CONTENTS OF BLUE DUCK FAECES FROM THE TONGARIRO RIVER

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ABSTRACT

Aquatic invertebrates were extracted and identified from seven Blue Duck faeces collected from the Tongariro River in December 1990. A total of 927 aquatic invertebrates representing 37 taxa was identified. Over all samples, 45% of the aquatic invertebrates extracted were Chironomidae (samples ranging from 19-76%), 28% Trichoptera (ranging 11-49%), and 16% Ephemeroptera (ranging 2-42%). The dominant chironomid was *Eukiefferiella* sp., although *Cricotopus* spp. were also relatively abundant in some samples. Cased caddisflies were the main Trichoptera in all samples, but no one taxon was consistently dominant. Plecoptera comprised 0-20% of invertebrates in the faeces. In most samples collected below Tree Trunk Gorge, chironomids comprised >61% of individuals recorded in the faeces, whereas above the gorge they comprised <40% in any sample. Overall, the diet of Blue Duck on the Tongariro River in December 1990 was variable in terms of the proportions of species and the number of invertebrates that were consumed. This has also been shown in studies of Blue Duck diet on other rivers.

INTRODUCTION

The Blue Duck (*Hymenolaimus malacorhynchos*) is an endemic duck largely restricted to forested upland catchments in the central North Island and the west coast of the South Island (Fordyce 1976). Its main food is aquatic invertebrates, which it mainly gleans from submerged rock surfaces (Kear & Burton 1971, Craig 1974, Fordyce & Tunnicliffe 1973, Eldridge 1986, Veltman & Williams 1990). To understand more fully the range of invertebrate species and their proportions eaten, I analysed Blue Duck faeces taken from the upper section of the Tongariro River. Results from this are compared with the diet of Blue Duck recorded on other rivers.

STUDY AREA

The Tongariro River (Figure 1) drains the eastern slopes of Mounts Tongariro and Ruapehu (c.2700 m asl) and the western Kaimanawa Ranges. It runs north into Lake Taupo below Turangi (355 m asl) through vegetation ranging from alpine scrub to native forest, exotic forest, and regenerating scrub. The river is highly regarded for its recreational trout fishery, is an important nursery area for juvenile trout and provides habitat for blue duck in the upper sections (above Tree Trunk Gorge; Fig. 1). Blue Duck numbers are believed to have declined by about 40% since the commissioning of the power scheme (Speedy, C & Keys, H. 1992, Upper Tongariro River Blue Duck decline 1983-1991. Unpublished report. Department of Conservation, Tongariro/Taupo Conservancy). The power scheme draws water off at Rangipo Dam (7 km above Tree Trunk Gorge) and again below Waikato

