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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

A concession allows the holder to carry out commercial operations on PQL, including the grazing of livestock. Applications for concessions on PQL in Canterbury must follow the guidelines in the QMS and any other relevant policies and legislation (DQC, 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). Ty(4(ic)3i)9(20)-5(16)-5().)5()-3(T)-2q0.00000912 0 6

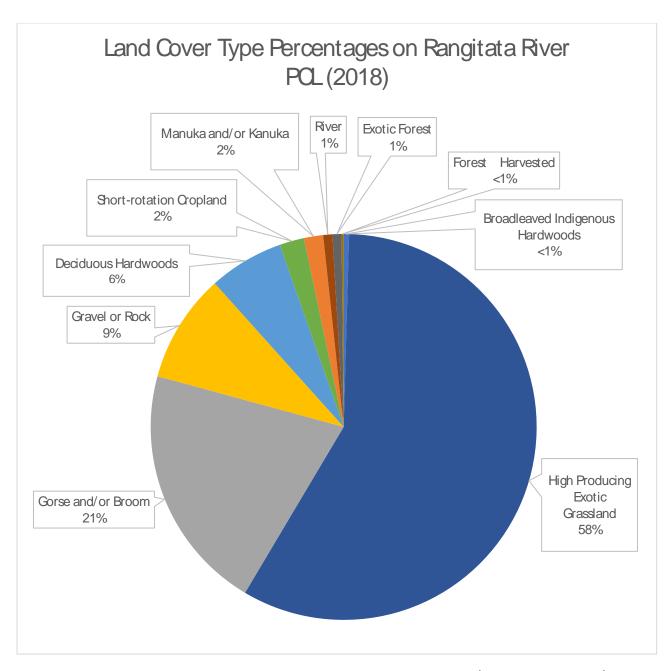


Figure 4: Land cover type percentages on the Rangitata River PCL (scinfo.org.nz, 2020).

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).

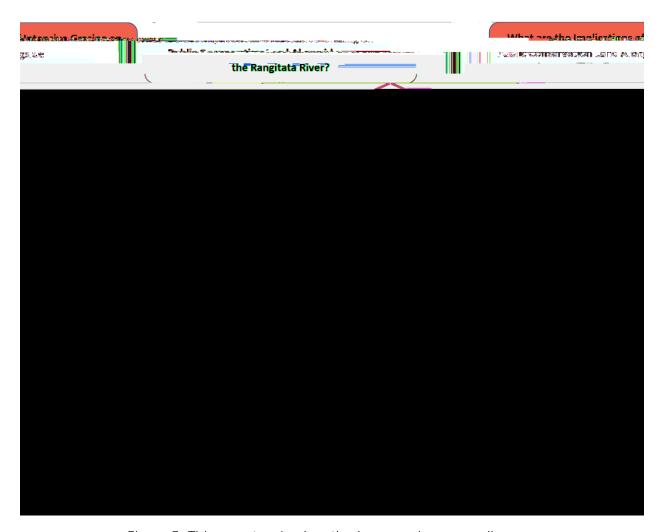


Figure 5: This reports mixed methods research process diagram.

3.2 Change Over Time

Geographic Information System (GIS) techniques were used to analyse POL change over time. Data were sourced from Land Information New Zealand (LINZ) and filtered in ArcMap to show only POL. 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, 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 PQL land in New Zealand used for grazing. This dataset detailed the number and type of concessions on PQL 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 PQL 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

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



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; Toit Te Whenua–Land Information New Zealand, 2011, 2019, 2021).



4.3 Advantages of Current Process

In 2012 there were 60 concessions for grazing and agriculture on PQL in Canterbury (DOC, 2016). This is comparatively low

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. Ste 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

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).

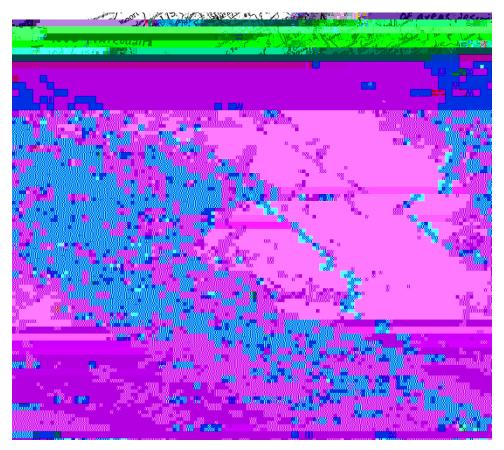


Figure 8: Shaded section shows area where all mahinga kai sites (including from Table 3) are located (modified from Anderson, 1988b).

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	Provides a list of mahinga kai sites (compiled by Kahu and Kuri at Arowhenua in 1889). Indudes places along the Rangitata. Referenced Beatties book (Table 3)
Wai27, H004 -Barry Brailsford	Documents that Rangitata was a trail used by iwi to access interior lakes (Hakatere trail)
Wai27, H010 - Jacko Reihana, Bill Torepe, Kelvin Anglem, Murray Bruce, Kelly Davis and Rangimarie Te Maiharoa	Rakitata well known for abundance of food resources to Maori

Table 3: Mahinga Kai sites near the Rangitata.

Place name:	Ste 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	

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

Ourrent 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).

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

This sentiment was furthered in 2018 in Ng i Tai ki T maki Tribal Trust v Minister of Conservation (2017). The Court of Appeal (approved by the Supreme Court) held that section 4 may require substantive outcomes to the treaty principles. This could include

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 PQL 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 R nanga, 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.

7. Acknowledgements

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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		

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 comquences for failin

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 R nanga.
- 2. If R Qlfgt GaQ g0 GaQ g0 GaQ g0 GaQi2s3()6(C)3(on)-7(c)3(reW*nBT/F1 11efp8 708.7 Tm0 g0 G[(A)-3