Water Ways
Consulting Ltd

RANGITATA RIVER CATCHMENT UPLAND LONGJAW GALAXIAS (GALAXIAS PROGNATHUS) SURVEY 2020

Prepared for: The Department of Conservation, Raukapuka / Geraldine Office
Date: July 2020
Report Number: 84-2019A

Table of Contents

List of Figures

List of Tables

Acknowledgments: Upper Rangitata Gorge Landcare Group and landowners are thanked for access, knowledge and assistance with this study.

Cover photos: Upland longjaw galaxias (top) and Clyde and Sinclair Rivers (bottom)

CHAPTER 1 INTRODUCTION

1.1 BACKGROUND

The upland longjaw galaxias, *Galaxias prognathus* is a small non-migratory galaxias currently found in two river catchments, the Rangitata and Rakaia rivers of Canterbury, New Zealand. Prior to 2002 all longjaw galaxias records in New Zealand, that included sites in the Kauru River, North Otago, and the Waitaki, Rangitata, Rakaia, and Hurunui rivers in Canterbury, and the Mauria River in Westland were attributed *G. prognathus.* However, in 2002 McDowall & Waters (2002) described the lowland longjaw galaxias (*G. cobitinis*) from the Kauru River in North Otago. Subsequently, some populations of longjaw galaxias in the Waitaki River catchment were also recognised as being lowland longjaw galaxias. Further genetic studies (Waters & Craw 2008) has shown both the lowland longjaw galaxias and upland longjaw galaxias are genetically divergent from the longjaw galaxias in catchments to the north and south. This has led to the longjaw galaxias populations in the Waitaki catchment to be designated as indeterminate taxa (Dunn et al 2018) and treated as distinct from the two described species, upland longjaw galaxias (Waitaki River), *G. aff. prognathus* "Waitaki", (to the north) and lowland longjaw galaxias (Waitaki River), *G. aff. cobitinis* "Waitaki" (to the south) (Bowie et al 2014). While the taxonomic revisions have been conducted, survey work by the Department of Conservation and other parties has failed to find longjaw galaxias in the Hurunui and Mauria catchments. It is now believed that these population are extinct. This reduction in geographic range due to population losses and the taxonomic revisions now leave the upland longjaw galaxias (Canterbury-West Coast) restricted to the Rangitata and Rakaia catchments. In line with this the threat classification for the species has been raised to *Nationally Vulnerable* (Dunn et al 2018).

Within the two remaining catchments the upland longjaw galaxias is restricted to reaches above the Canterbury Plains, but have not been reported in areas of the very upper reaches of these rivers. However, the present upstream and downstream limits are poorly defined due to limited survey effort and limited access to the upper reaches of the catchments.

A research project undertaken by the NIWA in the early 1990s gathered life history upland longjaw galaxias from sites in the Rangitata River and a tributary, Deep Stream on Erewhon Station (Bonnett 1990). This study provides the only information on the life history of upland longjaw galaxias.

1.2 SCOPE OF THE STUDY

The survey was designed to revisit reaches of the Rangitata River and its tributaries that have historic records of upland longjaw galaxias and also survey previously unsurveyed to attempt to delimit the current upstream and downstream limits and areas of high abundance for this species in the Rangitata catchment. The survey was conducted after an extremely large flood in the Rangitata catchment on the 9 December 2019 when the river at the Klondyke flow recorder peaked at approximately 2,700 m^3/s. This flood was expected to have some influence the results in terms of fish abundance and distribution. Fish length and abundance data was gathered to assess the health of the upland longjaw galaxias population and provide some insight into the possible flood effects.

CHAPTER 2 METHOD

Fish surveys were conducted over two weeks, 13-17 January 2020 and 17-20 February 2020. with up to three teams of two or three people conducting the survey work. All sites were fished using an EFM 300 backpack electric fishing machine. Sites were fished with a single pass and a pole net was used to collect downstream drifting fish. At most sites following each lift of the pole net fish in the net were identified to determine if any upland longjaw galaxias had been caught. When upland longjaw galaxias were noted to be in the pole net, habitat conditions were noted.

The fish survey targeted areas of habitat considered to suitable for upland longjaw galaxias and concentrated on shallow riffle habitat. Riffle habitat in the Rangitata River braids and tributaries is highly variable with the size of substrate particles and the packing of the particles being different. Upland longjaw galaxias have been reported to be found amongst loosely packed cobble riffles that are very shallow (Figure 1, Figure 2) (McDowall 1980, Allibone pers. obs.)

Figure 1: Riffle habitat in a spring fed tributary stream.

Figure 2: Riffle habitat in a Rangitata River braid.

Previous fish surveys on the Rangitata and Rakaia catchments have also found upland longjaw galaxias are common in spring fed streams and springs that feed directly into the Rangitata River braids. Therefore, the survey sites were spread across tributaries, springs fed braids of the main river channels and the main river braids. The survey area was restricted to the area upstream of the Rangitata Gorge and included tributary streams on the true left and true right of the Rangitata River (Figure 3).

All fishing was carried out on main stem river in conditions of falling river levels after high flow events.

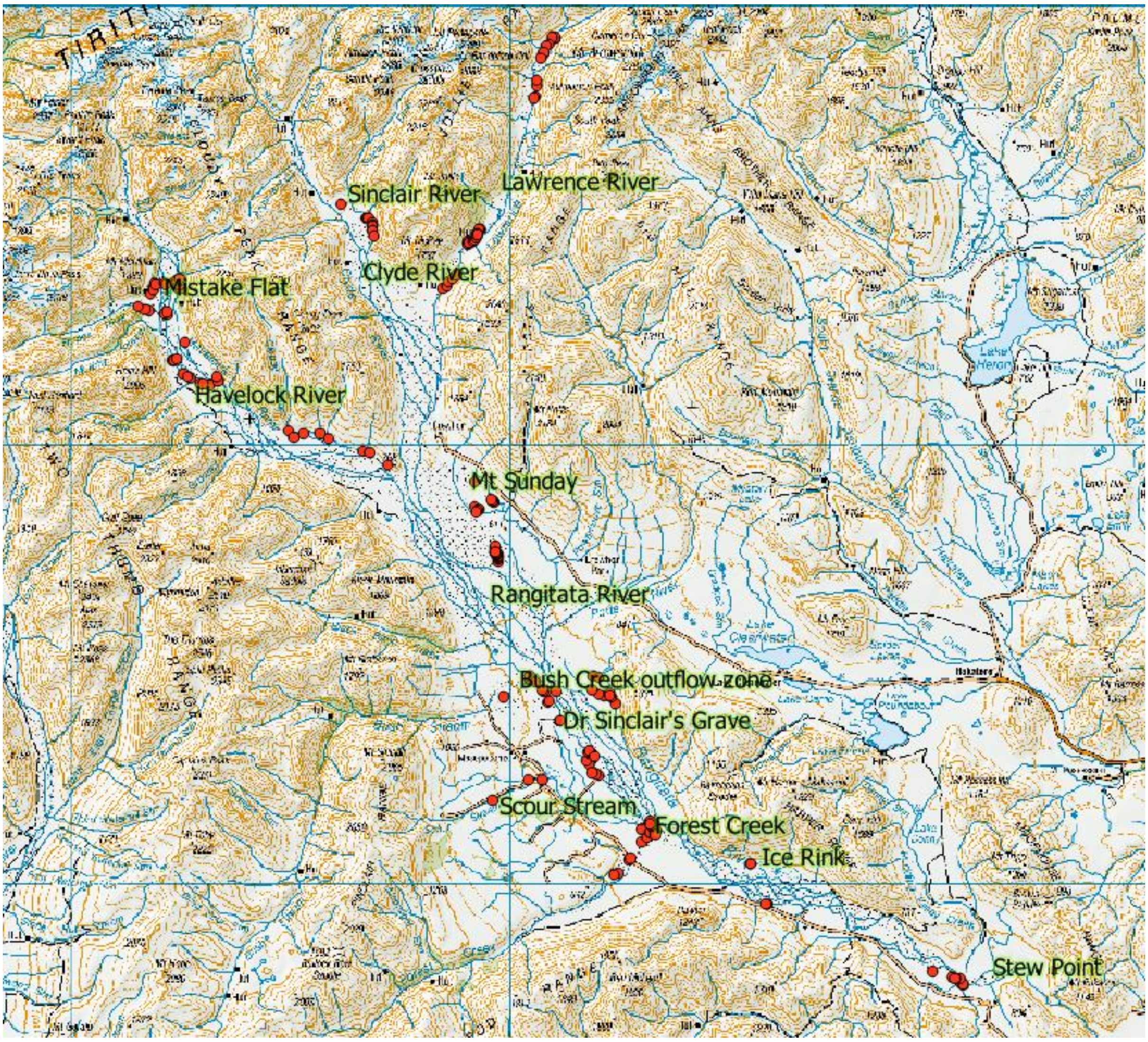

Figure 3: The location of all 2020 fish survey sites in the Rangitata River catchment.

As the objective of the fish survey was to locate areas with upland longjaw galaxias, sample sites varied in area as the survey teams sought to locate this fish rather than taking a standard sample area or reach length approach. Area fished therefore varied amongst the sites from approximately 10 m^2 to 200 m^2 depending on the area of riffle and run habitat considered suitable for upland longjaw galaxias to reside in. All fish caught at a site were identified to species level. The number of each species caught was recorded and all the upland longjaw galaxias and the majority of the fish from other species were measured before being released back to the river. When large numbers of upland bully and alpine galaxias where collected only a subset were measured and the rest counted.

Upon completion of the survey work the NZMS 50 maps the river gradient for areas occupied and unoccupied by upland longjaw galaxias. The change in altitude was read form the map contours and an estimated of river length was obtained by measuring river distance in a GIS setup for mapping the results. River gradient was calculated as m/km.

CHAPTER 3 RESULTS

3.1 FISH SPECIES OCCURRENCE AND DISTRIBUTIONS

Seven fish species were collected from the 185 sites surveyed (Table 1). The most frequently caught and most widespread species was the alpine galaxias (Figure 4). All other species collected had more limited distributions. The next two most widespread species were also galaxiids, Canterbury galaxias (Figure 5) and upland longjaw galaxias (Figure 6). The upland bully (Figure 7), and the three introduced salmonids, Chinook salmon (Figure 8), brown trout (Figure 9), rainbow trout (Figure 10) were all restricted to the Rangitata River and tributaries downstream of the Clyde and Havelock river confluence.

Table 1: Fish species caught and summary information for catches.

