Large galaxiid survey around the Taranaki Ring Plain, 2011/2012

Authors: Natasha Petrove, Rosemary Miller, Stella McQueen and Ursula Brandes
Department of Conservation, Taranaki Area Office

New Zealand Government

Department of Conservation
Te Papa Atawhai

ISBN: 978-0-478-14974-6 (Print)
ISBN: 978-0-478-14975-3 (web)

(if applicable)

Published by
Taranaki Area Office
Department of Conservation
PO Box 462
New Plymouth 4340
New Zealand

In the interest of forest conservation, we support paperless electronic publishing.

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Executive summary

Native fish spotlighting surveys were undertaken at 24 sites around the Taranaki ring plain in summer 2011 and summer/autumn 2012, targeting the four large galaxiid species: shortjaw kokopu (*Galaxias postvectis*), banded kokopu (*Galaxias fasciatus*), giant kokopu (*Galaxias argenteus*) and kōaro (*Galaxias brevipinnis*). The surveys were conducted as a follow up to 193 rapid assessment spotlighting surveys undertaken between May 2001 and June 2002.

Eight streams were highlighted as important sites for large galaxiids, having either high abundance of a large galaxiid species or a good diversity of species. These were: Te Henui (banded kokopu), Huatoki (giant kokopu), Katikara (kōaro), Mangatete (giant and shortjaw kokopu), and the Oakura River, Kiri Stream and a tributary of the Stony River (all of which had both shortjaw kokopu and kōaro), as well as a tributary of the Timaru Stream (that contained banded kokopu, giant kokopu and shortjaw kokopu). In six catchments no large galaxiids were detected, despite at least one of the four large galaxiid species being found in those catchments during past surveys. In six other catchments a new large galaxiid species was found that had not been seen there before.

The recent surveys used a standardised and repeatable spotlighting method developed by Environment Waikato (David & Hamer, 2010). This was compared with the rapid assessment method used in 2001/2002. At the majority of sites surveyed, more species were found in the 2011/2012 surveys. This is unlikely to indicate a general increase in fish numbers, but instead reflects the different methods: David & Hamer (2010) found that their spotlighting method (used in the recent surveys) has a greater probability of finding all species present in the section of stream than other spotlighting methods due to the greater intensity of surveying. In addition, the recent surveys were conducted in summer/autumn, while the 2001/2002 surveys were mostly conducted in winter, when native fish are less active.

Introduction

Twenty-four sites in streams around the Taranaki ring plain were surveyed for native fish during summer/autumn in 2011 and 2012 in order to gain more in-depth information on native fish diversity and distribution in Taranaki streams. The surveys were focussed on distribution of the four large galaxiid species: shortjaw kokopu (*Galaxias postvectis*), giant kokopu (*Galaxias argenteus*), kōaro (*Galaxias brevipinnis*) (all classified as 'at risk' and declining; Allibone et al., 2010) and banded kokopu (*Galaxias fasciatus*).

Some fairly extensive fish surveys have taken place in different parts of the region in past years, however, an increasing effort is beginning to be placed on repeat surveys in order to track changes over time. The Taranaki Regional Council (TRC), for example, now undertake regular monitoring of native fish populations in some streams around Taranaki as part of their State of Environment work (B. Jansma, pers. comm.).

The results from the recent surveys build on presence/absence information from earlier rapid assessment surveys undertaken in 2001/2002, and may assist in identification of high-value sites for long-term monitoring. The recent survey results also provide information on the baseline condition of current native fish populations in Taranaki streams, using a standardised method that can be repeated in the future and will therefore allow changes in fish diversity to be tracked. Increasing threats to freshwater ecosystems mean it is particularly important to be able to determine any impacts of changes on these ecosystems. Some examples of the threats faced include alteration of stream environment through potential invasion of exotic species such as didymo, and continued habitat loss and degradation as a result of intensified land use through activities such as small stream diversions or channelisations. Equally, stream restoration programmes, such as the TRC Ring Plain Riparian Programme, may result in positive changes in native fish diversity over time.

The objectives of this survey were to:

1. Gather baseline information that will enable identification of high value freshwater sites in the Taranaki region, in line with DOC guidelines for long-term management of didymo (Didymo operations framework, 2009);
2. Gain a more accurate picture of the density and distribution of large galaxiids in the Taranaki region;
3. Obtain fish population information for two catchments identified through the preliminary DOC Ecosystem Optimisation Process (Waiwhakaiho and Oakura);
4. Re-survey streams in which large galaxiids have previously been found, but have not been surveyed in at least ten years. This is in keeping with recommendations in the large galaxiid recovery plan (Department of Conservation, 2005) and, in addition, will reveal the structure of large galaxiid populations discovered during the rapid assessments.

Methods

Sites were selected for the survey through the following selection criteria:

- Catchments were selected where at least one of the four large galaxiid species had previously been found, according to the NIWA New Zealand Freshwater Fish Database (NZFFD) records. This ensured that these species could reasonably be expected to be present in the streams surveyed;
- The New Zealand fish prediction model produced by Leathwick et al. (2008) was used to identify stream segments where the probability of finding the target species was good (<0.5);
- Streams that not been surveyed in the last ten years were considered higher priority than those that had been surveyed more recently;
- Sites that are regularly surveyed by the Taranaki Regional Council were excluded;
- A priority was placed on sites that had been identified as key areas for large galaxiid habitat in the 2001/2002 survey. Six of these streams were selected for surveying in this study;
- Sites from two catchments that had been identified in the preliminary DOC Ecosystem Optimisation process were selected – these were the Oakura and Waiwhakaiho catchments;
- Site selections were restricted to smaller, wadeable streams, which are necessary for the spotlighting survey methodology;
- Any potential sites with known migration barriers downstream were excluded from the selection under the assumption that large galaxiids would be unlikely to be found above these;
- A spread of catchments from around the mountain were chosen;
- Some streams that had not been surveyed before were also included, in order to fill in gaps in fish survey records;
- In 2012, two sites from the 2011 survey were repeated: the Momona Stream was resurveyed as it was surprising that no galaxiids were found during the 2011 survey, even though they had been found there many times in the past; while the Katikara Stream was resurveyed as part of a separate regular shortjaw kokopu monitoring project.

