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Preliminary analysis of boat electrofishing in the Waikato River in the vicinity of the Huntly Power Station: Part 1 - fishing on 2 September 2013

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by

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Introduction

This report gives a basic summary of the first sampling of a three-part monitoring project for Genesis Power Ltd (Genesis) that the University of Waikato is undertaking in close collaboration with National Institute of Water and Environmental Research Institute Atmosphere Ltd (NIWA), Hamilton. Boat electrofishing results will eventually be combined with netting undertaken by NIWA in a final report to Genesis. The boat electrofishing survey took place on 2 September, the objective of which was to undertake the first of three surveys to estimate fish distributions and abundances over key seasons:

1. Early spring 2013 (end August/early September) to target peak trout abundances and cyprinid distributions during cooler months of the year.

2. Summer 2014 (January/February) to capture peak summer abundances for target indigenous and exotic species.

3. Winter 2014 (June/July) to target mullet and cyprinid distributions during cooler months of the year.

At the surveyed reach is about 80 km from the sea, and at this point the Waikato River is a 7th order river with at a bed elevation of about 19.1 m above sea level. The catchment area upstream is 12,188 km^2, and the river has a mean flow of 352.3 $m^3 s^{-1}$ and a mean annual low flow of 123.5 $m^3 s^{-1}$ (Freshwater Fish Database Assistant version 6.1, I.G. Jowett).

Methods

This fishing extends a survey in the same area that was conducted in November 2010 (Hicks et al. 2010) and a broader survey in February 2005 (Hicks et al. 2005). We used the University of Waikato's 4.5 m-long, aluminium-hulled electrofishing boat, which has a 6-kilowatt custom-wound Honda generator that provides current to a Smith Root 5.0 GPP (gas-powered pulsator) electrofishing unit. This is the American usage of gas, i.e., petrol. The electrofishing wave form from the electrofishing unit is delivered to two bow-mounted anode

poles, each with an array of six stainless steel droppers that dip about 1 m into the water, creating the fishing field at the bow. The boat hull acts as the cathode.

Sixteen sites were fished, four upstream of the thermal discharge from the Huntly Power Station (HPS) and four downstream on the true left side of the Waikato River, and eight on the opposite side of the channel (Figure 1). Of the four sites on the true left side of the channel upstream of the HPS, two sites were upstream of the Lake Waahi outlet and two were below. At each site we fished for 10-minutes (termed shots). All fishing was conducted within 10-20 m of each bank. The lengths of the sampled reaches were between 100 m and 435 m long (400 to 1,740 m² in area; Table 1). Black disc (Davies-Colley 1988.), a measure of underwater visibility, was 0.35 m. River discharge on 2 September 2013 at Huntly was c. 300 m^3 s^{-1}, (i.e., 107.395 to 107.417 m HPS datum), and the fishing crew considered the water dirtier than normal. Water temperature was 11.7-13.1^oC at sites upstream of the HPS and on the true right of the channel. Below the HPS, water temperature was 15.7-15.8^oC. Ambient electrical conductivity ranged from 109.9 to 137.0 µSeimens cm^{-1}, and specific conductivity was 145.4-173.6 µSeimens cm^{-1} (Table 1) We operated the electrofishing boat at 70% of low range voltage (100-500 V) and 60 pulses s^{-1} to produce an output current of 3.0-3.5 A root mean square.

For most of the fished length, a dense riparian zone of willows that extended into the water prevented access to the river bank, so fishing was conducted out from the margin in about 1.1 – 3.7 m of water. Sparse hornwort grew in places, but the river bed was mostly sand with some mud.

Table 1. Lengths and areas of sixteen sites sampled by boat electrofishing in the lower Waikato River above and below the Huntly Power Station (HPS) on 2 September 2013. Sites are ordered from upstream to downstream on each side of the channel. Wai 01 is in the confluence of the Waahi Stream, the outlet to Lake Waahi.

Site	Length (m)	Area (m^2)	Temperature (^oC)	Conductivity ($\mu S\ cm^{-1}$)	
				Ambient	Specific
True left, upstream HPS					
Wai 04	269	1,076	11.9	111.7	148.3
Wai 03	435	1,740	12.3	110.4	145.4
Wai 02	161	644	11.7	130.3	173.6
Wai 01	100	400	11.7	109.9	146.5
True left, downstream HPS					
Wai 09	165	660	15.7	130.8	160.5
Wai 10	119	476	15.7	130.2	159.8
Wai 11	162	648	15.7	130.2	159.8
Wai 12	152	608	15.8	137.0	167.7
True right					
Wai 08	230	920	12.4	127.3	167.3
Wai 07	352	1,408	12.4	127.0	166.9
Wai 06	228	912	12.5	125.1	164.1
Wai 05	141	564	12.3	123.6	162.8
Wai 13	325	1,300	13.1	129.0	167.1
Wai 14	224	896	13.2	129.8	167.8
Wai 15	191	764	13.0	128.8	167.2
Wai 16	394	1,576	12.9	128.7	167.4
Mean	228	912	13.3	125.6	162.0
Total	3,648	14,592			