Species	Common name	Number of sites and percentage sites the fish was caught at	Total number caught	Maximum number at a site
Galaxias paucispondylus	Alpine galaxias	108 (56 %)	1493	112
Galaxias vulgaris	Canterbury galaxias	68 (37 %)	376	71
Galaxias prognathus	Upland longjaw galaxias	40 (22 %)	183	32
Gobiomorphus breviceps	Upland bully	68 (37 %)	741	37
Salmo trutta	Brown trout	34 (18 %)	95	8
Oncorhynchus mykiss	Rainbow trout	15 (8 %)	22	4
Oncorhynchus tshawytscha	Chinook salmon	1 (0.5 %)	1	1
No fish caught		45 (24 %)	-	-

However, the fish abundance that is reported across the survey does provide a reasonable representation of the relative abundance of the seven species. Alpine galaxias, as well as being widespread was the most abundant fish encountered. Upland bully was also abundant in the areas where it was present. Salmonids were generally rare and commonly small fish less than 100 mm long. The small size was due to the sampling programme targeting shallow riffle habitats that are not suitable habitat for larger salmonids that were present in streams such as Scour Creek (Figure 11). However, even small salmonids were absent from samples from the Havelock and Clyde rivers and other areas of the upper Rangitata catchment.

Forty five sites were fished where no fish were collected. These sites were more common in the upper reaches of the catchment (Figure 12)

The majority of sites (that had fish) had combinations of alpine galaxias, upland longjaw galaxias, Canterbury galaxias and upland bully. The sample sites with the most fish had high numbers of alpine galaxias and upland longjaw galaxias and were collected from riffle habitat on the braided riverbed downstream of the Bush Creek outflows. At these sites, while up to 32 upland longjaw galaxias were caught, alpine galaxias where up to four times as abundant (Figure 13).

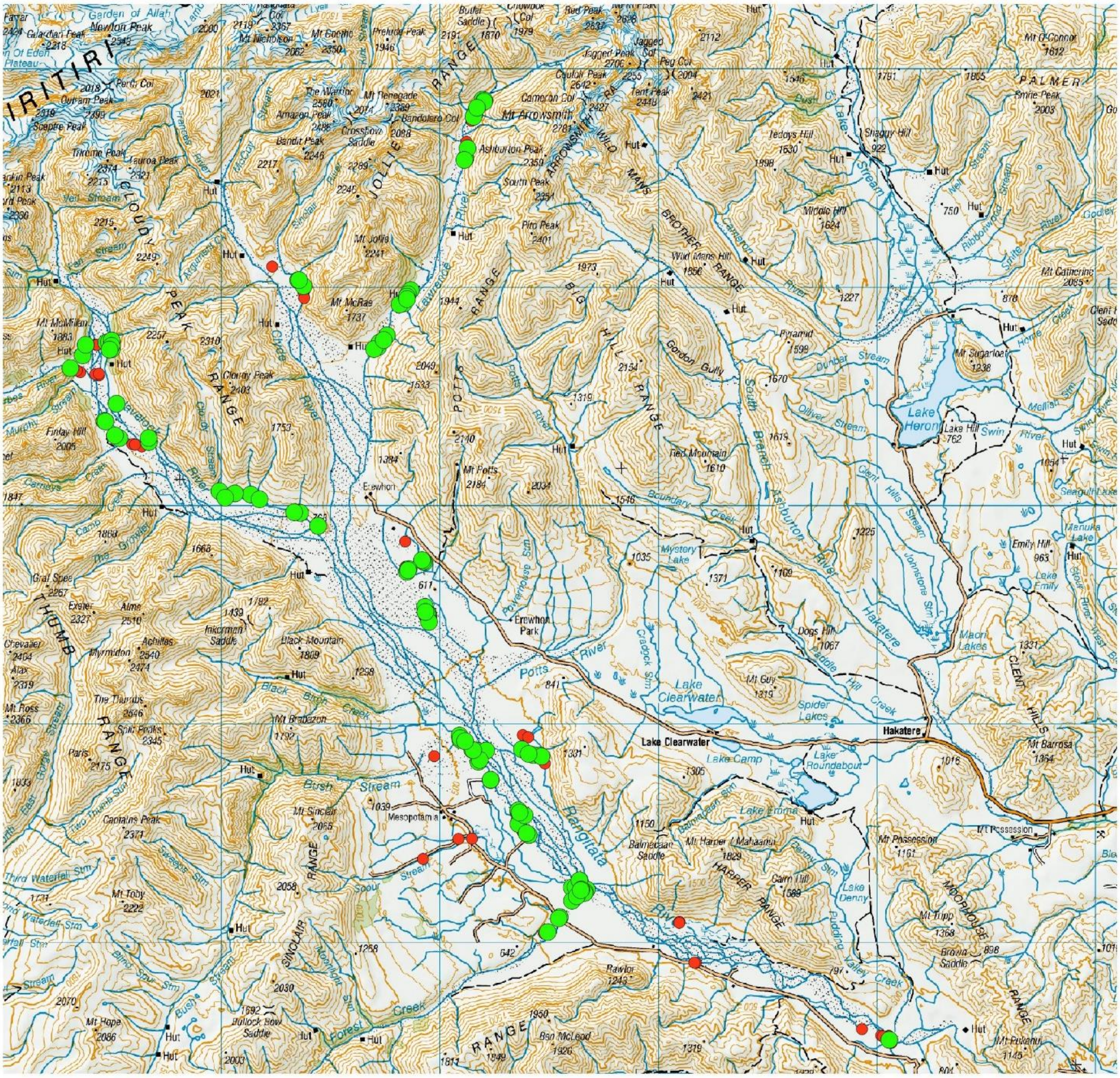

Figure 4: Alpine galaxias locations (green) and other survey sites (red).

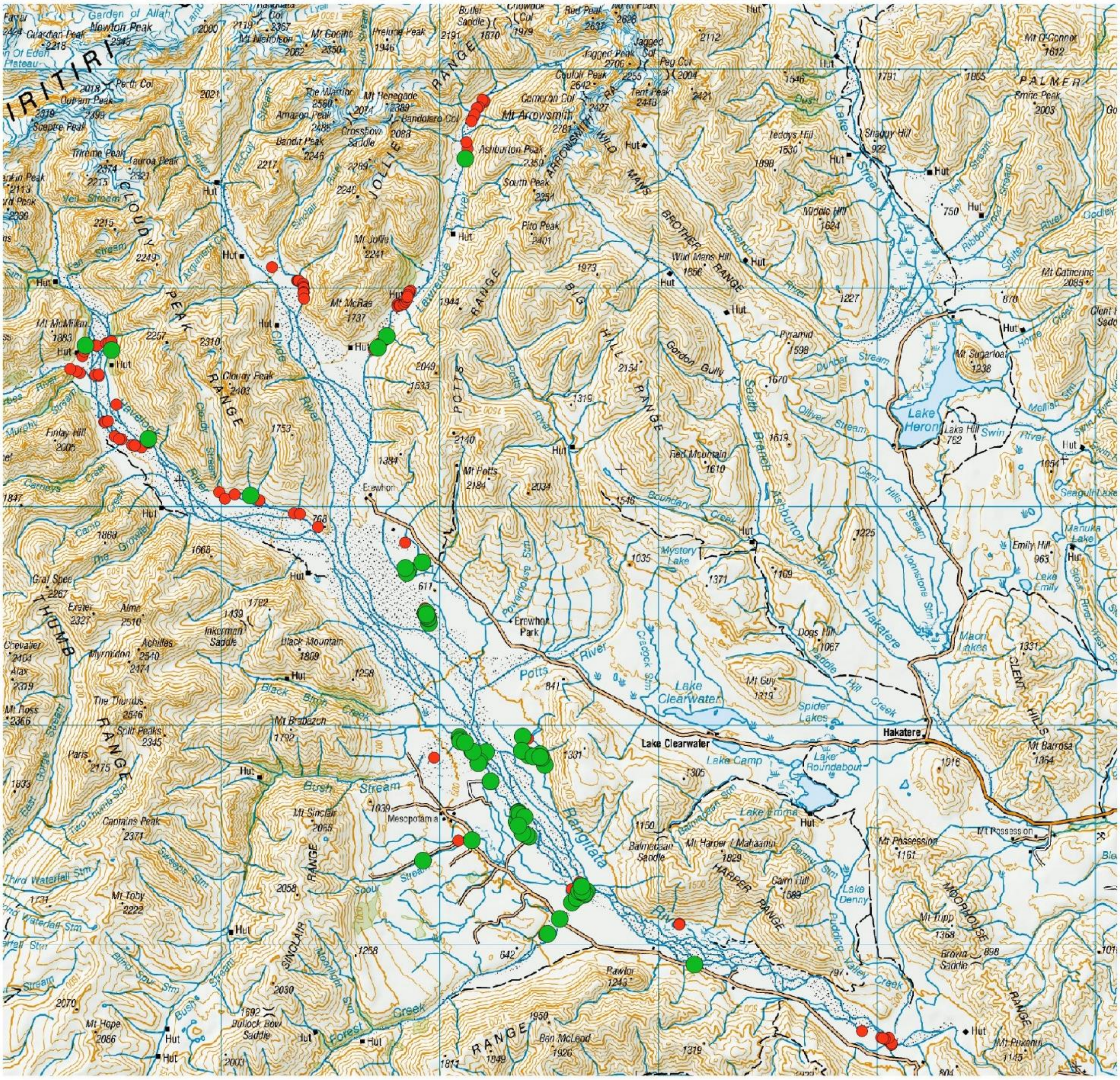

Figure 5: Canterbury galaxias locations (green) and other survey sites (red).