A total of 24 streams in nineteen catchments were surveyed. The streams were not always re-surveyed in the same reach as previous surveys, either due to better access at other locations or high predictions of large galaxiids in other reaches of the stream. The final sites chosen were spread across low, mid and upper reaches of their catchments (see map of survey sites in Appendix A).

Two of the selected sites, Pungareere and Oaoiti streams, differed from the other sites as large galaxiids had never been found there before. The Pungareere had been surveyed in the 2001/2002 surveys to fill in gaps in previous survey records, but spotlighting conditions were poor when it was surveyed, so this site was selected for re-survey in 2011. The Oaoiti had a good probability of containing banded kokopu and kōaro according to the New Zealand fish prediction model produced by Leathwick et al. (2008).

The streams were spotlighted, as this is the most effective way to gather information on large galaxiids (Barrier et al, unpublished; Studholme et al, 1999). Prior to the late 1990s, most large galaxiid studies in the region had based distribution information on the results of electrofishing, which has since been recognised as less effective for detecting large galaxiids (Barrier et al., unpublished; Studholme et al., 1999). Spotlighting surveys subsequent to 1998 greatly expanded the knowledge of large galaxiid populations in Taranaki, with these species found to be more widespread in the region than had previously been thought (e.g. Joy, 1999).

The spotlighting method used was developed by Environment Waikato (David & Hamer, 2010), and it provides a repeatable monitoring technique that allows comparisons of fish populations to be made between years and sites. In this method, a 150 metre stretch of stream is divided into ten sections of equal length. In each section the stream width is measured and available habitat types (i.e. backwater, pool, run, riffle, rapid or cascade) are estimated. Other variables, such as in-stream habitat, riparian vegetation and catchment landuse, were also recorded according to NZFFD data collection methods, to provide an overall picture of stream characteristics. Surveys were only conducted on fine nights and not following heavy rainfall events, as the higher water levels and increased sediment load result in poor visibility. Surveying began a minimum of 45 minutes after sunset, by which time fish have usually emerged and behaviour has settled (David & Hamer, 2010). An estimate of 'fishable area' was made at the end of each section, allowing the overall area spotlighted to be calculated for each stream.

All fish, including non-target species, were identified to species level where possible, then caught and their lengths recorded. If a fish was unable to be caught, the length was estimated. Large galaxiid lengths were later divided into predetermined size classes for each species (Table 1).

Table 1: Fish size classes for large galaxiids (David & Hamer 2010).

SPECIES NAME	TINY (MM)	SMALL (MM)	MEDIUM (MM)	LARGE (MM)
Kōaro (*Galaxias brevipinnis*)	≤50	51-100	101-150	151+
Shortjaw kokopu (*Galaxias postvectis*)	≤50	51-100	101-200	201+
Banded kokopu (*Galaxias fasciatus*)	≤50	51-100	101-200	201+
Giant kokopu (*Galaxias argenteus*)	≤50	51-140	141-250	251+

Information on the fish assemblages found at each site was sent to NIWA for inclusion in the NZFFD, and is also recorded in the files DOCDM 699586 and 918459. The results were analysed to compare fish densities in each of the 24 streams. Size class structure of the four large galaxiid species was examined as an indicator of recruitment.

Results

In 13 of the 19 catchments surveyed, at least one of the large galaxiid species was detected (Table 3). Seven sites had two or more of the large galaxiid species present (Table 2). See Tables 3 and 4 for a full list of fish species found at each site and Appendix B for a map showing locations of the sites at which large galaxiids were found.

The Pungareere Stream contained the highest density of fish, with moderate densities in the Te Henui, Huatoki, Kiri tributary, Timaru tributary, Matanehunehu, Otahi-iti and Waitotoroa streams (Table 2).

No sites had all four large galaxiids present. No large galaxiids were detected in six of the 22 streams where large galaxiids had previously been found, and only three individual galaxiids from two species were found in the nine streams from Matanehunehu south.

Table 2: Fish assemblages at each site. 'Unidentified species' refers to species that could not be positively identified (e.g. because it could not be caught) but may have been a different species from those that were identified. Large galaxiid species codes: SJ = shortjaw kokopu, BK = banded kokopu, GK = giant kokopu, KO = kōaro.