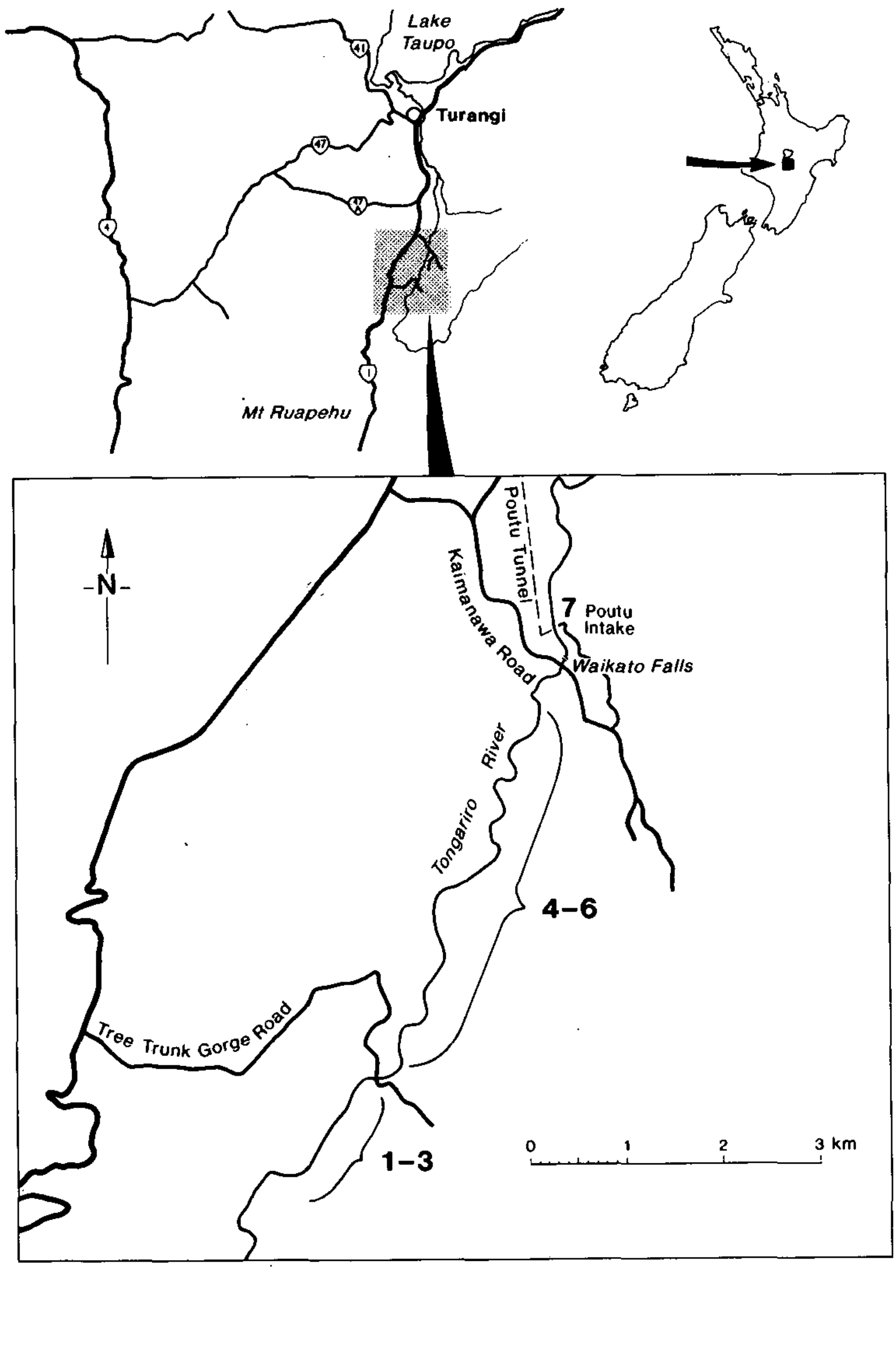

FIGURE 1 — Location of sampling sites (numbers) on the Tongariro River

Falls (5 km downstream of Tree Trunk Gorge). Water is returned to the Tongariro River above Poutu Intake at Waikato Falls and via the Poutu Stream 14 km below the falls.

METHODS

Seven Blue Duck faeces were scraped off emergent rocks from the middle section of the Tongariro River during December 1990. Samples were frozen and later thawed and soaked in water overnight to allow the faecal pellets to soften. The softened material was then broken up (deflocculated) with a magnetic stirrer to a homogenous solution. A drop of detergent was added to break the water surface tension and assist fragments to sink. The solution was split down to workable fractions (1/8th – 1/16th) by means of a Folsom-type plankton splitter so that, whenever possible, at least 100 individuals would be counted. Two samples (numbers 7 and 2) contained high levels of algae and few invertebrates (Table 1), and so the whole sample was sorted. Each sample was sorted under a stereoscopic microscope at 10-40x magnification in a Bogorov sorting tray.

Key fragments of aquatic insects were identified by comparison with slides prepared in lactophenol PVA, photographs, drawings from dissected invertebrates and the identification guides of Winterbourn & Gregson (1989) and Cowley (1978). The term "key fragments" refers to the specific parts of a taxon that remained intact through the digestive tract and are easily seen, distinguishable from other taxa and feasible to count (Appendix 1). Mandibles were the main key fragment used, being more variable than labra and more robust than clypera. Terminal segments of beetle (Elmidae) larvae and mouth hooks of some fly larvae (Muscidae) were also used in identification. Often part or whole heads remained intact, easing identification. Heads of chironomid larvae usually remained intact and these were mounted in lactophenol PVA on slides for more detailed identification (usually to genus) later. Sometimes all sclerotised parts of cased caddisfly larvae were trapped in their cases after digestion and this assisted in the positive association of fragments with caddisfly species.