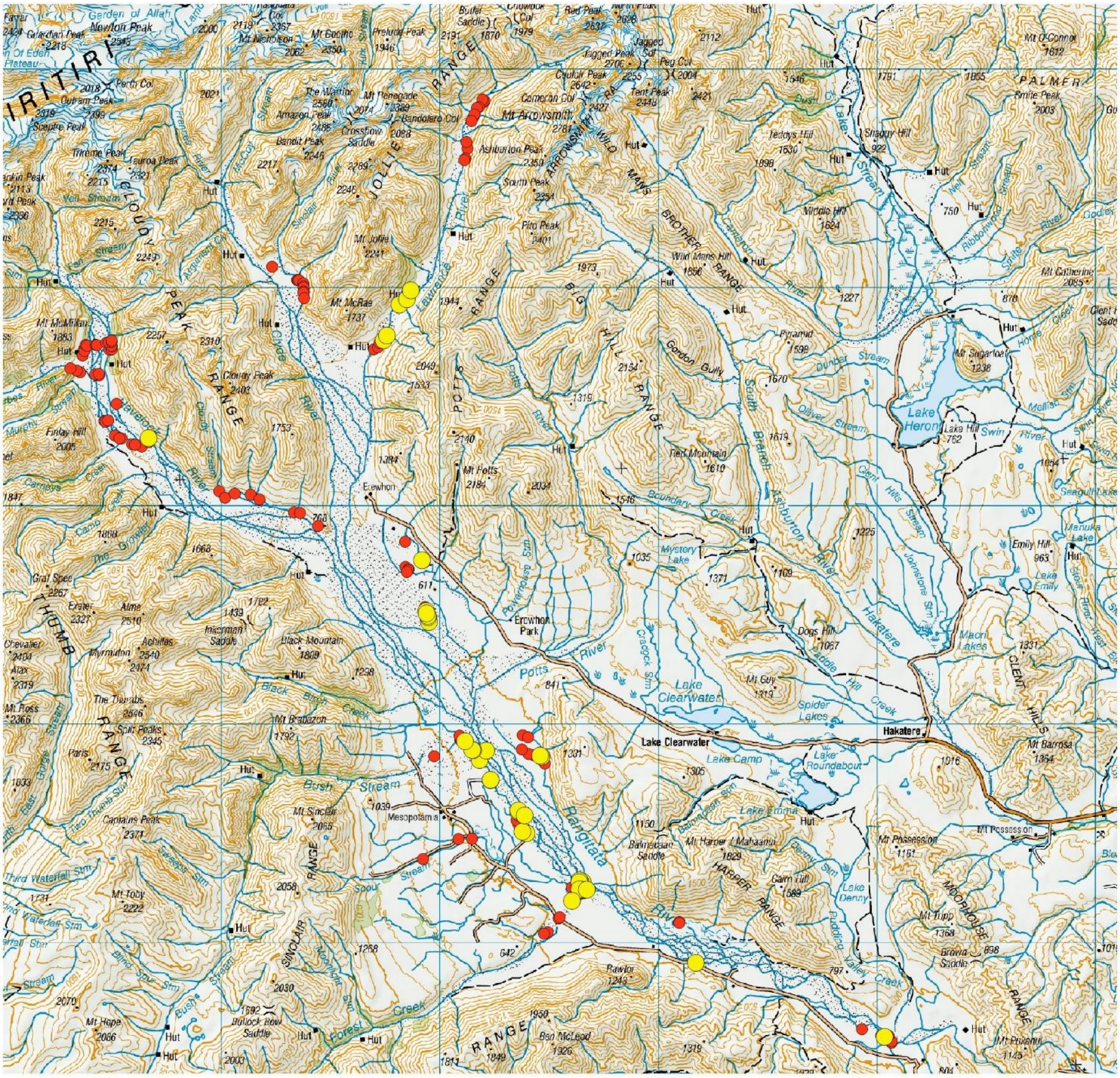

Figure 6: Upland longjaw galaxias locations (yellow) and other survey sites (red).

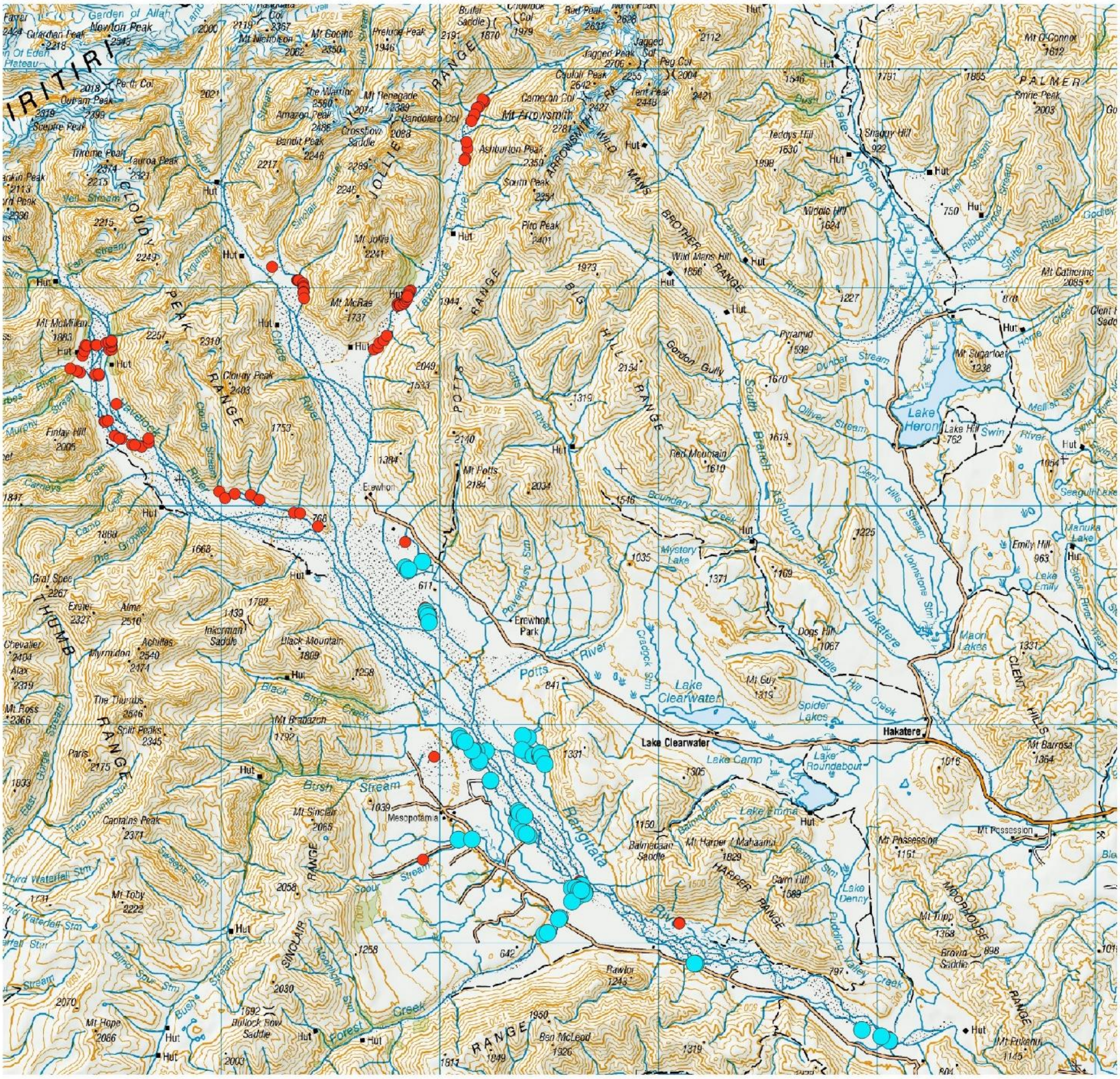

Figure 7: Upland bully locations (blue) and other survey sites (red).

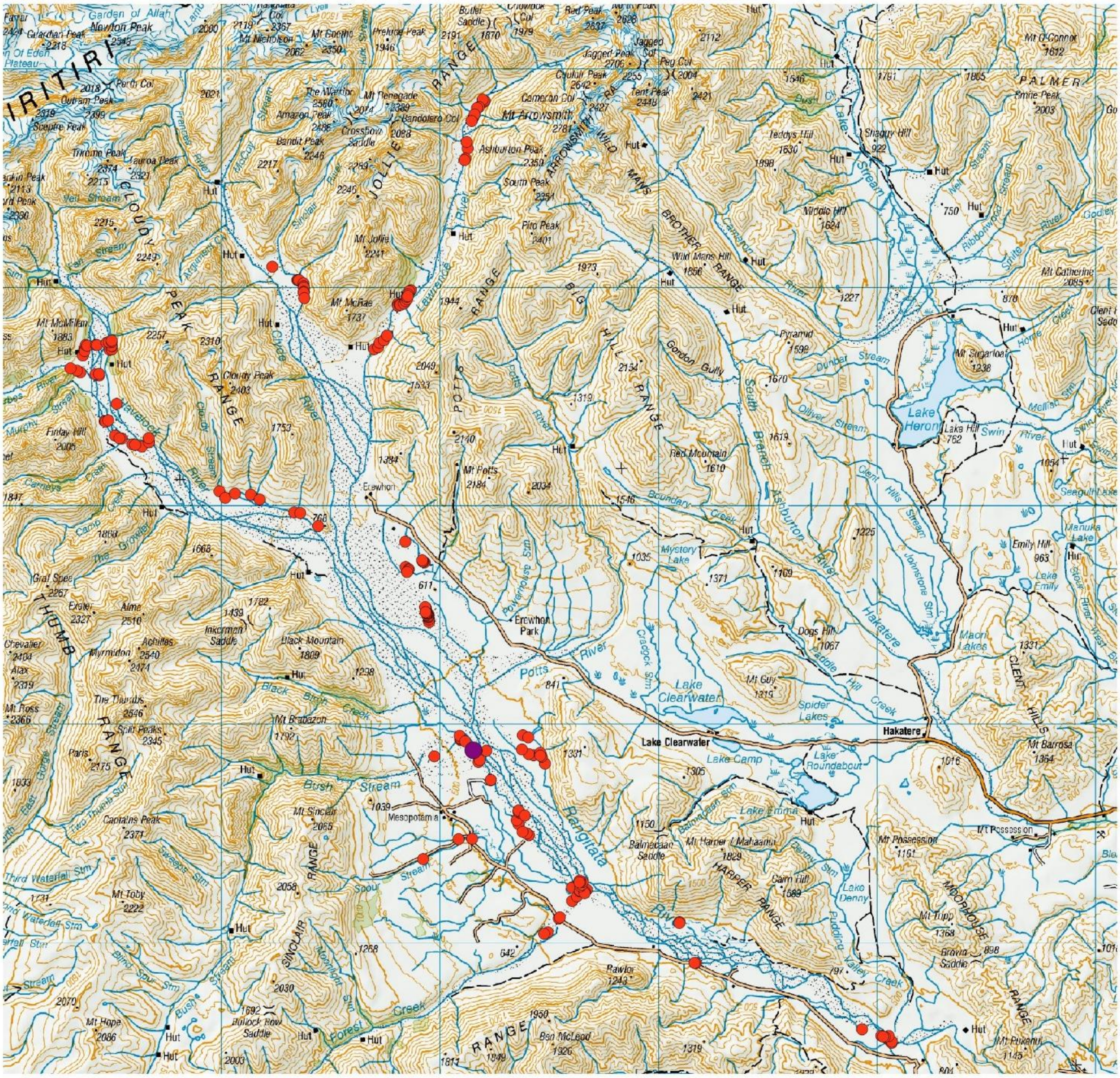

Figure 8: Chinook salmon locations (purple) and other survey sites (red).