WATERWAY NAME (LISTED FROM NORTH TO SOUTH)	NUMBER OF IDENTIFIED SPECIES	NUMBER OF UNIDENTIFIED SPECIES	NUMBER OF INDIVIDUAL FISH	NUMBER OF INDIVIDUALS PER 100M^2	LARGE GALAXIIDS PRESENT
Waiongana Stream	3	1	16	6.5	SJ
Mangaoraka Stream	3	1	26	5.8	-
Mangakotukutuku Stm	3	1	12	2.3	SJ, KO
Mangorei Stream	2	3	12	2.1	SJ
Te Henui Stream	7	2	80	11.3	BK, GK, KO
Huatoki Stream	3	2	61	12.6	GK
Paopaohaonui Stream	2	0	9	3.8	BK
Oakura River	3	1	24	4.0	SJ, KO
Momona Stream 2011 2012	1 2	1 1	9 14	1.6 3.2	- KO
Kiri Stream	4	3	25	8.7	SJ, KO
Kiri Stream tributary	1	1	15	10.2	-
Timaru Stm tributary	5	3	35	13.2	BK, GK, KO
Katikara Stream 2011 2012	2 2	2 1	20 23	5.2 4.3	KO KO
Mangatete Stream	4	3	38	8.2	SJ, GK
Stony River tributary	3	3	24	4.6	SJ, KO
Matanehunehu Stream	2	2	26	12.9	-
Otahi-iti Stream	2	1	30	13.1	-
Waitotoroa Stream	2	2	33	12.3	-
Pungareere Stream	3	1	162	33.4	-
Oaoiti Stream	2	0	10	7.2	-
Heimama Stream	1	2	10	7.6	GK
Otahi Stream	1	1	5	1.8	-
Taungatara Stream	1	1	3	0.9	KO
Ouri Stream	3	1	33	7.7	KO

Table 3: Large galaxiid species caught in each of the surveyed streams, divided into size classes (see Table 1 for definition of size classes for each species). Streams were surveyed in 2011 unless otherwise specified.

CATCHMENT	WATERWAY	SHORTJAW KOKOPU			BANDED KOKOPU			GIANT KOKOPU			KŌARO		
		SMALL	MEDIUM	LARGE	SMALL	MEDIUM	LARGE	SMALL	MEDIUM	LARGE	SMALL	MEDIUM	LARGE
Waiongana	Waiongana Stream	-	-	1	-	-	-	-	-	-	-	-	-
	Mangaoraka Stream	-	-	-	-	-	-	-	-	-	-	-	-
Waiwhakaiho	Mangakotukutuku Stream	-	-	1	-	-	-	-	-	-	-	-	1
	Mangorei Stream	-	-	1	-	-	-	-	-	-	-	-	-
Te Henui	Te Henui Stream	-	-	-	2	7	2	-	1	-	1	-	-
Huatoki	Huatoki Stream	-	-	-	-	-	-	9	2	3	-	-	-
Tapuae	Paopaohaonui Stream	-	-	-	-	-	1	-	-	-	-	-	-
Oakura	Oakura River (2012)	-	5	3	-	-	-	-	-	-	-	3	3
	Momona Stream 2011	-	-	-	-	-	-	-	-	-	-	-	-
	2012	-	-	-	-	-	-	-	-	-	-	2	5
	Kiri Stream (2012)	1	4	1	-	-	-	-	-	-	1	3	-
	Kiri Stream tributary	-	-	-	-	-	-	-	-	-	-	-	-
Timaru	Timaru Stream tributary	-	-	-	-	2	-	-	1	-	1	-	-
Katikara	Katikara Stream 2011	-	-	-	-	-	-	-	-	-	6	4	4
	2012	-	-	-	-	-	-	-	-	-	9	7	4
Kaihihi	Mangatete Stream	-	-	4	-	-	-	-	1	2	-	-	-
Stony River	Stony River tributary (2012)	-	4	3	-	-	-	-	-	-	2	5	1
Matanehunehu	Matanehunehu Stream (2012)	-	-	-	-	-	-	-	-	-	-	-	-
Otahi-iti	Otahi-iti Stream	-	-	-	-	-	-	-	-	-	-	-	-
Waitotoroa	Waitotoroa Stream	-	-	-	-	-	-	-	-	-	-	-	-
Pungareere	Pungareere Stream	-	-	-	-	-	-	-	-	-	-	-	-
Oaoiti	Oaoiti Stream (2012)	-	-	-	-	-	-	-	-	-	-	-	-
Heimama	Heimama Stream	-	-	-	-	-	-	1	-	-	-	-	-
Otahi	Otahi Stream	-	-	-	-	-	-	-	-	-	-	-	-
Taungatara	Taungatara Stream	-	-	-	-	-	-	-	-	-	-	-	2*
Ouri	Ouri Stream	-	-	-	-	-	-	-	-	-	-	-	1

* only one of these two kōaro was confirmed. The second fish was most likely a kōaro, but was swimming too fast in deep water to positively identify.

Table 4: All fish species observed at each of the surveyed streams. Streams were surveyed in 2011 unless otherwise specified.