Since the relative numbers of different key fragments for a taxon were usually near the expected ratio (e.g. mandibles:labrum = 2:1) it is assumed the splitting process resulted in a representative subsample. This was confirmed by analysis of two 1/16th subsamples of one sample which were similar in taxonomic composition (i.e. in the taxa present or their relative abundance).

The number of individuals of each taxon in the subsamples was calculated first by totalling the number of each key fragment. The number of mandibles was divided by two and rounded up to the nearest whole number so that it represented individuals. The most common key fragment for that taxon was used to calculate the number of individuals, and any whole individuals or intact heads were added. Data are presented at the taxonomic level at which the smallest larvae were recognisable (Appendix 2). High numbers of unidentifiable fragments were found in sample 2.

TABLE 1 — Summary of sampling information. Sample numbers correspond to site numbers in Figure 1

Sample	Subsample Size	Total Number of Fragments Counted	Calculated Number of Individuals in Whole Sample
1	1/16th	228	2048
2	Whole	74	55
3	1/8th	309	1208
4	1/8th	468	2648
5	1/16th	122	1504
6	1/16th	161	1760
7	Whole	71	58

RESULTS

Details of subsample sizes and number of individuals counted are given in Table 1. The calculated number of individuals in a whole sample varied from 55 (sample 2) to 2648 (sample 4). In all, 927 individuals were identified from the faecal samples, representing 37 taxa (Appendix 1). Of these 45% were Chironomidae, 28% Trichoptera, and 16% Ephemeroptera (all samples combined).

Chironomid larvae comprised > 18% of invertebrates in all faecal samples and were the dominant taxon in five of the samples (32%-76%; Fig. 2). The highest percentage of chironomids was found in sample 7, which contained large amounts of algae, suggesting that larvae may have been consumed in association with algae. However, sample 2, which also had high algal content, had only 39% chironomids. The dominant chironomid in faecal samples was *Eukiefferiella* sp., although *Cricotopus* spp. were also relatively abundant in samples 5 and 7 (Appendix 2).

Trichoptera comprised > 10% of the invertebrates in the faeces in all samples and was the dominant taxon in faecal samples 1 and 6 (35%-49%, Appendix 2). Cased caddisflies were the dominant Trichoptera in all samples except sample 2, where *Aoteapsyche* spp. were relatively abundant (10%, Appendix 2). Although cased caddis were a major component of Blue Duck faeces on the Tongariro River (Fig. 2), no one taxon from that group was consistently dominant (Appendix 2). Note the high proportions of *Oxyethira albiceps* in sample 6. Sample 3 was dominated by mayflies (42%, mainly *Austroclima* spp., Appendix 2), but otherwise they comprised < 17% in any other sample. Plecoptera comprised 26% of prey items in sample 2 but otherwise was < 11% (Fig. 2).

DISCUSSION

Most major invertebrate taxa known to be in the Tongariro River were represented in the faeces of Blue Duck (K.Collier, pers. comm.). However, a wider range of species appears to have been taken than reported elsewhere (Collier 1991, C.Veltman, pers. comm.), possibly due to the greater taxonomic resolution used in this study. The main taxa in the faeces collected in December 1990 were Chironomidae and Trichoptera, which collectively

