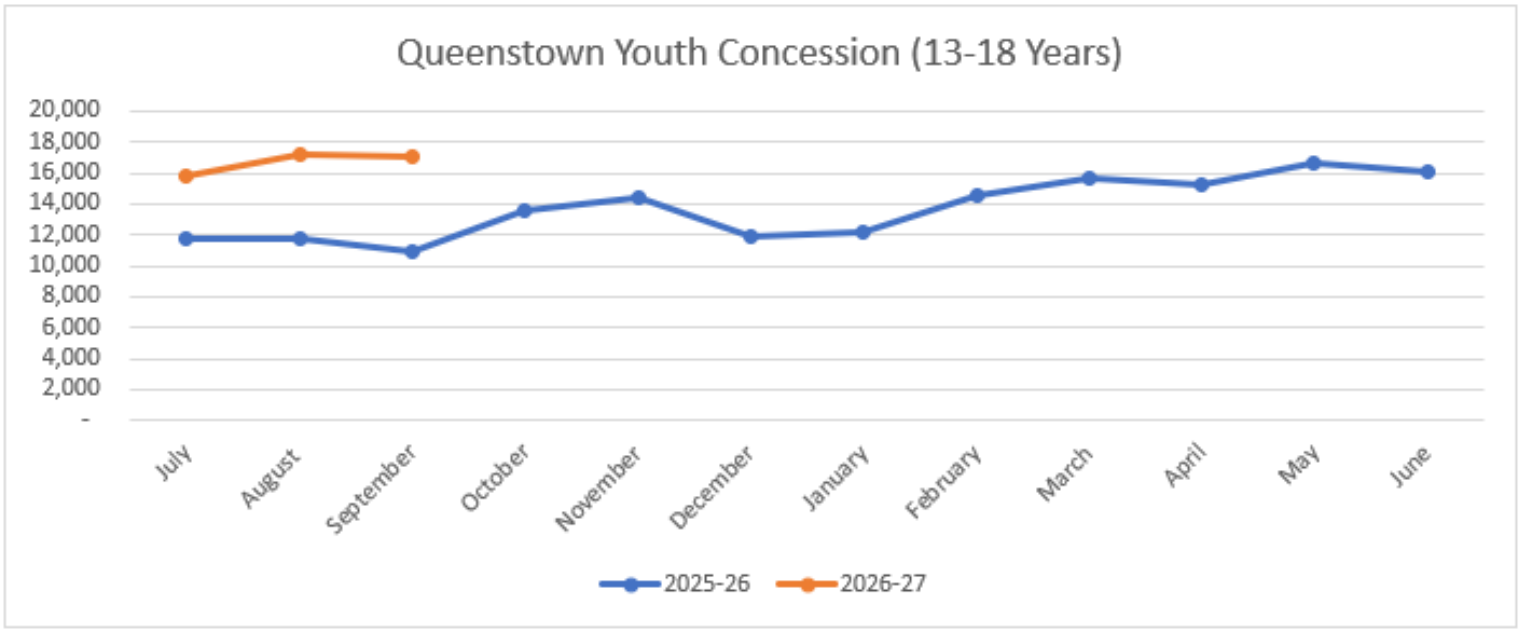


Figure 24: Youth concession patronage

[43] Figure 25 shows the spread of youth patronage across the day, peaking at 8:00am and 3:00pm, reflecting travel to and from school. Demand remains relatively strong through to early evening when compared to Dunedin.

