A biosurvey of the benthic macroinvertebrates, algae and deposited fine sediment of the Omaru Stream

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Author: Dr Alex James

F.I.S.H. Aquatic Ecology

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Cover photo: Omaru Stream facing downstream

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CONTENTS

Introduction

Omaru Stream is a tributary of the Waitotara River and flows for some of its length through the forest clad Whanganui National Park and Waitotara Conservation Area. Some of the headwaters of the Omaru Stream are on private land. A private landowner with property at the headwaters of the Omaru Stream would like to clear some vegetation for the construction of a fence line. Such clearance has the potential to negatively impact the Omaru Stream, primarily through the input of fine sediment. Though sedimentation is a naturally occurring process in waterways, human land-use activities have increased fine sediment deposition in many catchments. Fine sediment deposition can have numerous impacts on aquatic ecosystems including inhibited primary production, impaired macroinvertebrate communities and degradation of fish habitat (Wood & Armitage, 1997).

Concern over the potential impact of vegetation clearance in the headwaters of the Omaru Stream resulted in the Department of Conservation initiating a pre-impact sampling of algae, macroinvertebrates and deposited fine sediment. This was performed at a site downstream of the proposed impact location. This sampling gives an idea of the biota of the Omaru Stream at this point prior to any upstream sediment input. Additionally, it gives a snapshot of the aquatic biota at a site that has probably not been sampled before and provides a baseline in case the invasive algae *Didymosphenia geminata* ever invades the catchment.