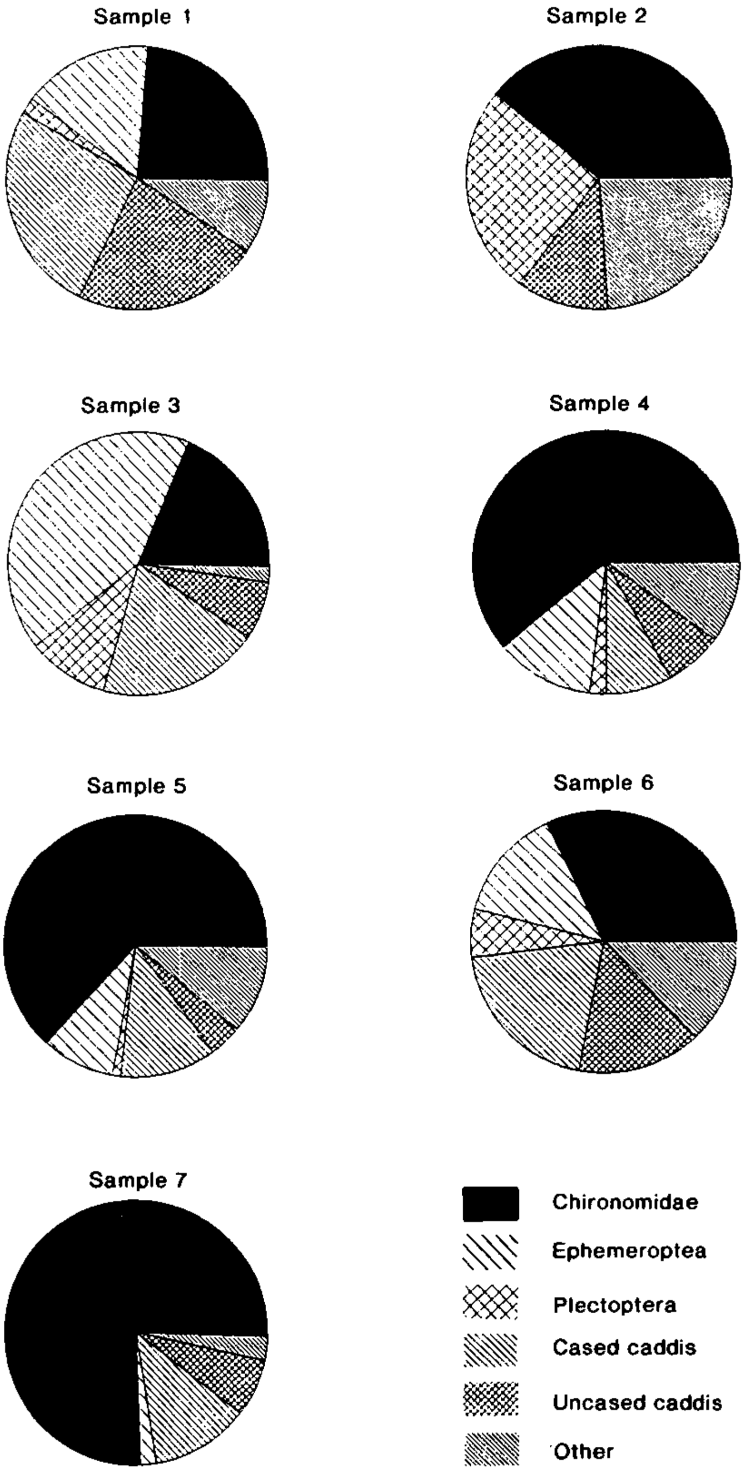

FIGURE 2 — Pie graphs of percent composition for the main taxa from seven Blue Duck faecal samples collected from the Tongariro River

comprised 46-95% of total larvae consumed. Ephemeroptera, *Zelandobius* sp. (Plecoptera), and Elmidae adults were also recorded in relatively high numbers in some samples.

The faecal samples collected varied in the number and taxonomic composition of aquatic invertebrates. Samples with low numbers of invertebrates contained large amounts of algae. Other studies have also reported large amounts of algae in faeces of Blue Duck, which appear to pass through the digestive tract without being broken down (Collier 1991). Williams (1991) associated ingestion of large quantities of algae with poor breeding success of Blue Duck on the Manganuiateao River.

As the exact locations at which samples were collected on the Tongariro River are not known, it is difficult to say whether changes in relative abundance of prey in the faeces are correlated with location on the river. It is also possible that some birds had been feeding mostly in tributaries before sample collection. In general, however, samples collected below Tree Trunk Gorge (samples 4-7) had higher proportions of chironomids in faeces than samples collected above the gorge. It is unclear whether this reflects changing selectivity by the ducks or compositional changes in the pool of potential prey. Quinn & Vickers (1992) found that numbers of Chirnomids (and algae) increased with distance down the Tongariro River and that numbers of *Cricotopus* spp. and *Eukiefferiella* sp. increased with increasing sand content in the substrate.