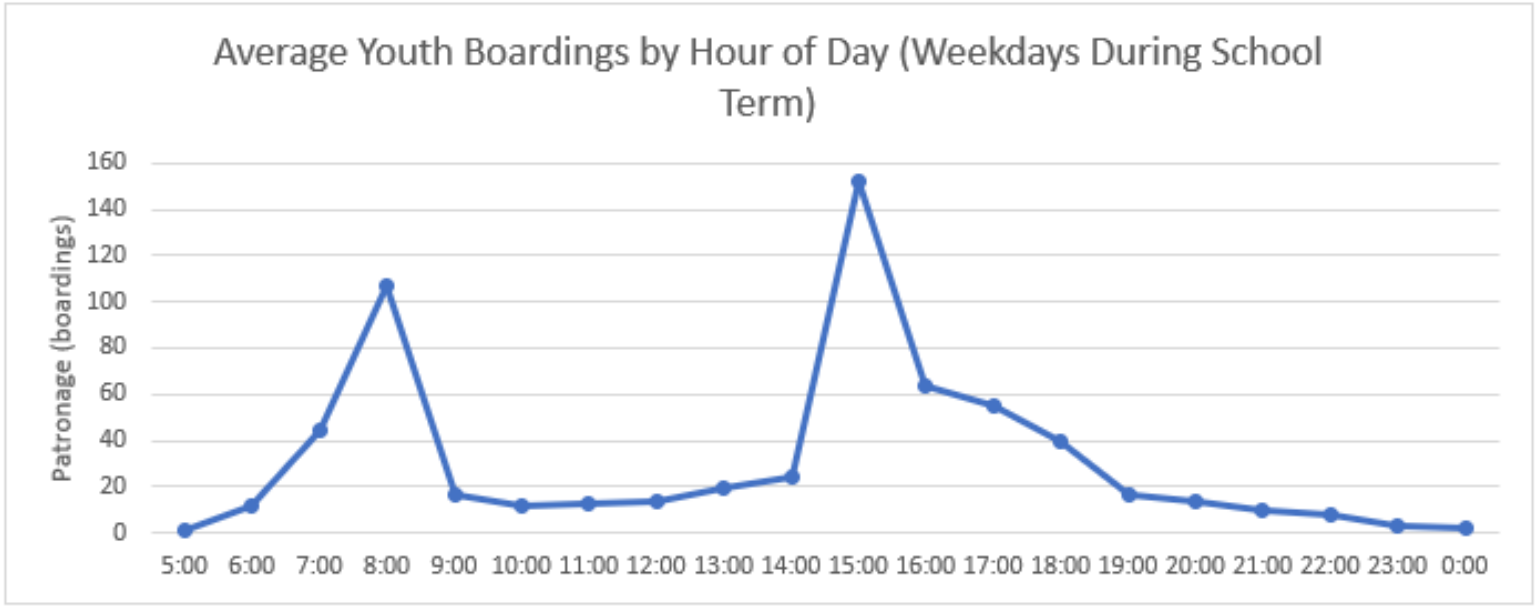


Figure 25: Youth concession patronage, time of day

[44] Figure 26 shows youth patronage by day of the week, noting lower patronage at weekends, although at a significantly higher proportion of trips than Dunedin.

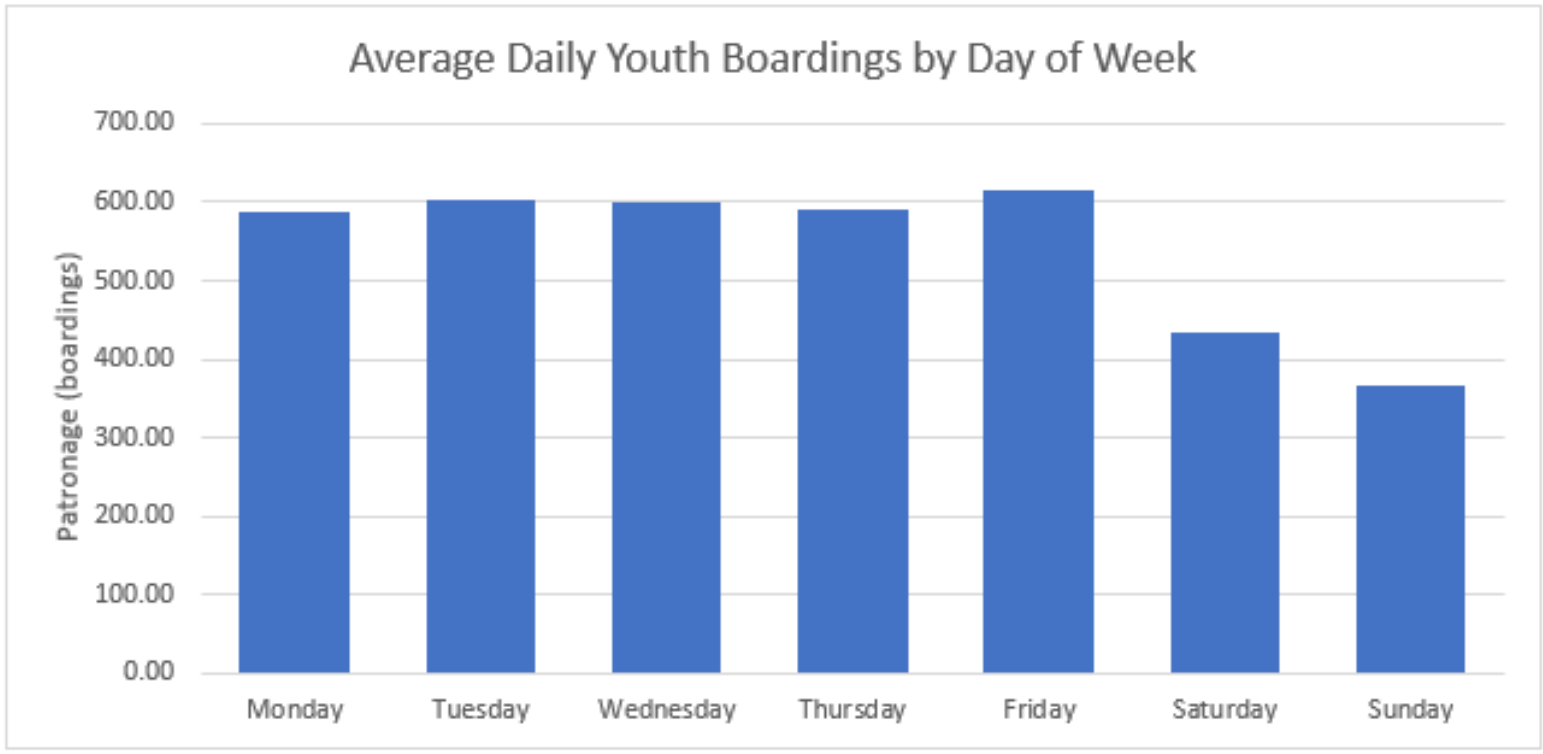


Figure 26: Youth concession patronage, day of travel

[45] Figure 27 splits the patronage between school term weekdays and school holidays. 56% of all youth boardings occur during school term.