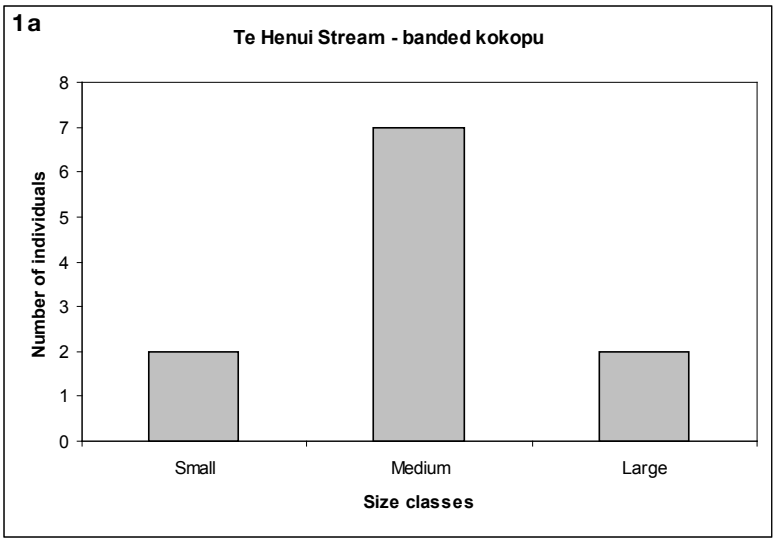
CATCHMENT	WATERWAY	SHORTJAW KOKOPU	BANDED KOKOPU	GIANT KOKOPU	KŌARO	UNID-ED GALAXIID	INANGA	LONGFIN EEL	SHORTFIN EEL	UNID-ED EEL	REDFIN BULLY	UNID-ED BULLY	BROWN TROUT
Waiongana	Waiongana Stream	1	-	-	-	-	-	7	-	6	-	-	2
	Mangaoraka Stream	-	-	-	-	-	1	9	-	15	1	-	-
Waiwhakaiho	Mangakotukutuku Stream	1	-	-	1	-	-	4	-	6	-	-	-
	Mangorei Stream	1	-	-	-	2	-	3	-	5	-	1	-
Te Henui	Te Henui Stream	-	11	1	1	2	14	8	1	6	32	4	-
Huatoki	Huatoki Stream	-	-	14	-	2	-	2	-	5	38	-	-
Tapuae	Paopaohaonui Stream	-	1	-	-	-	-	8	-	-	-	-	-
Oakura	Oakura River (2012)	8	-	-	6	-	-	6	-	4	-	-	-
	Momona Stream 2011	-	-	-	-	-	-	5	-	4	-	-	-
	2012	-	-	-	7	-	-	1	-	6	-	-	-
	Kiri Stream (2012)	6	-	-	4	5	-	1	-	3	3	3	-
	Kiri Stream tributary	-	-	-	-	-	-	7	-	8	-	-	-
Timaru	Timaru Stream tributary	-	2	1	1	1	14	-	-	3	8	5	-
Katikara	Katikara Stream 2011	-	-	-	14	2	-	3	-	1	-	-	-
	2012	-	-	-	20	-	-	1	-	2	-	-	-
Kaihihi	Mangatete Stream	4	-	3	-	2	-	7	-	16	5	1	-
Stony River	Stony River tributary (2012)	7	-	-	8	2	-	-	-	1	5	1	-
Matanehunehu	Matanehunehu Stream (2012)	-	-	-	-	-	-	14	-	4	7	1	-
Otahi-iti	Otahi-iti Stream	-	-	-	-	-	12	2	-	16	-	-	-
Waitotoroa	Waitotoroa Stream	-	-	-	-	-	-	7	-	5	13	8	-
Pungareere	Pungareere Stream	-	-	-	-	2	25	5	-	12	110	8	-
Oaoiti	Oaoiti Stream (2012)	-	-	-	-	-	-	5	2	3	-	-	-
Heimama	Heimama Stream	-	-	1	-	7	-	-	-	2	-	-	-
Otahi	Otahi Stream	-	-	-	-	-	-	3	-	2	-	-	-
Taungatara	Taungatara Stream	-	-	-	2 *	-	-	-	-	-	-	1	-
Ouri	Ouri Stream	-	-	-	1	-	-	6	-	1	-	-	25

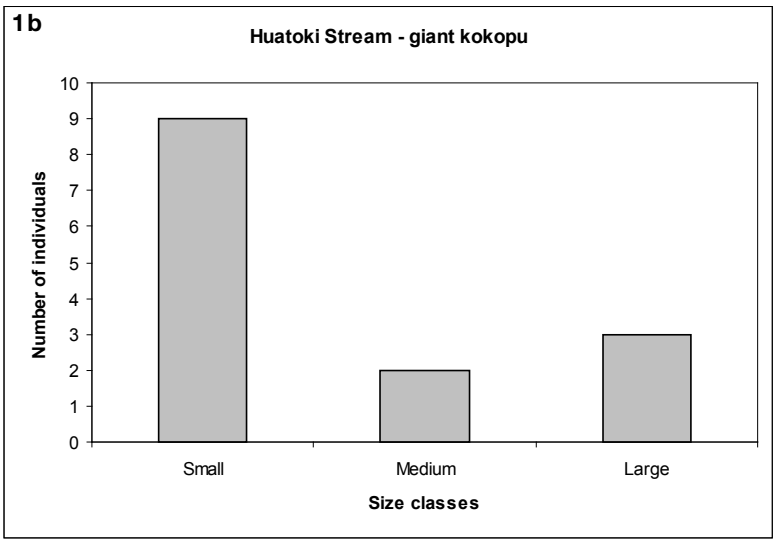
* only one of these two kōaro was confirmed. The second fish was most likely a kōaro, but was swimming too fast in deep water to positively identify.

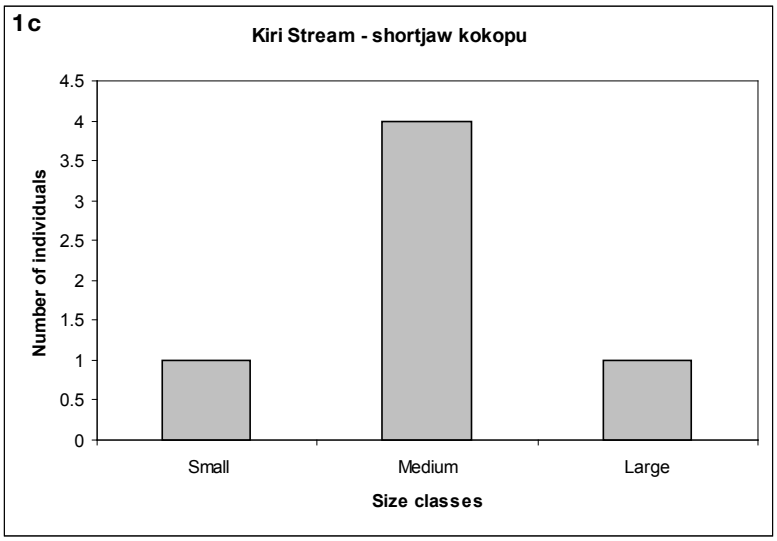
Six streams that had been identified in prior studies as containing key habitat for large galaxiids were re-surveyed. These were the: Mangorei (shortjaw kokopu), Te Henui, (giant and shortjaw kokopu) and, Mangatete (shortjaw kokopu); and the headwaters of the Mangaoraka Stream, Oakura River and Waitotoroa Stream (generally good large galaxiid habitat – no particular species defined). Large galaxiids were found in four of these streams in the recent survey, however, no large galaxiids were found in either the Mangaoraka or Waitotoroa Streams (Tables 2 and 3).