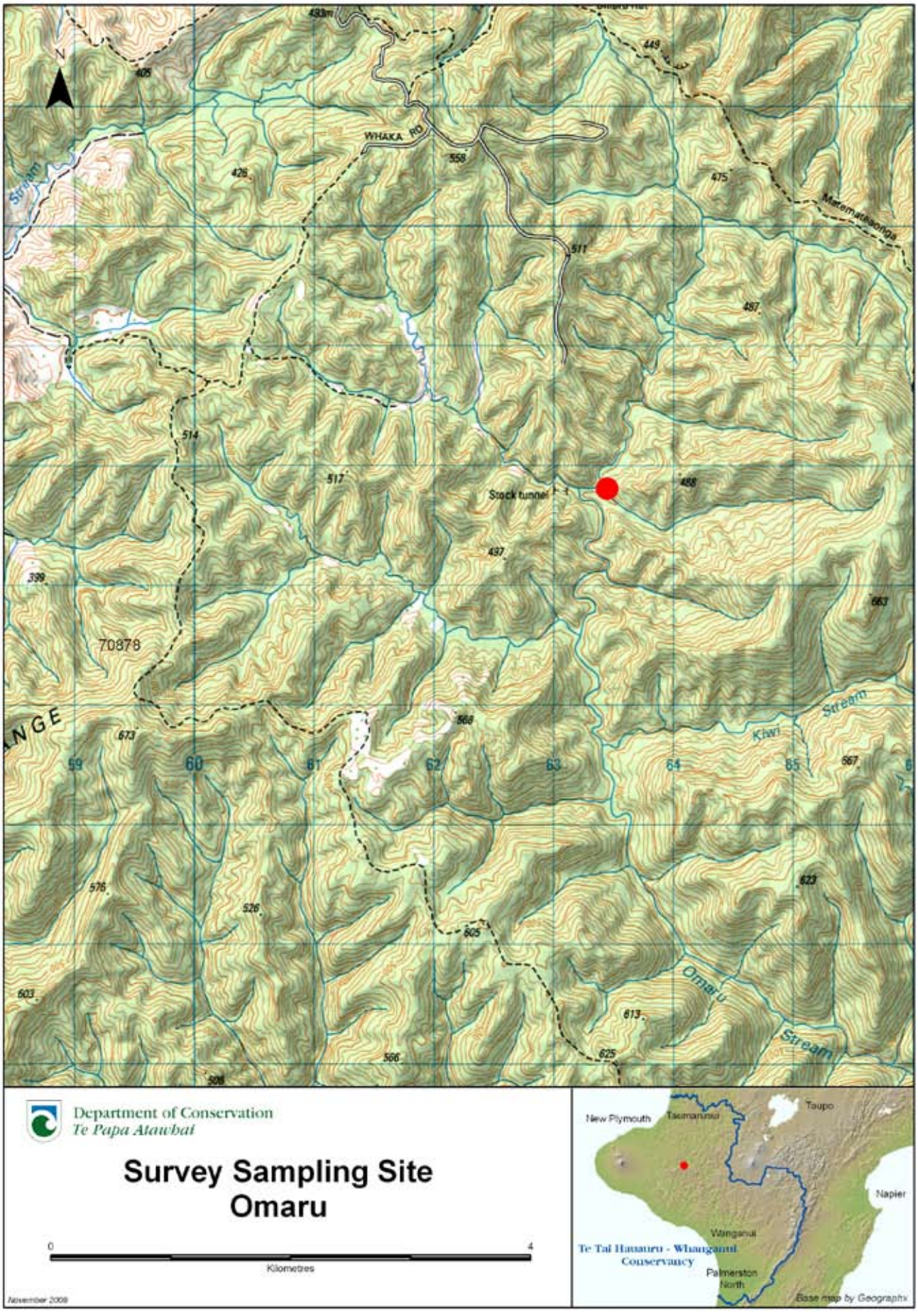
Methods

The coordinates of the sampling site were determined using NZMS 260 topographic maps and a Garmin Etrex Vista GPS unit. The site was accessed via helicopter on February 4, 2009 and is within the Waitotara Conservation Area (Figure: 1). Spot measurements of temperature, specific conductivity, pH and dissolved oxygen were recorded with Extech ExStik II handheld meters. The riparian characteristics, percentage of run/riffle/pool and substrate size were estimated visually. Water velocity was estimated at five points near where macroinvertebrates were sampled. Depths were measured near where the invertebrates were sampled. Wetted width was measured at five transects. Deposited fine sediment was measured at five points within the sampled riffle using the Quorer methodology. This involves the insertion of a bottomless bucket into the streambed, the suspension of the sediment within the area of the bucket by disturbing the streambed and the taking of a sample of the resultant slurry. A full explanation of this method can be found on the NIWA website (http://www.niwa.cri.nz:80/ncwr/tools/quorer). The Quorer procedure was repeated 5 times.

Periphyton was sampled by taking scrapings from four cm diameter circles from eight rocks using scalpels. Rocks from close proximity to the invertebrate sampling points were randomly selected. A total rock surface area of 100 cm^2 was sampled with all the samples being pooled. The periphyton sample was frozen as soon as possible and sent to NIWA for chlorophyll-*a*, ash-free dry weight (AFDW) and relative abundance analysis using the methodologies described in Biggs & Kilroy (2000).

Benthic macroinvertebrates were sampled by taking five Surber samples (0.1 m^2 area, 500 µm mesh size) from within a riffle in the survey reach. Samples were preserved in iso-propyl alcohol and washed through a 500 µm sieve prior to sorting and identification. Macroinvertebrates were identified to the lowest possible level using Smith & Ward (2005) and Winterbourn, Gregson & Dolphin (2006). Chironomids were identified to sub-family where possible.

FIGURE 1: THE SITE ON THE OMARU STREAM SURVEYED FOR MACROINVERTEBRATES, ALGAE, AND DEPOSITED FINE SEDIMENT ON FEBRUARY 4, 2009.



Results

PHYSICOCHEMICAL

TABLE 1: PHYSICOCHEMICAL CHARACTERISTICS OF THE OMARU STREAM SAMPLING LOCATION

MEASURE	RESULT
Coordinates	Sampling site: Easting 2663445, Northing 6207804 Impact location: Easting 2663990, Northing 6210220 The sampling site is approximately 3.5 km downstream of the proposed impact location (vegetation clearance).
Altitude	approximately 280 m
Temperature	15.9 °C at 12.40 pm on February 4, 2009
Specific conductivity	167 µS/cm
pH	6.5
Dissolved oxygen	93.4%, 9.10 mg/L
Run/riffle/pool (%)	10/10/80
Substrate size %: Boulders(>256 mm)/ Large cobble (128-256 mm)/ small cobble(64-128 mm)/ gravel(2-64 mm)/ sand silt (<2 mm)	5/1/24/60/10
Velocity (near Surber sites)	approx. 0.2 – 0.5 m/s
Mean depth (near Surber sites)	0.10 m (range: 0.08 – 0.13 m)
Mean wetted width	8.66 m (range: 4.4 – 10.4 m)
Deposited fine sediment means (+ SD)	Areal SIS: 1149.8 g/m^2 (724.4) Volumetric SIS: 8443 g/m^3 (5609.8) Areal SOS: 100.1 g/m^2 (68.9) Volumetric SOS: 758.7 g/m^3 (538.4) (See Appendix 2 for raw sediment data).
Riparian character	Native bush including manuka, tree ferns, ground ferns and Hebe sp. The stream is partially shaded and the true left bank is a ~30 m sheer cliff (Figure: 2).
Stream character	At the sampling location, riffles are rare and usually flow between boulders (Figure: 3). Much of the stream consists predominantly of slow flowing runs/pools (Figure: 4). The runs are up to 0.5 m deep while there are some deeper (~1 m) pools. The substrate is dominated by gravel size particles. There are some sandy beaches and bars. Tree trunks and smaller woody debris are common in the channel.

