

What are the implications of intensive grazing on Public Conservation Land alongside the Rangitata River?



A summary research report compiled and edited by:

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Executive Summary

The purpose of this report was to determine the implications of grazing concessions on Public Conservation Land along the Rangitata River and braid-plain.

Key findings included:

- Areas of the riverbed has been converted to farmland.
- Flooding onto farmland is a common occurrence. Frequency of high flow events is likely to increase in the future due to global warming.
- Concession conditions are typically followed, and considerations are being made to increase the frequency of compliance checks and reduce the terms of concessions.
- Department Of Conservation and iwi relationships are improving, with an increase of iwi consultation over the last 12 – 18 months.
- Rangitata Public Conservation Land concession income is estimated to be \$2.58 million, with estimated weed control costs as \$1.54 million. The use of PCL for grazing can reduce the cost of weed control for DOC.
- The Arowhenua restoration project in 2021 expresses the goal of imprinting whakapapa back to the Rangitata River and restore Mauri through riparian planting, pest control, and weed control. The project is funded by DOC with \$8.7 million.
- The water quality of the Rangitata River declines with increasing proximity to the coast, particularly with increases in nitrogen and *E-coli*. Water quality overall has declined over the last 5 years.
- Historically the Rangitata held significant value as a resource for Māori. There are 7 mahinga kai sites along the river and it was a valuable mode of transport.

The key recommendations developed through the discuss include:

- Increasing restoration projects to improve the balance between concession land used for grazing and conservation.
- Strategic grazing approaches, these could be incorporated into concession conditions.
- Greater setback distances to protect from flooding and reduce environmental impacts.
- Stricter concession conditions.
- Further consultation with local Rūnanga.
- Using a whole river management approach.
- Using a holistic view of conservation values in the Rangitata area that accounts for past, present, future, potential, cultural, and historic values.

1. Introduction

The objective of this report is to analyse the potential benefits and negative effects of grazing on Public Conservation Land (PCL) on the Rangitata braid plain. Concerns were raised by the Canterbury Aoraki Conservation Board (CACB) around whether approval of concessions could have adverse impacts on the health of the river and its unique ecosystems. The dynamic nature of braided rivers like the Rangitata also brings into the question the logistics and long-term costs of concession locations, many of which exist on recently active riverbeds which are prone to flooding. Research was undertaken to analyse the economic viability, cultural significance, river ecology, and geological implications. This research could provide insight for PCL concession implications on other braid-plains in New Zealand.

2. Theory and Concepts

The community partner for this project is the Canterbury Aoraki Conservation Board (CACB). Board members are appointed by the conservation minister as a voice for the community in conservation management issues, CACB also advise the Department of Conservation (DOC) on local conservation matters. The Board are also responsible for the development of several statutory plans including the Canterbury (Waitaha) Conservation Management Strategy (CMS). The CMS provides guidance to DOC for conservation management in the context of Waitaha (DOC, n.d.-a.).

After noticing a prevalence of applications for grazing permission on Public Conservation Land (PCL), the CACB wanted to determine how grazing on PCL contributes to conservation (CACB, 2020). The CACB are particularly concerned with a cluster of concessions alongside the Rangitata due to the potential impacts on water quality, ecosystem health, and mauri of the wai. They have also emphasized the importance of Rūnanga involvement in this issue and discussed have mentioned that the relationships between Rūnanga and DOC appears to be changing.

PCL is land administered and managed by DOC (Figure 1) in accordance with their role: to care and advocate for Papatūānuku (the land), waters, native species, and heritage. DOC's role also includes partnership with Māori, and to foster recreation (DOC, n.d.-b).

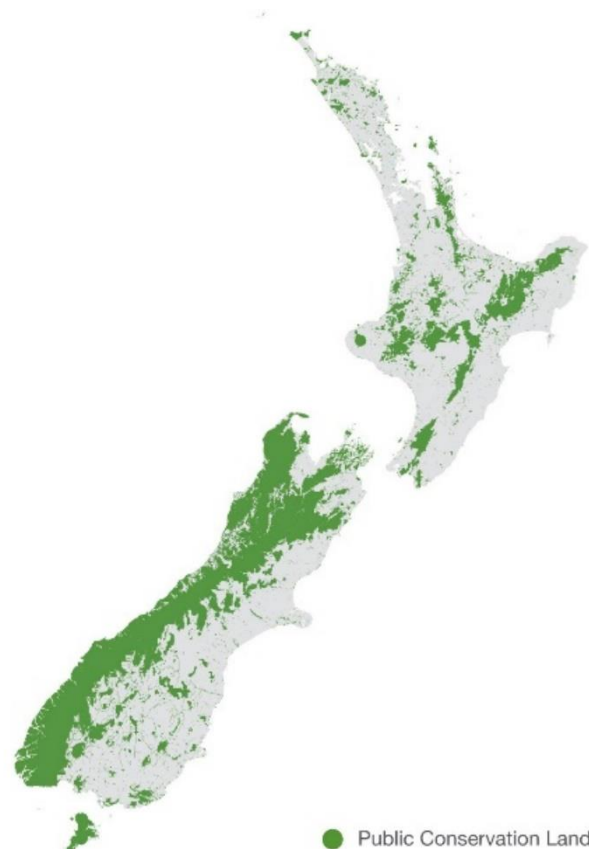


Figure 1: Public Conservation Land in New Zealand (DOC, 2014).

A concession allows the holder to carry out commercial operations on PCL, including the grazing of livestock. Applications for concessions on PCL in Canterbury must follow the guidelines in the CMS and any other relevant policies and legislation (DOC, 2010).

Policies in the CMS prescribe rules for when concessions should or should not be granted. Any grazing concessions must be consistent with relevant parts of the CMS, Conservation Act 1987, and the Conservation General Policy 2005. Policy 3.15 in the CMS also states that justification for any lowland PCL grazing is questionable (DOC, 2016). This, coupled with known environmental effects of farming, leads to the initial conclusion that the routine approval of concessions appears to be counterintuitive.