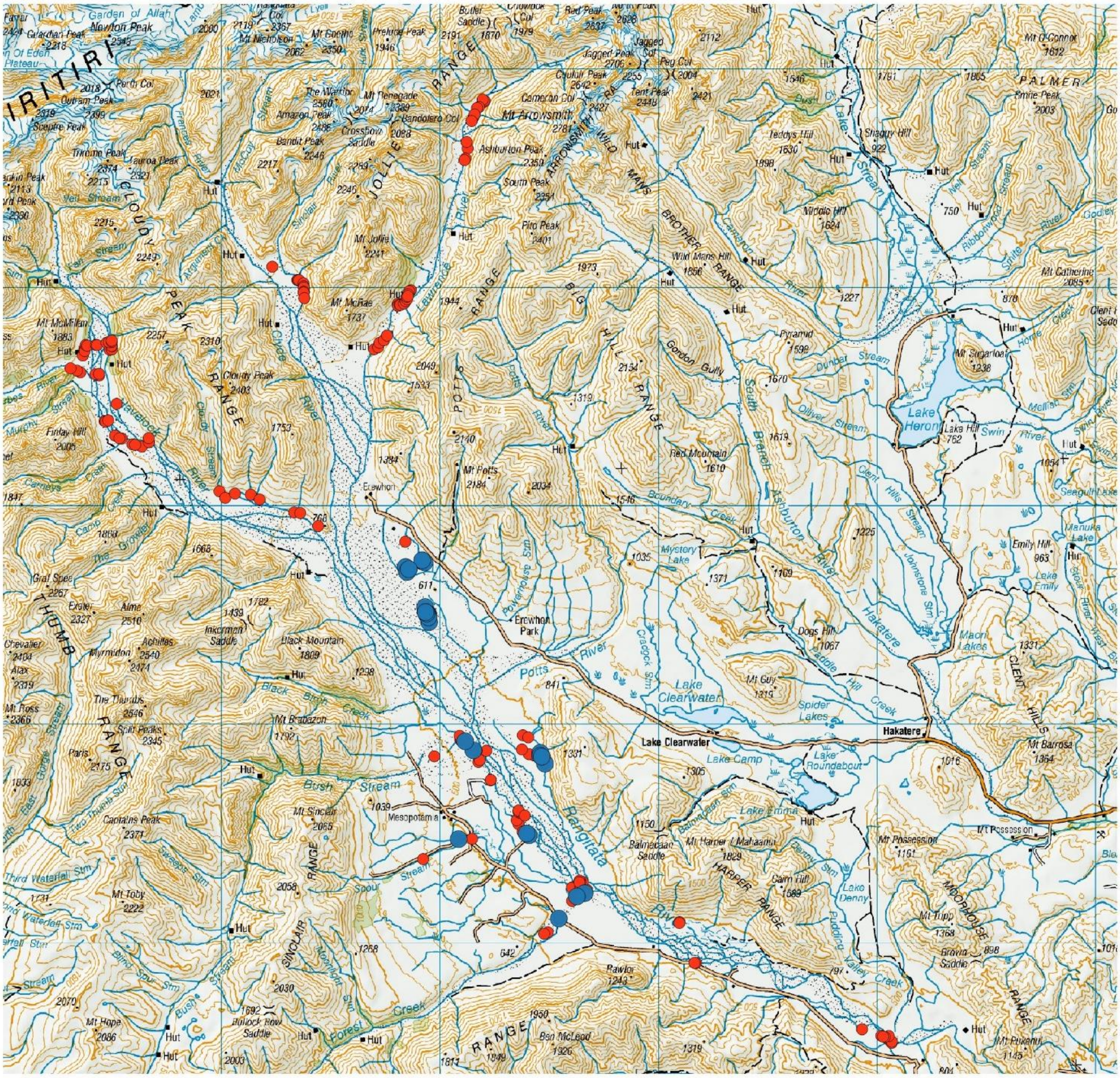

Figure 9: Brown trout locations (blue) and other survey sites (red).

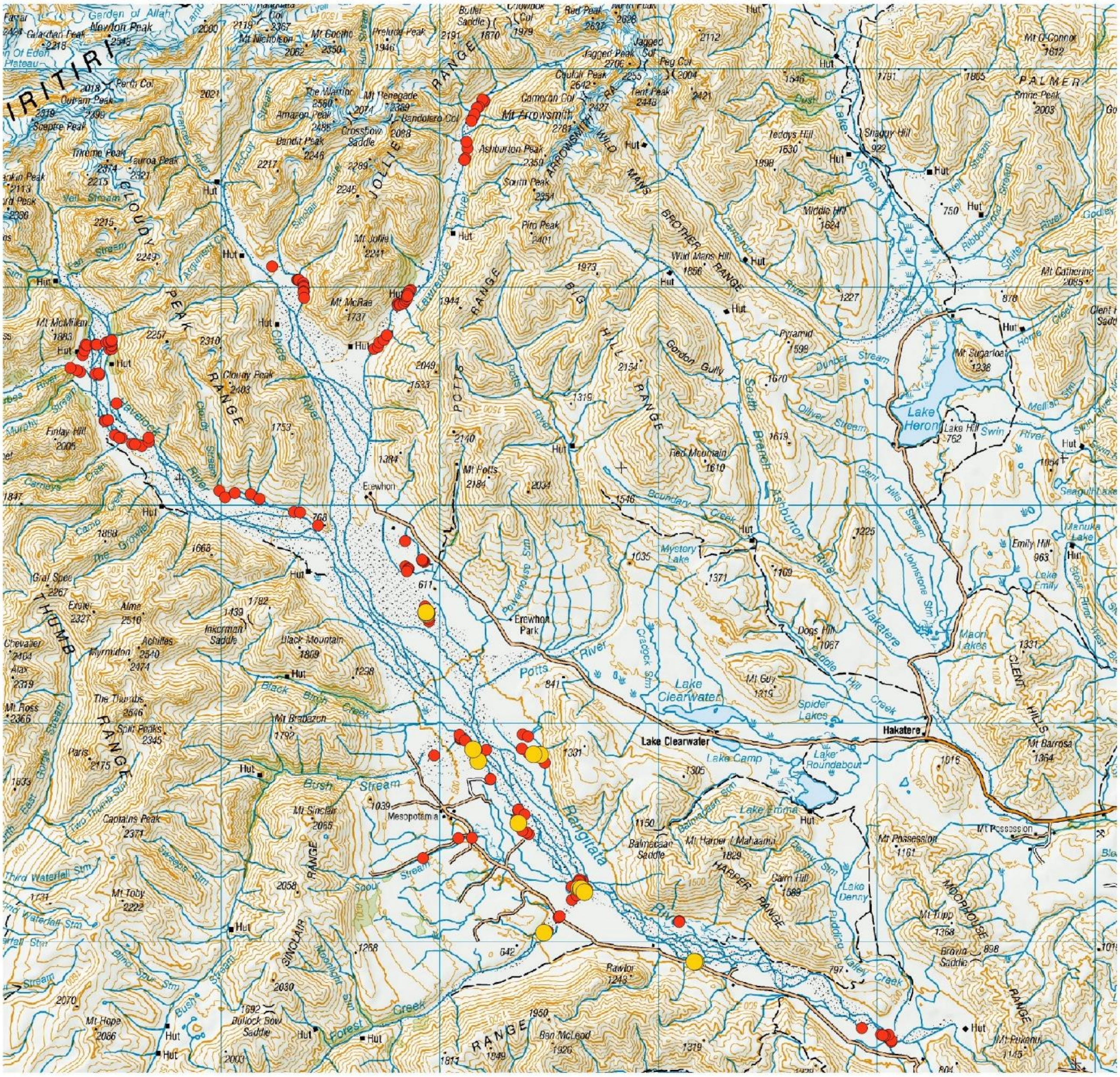

Figure 10: Rainbow trout locations (yellow) and other survey sites (red).

Figure 11: A rainbow trout from the lower reaches of Scour Stream.

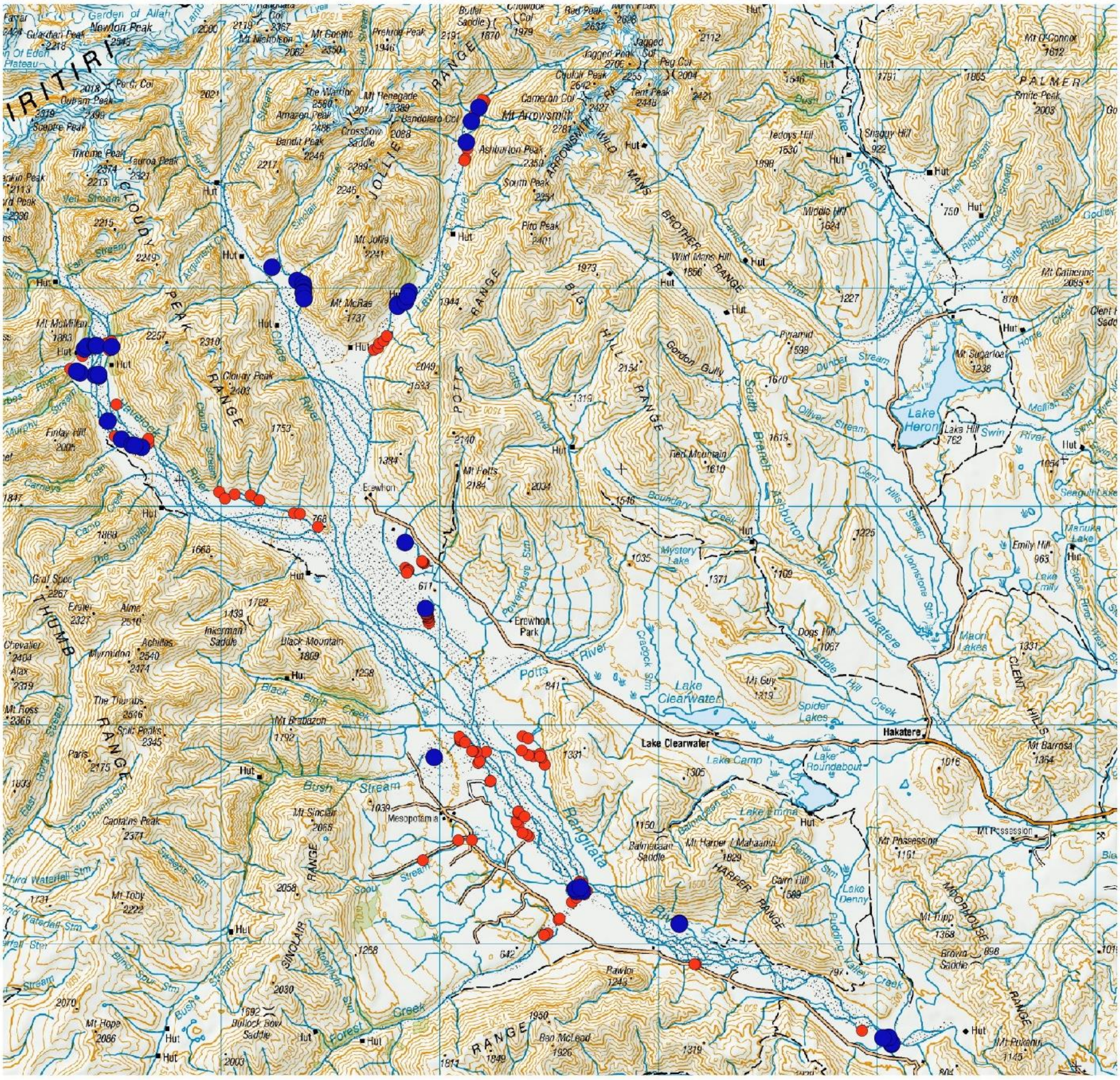

Figure 12: No fish collected locations (blue) and other survey sites (red).