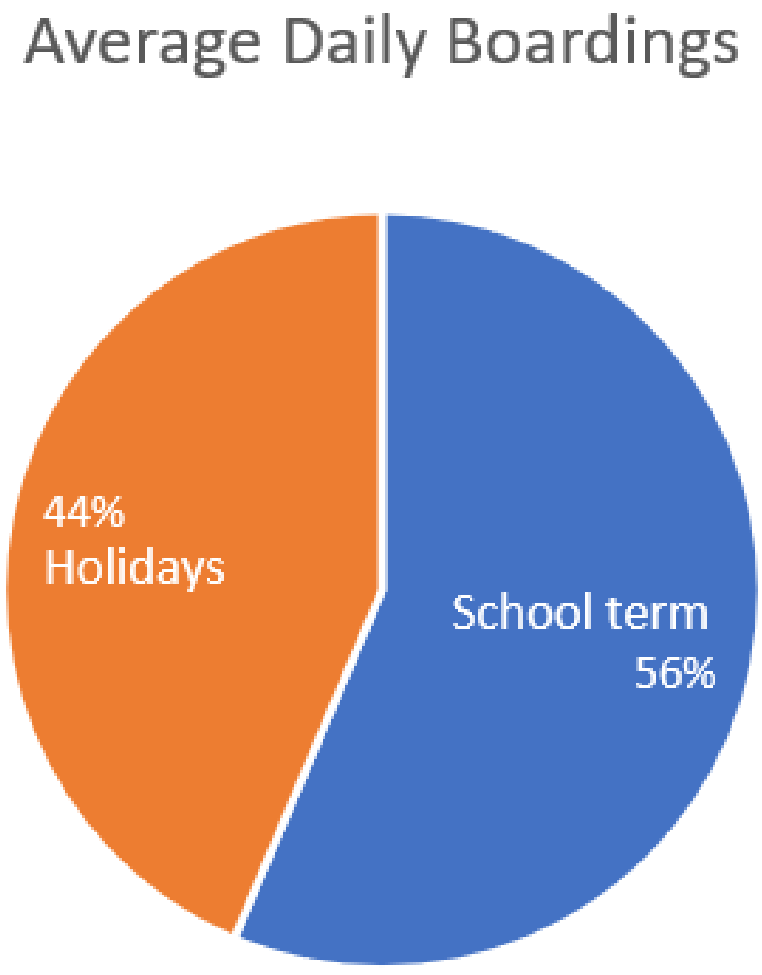


Figure 27: Youth concession patronage, school term vs holidays

[46] In summary, Queenstown experiences a much smaller variation between school term and holiday patronage than Dunedin, reflecting consistently strong weekend and holiday travel demand.

DISCUSSION – QUEENSTOWN FERRY

[47] Patronage and revenue for the Queenstown Ferry have significantly increased for Q1 2026/27. The data is set out in Figure 28 below.