The Rangitata is a braided river located in mid Canterbury (Figure 2). Braided rivers have multiple active channels that split and combine along the length of the river. They have a high sediment load which causes braids to migrate laterally over short periods of time. Large flood events usually initiate the river changing course. Their islands and channels foster a unique array of native bird, insect, and fish species, and are notably niche.



Figure 2: Canterbury region showing the location of the Rangitata River. The inactive south branch lies south of the main channel. (Google Earth, n.d.).

The PCL study area lies 20km inland of the east coast, between SH1 and the shoreline. It runs alongside large areas of the active river and on the dormant south branch (Figure 3). The most recent land cover data in Figure 4 shows that over half of PCL on the Rangitata is high producing exotic grassland

After discussing the topic with the community partner and understanding the contextual background, the project aims were focused on investigating whether the assumption that concession granting is counter to conservation is accurate. This led to the formulation of our research question:

What are the implications of intensive grazing on Public Conservation Land alongside the Rangitata River?



Figure 3: PCL on the Rangitata River. (Toitū Te Whenua - Land Information New Zealand, 2021).

Land Cover Type Percentages on Rangitata River PCL (2018)

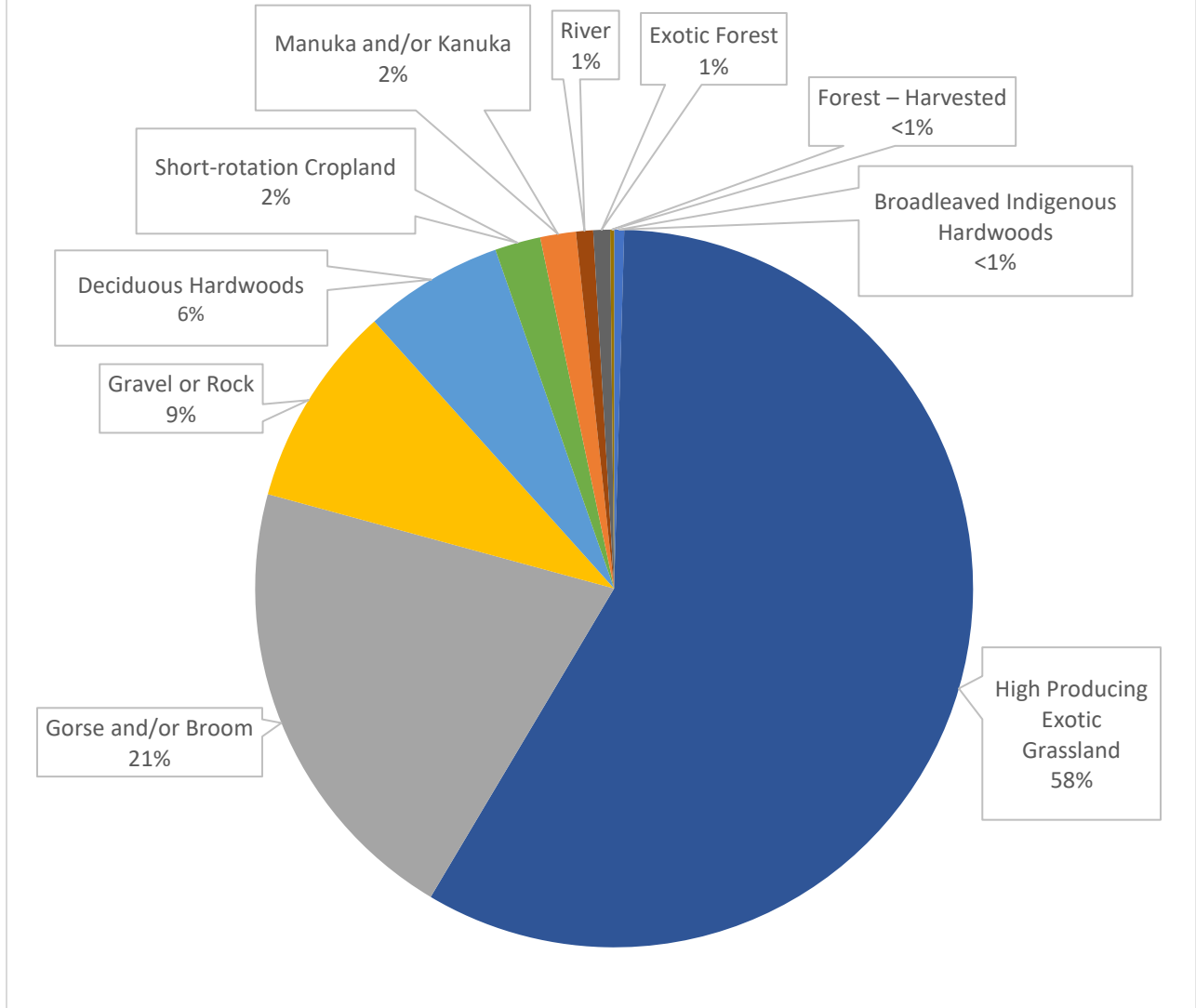


Figure 4: Land cover type percentages on the Rangitata River PCL (scinfo.org.nz, 2020).

3. Methods

3.1 Overarching Methodology

The scope of this report's research question requires the analysis of resource management (natural and other), stakeholder perspectives, environmental implications and interactions, and investigation of spatial and temporal context. These complex and distinct variables incorporate aspects of both social and physical science as well as qualitative and quantitative data, so a mixed-methods approach was applied (Figure 5). The mixed methods approach is particularly valuable when assessing indigenous groups as stakeholders in resource management (Bradshaw et al., 2001) and when using qualitative and quantitative data (Madsen & Adriansen, 2004; Dunning et al., 2008).