Figure 13: Alpine galaxias, upland bully and upland longjaw galaxias collected from approximately 20 m^2 of riffle habitat at Site R30.

3.2 UPLAND LONGJAW GALAXIAS

3.2.1 DISTRIBUTION

Fish surveys in the upper Havelock River found no upland longjaw galaxias. Habitat sampled in these areas was varied and included braided river channels, tarns, springs and spring fed streams. The survey collected 2 upland longjaw galaxias from one tributary of the Havelock River in the mid-reaches of the river (Figure 14). This site has two spring fed streams flowing out on to the braided riverbed via a large pool and riffle to then form a braid channel on the true left of the Havelock River riverbed. A return visit to this stream in March located a large adult in the same riffle and a smaller juvenile upstream in the small spring fed stream where is flows on to the braided riverbed. Aside from this small site no other upland longjaw galaxias were located in the Havelock River despite sampling sites in the upper, mid and lower reaches and the lower reaches of some tributaries (Figure 6).

Figure 14: Spring fed tributary of the Havelock River, upland longjaws found in the first riffle on the braided river bed and outflow of the small spring fed stream (arrowed).

Sampling in the Clyde River catchment was restricted to the lower Sinclair River. No upland longjaws were located in this area despite a range of disturbed and stable spring fed streams and braids being sampled.

The Lawrence River was sampled in two areas. A lower reach that includes a spring fed area where upland longjaw galaxias have previously been caught (in 2010, 2011 and 2016). Eleven upland longjaw galaxias were collected in this reach. Sampling was also conducted in the upper reaches of the Lawrence River and no upland longjaw galaxias were found at these upper reach sites (Figure 6).

Sampling was conducted in spring fed streams around Mt Sunday. Six upland longjaw galaxias captured in this area.

River braids on the true right bank of the Rangitata River were sampled along with the tributaries Bush Stream, Scour Stream, Tui Stream and Forest Creek. Upland longjaw were abundant in some riffles along a 4.5 km reach from Bush Stream, past Dr Sinclair's Grave and downstream (Figure 15). The fish were also common at the confluence of Forest Creek and the Rangitata River.

Upland longjaw galaxias were collected in low numbers at sites from Forest Creek downstream to Stew Point. These fish were collected from Rangitata River braids and tributary sampling was limited to two sites in an un-named stream, at the Ice Rink site, on the true left bank of the Rangitata River (Figure 7). The collection of two upland longjaw galaxias near Stew Point was 10 km further downstream than any previous record of upland longjaw galaxias (in the New Zealand freshwater fish database).

Using the most upstream and most downstream records from this survey the distance from the Havelock River and the Lawrence River upland longjaw galaxias sites to the Stew Point site the upland longjaw galaxias are present along a 45 km and 48 km reach of the Rangitata River. However, the high-density zone of upland longjaws is a smaller reach approximately 10 km long centred on the true left of the Rangitata River from Bush Creek downstream.

Sampling in various tributaries in including Forest Creek and Scour Stream found upland longjaws in small numbers and general these were juvenile fish. Upland longjaws were present in the first riffles of Forest Creek upstream from the confluence with the Rangitata River and one individual was found further upstream. Three juvenile individuals were found in the very lower reach of Scour Creek. Five upland longjaw galaxias were found in Trib A, a spring fed stream close to the true right of Rangitata River and three in Trib B a second spring fed stream on the true left of the river (Figure 15).

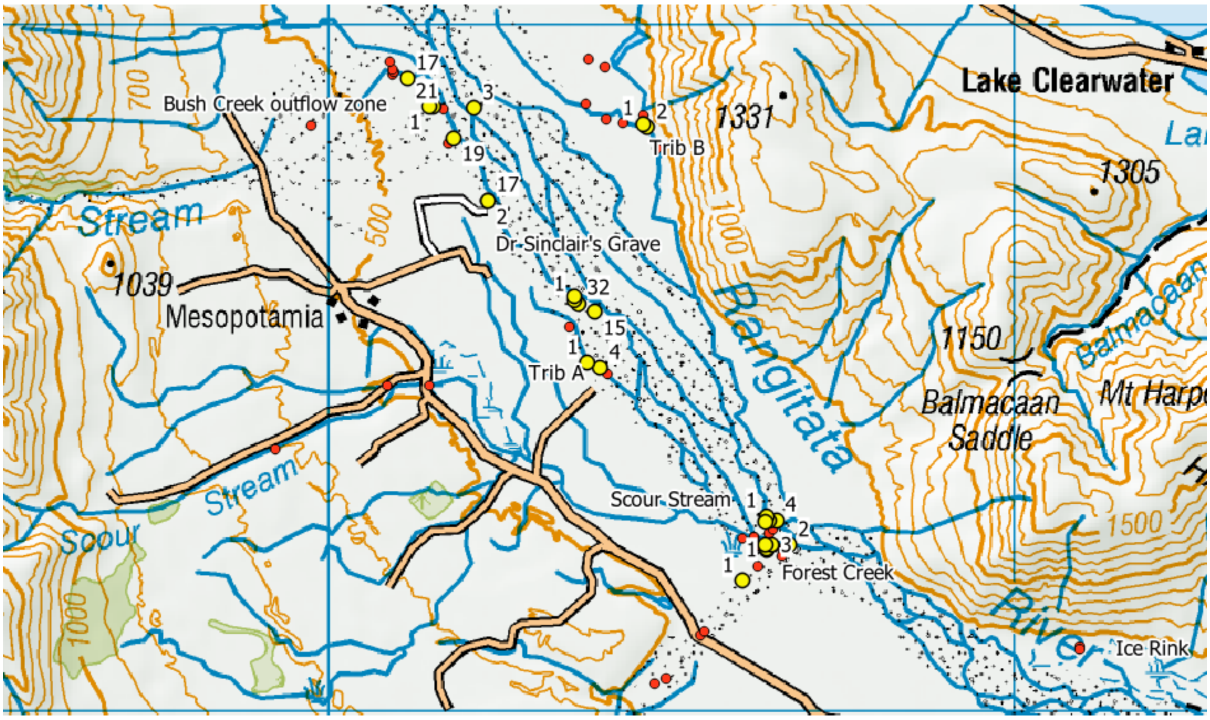

Figure 15: Upland longjaw galaxias locations (yellow) with number the number of fish, and all sampling sites (red) in the high density reach of the Rangitata River.

The river gradient was calculated for a series of river reaches that encompass various upland longjaw galaxias population states – no longjaws, low density areas and high density reaches. The upland longjaw galaxias appear to be absent from the Clyde River upstream of the Lawrence River confluence and the section of the Clyde for 5 km upstream of the confluence with the Lawrence has a gradient of 0.020 m/km, whereas the lower Clyde River downstream of the Lawrence confluence has a gradient of 0.015 m/km. The Lawrence River has a gradient of 0.010 m/km in the reach occupied by upland longjaw galaxias. The upper Havelock River from the upland longjaw galaxias stream to Mistake Flat has gradient of 0.021 m/km. Whereas the lower Havelock River from the upland longjaw galaxias stream to the Clyde River confluence has a gradient of 0.012 m/km. The Rangitata River section from Mt Sunday to Forest Creek, the main section occupied by upland longjaw galaxias has a gradient of 0.003 m/km.

3.2.2 UPLAND LONGJAW HABITAT USE OBSERVATIONS

The sampling programme often sampled areas in very close proximity to one another as adjacent riffle habitats were at times sampled and the sampling moved from stable braids, spring fed streams, to highly unstable minor and major braids of the Rangitata River. This sampling strategy observed a number of habitat features that appeared correlated to the habitat the upland longjaws were found in.

Using the abundance and size range of the upland longjaw galaxias collected at sites as a guide to habitat preference, then riffle habitat with three characteristics indicate its suitability for upland longjaw galaxias:

- Very shallow water estimated to be less than 5 cm deep and often 1-2 cm deep;
- Loose gravel and cobble substrate that was easily disturbed; and
- A relatively steep riffle gradient (Figure 16, Figure 17).

When these habitat conditions were not all met there was still a preference for very shallow water or cover amongst the stream bed substrate for the fish.

While upland longjaw galaxias were present in spring fed areas none were collected from the springhead, rather these areas were generally occupied by Canterbury galaxias. However, the spring heads were often small, estimated to be just a few 10s cm wide and the spring flows were often estimated to be less than 1 L/s at individual outflow points (Figure 18).

When silt and sand was abundant on the stream or riverbed upland longjaw galaxias were rare or absent (Figure 19). The presence of these fine bed material often meant there was little if any interstitial space for the galaxiids to reside in.

When riffle habitat was not present low numbers of upland longjaws could be found in habitat that provided some cover for the fish. This was not common but at the mouth of Forest Creek/Scour Burn a line of small cobbles on a gravel stream bed provided cover that was used by juvenile upland longjaw galaxias (Figure 20).

Figure 16: Riffle habitat in a Bush Creek channel utilised by upland longjaw galaxias.

Figure 17: Rangitata River braid riffle with abundant upland longjaw galaxias.

Figure 18: Small spring fed stream riffle habitat with no upland longjaw galaxias.


Figure 19: Rangitata River braid riffle with no upland longjaw galaxias.


Figure 20: Forest Creek Scour Burn confluence with green algal marking a line of cobbles that juvenile upland longjaw galaxias were found amongst.

The sampling at many sites around the river, found no upland longjaw galaxias. The presence of unoccupied riffle habitat, especially in the upper reaches of the catchment indicate habitat alone is not controlling the presence or absence of upland longjaw galaxias.

3.2.3 UPLAND LONGJAW GALAXIAS LENGTH RANGE

The two survey weeks collected a total of 185 upland longjaw galaxias. The shortest upland longjaw galaxias captured was 40 mm long and the longest 80 mm long. The majority of fish collected where between 40 mm and 66 mm long. Length frequency graphs do not show any distinct length frequency cohorts that would indicate different year classes (Figure 21). A comparison of the size range of upland longjaws collected upstream of Bush Creek versus Bush Creek and downstream shows the catch in the Lawrence, Havelock and Mt Sunday areas was composed of a few large fish with the three largest upland longjaw galaxias collected in the upper catchment.