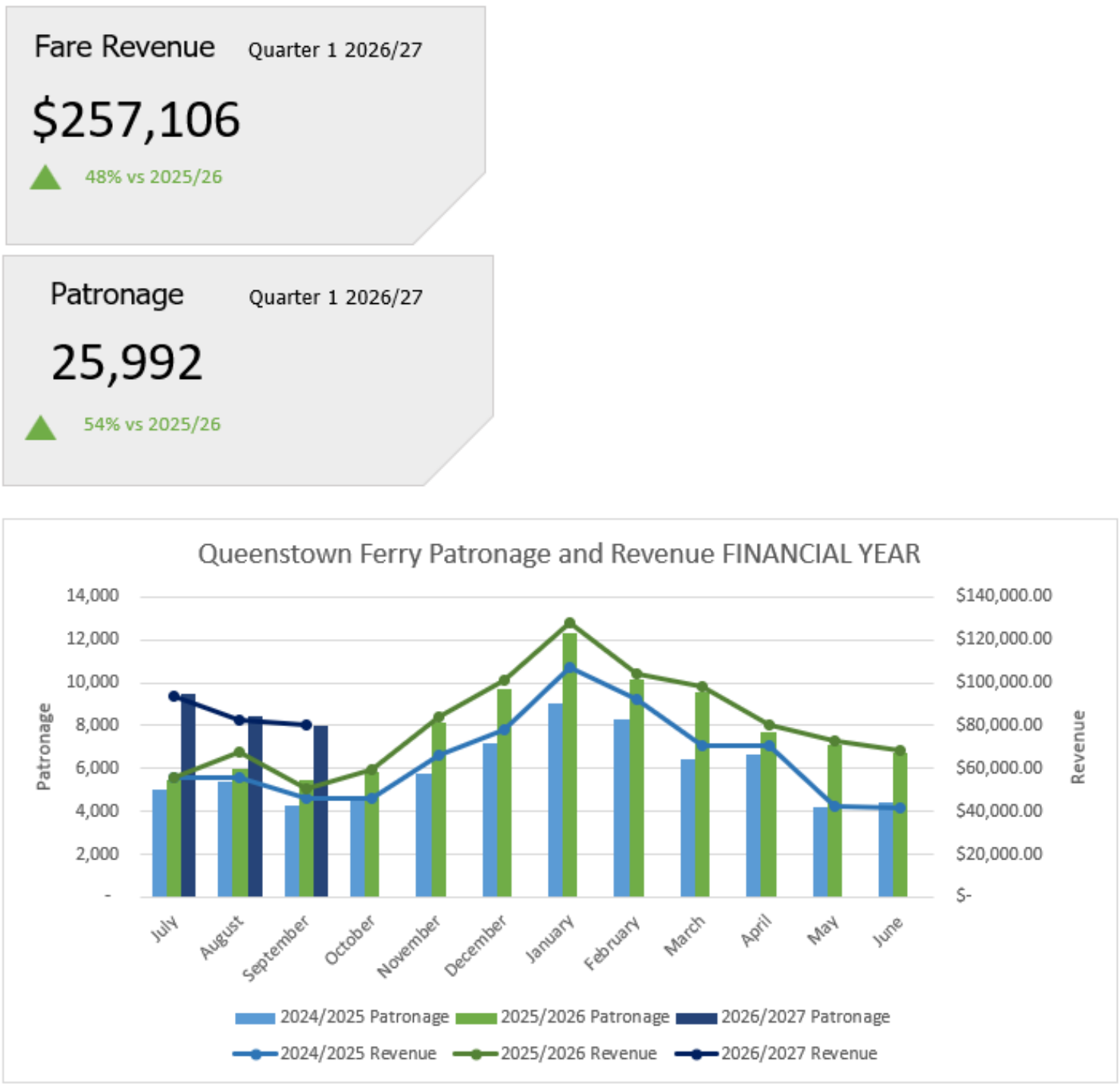


Figure 28: Queenstown Ferry 2026/27 Patronage and Revenue

[48] Fare revenue for Q1 2026/27 is up 48% compared to the previous period and total patronage for the period is up 54%.

[49] In July 2025, late-night services were extended from three nights per week to seven nights per week, and daytime services were increased to run on an hourly frequency between approximately 8:15 am and 9:45 pm.

[50] From late October 2026, ferry users will benefit from a trial 30-minute service frequency across most of the day, to the end of the financial year, replacing the current hourly timetable. This improvement is being made possible by the new Orbus Ferries-branded vessel introduced in August 2026.



Figure 29: New vessel, 'Cecil', in service near Frankton.

DISCUSSION - TOTAL MOBILITY

a. Total Mobility provides subsidised door-to-door transport through contracted small passenger services for those with long-term impairments who are unable to safely and reliably use conventional public transport.

b. On 1st July 2026, ORC implemented Ministry of Transport (MoT) guidance to reduce the Total Mobility subsidy level from 75% to 65%, alongside a reduction in fare cap from $50 to $45. Per trip, this means the maximum subsidy available has reduced from $37.50 to $29.25.

c. Q1 2026/27 Total Mobility trips have decreased by 2.9% compared to Q1 2025/6. Wheelchair hoist trips have seen a 1.1% increase.

Q1	2025/26	2026/27	% change
Client trips	39,134	37,974	-2.9
Wheelchair hoist trips	6,603	6,680	+1.1
Average trip length	6.9304 km	6.1765 km	-10%