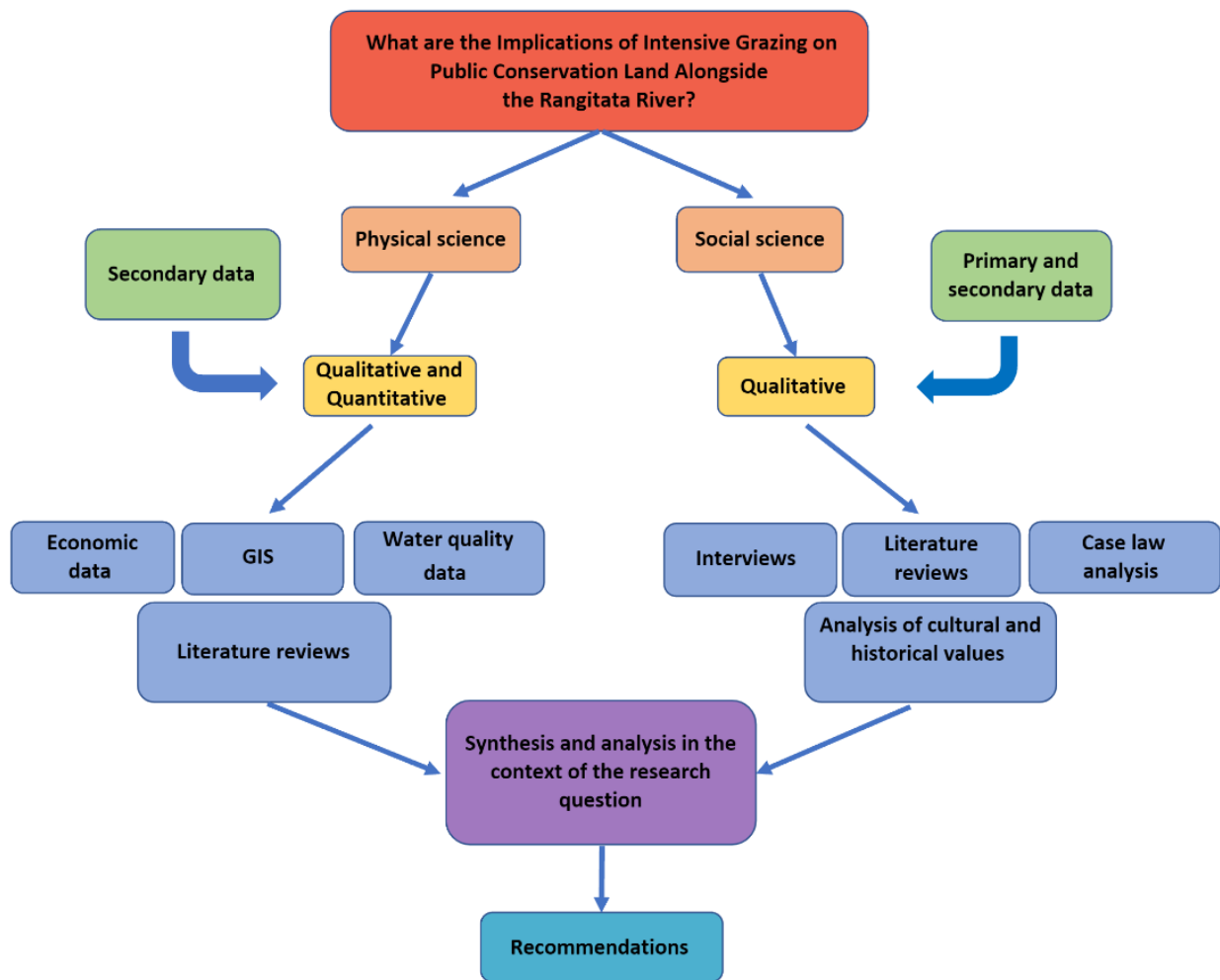


Figure 5: This reports mixed methods research process diagram.

3.2 Change Over Time

Geographic Information System (GIS) techniques were used to analyse PCL change over time. Data were sourced from Land Information New Zealand (LINZ) and filtered in ArcMap to show only PCL. Aerial photography images were sourced from LINZ and Retrolens. The 1937 photos were georeferenced in ArcMap. Land cover data was obtained and analysed from The Land Resource Information System (LRIS) catalogue.

3.3 Inundation Risk and Costs

Journal articles, news reports, and policy documents outlining current flooding and flood modelling for the area, were the primary source of information surrounding the geomorphology and nature of braid plain migration. For example, Environment Canterbury's reports on the December 2019 flood and modelling techniques explored by Nagy et al. (2017). Section 2(1) of the Resource Management Act was examined as context for the legal definition of a riverbed. Primary data was obtained through an interviewee at DOC, to gain insight on the practical application of the concession process.

3.4 PCL Concession Data

A dataset sourced from the Ministry for the Environment was used to investigate PCL land in New Zealand used for grazing. This dataset detailed the number and type of concessions on PCL between 2012 and 2017 in an Excel spreadsheet. Additionally, the number of concessions in Canterbury in 2012 was gained from the CACB report (CACB, 2020). This data was used to identify the number of grazing concessions in Canterbury compared to the rest of New Zealand. A calculation was made to determine the percentage of PCL used for grazing concessions nationally by adding up the number of grazing concessions between 2012 and 2017, then divided by the total number of concessions. Data on the stocking units and weeks of the year permitted in grazing concessions was sourced from the CACB report (CACB, 2020).

3.5 Financial

The estimated DOC income from PCL was calculated using average grazing revenues per hectare for different grazing types in the Canterbury region (Saunders & Saunders, 2012). These revenues were multiplied by the total area of each individual farm type to give an estimate of the total revenue. This was multiplied by DOC's PCL lease rate to give DOC's estimated income generated by concessions. DOC's estimated weed control cost is taken from average herbicide application costs per hectare (Saunders et al., 2017) and then multiplied by PCL used for grazing on the Rangitata braid-plain (Appendix A).