SIS = suspendable inorganic sediment, SOS = suspendable organic sediment.

FIGURE 2: RIPARIAN VEGETATION AT THE SAMPLING SITE IN THE OMARU STREAM.

FIGURE 3: THE SAMPLED RIFFLE IN THE OMARU STREAM.

FIGURE 4: A SLOWLY FLOWING REACH DIRECTLY UPSTREAM OF THE SAMPLED RIFFLE IN THE OMARU STREAM.

MACROINVERTEBRATES

A combined total of 32 macroinvertebrate taxa were present in the five Surber samples with a mean of 18.6 taxa per sample (Table: 2). Additionally, *Helicopsyche* sp. (Trichoptera) and freshwater crayfish (Crustacea) were sighted, making a grand total of 34 taxa observed in the sampling reach. Water quality as measured by the Macroinvertebrate Community Index (MCI) and Quantitative Macroinvertebrate Community Index (QMCI) indicate the Omaru Stream at the sampling site had clean water according to the interpretation classes of Boothroyd & Stark (2000). The EPT (Ephemeroptera, Plecoptera, Trichoptera) orders comprised nearly three quarters of all individuals and over half of all taxa (Table 2). The EPT orders are considered sensitive to water and habitat quality degradation. Hydroptilid trichoptera which often thrive in degraded streams, and are thus usually not included in EPT calculations, were not present in the samples. The invertebrate community was dominated numerically by the mayfly, *Deleatidium* sp. (Appendix: 1).

TABLE 2. THE MEAN (+SD) AND RANGE OF MACROINVERTEBRATE METRICS CALCULATED FROM SAMPLES TAKEN IN THE OMARU STREAM ON FEBRUARY 4, 2009.

MEASURE	MEAN	STANDARD DEVIATION	RANGE
Total individuals (per 0.1 m^2)	285	106.8	135 – 408
Total taxa			
(per 0.1 m^2)	18.6	4.0	13 – 23
MCI	126	7.6	114 – 134
QMCI	7.2	0.7	6.2 – 7.9
% EPT individuals	74.4	12.7	58.6 – 87.4
% EPT taxa	57.6	2.9	53.8 – 60.9

ALGAE

Very little algae were present at the sampling site. Despite collecting algal scrapings from an area of 100 cm^2 the algal sample contained lots of detritus and little algae. Relative abundances could not be ascertained because there were too few cells. Only diatoms were identified and the species present, ash free dry weight and chlorophyll-*a* concentrations are given in Table:3.

TABLE 3. THE DIATOM SPECIES PRESENT AND ALGAL BIOMASS METRICS FROM PERIPHYTON SCRAPING SAMPLES TAKEN IN THE OMARU STREAM ON FEBRUARY 4, 2009.

	SPECIES OR CONCENTRATION
Diatoms present	*Cocconeis placentula*
	Cymbella cf. *tumida*
	Gomphonema spp. 20um
	Navicula cf. *lanceolata*
	Nitzschia spp.(small)
	Synedra ulna cf. *rumpens*
Ash free dry weight (mg/cm^2)	0.4312
Chlorophyll a (mg/cm^2)	0.0003

Conclusions

- At the sampling site, the Omaru Stream had a benthic macroinvertebrate community dominated by taxa sensitive to anthropogenic land-use changes. The MCI and QMCI interpret this community as being indicative of clean water.
- The algal community was comprised entirely of diatoms and the there were so few cells in the samples that relative taxon abundances could not be determined.
- Deposited fine sediment samples displayed great variability with some very high values for a forested catchment, however this is likely related to the soft geology of the area.
- It is recommended that the landowner is made aware of, and preferably reads, the recent Environment Waikato technical report on erosion and sediment control (Environment Waikato, 2009). Ideally they will utilise appropriate sediment control methods when they undertake the proposed vegetation clearance.
- It is recommended that a second sampling occurs following any upstream vegetation clearance. This should not be too long after the clearance but preferably after one or two runoff inducing rainfall events have mobilised any sediment released or exposed by the proposed land development activities.