Figure 30: Total Mobility patronage

d. Average trip length has dropped 10% from 6.9 km per trip, to 6.2 km

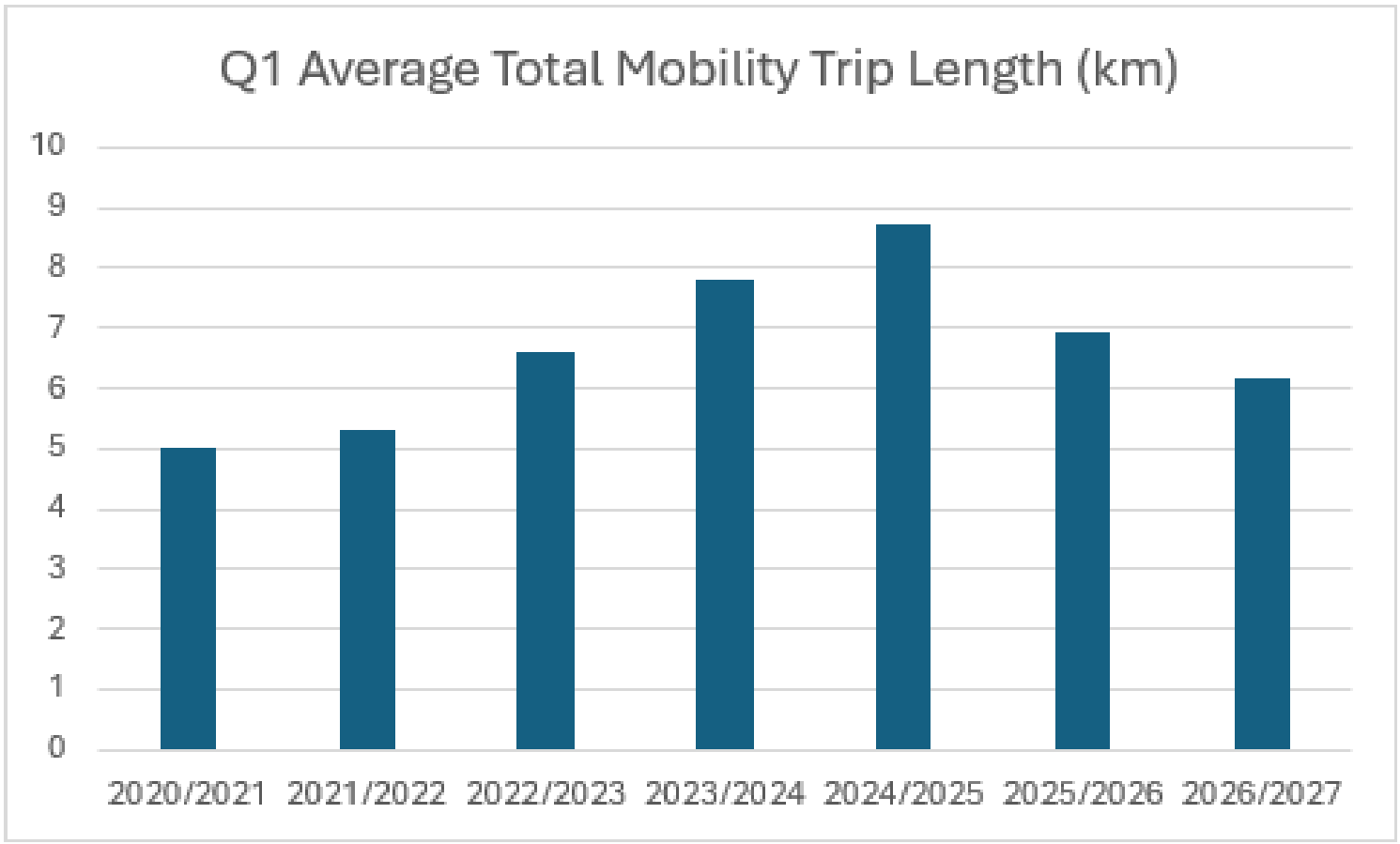


Figure 31: Total Mobility average trip length

e. In September, staff undertook a client audit, suspending accounts that have not been used in-taxi in more than two years, and cancelling accounts that have not been used in-taxi in more than three years. This reflects the terms and conditions of the Total Mobility scheme, ensuring compliance with the Privacy Act 2020, and reporting on card holders who are actively using the scheme.

f. Whilst staff attempted to contact clients during the review, outdated client details prevented them from reaching some cardholders. If clients contact staff because they can no longer access the scheme, suspended accounts can be reactivated, and cancelled accounts are referred to an assessment agency to confirm they still meet the eligibility criteria.

g. In the event Total Mobility users get in contact due to no longer being able to access the scheme, suspended accounts are re-activated upon confirming the required details. Those with cancelled accounts are referred to one of ORCs contracted assessing agencies to confirm they still meet eligibility criteria

h. Client reviews follow a three-year cycle, aligning with the launch of the current card-based system in 2017, resulting in accounts requiring review in 2026. The outcomes of the client audit are shown in Figure 32.

Original number of accounts	7,520
Number of accounts suspended	235
Number of accounts cancelled	1,334
Current number of Active accounts	5,951 (20.8% decrease)

Figure 32: 2026 Total Mobility client audit results

DISCUSSION – PASSENGER FEEDBACK

[43] Passenger engagement during the reporting period recorded a total of 1,353 feedback entries. This reflects a consistent level of public interaction with the transport network.

[44] General enquiries account for 48% of all entries. Complaints comprise 47% of total feedback, with the remaining 5% of entries distributed between positive feedback, incidents/accidents, and lost property.

[45] From a total of 116,513 scheduled trips, the complaint rate remains low at 0.55%. This indicates that while complaints represent a significant portion of feedback volume, they occur on fewer than one in every 182 trips, suggesting high overall operational reliability.

[46] Safety & Asset Management: Feedback regarding incidents and lost property remained minimal, each accounting for 2.7% of total entries.

[47] Figure 32 shows the split between feedback type, together with a detailed categorization of the complaints segment.