3.6 Water Degradation

Data regarding water degradation in the Rangitata Catchment was gathered via water quality measurements taken by LAWA and DOC. This data measures a range of physical parameters over time that can be attributed to different sources.

3.7 Cultural and Historic Conservation Value

Submissions and supporting documents were accessed through the Ngai Tahu Kareao Website which contains pdf scans of the submissions. Submissions were searched for key words including Rangitata, Rakitata, and mahinga kai. This uncovered lists of mahinga kai sites and natural resources that were gathered. This investigation led to another text "*Maori Place-names of Canterbury*" (Beattie, 1945) to which the above process was repeated.

3.8 Interviews

Two semi-structured interviews were conducted. Contact information was provided by the community partner. Interviewee 1 was an Arowhenua Rūnanga representative and Interviewee 2 was a current DOC employee. The interviews were conducted over zoom. A series of questions and themes were prepared by the researchers before the interviews (Appendix 2 and 3). These were posed to the interviewee(s), but conversation was allowed to develop organically.

4. Results

4.1 Land Cover Change

GIS analysis shows the south branch was a year-round active channel (Figure 6a), but now remains dry and only carries water during large flood events. Between 1937 and 1999 the south branch stopped flowing year-round. This led to farming development on the previous riverbed (Figure 6a & 6b). From 1999-2018 farming development on Rangitata PCL has intensified (Figure 6b & 6c).

Analysis of land cover change on Rangitata PCL shows significant changes of three land cover types. Exotic forests decrease by 9ha, and gorse and/or broom decreases by 4.5ha (Table 1). These decreases are mostly balanced by an increase in high producing exotic grassland of 11ha. These changes suggest that since 1996 forested areas and weeds have been cleared and replaced by grassland for farming.

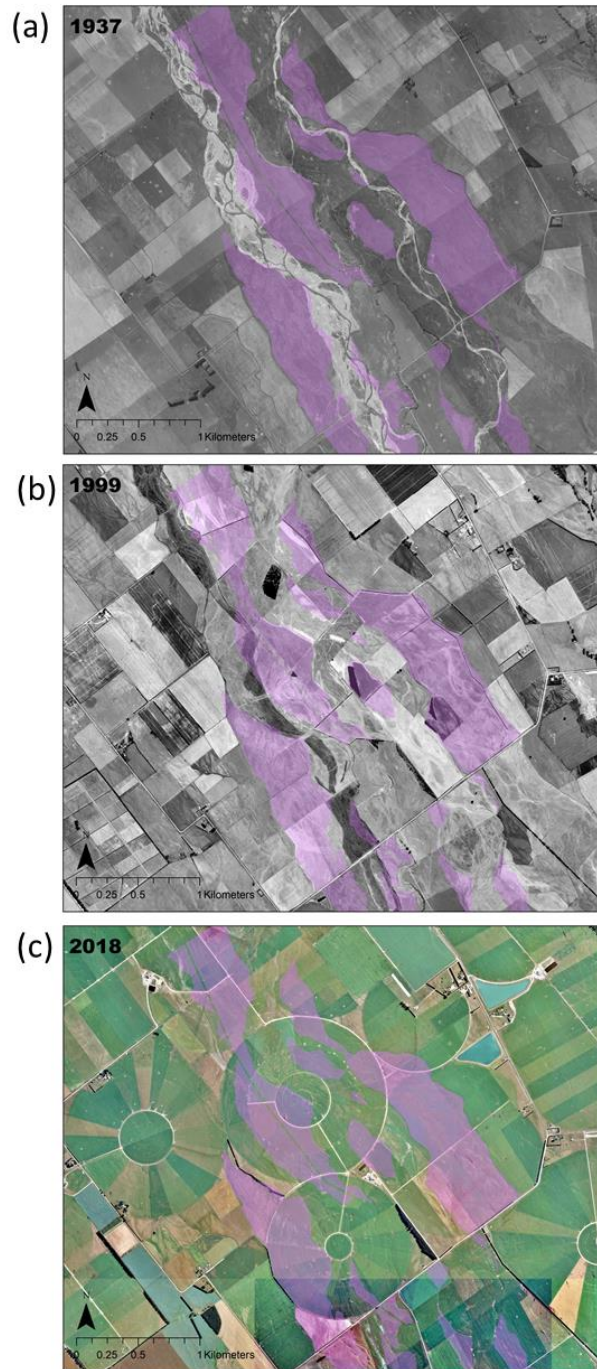


Figure 6: Change on PCL on the south branch of the Rangitata River from 1937-2018. (a) Active south branch of the Rangitata on PCL. (b) Paddocks are where the south branch no longer actively flows year-round. (c) Intensive farming shown by pivot irrigators on the south branch PCL. (Retrolens–Historical Image Resource, 2021; Toitū Te Whenua–Land Information New Zealand, 2011, 2019, 2021).

Table 1: Analysis of land cover change on Rangitata PCL from 1996 to 2018, note the significant change between Exotic forests, gorse and/or broom, and exotic grassland. (scinfo.org.nz, 2020).

Land Cover Type	1996 (ha)	2018 (ha)	Change (ha)
Broadleaved Indigenous Hardwoods	6.4	6.4	0.0
Deciduous Hardwoods	91.8	89.1	-2.6
Exotic Forest	19.7	10.7	-9.0
Forest – Harvested	0.0	2.5	2.5
Gorse and/or Broom	298.1	293.6	-4.5
Gravel or Rock	126.7	129.4	2.7
High Producing Exotic Grassland	813.1	824.0	11.0
Manuka and/or Kanuka	22.8	22.8	0.0
River	10.9	10.9	0.0
Short-rotation Cropland	29.2	29.2	0.0

4.2 Braid-plain Squeeze and Flooding

Flooding is a natural function of a braided river, acting as a flushing mechanism to reduce sediment build up. During high flow events water occupies the whole braid-plain (including the usually dry land along the margins of the river) (Hicks et al., 2020). Braid-plain boundaries are hard to define, and the issue has been taken to NZ’s High Court (Environment Canterbury, 2018). Anthropogenic activities on the flood buffer can negatively impact habitats and change the natural behaviour of the river. These activities reduce the ability of the river to move laterally, leading to the bed building up over time (as the sediment deposition area is reduced). This restriction reduces the volume of water required to flood the river (Hicks et al., 2020).