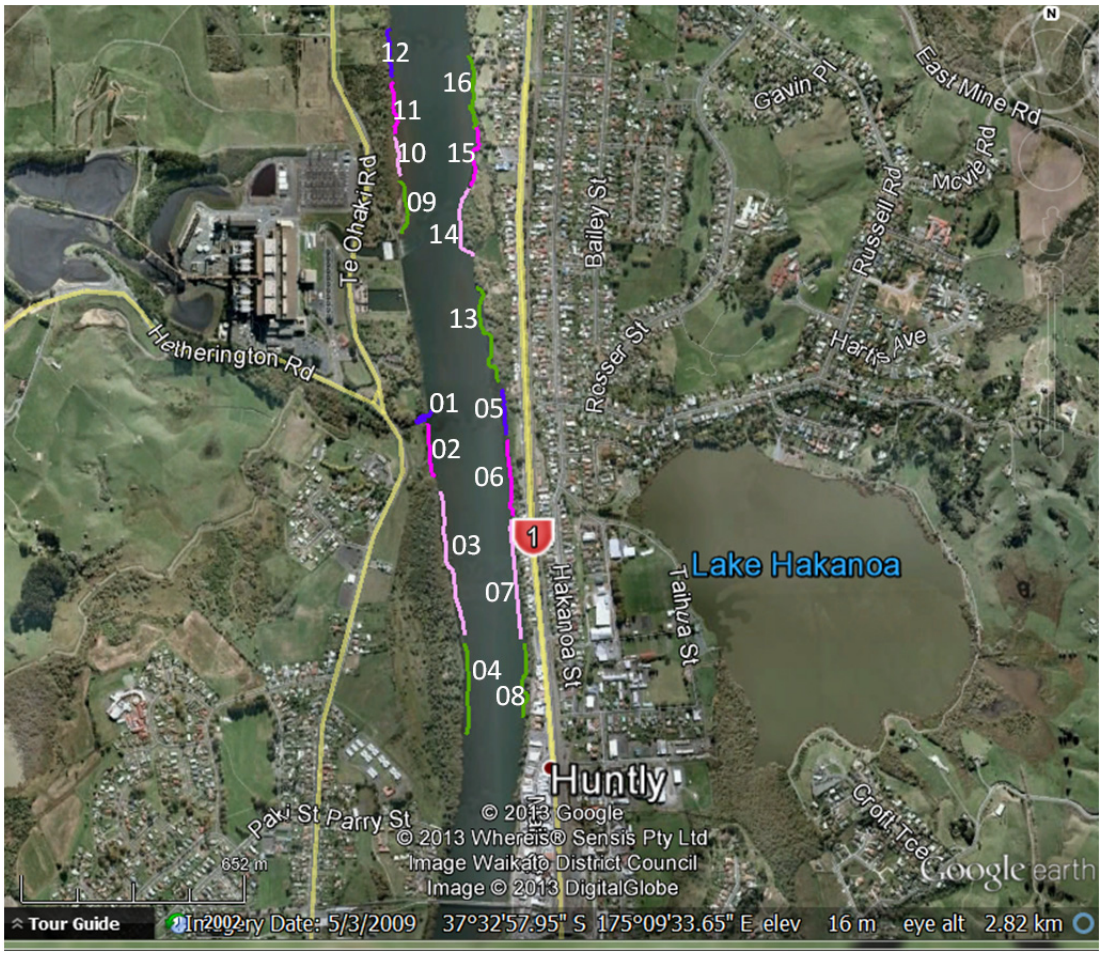

Figure 1. Location of sites fished on 2 September 2013 on the lower Waikato River upstream and downstream of the Huntly Power Station. Sites are prefixed with "Wai" in Tables 1-5.

Results and conclusions

Density

We fished for 160 mins elapsed time on the electrofishing unit in which time we covered 3,648 m of river edge (14,592 m^2 area). We caught a combined total of 324 fish at 16 sites (Table 2). Grey mullet (*Mugil cephalus*) were the most numerous fish species, followed by koi carp (*Cyprinus carpio*), and shortfin eels (*Anguilla australis*). Grey mullet and koi carp were more abundant below the HPS than above (Table 3). Grey mullet were most abundant downstream the power station on the true left bank. Shortfin eels were more consistently found on the true right side opposite the HPS. Brown trout (*Salmo trutta*) occurred at 2 of 8

sites on the true left side, and 4 of 8 sites on the true right. A single giant kokopu (*Galaxias argenteus*) was caught at the most downstream site on the true right side (Wai 16, Table 2).