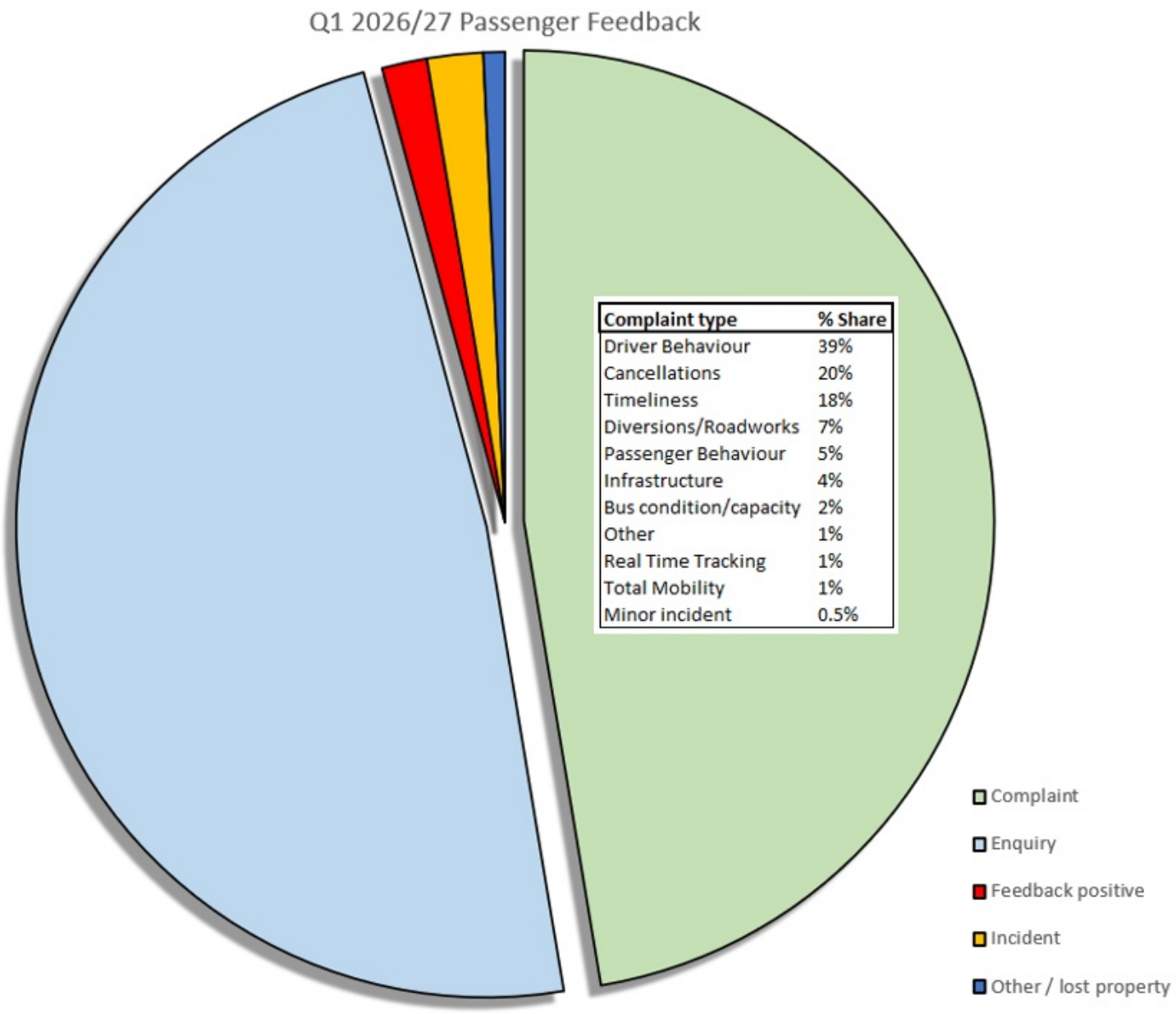


Figure 32: Passenger feedback categories, with complaint-subtypes

[48] Timeliness accounted for 20% of feedback this period. In Queenstown, these delays are largely systemic rather than a reflection of driver performance, representing the operational reality of a network navigating significant regional transformation.

[49] While the overall complaint rate is low relative to the number of trips, transport staff remain focused on the 39% of complaints that relate specifically to driver behaviour.

[50] Reports relating to driver behaviour, including concerns about intersection approach speeds, driving standards and the management of passenger behaviour on school services, continue to be treated as safety-related matters and are investigated on a case-by-case basis.

[51] Transport staff continue to attend operator toolbox meetings and depot briefings across the region. These sessions provide an opportunity to reinforce expectations around safe driving practices, heavy vehicle positioning, intersection etiquette and sharing the road with other users. The focus remains on fostering a strong safety culture across all contracted operators rather than responding solely to individual incidents.

[52] Annual accessibility training for contracted operators remains in place, delivered by a specialist accessibility facilitator. Depot managers, alongside ORC Transport Operations and Planning staff, participate in these sessions to ensure operators are equipped with the knowledge and skills required to provide accessible public transport services for all passengers.

[53] A significant proportion of complaints received towards the end of the quarter can be attributed to operational challenges associated with the transition between contracted operators as several public transport contracts approached expiry. This pattern started around May and was at its worst during August and September, resulting in n temporary timetable reductions across a number of services operated by the outgoing contractor. While these measures reduced the total number of scheduled trips operated, they also contributed to increased customer feedback relating to cancellations, reliability and capacity pressures on some services.

[54] As well as these transition-related issues, congestion remains a key driver of service variability across the network. Growing traffic volumes in both the Whakatipu Basin and central Dunedin continue to affect bus reliability, particularly as dedicated bus priority measures are not available.

[55] In Queenstown, the Kā Huanui a Tāhuna / Whakatipu Transport Programme Alliance programme continues to have a significant impact on traffic conditions around the Frankton (SH6/SH6A) intersection. While the works have introduced unavoidable delays as major upgrades are delivered, the project is expected to substantially improve public transport operations in the longer term through expansion of the Frankton Bus Hub, increased capacity and new signalised access arrangements for buses. Construction activity is expected to continue through 2027, with overall completion currently forecast for mid-2028.

[56] In Dunedin, ongoing infrastructure renewals and streetscape improvements, including works in the George Street and University areas, continue to affect traffic flows on key bus corridors. Across the wider Otago region, road maintenance programmes and temporary traffic management arrangements also contribute to network-wide delays and service disruption.

[57] While these projects can adversely affect punctuality and reliability in the short term, they remain important investments in the long-term resilience and efficiency of the transport network. Staff continue to provide passengers with service information through real-time tracking systems, the Transit app, website updates and social media channels. Work is also well progressed on the implementation of an automated customer information platform that will generate and publish service disruption alerts across multiple channels simultaneously.

[58] Staff continue to receive a growing number of enquiries regarding capacity constraints on Queenstown school bus services, particularly between Jacks Point/Hanley's Farm and Wakatipu High School. An interim service between Jacks Point and Wakatipu High School has been introduced while longer-term school transport solutions are being considered.