4.2.1 Case Study: Rangitata Flood December 2019

In December of 2019, the south branch of the Rangitata river flooded (Figure 7)(Environment Canterbury, 2020). This inundated several active concessions and was costly to both the land users and government. Costs of remediation continued for more than 12 months after the event (Littlewood, 2020).



Figure 7: December 2019 flooding event on the Rangitata River. (Environment Canterbury, 2020).

4.3 Advantages of Current Process

In 2012 there were 60 concessions for grazing and agriculture on PCL in Canterbury (DOC, 2016). This is comparatively low in comparison to the 2012 total of 796 grazing concessions nationally (Ministry for the Environment, 2018). Between 2012 and 2017, the percentage of concessions for grazing was 18%. This shows that out of all PCL in New Zealand, the proportion used for grazing concessions is minimal. Additionally, the number of grazing concessions in Canterbury is also minimal when viewed on the national scale. However, this calculation does not consider the proportion of concessions relative to the size of the area.

Concessions on the Rangitata allow grazing of specific amounts of stock, for certain times of the year. Many types of livestock are grazed on PCL and different types of livestock can be grazed together. PCL that is grazed by livestock typically has a maximum number permitted on the area at any one time. Additionally, many concessions have limits on what season grazing is permitted (often specified in the concession conditions as weeks permitted per year).

Concessions come with conditions that must be adhered to. Cooperation with these conditions is high despite them tightening. Nationally, *Dept of Conservation v Wairaki Station Ltd* (2019) and *DOC v Moir* (2010) were only instances of grazing without permit and no cases were found where conditions were not followed. Winter fodder crops are no longer permitted to be grown on PCL on the Rangitata. Interviewee 2 also mentioned there are considerations for an increase to quarterly compliance checks on concessions (as opposed to the current 1-3-year intervals).

According to interviewees 1 and 2, the relationship between DOC and Iwi is improving. There has been a shift over the last 12 – 18 months to include iwi more actively in consultation regarding grazing concessions. DOC has continuing discussions with Iwi regarding concession applications, issues, and potential mitigation strategies and is seeking to improve this communication moving forward (CACB, 2020).

4.4. Analysis of Financial Factors

DOC income from the concession land lease on the Rangitata is estimated to be approximately 2.58 million. This income is redistributed by DOC and has potential to be used for restoration projects involving iwi.

The estimated weed control cost on the Rangitata PCL is around 1.54 million per year. This is a cost DOC would be required to pay for to maintain control over gorse, broom, lupins, etc. In this aspect DOC is saving money that can be used for conservation elsewhere.

4.5 Negative Impacts of Agriculture on PCL

In New Zealand farm animals are the primary source of nitrogen in waterways. Cattle have the highest level of environmental impact of all livestock types. In New Zealand there are comparatively high concentrations of *E. coli*. Furthermore, nitrogen from dairy cows has more than doubled in the last 22 years (Scarsbrook & Melland, 2015). Land, Air, and Water Aotearoa (LAWA) monitoring sites in the Rangitata River catchment measure contaminants such as *E. coli*, turbidity, nitrogen, and phosphorous. Site measurements show increasing nutrient contaminants down the catchment, and 5-year trends indicating declining water quality for most parameters (LAWA, n.d.). ECan monitoring sites in the Rangitata catchment exhibit similar trends with increasing amounts of *E. coli*, turbidity, nitrogen, and other nutrients (Instream Consulting, 2019).

Links have been developed between livestock grazing and suspended sediment runoff due to soil trampling (Cournane, 2011). There are also correlations between land cover and erosion rates, with perennial grasses providing significantly less erosion resistance than shrub or tree cover (Basher, 2013). Rotation grazing and pasture management have been found to reduce soil erosion rates (Hancock et al., 2020), as well as riparian planting (Hughes, 2016).

4.6 Conservation Value: Actual and Perceived Results

The historical and cultural conservation value of the land has been explored through quantitative analysis. The Wai Tangi Tribunal submissions demonstrate longstanding evidence that the Rangitata held significant value as a resource (Table 2) (Anderson, 1988a; Brailsford,

1988; Reihana et al., 1988). The Rangitata was specifically mentioned in every submission relating to the Arowhenua area. One submission referenced an additional resource that has translated an 1880 list of mahinga kai sites compiled in 1880 in the Canterbury area (Figure 8). This list was created to preserve knowledge and serve as evidence in land disputes (Beattie, 1945).