Bush Creek to Forest Creek was composed of a wider size range including fish between 40 mm to 60 mm that were almost absent from the upper catchment areas (Figure 21). The difference in length frequency is more pronounced for upland longjaw galaxias caught in Forest Creek and the Rangitata River at and downstream of Forest Creek with the majority of these fish being less than 50 mm long.

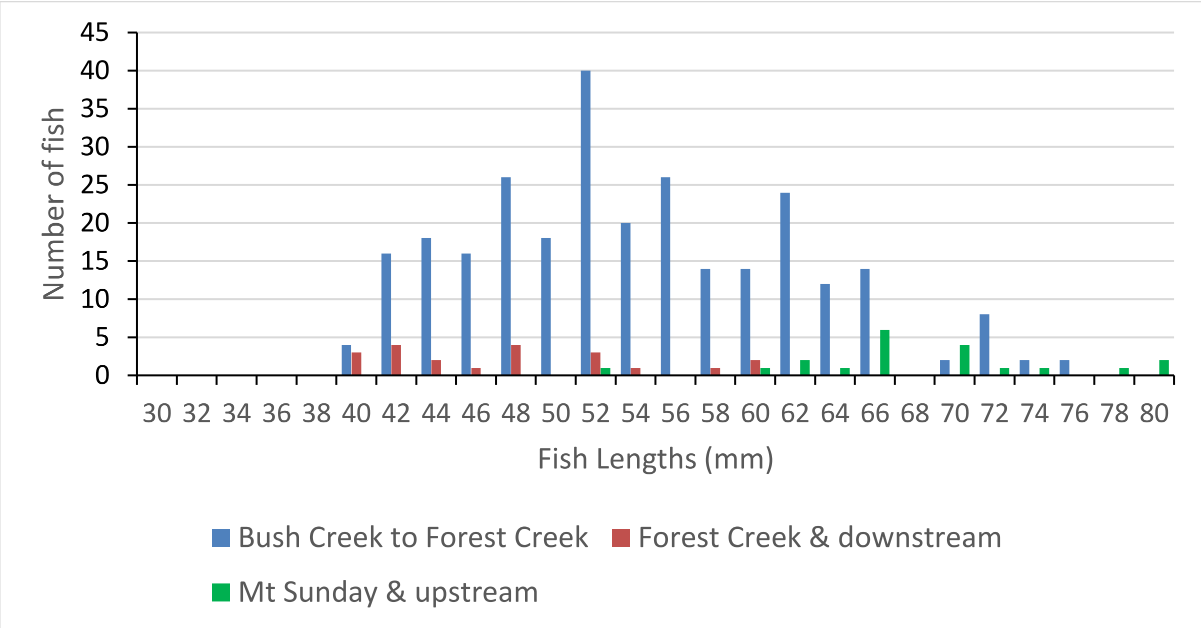

Figure 21: Length frequency graphs for upland longjaw galaxias from three sections of the Rangitata catchment.

CHAPTER 4 DISCUSSION

4.1 DISTRIBUTION

The distribution of upland longjaw galaxias in the upper reaches of the Rangitata catchment matched the previous knowledge with fish present part way up the Havelock Lawrence rivers. The downstream limit in this survey was 10.5 km downstream of the previous downstream limit (according to data in the NZFFD) (Figure 22). This gives rise to a utilised reach up to 48 km long. There is the potential for upland longjaw galaxias to be found further upstream in the Lawrence River in the survey gap between our lower and upper reaches where there is an 8 km reach gap in the survey sites. Despite the long-utilised reach, much of the area has low density upland longjaw galaxias populations or no upland longjaw galaxias where located at all. The key section of river with upland longjaws galaxias from this survey was the 6 km reach centred in the Rangitata River around Dr Sinclair grave.

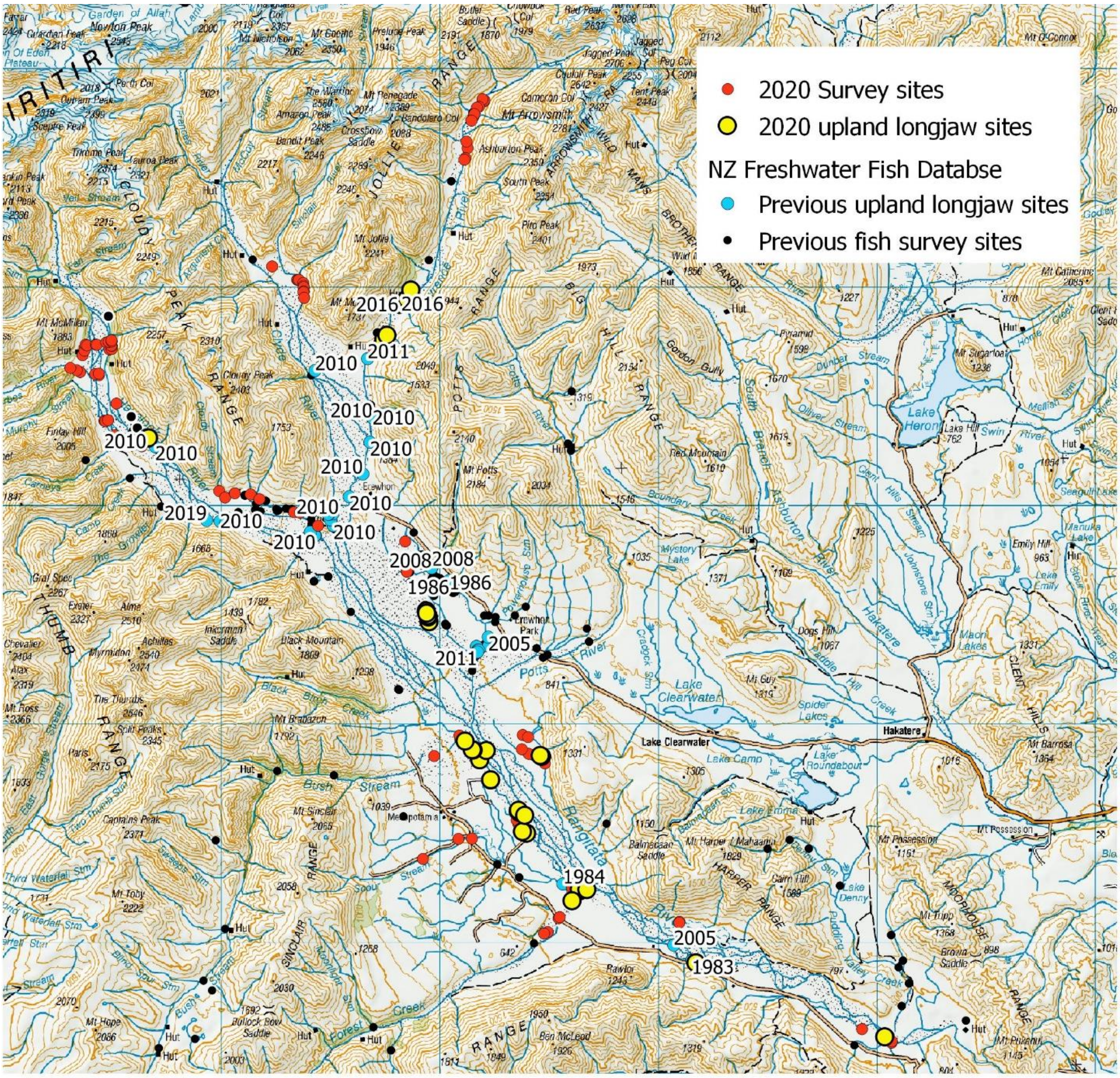

Figure 22: The 2020 survey sites and historic fish survey sites with the year of the survey displayed for historic upland longjaw galaxias sites.

There is potential for this high-density reach to extend upstream of Bush Creek as no sampling was conducted upstream of Bush Creek on the true right bank of the Rangitata River and there has been limited previous fish survey effort in this area.

The importance of the Dr Sinclairs grave reach of the river fish habitat was also apparent for other fish species. This survey found upland bully, and the three salmonids had their upstream limits at the Havelock and Clyde rivers confluence. The historic survey data in the NZFFD also shows that these species do not penetrate up the Clyde River and are only rarely recorded in the Havelock catchment

The sampling also showed that while the upland longjaw galaxias was abundant in some of the braids of the Rangitata River close to the edge of the river channel the fish was not abundant in the tributaries and has not been reported in tributaries aside from the around Mt Sunday in previous survey work. Most of the upland longjaw galaxias captured in the tributaries (e.g., Forest

Creek, Trib A) were smaller fish indicating that adult populations may be rare or absent from the tributaries. For Forest Creek this is likely to be due to the lower reaches downstream of the Rangitata Gorge Road drying most summers and so this stream is unable to support fish populations in this drying reach. Other areas such as Scour Stream, Trib A and Trib B were stable spring fed streams with little or no unstable shallow riffle water found during this fish survey. Canterbury galaxias and upland bully were common in Trib A and Trib B which may indicate either interspecific interactions are limiting the upland longjaw galaxias or the habitat is not suitable and more appropriate for upland bully and Canterbury galaxias.

The historic survey data shows upland longjaw galaxias along the true right bank of the lower Havelock River, but repeated surveys of the lower true left have failed to find any upland longjaw galaxias. In the lower Clyde River, a 2010 survey found upland longjaws along the true left edge until near the confluence with the havelock River where upland longjaws spread across the river. The small population of upland longjaw galaxias in the mid-reaches of the Havelock River appear isolated from the downstream populations but there is a survey gap of approximately 4 km from this population downstream to fish surveys sites in this study and 2010 (true left)and 2019 (true right).

The reason for the upland longjaw galaxias distribution to be restricted to the Dr Sinclair Grave zone is unclear. The river gradient is one possible factor influencing the fish distribution. The gradient may not be the direct limiting factor, but the gradient coupled with the narrower riverbeds in the upper catchment will influence sediment transport and disturbance along the riverbed. During this survey it was noted the December flood and subsequent freshes had disturbed and scoured the river beds removal algae, invertebrates and fish. Rangitata River reach downstream of the Havelock and Clyde river confluence is wide and has a lower gradient leading to an environment with lower energy than the upper reaches and a likely depositional zone for cobble and gravel. However, this reach is often turbid indicating that fine sediment can be transported further downstream. This lower energy environment also has the potential to provide refuge habitat in flood events.

The habitat observations in this survey noted upland longjaw galaxias were common in riffles with loose cobble and gravel substrate but avoided areas with large proportions of fine sediment. These loose cobble and gravel riffle provide the interstitial space for the upland longjaw galaxias to reside in amongst the substrate. Substrate compositions were not assessed systematically at all survey sites but further investigations of the upland longjaw galaxias habitat use should relate fish abundance to substrate size class proportions, the presence of interstitial space and algae and macrophyte communities.