SUMMARY OF CONSIDERATIONS

Community Outcomes

This work aligns with the following community outcomes from the ORC 2024-2034 Long-Term Plan:

Transport

Otago has an integrated transport system that contributes to the accessibility and connectivity of our community, reduces congestion and supports community wellbeing aspirations.

Councillor Priority Actions

This work is delivering on the following Councillor Priority Action:

Ensure public transport performance reporting supports effective governance oversight, including reliability, accessibility and service effectiveness.

Alignment With Central Government Legislation

This work is consistent with relevant central government policy and direction. Specifically, it aligns with the Land Transport Management Act 2003 and reporting requirements from New Zealand Transport Agency (NZTA).

Alignment With ORC Internal Policy

The provision of public transport services in Otago is consistent with the vision to provide safe, sustainable, and inclusive transport.

Financial Considerations

There are no direct financial implications resulting from this report. However, we use our monitoring of network performance to inform decision making for transport activities.

Legal/Compliance Risk

There is insignificant/minor risk that decisions arising from this report could expose Council to litigation, regulatory non-compliance, or breach of policy/legislation. This report is for noting only and does not ask Council to change any service, policy or funding. It aligns with the Land Transport Management Act 2003 and NZTA reporting requirements, and the Total Mobility client audit was carried out in line with the scheme's terms and conditions and the Privacy Act

2020. Driver behaviour concerns are treated as safety-related matters and are investigated case by case.

Reputational Risk
Ongoing complaints about bus reliability, delays, and cancellations may reduce public confidence in the council's transport services. A significant proportion of recent complaints relate to the changeover between contracted operators, with road works and congestion also affecting reliability. The overall complaint rate remains low relative to the number of trips operated. Staff are working with operators to address service and driver behaviour concerns, and keep passengers informed through a range of channels. Other matters, including child patronage following the 2025 fare change, Total Mobility access and school bus capacity in Queenstown, may also attract community interest.

Climate Resilience
The impacts of climate-related risks (e.g. flooding, drought, extreme winds, coastal erosion, wildfires) on this work has not been assessed.

Carbon Emissions
Having a reliable and efficient public transport network supports mode shift, and increased patronage, which in turn contributes to ORC's carbon emissions reduction goals.

He Mahi Rau Rika: Significance, Engagement and Māori Participation Policy
This work is of low significance as assessed against He Mahi Rau Rika.

Engagement With Mana Whenua
There has been no engagement with mana whenua or Māori specifically for this work.

Stakeholder Engagement
Ongoing community feedback through CSI surveys, community board meetings, CRM data, and other engagement channels helps identify issues and opportunities, enabling continuous improvements to public transport services.

Communication
Clear and timely communication helps manage customer expectations, keep passengers informed of service changes, and maintain public confidence in the public transport network.

NEXT STEPS

[51] A review of Quarter 1 and 2 performances for 2026/27 will be presented to Council at the end of the period.

ATTACHMENTS

Nil

9.7. Consideration of Meeting Schedule for 2027

Prepared for:	Council
Report No.	S&C2650
Activity:	Governance
Author:	Dianne Railton (Team Leader Governance)
Endorsed by:	Amanda Vercoe (General Manager Strategy and Customer)
Date:	18 November 2026
Portfolio Leads:	Chair Calvert and Cr Laws, Strategy and Customer

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PURPOSE

[1] To adopt a meeting schedule for the Otago Regional Council for 2027.

EXECUTIVE SUMMARY

[2] A draft schedule of meetings for 2027 has been put together for Council review and consideration.

[3] The proposed schedule for meetings in 2027 provides for monthly Council meetings; quarterly meetings: Audit and Risk Committee, Mana to Mana, CDEM Coordinating Executive Group, Otago Emergency Management Committee, Regional Transport Committee; and scheduled Mayoral Forum meetings. Dates for Long-Term Plan hearing and deliberations are scheduled in May 2027.

[4] Two regional meetings have been proposed to be held in Oamaru and Central Otago.

[5] Changes or additional meetings or workshops may be required, which will be notified to elected members and appointed members as soon as possible as they arise.

RECOMMENDATION

That the Council:

1) ***Notes*** *this report and the draft attached meeting schedule.*
2) ***Adopts*** *the meeting schedule, with or without changes.*

BACKGROUND

[6] Under Schedule 7, Clause 19 (6)(a)&(b) a local authority may adopt a forward schedule of meetings, and notification of that constitutes as notification to members under the Act of the meetings. The schedule can be amended following adoption.

[7] ORC's regional meetings held in this triennium include:

a. March 2026 – Balclutha
b. September 2026 – Queenstown

[8] ORC's regional meetings for 2027 are proposed to be held in Oamaru and Central Otago.

DISCUSSION

[9] Nil.

OPTIONS

[10] Council can choose to adopt the schedule, with or without amendments.

SUMMARY OF CONSIDERATIONS

Community Outcomes
This work aligns with the following community outcomes from the ORC 2024-2034 Long-Term Plan:

Whole of Organisation

This work supports the whole organisation and, therefore, all Community Outcomes.

Councillor Priority Actions
Not applicable.

Alignment with Central Government Legislation
This work is consistent with relevant central government policy and direction. Specifically, it aligns with

Alignment with Otago Regional Council Internal Policy
Nil.

Financial Considerations
Regular meetings are budgeted for.

Legal Compliance/Risk
There is no risk that decisions arising from this report could expose Council to litigation, regulatory non-compliance, or breach of legislation.