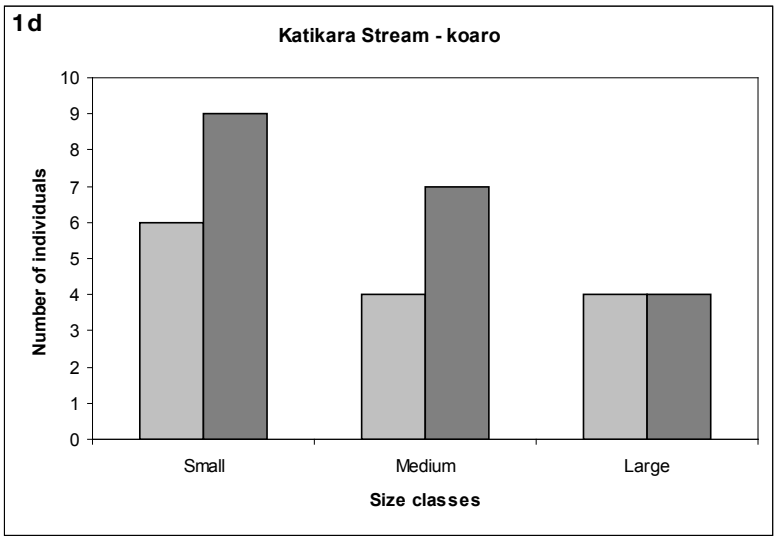
Small, medium and large individuals of banded kokopu, giant kokopu and kōaro were found during the survey (Table 3), but at 10 of the 24 sites only one size class was present per species. Only five sites had all three size classes of a particular large galaxiid species present (Figures 1a-e). These were banded kokopu in Te Henui, giant kokopu in the Huatoki, shortjaw kokopu in the Kiri, and kōaro in the Katikara and Stony River tributary.

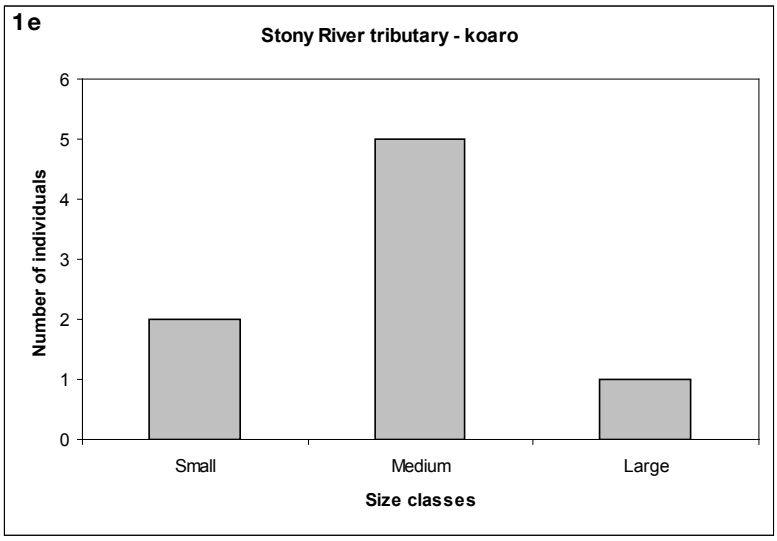
Figures 1a-e: Graphs showing the size distribution of individual fish in the five streams where large galaxiids were present across all three size classes. Figure 1d (Katikara Stream) shows data from both 2011 and 2012: light grey bars, 2011; dark grey bars, 2012.











While there are NZFFD records for all four large galaxiid species in the Oakura catchment, no large galaxiids were seen in either the Momona Stream or the tributary of Kiri Stream during the 2011 survey. However, when the Momona was re-surveyed in 2012, medium and large kōaro were present, while the Kiri Stream (which was surveyed at a spot well above where the tributary surveyed in 2011 entered) had both shortjaw kokopu and kōaro.

Discussion

Species richness varied greatly between the surveyed sites. Te Henui Stream had the greatest number of species, with seven species identified. The streams with the lowest number of identified species were the Momona (when surveyed in 2011), Kiri tributary, Heimama, Otahi and Taungatara. The Momona (in 2011), Otahi and Taungatara Streams also had the lowest densities of fish, with less than two fish per 100m^2 of stream. All three of these streams were within the Egmont National Park, with similar habitat conditions (although there was individual variation between streams). However, several other streams were also surveyed in similar locations of their catchments, within the national park. As all sites were surveyed during periods of fine weather when visibility in streams was good, all species present should have been detected. In some cases there could be a possibility that barriers were affecting accessibility to the sites, but further survey and investigation work (e.g. regarding possible fish barriers or habitat differences) would be necessary to determine the cause of these seemingly low fish diversities and abundances. For example, in the Momona Stream, which was re-surveyed in 2012 after low fish densities and a lack of large galaxiids were in 2011 survey, it seems unlikely that barriers were affecting fish abundance, as in 2012 a higher density of fish were observed, and kōaro (in more than one size class) were found.