References

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Appendix 1: Benthic macroinvertebrate raw data

	TAXON	OMARU STREAM 1	OMARU STREAM 2	OMARU STREAM 3	OMARU STREAM 4	OMARU STREAM 5	MEAN
Ephemeroptera	*Amelotopsis perscitus*	0	0	0	1	0	0.2
	Austroclima sepia	1	4	12	5	3	5
	Coloburiscus humeralis	1	1	0	5	9	3.2
	Deleatidium sp.	76	153	96	191	227	148.6
	Ichthybotus hudsoni	0	0	0	0	3	0.6
	Neozephlebia scita	0	1	0	0	0	0.2
	Nesameletus ornatus	35	44	29	30	9	29.4
	Zephlebia dentata	0	1	0	0	0	0.2
Plecoptera	*Austroperla cryene*	0	0	1	0	0	0.2
	Zelandobius sp.	2	0	0	1	1	0.8
	Zelandoperla sp.	0	5	2	2	3	2.4
	Stenoperla sp.	0	0	1	2	3	1.2
Trichoptera	*Aoteapsyche* sp.	1	0	11	2	3	3.4
	Beraeoptera roria	0	0	1	0	0	0.2
	Hydrobiosis gollanis	2	1	3	0	3	1.8
	Hydrobiosis parumbripennis	0	0	0	5	0	1
	Hydrobiosis soror	0	4	2	12	9	5.4
	Hydrochorema sp.	0	0	0	1	0	0.2
	Neurochorema armstrongi	0	0	1	0	0	0.2
	Psilochorema sp.	0	0	0	2	1	0.6
	Zelolessica sp.	0	0	1	2	0	0.6
Diptera	*Aphrophila* sp.	0	0	2	1	0	0.6
	Austrosimulium sp.	0	1	2	2	7	2.4
	Empididae	1	0	1	4	7	2.6
	Hexatomini	0	0	0	0	1	0.2
	Orthocladiinae	0	1	59	12	8	16
	Tanytarsini	1	7	8	39	41	19.2
Coleoptera	Elmidae	10	9	35	10	28	18.4
	Hydraenidae	0	4	0	2	10	3.2
Megaloptera	*Archichauliodes diversus*	1	7	4	31	28	14.2
Mollusca	*Potamopyrgus antipodarum*	1	2	2	2	4	2.2
Oligochaeta		3	0	0	0	0	0.6

Appendix 2 – Deposited fine sediment raw data

SAMPLE	TSS (G/M³)	BACKGROUND (G/M³)	TSS CORRECTED (G/M³)	ORGANIC (G/M³)	BACKGROUND (G/M³)	ORGANIC CORRECTED (G/M³)	AVE DEPTH (M)	STIRRED DEPTH (M)	AREAL SIS (G/M²)	VOLUMETRIC SIS (G/M³)	AREAL SOS (G/M²)	VOLUMETRIC SOS (G/M³)
1	5400	7	5393	580	3.8	576.2	0.055	0.075	264.924	3532.32	31.691	422.547
2	5800	7	5793	440	3.8	436.2	0.14	0.2	749.952	3749.76	61.068	305.34
3	20000	7	19993	1700	3.8	1696.2	0.08	0.11	1463.744	13306.764	135.696	1233.6
4	34000	7	33993	2900	3.8	2896.2	0.07	0.14	2176.776	15548.4	202.734	1448.1
5	9700	7	9693	580	3.8	576.2	0.12	0.18	1094.016	6077.867	69.144	384.133
								Average	1149.882	8443.022	100.067	758.744
								S.D.	724.437	5609.769	68.852	538.432

TSS = total suspended solids
SIS = suspendable inorganic sediments
SOS = suspendable organic sediments