Reputational Risk
There is no risk that decisions arising from this report could adversely impact Council's reputation or community trust.

Climate Resilience
The impacts of climate-related risks (e.g. flooding, drought, extreme winds, coastal erosion, wildfires) on this work has not been assessed.

Carbon Emissions
Not Applicable.

He Mahi Rau Rika: Significance, Engagement and Māori Participation Policy
Not Applicable

Engagement with Mana Whenua
Dates for Mana to Mana in 2026 will be discussed at Mana to Mana on the 19th of November.

Stakeholder Engagement
Nil.

Communications
The adopted 2027 Council Calendar will be published on the website.

NEXT STEPS

[11] Outlook calendar invitations will be sent to councillors and appointed members for the agreed meeting dates and will be published on the Council's website as per statutory obligations.

ATTACHMENTS

1. 2027 DRAFT Council Calendar - for Council Paper [**9.7.1** - 1 page]

DRAFT Otago Regional Council 2027 Calendar

Day	January	February	March	April	May	June	July	August	September	October	November	December
Monday		1	1								1	
Tuesday		2	2			1					2	
Wednesday		Council (LTP) 3	3			2			1		3	1
Thursday		Council 4	4	1		3	1		2		4	2
Friday	New Years Day 1	5	5	CE Forum CEG 2		CE Forum CEG 4	Mayoral Forum/TRT 2		3	1	CE Forum CEG 5	3
Saturday	2	Waitangi Day 6	6	3	1	5	3		4	2	6	4
Sunday	3	7	7	4	2	6	4	1	5	3	7	5
Monday	New Year holiday 4	Waitangi Day obs. 8	8	5	3	King's Birthday 7	5	2	6	4	8	6
Tuesday	5	9	9	6	4	8	6	3	7	5	9	7
Wednesday	6	Presentations 10	Presentations 10	7	LTP Hearings 5	Presentations 9	7	4	8	6	Presentations 10	Council 8
Thursday	7	Presentations 11	Presentations 11	Zone 5&6 Invercargill 8	LTP Hearings 6	Presentations 10	8	5	9	Zone 5&6 Hamner 7	Presentations 11	Audit & Risk 9
Friday	8	12	LTP Consultation Opens 12	Zone 5&6 Invercargill 9	Mayoral Forum OEMC 7	11	9	6	10	Zone 5&6 Hamner 8	12	10
Saturday	9	13	13	10	8	12	10	7	11	9	13	11
Sunday	10	14	14	11	9	13	11	8	12	10	14	12
Monday	11	15	15	12	10	14	12	9	13	RTC 11	15	13
Tuesday	12	16	16	13	11	15	13	10	14	12	16	14
Wednesday	13	17	Council 17	Presentations 14	Presentations 12	16	Presentations 14	Presentations 11	Presentations 15	Presentations 13	Council 17	15
Thursday	14	18	Council Audit & Risk 18	Presentations 15	Presentations Mana to Mana 13	Audit & Risk 17	Presentations 15	Presentations 12	Presentations 16	Presentations 14	Council Mana to Mana 18	16
Friday	15	19	19	16	14	18	16	13	17	15	19	17
Saturday	16	20	20	17	15	19	17	14	18	16	20	18
Sunday	17	21	21	18	16	20	18	15	19	17	21	19
Monday	18	RTC 22	Otago Ann. Day 22	19	17	RTC 21	19	16	20	18	22	20
Tuesday	19	23	23	20	18	22	20	17	21	19	23	21
Wednesday	20	Council 24	24	21	19	Council 23	Council 21	18	22	20	24	22
Thursday	21	Council Mana to Mana 25	RTC 25	22	20	Council 24	Council 22	19	Audit & Risk 23	21	25	23
Friday	22	Mayoral Forum/TRT 26	Good Friday 26	LTP Consultation Ends 23	21	Matariki 25	23	20	Mayoral Forum OEMC 24	22	Mayoral Forum/TRT 26	24
Saturday	23	27	27	24	22	26	24	21	25	23	27	Christmas Day 25
Sunday	24	28	28	Anzac Day 25	23	27	25	22	26	24	28	26
Monday	25		Easter Monday 29	Anzac Day obs. 26	24	28	26	23	27	Labour Day 25	29	Christmas Day obs. 27
Tuesday	26		Otago Ann. obs. 30	27	LTP Deliberations 25	29	LGNZ Super Local Hamilton 27	24	28	26	30	Boxing Day 28
Wednesday	27		31	Council (AWAY) 28	LTP Deliberations 26	30	LGNZ Super Local Hamilton 28	Council 25	Council (AWAY) 29	Council 27		ORC office closed 29
Thursday	28			Council (AWAY) 29	Council 27		LGNZ Super Local Hamilton 29	Council Mana to Mana 26	Council (AWAY) 30	Council 28		ORC office closed 30
Friday	CE Forum CEG 29			30	28		30	27		29		ORC office closed 31
Saturday	30				29		31	28		30		
Sunday	31				30			29		31		
Monday					31			30				
Tuesday								31				

Public holidays | Dates in red = school & public holidays

Note: **1.** LTP = Long Term Plan; **2**. CEG = CDEM Coordinating Executive Group; 3. OEMC = Otago Emergency Management Committee; **4.** TRT = Te Rōpū Taiao **5.** RTC = Regional Transport Committee