Large galaxiids were present in 16 of the 24 streams surveyed. Some large galaxiid species were absent from streams they had previously been detected in, and present in streams in 2012 where they were not detected the previous year, despite using the same methods. This may indicate some range reduction or expansion, but further analysis of data would be necessary to verify this. However, due to the difference in methodologies used, locations of sites surveyed and time of year the surveys were undertaken, in-depth comparison of historical records to current data is not likely to provide an accurate indication of whether range reductions or expansions have occurred.

Although information from past surveys was used to identify catchments where the four large galaxiid species had previously been found, these catchments were not always resurveyed in the same location, meaning the apparent absence of species from a stream may instead be related to the particular site surveyed being unsuitable for that species. For example, past surveys of the Taungatara Stream had found giant kokopu and no other galaxiids, but the 2011 surveys found kōaro but no giant kokopu. However, all previous surveys had been conducted in lowland sections of the catchment, where habitat would not be suited to kōaro, while the 2011 survey site was located in a higher, fast-flowing section of stream – favoured by kōaro but not suitable habitat for giant kokopu. In catchments such as the Taungatara, where large galaxiids that had previously been recorded were not detected in this survey, more surveying is necessary to determine if these other large galaxiid species are still present.

Eight streams were identified as important sites for large galaxiids during this survey. These were: the Te Henui, Huatoki, Kiri, Katikara and Mangatete Streams, the Oakura River, and tributaries of the Timaru Stream and Stony River. All of these streams had either more than one large galaxiid species present, or had a large galaxiid species that had individual fish in all three size classes, or both.

Eight of the streams surveyed had no large galaxiids present. In a ninth stream, the Momona, no large galaxiids were found during the 2011 survey, but when re-surveyed in 2012, kōaro were present. These streams all had great variation in habitat conditions, and the survey sites were located in different reaches of the catchment. Four factors may have been affecting large galaxiid presence (or detectability) at the sites: either, a barrier prevented migratory large galaxiids from reaching the site; the habitat was unsuitable; another species, such as trout, was affecting distribution; or the survey methodology was insufficient at detecting presence of all fish species at the sites.

While every effort was made to exclude streams that had known barriers to large galaxiid migration from the site selection process, it is possible that barriers may have been present, especially as it takes only one small structure, such as a stepped culvert, to prevent upstream migration of juvenile galaxiids. However, barriers were unlikely to be the cause of large galaxiid absence in at least four of the sites, based on other species present at the site, or further upstream in the catchment (for example, inanga and smelt – other fish that would have been stopped by a barrier). While most sites appeared suitable for at least one large galaxiid species (and large galaxiids had previously been found in six of these eight streams), further investigation of habitat variables would be necessary to determine whether habitat factors were affecting large galaxiid distribution at these sites. Given that trout were only present in two of the surveyed streams, both of which also had a large galaxiid present, and no other introduced fish were found during the survey, it is unlikely that they were affecting native fish distribution. Finally, the survey methodology used is one that has been tested, and the length of stream set based on the likelihood of detecting maximum diversity at a site, irrespective of stream size, distance inland or geographic position (David & Hamer, 2010). This means, fish should have detected if they were present - although, in the Momona, only eels were found during the 2011 survey, but seven kōaro were found when re-surveyed in 2012. It is therefore necessary to undertake further investigation in these catchments regarding the apparent absence of large galaxiids.

All four large galaxiid species were found in more than one stream, and in all three size classes. However, only eight of the 24 streams had more than one size class present. This may indicate that large galaxiids have variable recruitment between years in Taranaki streams, but more surveys, combined with more analysis of recent survey work, need to be conducted before this can be confirmed. Again, further investigation work would be needed to ensure that unknown downstream barriers were not affecting recruitment.

In the earlier 2001/2002 survey the Te Henui Stream was highlighted as a key catchment for giant and shortjaw kokopu. Only one 'large' giant kokopu was seen during this survey, and there were no shortjaw kokopu. However, two unidentified galaxiids were seen, so it is possible that shortjaw kokopu were present. Several banded kokopu and one 'small' kōaro were also found, despite neither of these species being recorded in Te Henui Stream in any of the seven surveys conducted since 1990. These surveys may have failed to detect the presence of kōaro in this stream, or kōaro may be re-establishing in the Te Henui.

The Heimama Stream is a small, lowland stream, surrounded by farmland, with very poor water quality but, despite this, one 'small' giant kokopu, and several other unidentified juvenile galaxiids were found. Giant kokopu have also been found in this stream in the past. Small lowland streams provide important habitat for native fish species such as giant kokopu, however, their small size mean that impacts from any changes to landuse can be especially significant. Finding juvenile galaxiids in this stream means that despite the poor water quality, they were still attempting to migrate up. This highlights the importance of improving habitat quality even in small streams.

The Mangorei Stream, in the Waiwhakaiho catchment, was surveyed above the weir at Scout Road. This weir has been in place for many years, and in 2002 was identified as an important trout barrier, allowing passage of native fish to the reaches of stream above the weir, but preventing trout from migrating past it. The weir was partially broken, and it was believed that the broken section was allowing native fish passage, although only for climbing species. This means native fish populations in the stream above the weir should be thriving in the absence of an exotic competitor. When surveyed, no trout were found in the Mangorei Stream; the native fish community was comprised of longfin and unidentified eels, one 'large' shortjaw kokopu, two unidentified galaxiids and one missed fish. All of these native species are capable of climbing over barriers during their upstream migration phase. While the barrier is likely insurmountable by non-climbing native fish, there are few non-climbing species in the region that would travel this far inland. It would therefore be preferable to maintain this weir as a fish barrier, than to consider changing it to allow passage for other non-climbing fish, which would include trout. However, as no small fish were found during the survey, it is important to undertake more surveying both above and below the weir, to better determine the effects on the native fish communities.