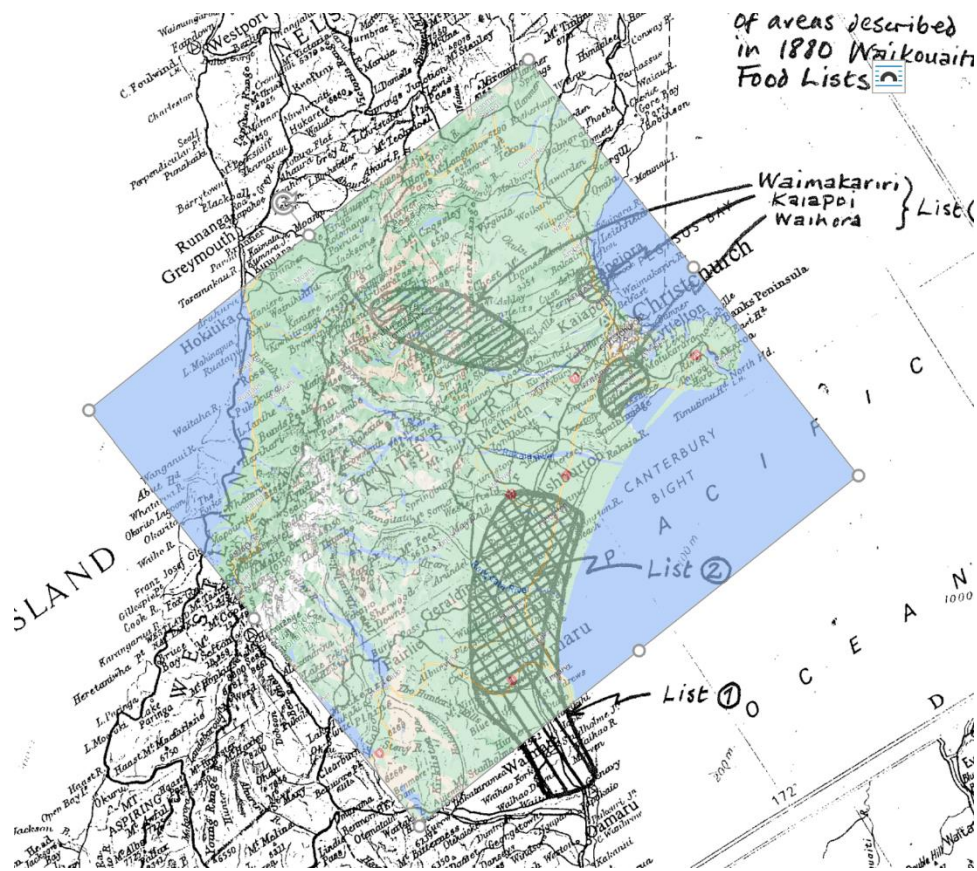


Figure 8: Shaded section shows area where all mahinga kai sites (including from Table 3) are located (modified from Anderson, 1988b).

This list mentions 7 mahinga kai sites along the Rangitata and 15 native species that were abundant enough to gather as resources (Table 3) (Beattie, 1945). The river was also documented as being a valuable mode of transportation (Brailsford, 1988).

Table 2: Discussion of Rangitata River in Wai Tangi Tribunal Submissions.

Submission:	Rangitata Relevant Content:
Wai27, H001 – Atholl Anderson	<ul style="list-style-type: none"> • Provides a list of mahinga kai sites (compiled by Kahu and Kuri at Arowhenua in 1889). • Includes places along the Rangitata. • Referenced Beatties book (Table 3)
Wai27, H004 -Barry Brailsford	<ul style="list-style-type: none"> • Documents that Rangitata was a trail used by iwi to access interior lakes (Hakaterere trail)
Wai27, H010 - Jacko Reihana, Bill Torepe, Kelvin Anglem, Murray Bruce, Kelly Davis and Rangimarie Te Maiharoa	<ul style="list-style-type: none"> • Rakitata well known for abundance of food resources to Maori

Table 3: Mahinga Kai sites near the Rangitata.

Place name:	Site Information:	Resource gathered:
Te-aika-a-wai	Village on eastern side of Rangitata River	Tuna, fernroot, woodhens, rats, tutu, raupo.
Ti-maur-raki	A place where people lived on the North side of Rangitata river mouth (included a sacred altar and burial place)	Tutu
Tawhari-toka	Up the Rangitata	
O-tua-kiri	south side of rakitata was a place of fixed habitation, had a burial ground and food in the district	
Te au-o-kahu-tawe	Up the Rangitata	
Tuna-a-te-whiwhi	On Rakitata river	
Ko-o-kura-mahak	South side of the Rakitata Mouth	
Rakitata River as a whole		flounders, Tuna, kahawai, mullet, lampreys, minnows, native trout, small fish (known as paraki, panako, waharua and pipiki)

4.7 Interviews

For ethical reasons, the results of the interviews will not be published in this report they will, however, be referenced throughout the discussion.

5. Synthesis and Discussion

5.1 Tightening Conditions

Current research indicates that anthropogenic activity can disturb and harm braided river ecosystems (DOC, 2016; Gray & Harding, 2009; Ullmann et al., 2007). Given the widely accepted negative effects of intensive cattle grazing on rivers, it is plausible that grazing concessions are contributing to the decline in Rangitata River water quality. This potential degradation goes against Section 11.2 of the Conservation General Policy, which outlines that all negative effects of grazing concessions must be mitigated and minimized (DOC, 2019). There is no requirement for concession holders to contribute to conservation, only mitigate negative effects.

The tightening of consent conditions may prove useful for mitigating negative effects. Increased set-back distance requirements for consents could see land adjacent to the river become available for biodiversity restoration (Norris, 2008; Fenemor & Samarasinghe, 2020), and function as a buffer zone for grazing-introduced contaminants through riparian planting. This could lead to better effluent and nutrient management, improving water quality (Scarsbrook & Melland, 2015).

A more challenging change could be requiring concessions holders to make a net contribution to conservation. This would bring the practice of allowing grazing concessions more in line with DOC's goals and desired outcomes, such as protecting the land, water, indigenous species, and heritage (DOC, n.d.-a).

5.2 Future Financial Viability

Money is generated by leases on the Rangitata PCL. This which poses the question of whether the funds are such that they offset the negative effects of grazing on PCL. Due to the complexities of environmental degradation, the true costs of lost ecosystem services can be difficult to quantify (Mehvar et al., 2018).