Biomass

Of the 303.6 kg of fish caught, koi carp comprised 177.6 kg (61%) and grey mullet 104.4 kg (33%; Table 4, 6). These total biomasses are higher than those found on 15 Nov 2010, but the areal biomasses of the most abundant species were very similar (Table 6). Shortfin eels comprised 10.6 kg in total (Table 4), but are likely to be under represented in electrofishing samples. The greatest biomass of koi carp was found at site Wai 10 (45.2 g m^{-2}, Table 5), close to the discharge from the HPS, where water temperature was warmest, i.e., 15.7 $^{\circ}$C). While grey mullet abundance was highest below the HPS, biomass appeared to be inversely related to koi carp biomass (Table 5). The largest biomass of brown trout and shortfin eels was found at Wai 05 on the true right side of the river, and Wai 02 upstream of HPS on the true left side of the river, respectively.

Table 2. Number of fish caught by boat electrofishing in sixteen 10-minute shots on the lower Waikato River above and below the Huntly Power Station on 2 September 2013. Sites are ordered from upstream to downstream on each side of the channel. Blank cells are zero.

Site	Number of fish per 10-min shot									
	Brown trout	Catfish	Giant kokopu	Goldfish	Grey mullet	Koi carp	Perch	Shortfin eel	Smelt	Total
True left, upstream HPS										
Wai 04					7	6			2	15
Wai 03					1	1		5	1	8
Wai 02	1			1		1		15	1	19
Wai 01	1					7	2	1		11
True left, downstream HPS										
Wai 09					14	10				24
Wai 10					2	9				11
Wai 11					23	8				31
Wai 12					31	1			7	39
True right										
Wai 08	1				9					10
Wai 07					16	2		2		20
Wai 06	1	1		2		5	1	3		13
Wai 05	2	1			9	6		5		23
Wai 13				3	12	15		2	4	36
Wai 14				1	2	7		5	4	19
Wai 15					6	6		7	5	24
Wai 16	2		1	1	3	1		13		21
Total	8	2	1	8	135	85	3	58	24	324

Table 3. Density of fish caught by boat electrofishing in sixteen 10-minute shots on the lower Waikato River above and below the Huntly Power Station on 2 September 2013. Sites are ordered from upstream to downstream on each side of the channel.

Site	Density (fish 100 m^{-2})									
	Brown trout	Catfish	Giant kokopu	Goldfish	Grey mullet	Koi carp	Perch	Shortfin eel	Smelt	Total
True left, upstream HPS										
Wai 04	0.00	0.00	0.00	0.00	0.65	0.56	0.00	0.00	0.19	1.39
Wai 03	0.00	0.00	0.00	0.00	0.06	0.06	0.00	0.29	0.06	0.46
Wai 02	0.16	0.00	0.00	0.16	0.00	0.16	0.00	2.33	0.16	2.95
Wai 01	0.25	0.00	0.00	0.00	0.00	1.75	0.50	0.25	0.00	2.75
True left, downstream HPS										
Wai 09	0.00	0.00	0.00	0.00	2.12	1.52	0.00	0.00	0.00	3.64
Wai 10	0.00	0.00	0.00	0.00	0.42	1.89	0.00	0.00	0.00	2.31
Wai 11	0.00	0.00	0.00	0.00	3.55	1.23	0.00	0.00	0.00	4.78
Wai 12	0.00	0.00	0.00	0.00	5.10	0.16	0.00	0.00	1.15	6.41
True right										
Wai 08	0.11	0.00	0.00	0.00	0.98	0.00	0.00	0.00	0.00	1.09
Wai 07	0.00	0.00	0.00	0.00	1.14	0.14	0.00	0.14	0.00	1.42
Wai 06	0.11	0.11	0.00	0.22	0.00	0.55	0.11	0.33	0.00	1.43
Wai 05	0.35	0.18	0.00	0.00	1.60	1.06	0.00	0.89	0.00	4.08
Wai 13	0.00	0.00	0.00	0.23	0.92	1.15	0.00	0.15	0.31	2.77
Wai 14	0.00	0.00	0.00	0.11	0.22	0.78	0.00	0.56	0.45	2.12
Wai 15	0.00	0.00	0.00	0.00	0.79	0.79	0.00	0.92	0.65	3.14
Wai 16	0.13	0.00	0.06	0.06	0.19	0.06	0.00	0.82	0.00	1.33
Mean	0.07	0.02	0.00	0.05	1.11	0.74	0.04	0.42	0.18	2.63

Table 4. Biomass of fish caught by boat electrofishing in sixteen 10-minute shots on the lower Waikato River above and below the Huntly Power Station on 2 September 2013. Sites are ordered from upstream to downstream on each side of the channel.