Only a small number of sites were surveyed in this study, meaning that the results of these cannot be used to draw conclusions on the state of large galaxiid populations in Taranaki. However, they do provide a base for further surveys to work from. Further studies need to be undertaken in more streams in the region, as well as re-surveying some of the streams from this study, in order to gain a better idea of large galaxiid distribution in Taranaki.

Recommendations

Further surveys need to be undertaken in other catchments around the mountain.

While an initial focus could still be on sites that have not been surveyed recently, it is important to survey other catchments using the Environment Waikato method. This will provide a base of information on the distribution of each of the large galaxiid species in Taranaki streams, as well as providing data on species assemblage and diversity that can be compared with future surveys. The quantitative data obtained with the repeatable method will enable changes between years and within catchments to be determined.

Sites may need to re-surveyed in locations where fish predictions were high or habitat conditions good, but no large galaxiids were found.

While the Environment Waikato method has been tested, and found to accurately reflect fish populations within a stream, results from the survey of the Momona Stream indicate that this method may not always detect all species present, making additional surveys necessary. When initially surveyed in 2011, no native fish other than eels were found in the Momona Stream. However, this absence of large galaxiids was at odds with the habitat conditions, fish predictions and past records, so the site was re-surveyed in 2012 and kōaro found. Repeat spotlighting surveys, or spotlighting of stream reaches on two successive nights may therefore be necessary in some locations.

More surveys need to be conducted in larger catchments.

Surveys within a catchment should be reflective of the size of that catchment; one or two sites within a large catchment does not provide an accurate picture of species assemblage in that catchment. A spread of survey sites in upper, mid and lower reaches of each catchment would provide a better representation of that catchment, incorporating variations in habitat from pristine sections of stream to those impacted by intensified landuse. Even in small catchments, conducting more than one survey would provide valuable information on species distribution in that catchment. If a proportional number of surveys in each catchment are surveyed, areas with good native fish communities will be highlighted, enabling selection of long term monitoring sites.

Further surveying of streams in the southern and eastern areas of the mountain.

Only three individual galaxiids were found in the nine streams from Matanehunehu south. These catchments cover the south-eastern region of Taranaki. There are fewer large galaxiids recorded in these streams in the NZFFD records, however, when looking at maps of sites surveyed, there have been a greater number of surveys in the northern streams. The 2011/2012 surveys also focussed more on northern streams, so future surveys need to have a greater focus on streams in the southern and eastern areas of the ring-plain, in order to determine whether there are fewer large galaxiids in this area, or if this apparent lack is simply a reflection of lesser sampling effort.

The Environment Waikato spotlighting method should continue to be used for future surveys.

The rapid assessment spotlighting surveys conducted in 2001/2002 covered a large number of streams, but the surveys were limited in that no information on population structure or density was gained. While the time involved in using the more in-depth Environment Waikato method means fewer streams are able to be covered, the methodology: has a greater probability of finding all species present (David & Hamer 2010), gives a

standardised effort that is comparable between streams and, the daytime visits to the site prior to spotlighting allow information on habitat variables to be obtained. The information gained on population structure and density gives a better long-term comparison of sites, providing a basis for assessing change, and allows collection of baseline data and identification of high value freshwater sites, in line with the Didymo operations framework (2009).

Regular surveying in the Mangorei Stream above and below the Scout Road weir.

The Scout Road weir was retained in order to prevent trout access to the upper reaches of the Mangorei Stream. Regular monitoring needs to be undertaken to confirm that the weir is not only continuing to prevent access of trout, but also that native fish species are successfully migrating past the barrier. The 2011 survey found only large shortjaw kokopu and kōaro at a site above the weir; further surveys are necessary to ensure that recruitment of the population is occurring. In addition, regular surveys will provide some information on the effects of trout on these native fish communities.

Streams that were surveyed during this study should be re-surveyed to gain more information on population dynamics.

This is important for streams in which good large galaxiid populations have been found, as well as those where only small numbers of one size class were seen. This will give a better indication of the state of large galaxiid populations in Taranaki and allow the full implications of any changes to the stream ecosystems in following years to be shown.

Resurveying will also enable further investigation of size class distribution. Several surveys in one catchment, with a range of sites from lowland to upper reaches should show whether small fish are attempting to establish in that catchment, or if there are only 'large' individuals in the upper reaches.

Sites for re-survey should include the eight streams identified as important large galaxiid sites: Te Henui Stream, Huatoki Stream, Oakura River, Kiri Stream, Timaru tributary, Katikara Stream, Mangatete Stream, and Stony River.

Once more information on population structure has been gained, analyse this in relation to habitat variables.

The Environment Waikato spotlighting method used in this survey allows for collection of habitat data, in addition to that of fish populations. If habitat data continues to be collected, this should be used to look at the relationship between fish diversity, distribution etc. and habitat variables.

After gaining more information on distribution and populations of the four large galaxiid species in Taranaki, select long-term monitoring sites.

Long term monitoring of high value freshwater sites aligns with DOC guidelines under the Didymo Operations Framework (2009). Eight streams were identified as important sites for large galaxiids during this survey (p11), and further surveying in these streams to gain more information on population structure (as per the above recommendations) will enable selection of the best sites for focussing long-term monitoring efforts.

Surveys also need to be conducted in a wider area, including waterways other than those within the ring plain. For example, regular monitoring of large galaxiid populations identified in the Large Galaxiid Recovery Plan (Department of Conservation, 2005). Two shortjaw kokopu sites are currently monitored, but there are also three giant kokopu sites identified in p32 of the plan.