The active nature of the braid plain affects land use on a regular but unexpected basis. The illustration of this can be seen in Figure 7. The financial burden of this inundation was significant to the government and the farmers (Littlewood, 2020). Increased frequency and intensity of these events due to global climate change (Lawrence et al., 2013) may exacerbate this financial strain in the future. This brings into question whether it is economically viable to continue to approve concessions alongside the Rangitata River.

5.3 Management

Research from literature reviews indicates the present conservation value of the land may be underrepresented. Previously, braided rivers were thought of as biological deserts (Gray & Harding, 2007). This attitude is changing through the discovery of the diversity of invertebrate communities in braided rivers (including the Rangitata) (Gray & Harding, 2009) and discovery that braided rivers provide dynamic, distinct, and rare habitats for specialized species (Caruso, 2006; Gray & Harding., 2007; Ullmann et al., 2007). Braided rivers are now said to be some of the most diverse and productive ecosystems, but among the most threatened (Caruso, 2006).

Literature indicates braided river diversity is often found in the lateral parts of the river (in creeks and temporarily dry areas) (Gray & Harding, 2009; Gray & Harding., 2007; Caruso, 2006). Therefore, although adjacent land (where grazing is occurring) may not have directly measurable conservation values, the management of this land will heavily impact the braided river ecosystems due to the interconnected nature of their habitats (Caruso, 2006; DOC, 2016; Gray & Harding, 2009; Hamblin, 2019; Ullmann et al., 2007). Furthermore, historic evidence surrounding the Rangitata (Section 4.7.) demonstrates the former biological richness of the environment and the cultural importance to Māori.

This means that the river needs to be managed with a whole systems approach and not compartmentalized (Gray & Harding, 2009; Gray & Harding, 2007). This also aligns with Ngai Tahu Policy (DOC, 2016). Failing to realize this value and manage the river accordingly may lead to further degradation and an undercutting of future generations' interests.

According to policy 2.6.7 of the CMS, grazing concession should not be granted near riverways where land provides surrogate indigenous species habitat or habitat corridors that may provide potential future restoration possibilities (DOC, 2016). Land alongside the Rangitata may provide valuable restoration opportunities (Section 4.5) and have significant habitat value for native and endemic species. A potential avenue for achieving this could be returning PCL to local Rūnanga for management and restoration (through a right of first refusal for iwi as a condition of concessions (Interviewee 1, Appendix D).

5.3.1 Case Study: Arowhenua Rūnanga Restoration Project

DOC started the Ngā Awa River Restoration project in 2019. DOC has invested \$16 million into a Rangitata River restoration project which will create 34 jobs over 4 years. Te Rūnanga o Arowhenua is leading the Lower Rangitata restoration project using \$8.7 million of this funding (Department of Conservation, 2021). The project has the goal of imprinting whakapapa back to the river and restoring its mauri. Work will focus on planting projects, fencing riparian waterways, and pest and weed control. The project is looking to continue further on PCL and

LINZ land (S. Erasito, personal communication, October 4, 2021). Restoration projects such as these could provide a viable alternate use for PCL alongside the Rangitata.

Overall nationwide riparian planting provides net benefits ranging between \$1.7 – \$5.2 billion per year. More importantly, however, benefit-to-cost ratios overall were between 1.4 – 22.4 (Daigneault et al., 2017). This shows that even the least effective riparian planting or restoration systems provide greater benefits than their costs.

5.3.2 Case study: Strategic grazing

Alternatively, a middle ground between a business-as-usual approach and restoration conversion is strategic grazing. Strategic grazing approaches are a relatively simple & low-cost way of reducing the environmental impacts caused by grazing, particularly around waterways (Monaghan et al., 2017). This is done by identifying critical source areas where overland flow of contaminants may be channelled into nearby waterways. These areas are fenced off with a buffer zone surrounding them (Beef and Lamb New Zealand, 2019). The buffer zone acts as a filter and traps contaminants. The faster water flows into a buffer zone, the wider the buffer zone must be (to provide time for effective filtering) (Dairy New Zealand, 2021).

Another strategic grazing approach is the incorporation of periods of planned rest for pastures (McDonald et al., 2019). This ensures that grazing does not occur continuously which minimising environmental impacts. Strategic grazing approaches could be implemented in the Rangitata area to manage grazing in a way that prevents ongoing degradation to the braided river environment.

5.4 Treaty Partnership

Interviewee 1 indicated that from their perspective, Arowhenua are dissatisfied with the current concession granting process, conditions, and outcomes. However, both Interviewees 1 and 2 indicated there have been significant improvements in recent years. The sentiment for ongoing improvement has been echoed by recent legal action taken by Ngai Tahu and Ngai Tai Ki Tamaki. Section 4 of the Conservation Act 1987 requires DOC to ‘give effect to’ the treaty principles. This is the highest standard of treatment of the treaty principles in legislation. The meaning of this treatment has been interpreted by the New Zealand courts.

In *Ngāi Tahu Māori Trust Board v Director-General of Conservation* (1995), the Court of Appeal determined whether DOC was correct in deciding there was no “preference” for iwi in the concession process. The court held that Ngai Tahu are “entitled to a reasonable degree of preference” and that a reasonable treaty partner would have realized that the treaty principles were relevant. This indicates that along the sliding scale of consultation, decisions relating to

concessions appear to be high, and iwi concession applicants may be in a different position to others.

This sentiment was furthered in 2018 in *Ngāi Tai ki Tāmaki Tribal Trust v Minister of Conservation* (2017). The Court of Appeal (approved by the Supreme Court) held that section 4 may require substantive outcomes when “giving effect” to the treaty principles. This could include the decline of concessions applications. Declining applications for concessions may be a way to give effect to the principles by enabling iwi to connect to ancestral land by up taking opportunities on the conservation estate (whether through concessions or in other ways).

These decisions have created uncertainty around the relationship between DOC and iwi. The general comments about section 4 and concessions may have further implications for iwi rights in relation to the management of conservation land and establish a strong duty to consider iwi interests and wishes regarding conservation land.