4.2 UPLAND LONGJAW GALAXIAS POPULATION PROFILE

The study of Bonnett (1990) provides the only published population and length data for upland longjaw galaxias. Bonnett (1990) reported the result of fish survey work conducted between August 1983 and April 1989 from fifteen sampling events. In this period Bonnett (1990) collected 397 upland longjaw galaxias from two areas; streams around Mt Sunday and the Rangitata River bed approximately 5 km downstream of the Forest Creek confluence. The size range of fish caught ranged from 30 m to 87 mm. The Mt Sunday area collection had fish of all size ranges but the site downstream of Forest Creek had only smaller fish generally less than 45 mm long. This pattern of smaller fish in the downstream reaches and large and small fish further upstream as found by Bonnett (1990) was repeated in this study. This would suggest a consistent population dynamic with the reproductively active adult population present in the Mt Sunday Dr Sinclair's grave area of the Rangitata River. Bonnett (1990) did not sample further upstream, but the presence of large adult fish in the Havelock and Lawrence catchments indicates that reproductively active fish are present over a wide area of the river, although the upper catchment areas are possibly sparsely occupied. The length ranges found in this survey are similar to those reported by Bonnett (1990). The consistent presence of small juvenile fish in the reach downstream of Forest Creek would suggest juvenile fish are dispersing downstream. The two studies also indicate that the downstream dispersal does not appear to be leading to the establishment of adult populations downstream of Forest Creek.

4.3 FLOOD EFFECTS

The Rangitata River and its tributaries experienced an extreme flood event in December 2019 with major bed disturbance occurring over much of the upper catchment. Despite this some of the channels on the true left around Dr Sinclair's grave and the spring fed streams along the river flat showed little or no evidence of disturbance. The upland longjaw galaxias were common in braided river channels that would have been subject to flood flows, but these channels were along the river margin and appear to have had little or no disturbance. In these areas the upland longjaw galaxias survived the flood event in situ or have preferentially recolonised areas after the flood from flood refuges. The resilience of the upland longjaw population to such a large flood event indicates it has survival behaviours or habitat refuges that allow the galaxiid to persist. The flood event could have led to additional downstream dispersal of juvenile fish and possibly contributed to the downstream upland longjaw records at Stew Point.

The Dr Sinclair's grave reach of the river does appear to have been sheltered from the main braid and presumably the most powerful flood flow. Bush Creek has a large alluvial fan that extends a short distance on to the Rangitata River riverbed. Aerial photography shows this fan deflects the main river braid towards the true left bank and away from the true right bank between Bush Creek to Forest Creek (Figure 23). This may be creating a protected zone along this true right bank where the upland longjaw galaxias (and other fish) survive flood events.

In the Havelock and Sinclair river areas surveyed the flood effects appear to have been more extreme. It was common to fish area and collect no fish and for invertebrates to be rare or absent and event algal communities appears to have been removed by the scouring. It was obvious during the fish surveys that the presence of algal growths on the riverbed was a very good indicator that fish and invertebrates would be present. The absence of fish, including the widespread alpine galaxias, indicated that the fish communities in general had been impacted. This high impact zone does correlate with the higher gradient zone noted. It is notable that the small upland longjaw population in the Havelock River is located on a braid area protected from flood disturbance by an upstream rock slide (Figure 14).

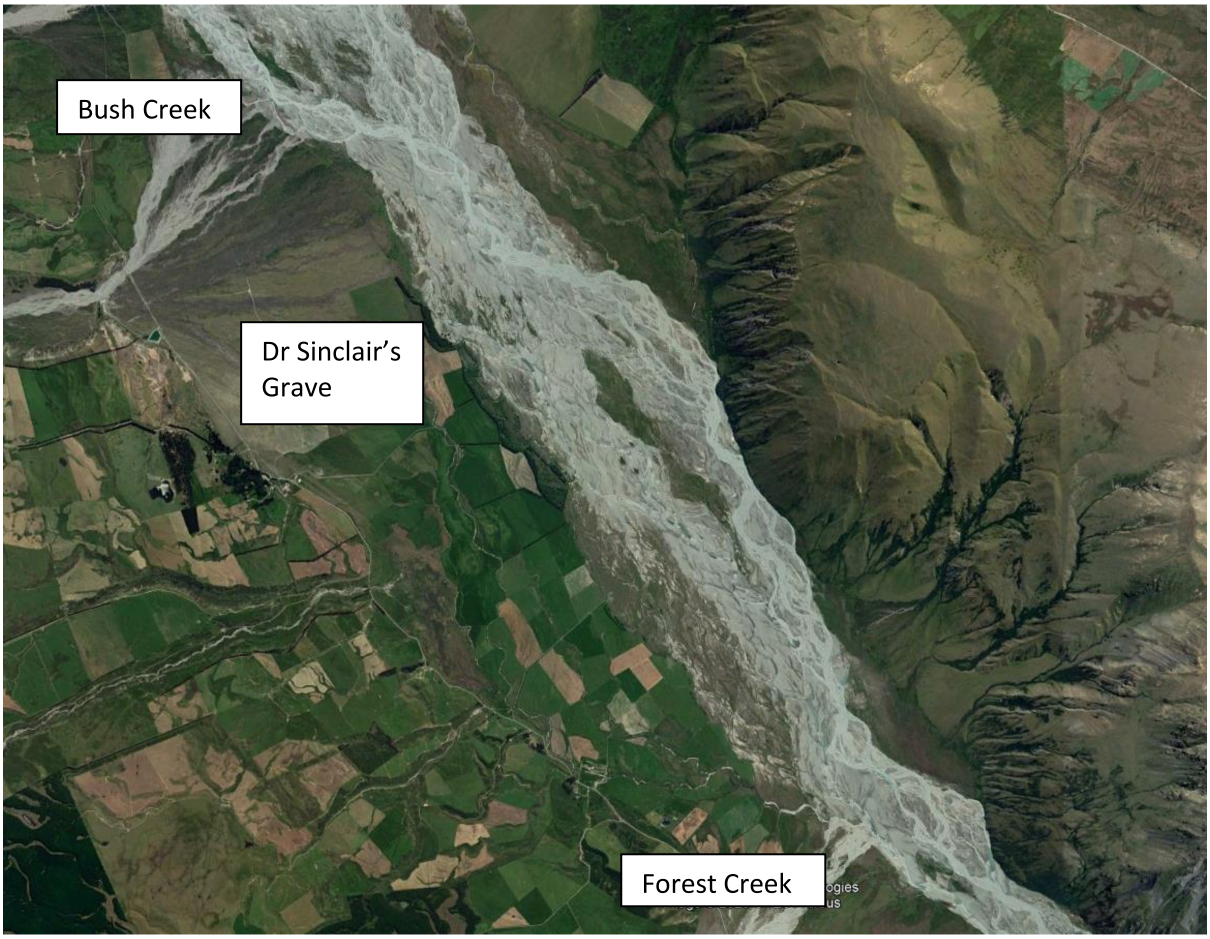

Figure 23: An aerial view of the Dr Sinclair's grave reach of the river showing the main Rangitata River braid flowing along the far true left bank.

4.4 POSSSIBLE FUTURE WORK

Future upland longjaw galaxias surveys can address the following:

- As noted in there are some survey gaps in the Lawrence and Havelock catchments that can be filled to complete general distribution surveys.
- Upland longjaw galaxias surveys can be conducted in the Dr Sinclair 's grave area and upstream of Bush Creek to determine if the high density zone exists into the future and whether it extends upstream of the survey sites in this survey;
- Repeat surveys from Forest Creek downstream can be conducted to determine if this area only supports juvenile longjaw galaxias;
- The Clyde River between the Lawrence river and Havelock River confluences should be resurveyed to assess the population health in this river reach;
- Detailed habitat assessments can be conducted at sites with and without upland longjaws to improve the habitat use knowledge; and
- A detailed survey of the Havelock River spring tributary could be conducted as surveys indicate the upland longjaws are limited to riffles at the braided river edge and this population is potentially very small and vulnerable to being lost.

CHAPTER 5 SUMMARY

A fish survey at 185 sites in the upper Rangitata River catchment was conducted over two weeks, 13-17 January 2020 and 17-20 February 2020. The aimed to locate areas of the catchment with upland longjaw galaxias and confirm the population had survived a large flood event on the 9 December 2019. Upland longjaw galaxias were located at 40 sites with most of fish being located in small Rangitata River braids on the true river of the river at and downstream of Dr Sinclair's grave. Juvenile fish were found 10.8 km downstream of the previous known downstream limit of the upland longjaw galaxias, but it is unknown whether this downstream range increase is the result of flood related downstream dispersal or is a natural yearly dispersal event. The upstream limit was at previous located upland longjaw galaxias sites in the Havelock and Lawrence rivers and no upland longjaw galaxias where located in the Clyde River catchment upstream of the Lawrence river confluence. The survey does show the upland longjaw galaxias survived the December flood event and the centre of its population is the low gradient reach of the Rangitata River downstream of the Havelock and Clyde river confluence. Here it is present in small relatively undisturbed braids along the true right of the river. Small numbers of mainly juvenile fish were also located in tributaries of the Rangitata river in this area. It is possible that this zone of high abundance is protected from flood events by the Bush Creek alluvial fan that directs the main Rangitata River braid to the true left bank of the river creating a zone of low disturbance downstream to Forest Creek. Additional survey effort is recommended to fill some survey gaps and monitoring of the high abundance zone is also recommended to ensure the Rangitata upland longjaw population is secure.

CHAPTER 6 REFERENCES

Bonnett, M. L. (1990). Age and growth of alpine galaxias (*Galaxias paucispondylus* Stokell) and longjawed galaxias (*G. prognathus* Stokell) in the Rangitata River. *New Zealand Journal of Marine and Freshwater Research 24*: 151-158.

Bowie, S.; Pham, L.; Dunn, N.; Allibone, R.; Crow, S. (Eds) 2014: Freshwater fish taxonomic workshop – focussing on New Zealand non-migratory galaxias taxonomic issues. Proceedings of a workshop, Dunedin 14th May 2013. Unpublished DOC publication. Christchurch. 42 p.

Dunn, N. R., Allibone, R.M., Closs, G.P., Crow, S.K., David, D.O., Goodman, J.M., Griffiths, M., Jack, D.C., Ling, N., Waters, J.M., Rolfe, J.R. (2018). Conservation status of New Zealand freshwater fish. *New Zealand threat classification series 24*. Wellington, Department of Conservation.

McDowall, R. M. and J. M. Waters (2002). A new longjaw species (Teleostei: Galaxiidae) from the Kauru River, North Otago, New Zealand. *New Zealand Journal of Zoology 29*: 41-52.

Waters, J. M. and D. Craw (2008). Evolution and biogeography of New Zealand's longjaw galaxiids (Osmeriformes: Galaxiidae): the genetic effects of glaciation and mountain building. *Freshwater Biology 53*: 521-534.