It is important that all long-term monitoring is undertaken during summer/autumn months. Native fish are most active during this time, so surveys undertaken then have the best chance of detecting a good representation of the population.

Use native fish survey data to test Leathwick et al.'s (2008) fish prediction model.

A preliminary analysis of the model using the data from the 2011 surveys indicated that the model was not accurate at predicting large galaxiid distribution in Taranaki streams. However, only a small number of sites were used in the analysis. Compilation of data from Sriyan Jayasuriya (a Massey University PhD student undertaking native fish survey work in Taranaki streams) and TRC records should be used in conjunction with DOC survey results to further test the Leathwick et al. (2008) fish prediction model.

Acknowledgements

Dean Caskey and Bart Jansma (TRC) provided extremely valuable input and advice in selection of sites. Thank you also to Dean for helping us with the first survey and giving us a few spotlighting tips. Rob Dykes provided some much needed assistance in creating the maps of fish distribution and location of survey sites. And last, but not least, help from all the landowners who provided us access to streams across their properties, and were often eager to take the time to show us the best ways to get to the streams, this was much appreciated.

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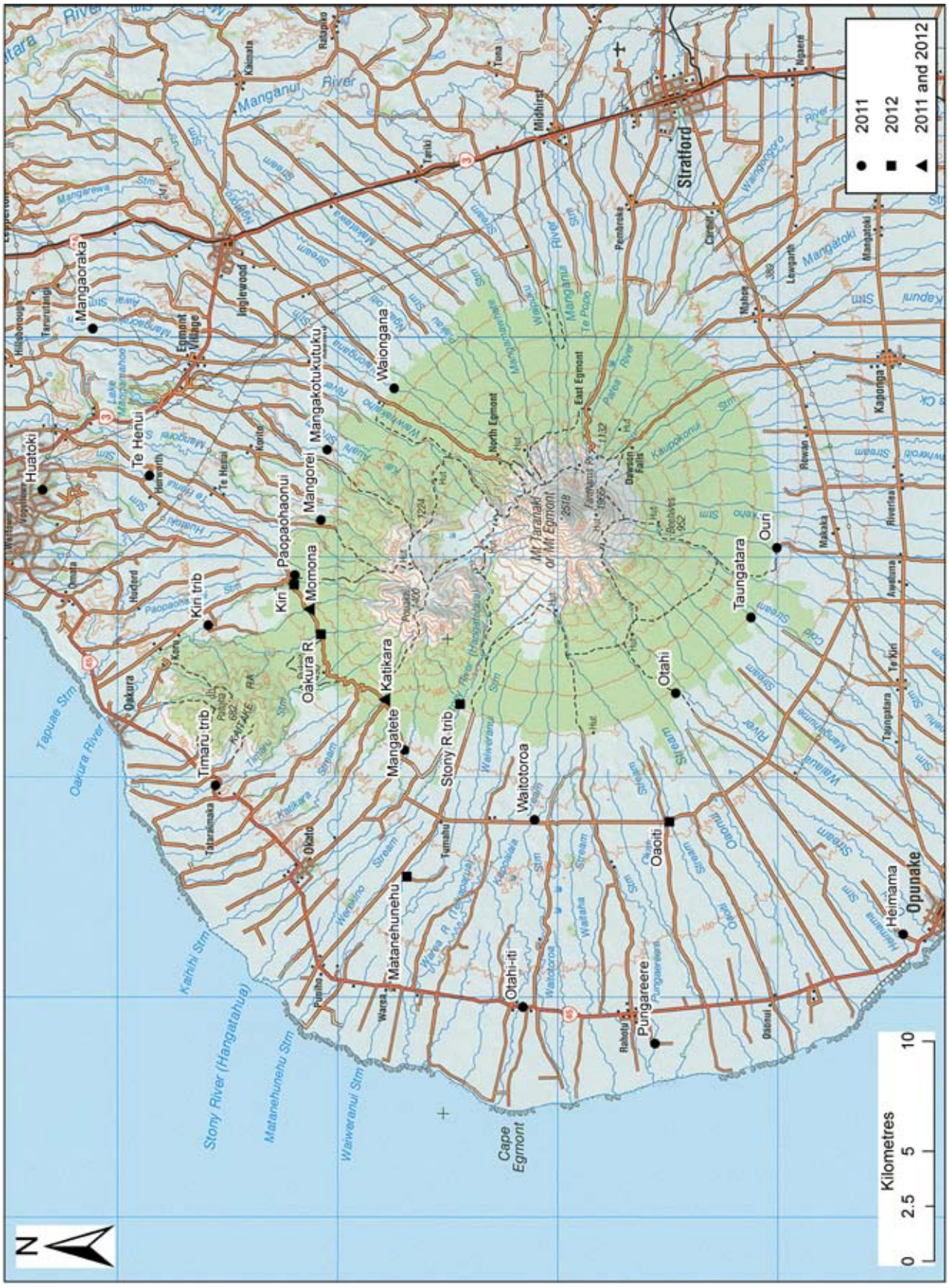
Raw data from the surveys (including habitat data etc.) are in DOCDM 699586 and 918459. All figures and analysis are in DOCDM 1013250. Copies of maps can be found in DOCDM 762257, 1137494 and 1137496.

Appendices

Appendix A

Map showing the location of the 24 survey sites and the year in which each site was surveyed.



Appendix B

Map showing which large galaxiid species were present at each of the 16 streams they were found in during the 2011/2012 surveys. For clarity, the symbols at Paopaohaonui and Kiri Streams have been offset from the actual location of the survey site. Refer to the site map in Appendix A (or GPS points in DOCDM 699586 and 918459) for the exact locations of these two sites.