5.5 Limitations

The major limitations of the project included time constraints, Covid-19, and data limitations. This narrowed the quality and scope of the data collected and analysed.

A farmer who uses PCL concessions was not able to be contacted for a representative view. This has limited the scope of stakeholder’s involvement and perspective.

The current Covid-19 pandemic and the August level 4 lockdown restricted plans to meet with iwi at the Arowhenua marae and visit sites of cultural importance. The pandemic also limited the ability to interview in person, this may have reduced the quality of communication quality due it being online (Race et al., 2021).

The information used for the case study and recommendation on strategic grazing was taken from generic sources and was primarily focused on winter grazing. It was therefore not specific to the Rangitata or braided rivers. The flat nature of a braid-plain may impact the discussed benefits of strategic grazing strategies.

Specific farm incomes for PCL on the Rangitata were not used due to the sensitivity of this information. Instead, average farm type revenues for the Canterbury region from a 2012 report were used. These have limitations because average revenues are likely to have changed since then.

Estimation of weed control cost was taken from a report outlining average herbicide costs for a single application in New Zealand. These costs could differ as herbicide may be applied more than once a year. There may also be other weed control costs not considered here such as the removal of plants. This inaccuracy could have been reduced if the group were able to speak to a

farmer with practical knowledge of weed control.

5.6 Future Research

Future research could be undertaken on the same topic with more specific data collected from and about the study area. The use of financial data that is specific to concessions on the Rangitata would provide a more accurate analyses of costs and potential benefits associated with grazing on this area.

An investigation of strategic grazing and setback distances specific to the braided river environment of the Rangitata could lead to a better understanding of these practices potential to reduce the environmental effects caused by grazing on PCL.

Interviewee 1 discussed a wish for applications to consider the presence of mahinga kai and taonga sites. This projects research into mahinga kai sites was only able to find record of numbers and species collected, not specific locations. To fulfil this wish of Interviewee 1, more detailed mapping of mahinga kai sites would need to be ascertained or created.

6. Recommendations

The results from this research, informed by wider literature have led to the formulation of several recommendations surrounding grazing concessions alongside the Rangitata and the management of PCL more generally.

These recommendations are:

- Implementing more restoration projects to create a better balance of PCL used for concessions versus restoration, and potentially use concession fees to fund restoration.
- Incorporate strategic grazing approaches into conditions to reduce environmental impacts of grazing.
- Increase setback distances to reduce environmental impacts and flooding effects.
- Enforce stricter concession conditions if grazing concessions are to continue.
 - This could include a mandate for concessions to contribute to conservation but would require high level policy change.
- Further improve consultation with local Rūnanga, giving their views more weight in the decision-making process

Wider scale recommendations are:

- Adopting a whole-river management approach to take into account entire braided river system.
- Consider a holistic view of conservation values in Rangitata area and account for past, present, future, potential values, as well as cultural, historical, and environmental values.

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Appendices

Appendix A

Table used for cost-benefit calculations

Farm Type	Total Area (Ha)	Estimated Potential Revenue (Irrigated Land)	Estimated Weed Control Cost	Estimated DOC Concession Revenue
Beef	20877.9	31880553.3	1479199.215	2391041.498
Sheep	755.3	1153343.1	53513.005	86500.7325
Dairy	156.9	1341495	11116.365	100612.125
Total	21790.1	34375391.4	1543828.585	2578154.155

Appendix B

Questions used for Interviewee 1

Questions:
What is the consultation (if any) with Māori when concessions are made available/reviewed?
Are you aware of any concessions that have been granted to Māori?
What alternative land uses would Arowhenua like to see for the land currently being grazed/ what is the vision for the area?
Are there tapu/special areas/mahinga kai areas involved in the area of interest (lower Rangitata) -would you like greater protection for specific areas?
What conditions would you like to see on the concessions?
Are there tapu/special areas/mahinga kai areas involved in the area of interest (lower Rangitata)
Would you like greater protection for specific areas?

Appendix C

Questions used for Interviewee 2

Themes:	Questions:
Concession Application/Process:	
	What is the process for your team when an application for a concession is received?
	Has there been a more visible shift to consider iwi opinions on granting concessions? How might that look in the future?
	Has a concession ever been denied? For what reason?
Concession Conditions:	
	What are the types of conditions that concessions can have?
	How are the conditions for a concession formulated?
	Are there any cases of conditions being breached?
Renewals:	
	How do concession renewals work in the case of the Rangitata?
Monitoring and Compliance:	
	When a concession is granted, is it monitored? If so, how often over its term?
	What are the consequences for failing to comply with the conditions of a concession?
Costs:	
	Do you have any estimates of general income per Ha for grazing, cost of irrigation, weed control, etc.?
Other:	
	Do you know of any farmers we could talk to?

Appendix D

Interviewee 1: Vision for Concession Process

Potential conditions for concessions could include:

1. Offering a right of first refusal for renewals and new concessions to local Rūnanga.
2. If Rūnanga refuse offer, then the length of a concession would be next concern (i.e. the shorter the better)
3. Determining the type of intensification:
 - a. What is the scope of the intensification
 - b. What type of grazing
 - c. How much is planned
4. Ensuring that public access is maintained
5. Before approving any concession, undertake an assessment of what is on the PCL:
 - a. Consider any signs of:
 - i. Tributaries
 - ii. Biodiversity
 - iii. Mahinga kai sites
 - iv. Taonga sites
 - b. If a waterway is present:
 - i. Is it fenced off?
 - ii. What is the setback? Would like to see mandatory distances increase.
 - iii. Is there riparian planting?
 - c. Flooding: some farmers are abandoning flooding land and letting the river take over. Interviewee said local Rūnanga would like this land planted, fenced off and left alone.
6. Include a mandate that requires concession holders to contribute to conservation (e.g. protect and increase biodiversity through restoration).