Site	Biomass (g)									
	Brown trout	Catfish	Giant kokopu	Goldfish	Grey mullet	Koi carp	Perch	Shortfin eel	Smelt	Total
True left, upstream HPS										
Wai 04					5,805	18,620			3	24,428
Wai 03					462	2,709		1,370	1	4,542
Wai 02	1,061			2		1,588		1,962	1	4,614
Wai 01	1,550					14,611	575	148		16,884
True left, downstream HPS										
Wai 09					11,207	25,273				36,480
Wai 10					1,933	21,497				23,430
Wai 11					17,312	23,188				40,500
Wai 12					23,519	3,177			8	26,704
True right										
Wai 08	617				6,625					7,242
Wai 07					13,078	1,537		1,503		16,118
Wai 06	715	199		389		5,826	136	625		7,890
Wai 05	2,218	187			7,644	5,630		838		16,517
Wai 13				422	9,456	28,632		499	5	39,014
Wai 14				196	979	13,238		281	5	14,699
Wai 15					4,168	11,659		221	6	16,054
Wai 16	2,423		160	103	2,222	443		3,107		8,458
Total	8,584	386	160	1,112	104,410	177,628	711	10,554	28	303,573

Table 5. Areal biomass of fish caught by boat electrofishing in sixteen 10-minute shots on the lower Waikato River above and below the Huntly Power Station on 2 September 2013. Sites are ordered from upstream to downstream on each side of the channel.

Site	Biomass (g m^{-2})									
	Brown trout	Catfish	Giant kokopu	Goldfish	Grey mullet	Koi carp	Perch	Shortfin eel	Smelt	Total
True left, upstream HPS										
Wai 04	0.00	0.00	0.00	0.00	5.39	17.30	0.00	0.00	0.00	22.70
Wai 03	0.00	0.00	0.00	0.00	0.27	1.56	0.00	0.79	0.00	2.61
Wai 02	1.65	0.00	0.00	0.00	0.00	2.47	0.00	3.05	0.00	7.16
Wai 01	3.88	0.00	0.00	0.00	0.00	36.53	1.44	0.37	0.00	42.21
True left, downstream HPS										
Wai 09	0.00	0.00	0.00	0.00	16.98	38.29	0.00	0.00	0.00	55.27
Wai 10	0.00	0.00	0.00	0.00	4.06	45.16	0.00	0.00	0.00	49.22
Wai 11	0.00	0.00	0.00	0.00	26.72	35.78	0.00	0.00	0.00	62.50
Wai 12	0.00	0.00	0.00	0.00	38.68	5.23	0.00	0.00	0.01	43.92
True right										
Wai 08	0.67	0.00	0.00	0.00	7.20	0.00	0.00	0.00	0.00	7.87
Wai 07	0.00	0.00	0.00	0.00	9.29	1.09	0.00	1.07	0.00	11.45
Wai 06	0.78	0.22	0.00	0.43	0.00	6.39	0.15	0.69	0.00	8.65
Wai 05	3.93	0.33	0.00	0.00	13.55	9.98	0.00	1.49	0.00	29.29
Wai 13	0.00	0.00	0.00	0.32	7.27	22.02	0.00	0.38	0.00	30.01
Wai 14	0.00	0.00	0.00	0.22	1.09	14.77	0.00	0.31	0.01	16.40
Wai 15	0.00	0.00	0.00	0.00	5.46	15.26	0.00	0.29	0.01	21.01
Wai 16	1.54	0.00	0.10	0.07	1.41	0.28	0.00	1.97	0.00	5.37
Mean	0.78	0.03	0.01	0.06	8.59	15.76	0.10	0.65	0.00	25.98

Table 6. Areal biomass of fish caught by boat electrofishing in the lower Waikato River above and below the Huntly Power Station at eight sites in 2010 and sixteen sites 2013. Source of 2010 data - Hicks et al. (2010). – fish present but not weighed.

	Biomass (g m^{-2})		Percent of total	
Species	10-Nov-10	2-Sep-13	10-Nov-10	2-Sep-13
Brown trout	0.00	0.78	0.00	2.99
Catfish	0.21	0.03	0.92	0.13
Giant kokopu	0.00	0.01	0.00	0.02
Goldfish	0.60	0.06	2.62	0.25
Grey mullet	9.57	8.59	41.91	33.05
Koi carp	13.88	15.76	60.79	60.66
Perch	0.00	0.10	0.00	0.38
Rudd	0.04	0.00	0.18	0.00
Shortfin eel	1.39	0.65	6.07	2.50
Smelt	–	0.00	–	0.01
Common bullies	–	0.00	–	0.00
Total	22.83	25.98	100.00	100.00

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