CHAPTER 7 APPENDIX 1 SITE LOCATIONS AND CATCH DATA

Site	Survey Week	Lat	Long	Alpine galaxias	Canterbury galaxias	Upland longjaw	Upland bully	Brown trout	Rainbow trout	Chinook salmon	no fish
R1	Jan	-43.6731	170.9715	7	7	3	17		3		
R2	Jan	-43.673	170.9703	2	7	2	12		1		
R3	Jan	-43.6848	170.9583	4			4	2			
R4	Jan	-43.6777	170.9661	5	1	1	12				
R5	Jan	-43.6734	170.9712	12	4		9		2		
R6	Jan	-43.6733	170.9721		7		7				Y
R7	Jan	-43.6732	170.9746	1	1	2					
R8	Jan	-43.6511	170.9102		1		20				
R9	Jan	-43.6501	170.9425	7	2		21	1		,	
R10	Jan	-43.6494	170.9412	10	11	4	57	1			
R11	Jan	-43.6455	170.9367	3	34		19		2		
R12	Jan	-43.6439	170.9357		2		5				
R13	Jan	-43.6589	170.8821		5						
R14	Jan	-43.651	170.9025				4	10			
R15	Jan	-43.6271	170.9216	8	2	2	2				
R16	Jan	-43.627	170.9216	24	5	17	11				
R17	Jan	-43.6167	170.8899								Y
R18	Jan	-43.6194	170.9149	81	7		1		1		
R19	Jan	-43.6187	170.9157	87	4	15	4				
R20	Jan	-43.6149	170.9195	7	1	3	1				
R21	Jan	-43.6148	170.914	4			3				
R22	Jan	-43.6146	170.9121	107	9	20	3	1	1	1	
R23	Jan	-43.6145	170.9116	27	5	1	6				
R24	Jan	-43.6102	170.905	2	8		1				
R25	Jan	-43.6099	170.9052		2		3				
R26	Jan	-43.6095	170.905	21	3		4				
R27	Jan	-43.6084	170.9046	11	1		1				

R28	Jan	-43.6108	170.9076	112	13	17	9	1			
R29	Jan	-43.6487	170.9389		30	1	35				
R30	Jan	-43.6408	170.9375	96	6	32	23				
R31	Jan	-43.6403	170.9368	5	5	1	9				
R32	Jan	-43.6399	170.9369	13	1	2	15				
R33	Jan	-43.642	170.9404	86	9	15	26				
B34	Jan	-43.6732	170.969								Y
B35	Jan	-43.6732	170.9689				1				
B36	Jan	-43.6733	170.9688								Y
B37	Jan	-43.6733	170.9688								Y
B38	Jan	-43.6722	170.9682								Y
B39	Jan	-43.6721	170.9684	1			2				
B40	Jan	-43.6721	170.9683	3			1				
B41	Jan	-43.6721	170.9683								
B42	Jan	-43.6722	170.9661	2	2		2				
B43	Jan	-43.6843	170.9589	6			3				
B44	Jan	-43.6759	170.9688	10	3		3	3			
B45	Jan	-43.6737	170.9705		1	1					
B46	Jan	-43.6736	170.9706		1	2					
B47	Jan	-43.6742	170.9735	1	3		7				
B48	Jan	-43.6746	170.9733	5	2		7	1	4		
B49	Jan	-43.6717	170.971								Y
B50	Jan	-43.6711	170.9718		7		1				
B51	Jan	-43.6699	170.9724			25					
B52	Jan	-43.6699	170.9711			4					
B53	Jan	-43.6694	170.9706	3		1					
B54	Jan	-43.6701	170.9704			1					
B55	Jan	-43.7045	171.0355			2	2		1		
B56	Jan	-43.7045	171.0347		7		18		1		
N33	Feb	-43.6875	171.0268								Y
N34	Feb	-43.6879	171.0267								Y
N35	Feb	-43.5613	170.8889	12	1	1	9	1			

N36	Feb	-43.5567	170.8875		3	1	2				
N37	Feb	-43.5553	170.8872								Y
N38	Feb	-43.555	170.8869	4				1			
N39	Feb	-43.5601	170.8889				3				
N40	Feb	-43.5593	170.8885	2	1	1		4			
N41[1]	Feb			8	3		6	6			
N42	Feb	-43.5591	170.8886		2			2			
N43	Feb	-43.5587	170.8884	4	1	1	3	1			
N44	Feb	-43.5578	170.8885	6			1	1			
N45	Feb	-43.5582	170.8877	1	5		2	3	1		
N46	Feb	-43.5577	170.888	10				3			
N47	Feb	-43.5577	170.8877	8	8	1	2	6	1		
N48	Feb	-43.5575	170.8874	6				5	1		
N49	Feb	-43.5571	170.887	2				8			
N50	Feb	-43.5571	170.887	18	2			2			
S1	Feb			2			5				
S2	Feb	-43.7334	171.1291				1				
S3	Feb	-43.5383	170.8764		3		1	2			
S4	Feb	-43.5392	170.8781	12	2		5	6			
S5	Feb	-43.5366	170.8872	2				3			
S6	Feb	-43.5362	170.8865	6				1			
S7	Feb	-43.5362	170.8861		3		3	1			
S8	Feb	-43.5362	170.8861		4			1			
S9	Feb	-43.5357	170.8858	10		1		3			
S10	Feb	-43.5397	170.8778	21	1		1	3			
S11	Feb	-43.5404	170.8771	10	2			5			
S12	Feb	-43.3473	170.9275	20							
S13	Feb	-43.3468	170.9276	11							
S14	Feb	-43.3464	170.9266	1							
S15	Feb	-43.3494	170.9245								Y

[1] Sites with no coordinates reported have been retained in this table as part of the fish capture data.

S16	Feb	-43.3498	170.9233	52								
S17	Feb	-43.3535	170.9213	16								
S18	Feb	-43.3524	170.9218	12								
S19	Feb	-43.5051	170.7721	12								
S20	Feb	-43.5079	170.7753	26								
S21	Feb	-43.5062	170.7808	24								
S22	Feb	-43.5068	170.7898	14	1							
S23	Feb	-43.5089	170.7947	16								
S24	Feb	-43.5146	170.8141	3								
S25	Feb	-43.5149	170.8175	1								
S26	Feb	-43.5205	170.8274	1								
S27	Feb			3								
S28	Feb	-43.3664	170.9175	11								
S29	Feb	-43.3637	170.917									Y
S30	Feb	-43.3551	170.9201									Y
S31	Feb	-43.3705	170.9161	8	1							
S32	Feb	-43.3712	170.9155	32								
R57	Feb	-43.4131	170.8053									Y
R58	Feb	-43.4189	170.8193									Y
R59	Feb	-43.419	170.8198	1								
R60	Feb	-43.4189	170.8203	15								
R61	Feb	-43.4203	170.8227									Y
R62	Feb	-43.4215	170.8228	1								
R63	Feb	-43.422	170.8229									Y
R64	Feb	-43.4237	170.8228									Y
R65	Feb	-43.4241	170.8226									Y
R66	Feb	-43.4264	170.823									Y
R67	Feb	-43.4749	170.7082	2								
R68	Feb	-43.4751	170.7087	6								
R69	Feb	-43.4746	170.7102									Y
R70	Feb	-43.481	170.7138	2								
R71	Feb	-43.4823	170.7176									Y

R72	Feb	-43.4821	170.7163	1							
R73	Feb	-43.4848	170.7235								Y
R74	Feb	-43.4858	170.7289								Y
R75	Feb	-43.485	170.7251								Y
R76	Feb	-43.4841	170.7329	8							
R77	Feb	-43.4824	170.7329	52	2	2					
R78	Feb	-43.6904	170.9518	1	1		5				
R79	Feb	-43.691	170.9497				2		1		
R80	Feb	-43.7381	171.1444	2			1				
R81	Feb	-43.7363	171.1399				3				
R82	Feb	-43.6208	170.9526		2		71	2			
R83	Feb	-43.6179	170.9508	2	21	2	61	3			
R84	Feb	-43.6172	170.9463	1	15		35		1		
R85	Feb	-43.6167	170.9435	3	12		18				
R86	Feb	-43.6147	170.9397	1	12		20				
R87	Feb	-43.6089	170.9404		5		2				
R88	Feb	-43.6098	170.9435				1				
R89	Feb	-43.6163	170.9501		1		49	1			
R90	Feb	-43.6175	170.95	2	37	1	41	1	1		
B51	Feb	-43.4679	170.7153	2							
B52	Feb	-43.456	170.7058								Y
B53	Feb	-43.4555	170.7037								Y
B54	Feb	-43.4553	170.7058								Y
B55	Feb	-43.4545	170.6952								Y
B56	Feb	-43.4537	170.6933								Y
B57	Feb	-43.4527	170.6897	1							
B58	Feb	-43.4447	170.6981								Y
B59	Feb	-43.4476	170.6968	1							
B60	Feb	-43.4457	170.698								
B61	Feb	-43.4433	170.6987	6	2						
B62	Feb	-43.4436	170.6995								Y
B63	Feb	-43.4434	170.7045								Y

B64	Feb	-43.4434	170.7051								Y
B65	Feb	-43.4426	170.7105	2							
B66	Feb	-43.4455	170.7121	25							
B67	Feb	-43.4454	170.7134	7	1						
B68	Feb	-43.4441	170.7135								Y
B69	Feb	-43.444	170.7133	20							
B70	Feb	-43.4424	170.7118	5							
B71	Feb	-43.4423	170.7135	15							
B72	Feb	-43.4418	170.7135	19							
B73	Feb	-43.4482	170.8617	11							
B74	Feb	-43.4474	170.864	7	2						
B75	Feb	-43.4456	170.8648	7							
B76	Feb	-43.4446	170.8673	12		1					
B77	Feb			9	1		2				
B78	Feb	-43.4427	170.8692	11	1	2					
B79	Feb			2		1					
B80	Feb	-43.4296	170.8758								Y
B81	Feb	-43.4305	170.8758								Y
B82	Feb	-43.4301	170.8768	7		2					
B83	Feb	-43.4302	170.8771								
B84	Feb	-43.4297	170.8793	2							
B85	Feb	-43.5279	170.8766								Y
B86	Feb	-43.4287	170.8802								Y
B87	Feb	-43.4279	170.8811	29		5					
B88	Feb	-43.4269	170.8809	19							
B89	Feb	-43.7393	171.1457								Y
B90	Feb	-43.7388	171.1458								Y
B91	Feb	-43.7364	171.1441								Y
B92	Feb	-43.7368	171.1418			2					
B93	Feb	-43.7366	171.1408								Y
B94	Feb	-43.4243	170.8834	6		1					
B95	Feb	-43.4247	170.8824								Y

B96	Feb	-43.4259	170.8817	6							
B98	Feb	-43.4267	170.8815								Y