Collier (1991) found variability in the diet of birds presumed to be feeding in the same territory on the Manganuiateao River. This suggested a heterogeneous distribution of the prey and/or elements of chance or individuality in which prey taxa are encountered and eaten. Blue Duck diet was also shown to vary in seperate parts of the North Island and this appeared largely to reflect the pool of potential prey (Collier 1991). The dominant taxon consumed by the Blue Duck in the study of Collier (1991) was cased caddis (thought to be mainly *Helicopsyche* spp., *Pycnocentrodes* spp. and *Beraeoptera* sp.) although Plecoptera, Elmidae and Chironomidae were dominant at some sites. Veltman (pers. comm.) found variation in Blue Duck diet over one year on the Manganuiateao River with chironomids, cased caddis and hydrobiosids dominant in the faeces. No evidence was found of consistent prey selectivity over time in that study. The variable composition of the Blue Duck faeces collected from the Tongariro River is consistent with those findings.

ACKNOWLEDGEMENTS

I thank Cam Speedy of DoC Turangi for collecting the faecal samples, Clare Veltman and Ian Henderson of Massey University for lending photos of key fragments, and Kevin Collier, Chris Pugsley, Dave Towns and Murray Williams for comments on drafts.

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APPENDIX 1 — List of taxa identified from Blue Duck faeces on the Tongariro River and the key fragments used

Taxa	Key Fragments	
Ephemeroptera		
Deleatidium spp.	l, m	Cs = Case
Austroclima spp.	l, m	W = Whole
Coloburiscus humeralis	l, m	h = Head
Nesameletus spp.	m	c = Clypera
Zephlebia spp.	l	l = Labra
Plecoptera		m = Mandible
Zelandobius furcillatus	h, m	ps = Prosternal sclerite
Zelandoperla spp.	l, m	Ts = Terminal segment
Spaniocerca spp.	m	Mh = Mouth hooks
Austroperla cyrene	h, l, m	
Trichoptera		
Hydropsychidae	h, c, l, m	
Aoteapsyche colonica	m	
Aoteapsyche raruraru	m	
Aoteapsyche ?tepoka	m	
Orthopsyche sp.	m	
Polyplectropus sp.	c, m	
Plectrocnemia sp.	h, m	
Hydrobiosidae	h, c, l, m, ps	
Hydrobiosis spp.	h, c, l, m, ps	
Hydrobiosis parumbripennis	ps	
Neurochorema spp.	h, c, l, m , ps	
Costachorema spp.	h, c, l, m	
Psilochorema spp.	l, m, ps	
Oxyethira albiceps	Cs	
Helicopsyche spp.	h, c, m	
Zelolessica cheira	Cs, W, h, c, l, m	
Conoesucidae		
Olinga feredayi	c, l, m	
Beraeoptera roria	Cs, h, c, l, m	
Pycnocentrodes spp.	W, h, c, l, m	
Pycnocentria spp.	Cs, h, c, l, m	
Coleoptera		
Elmidae spp.(adults and larvae)	Ts, h, m, l	
Unknown sp A.	m	
Unknown sp B.	m	
Diptera		
Chironomidae		
Eukiefferiella sp.	h	
Orthocladinae sp A.	h	
Cricotopus spp.	h	
Tanytarsus vespertinus	h	
Aphrophila neozelandica	h, m	
Muscidae sp.	Mh	
Megaloptera		
Archichaulioides diversus	l, m	

APPENDIX 2 — Percent composition for taxa that comprised >5% in any one sample of Blue Duck faeces on the Tongariro River. Total indicates all samples combined. (Chironomidae from sample 4 were not identified to genus level.)

Sample	1	2	3	4	5	6	7	Total
EPHEMEROPTERA	**16**	**0**	**42**	**12**	**9**	**14**	**2**	**16**
Deleatidium spp.	9	0	14	8	3	5	2	8
Austroclima spp.	5	0	25	3	5	5	0	7
PLECOPTERA	**2**	**26**	**10**	**2**	**1**	**6**	**0**	**4**
Zelandoperla spp.	0	0	6	1	1	3	0	2
Zelandobius sp.	0	26	1	0.3	0	2	0	1
TRICHOPTERA	**49**	**11**	**27**	**15**	**16**	**35**	**19**	**28**
Uncased caddis	23	11	7	7	4	15	7	12
Aoteapsyche spp.	12	10	1	1	1	2	3	4
Hydrobiosidae	9	0	5	5	3	11	0	7
Hydrobiosis spp.	6	0	3	1	1	4	0	3
Cased caddis	26	0	20	8	12	20	12	16
Helicopsyche spp.	2	0	5	1	0	0	0	1
Oxyethira albiceps	9	0	1	0	0	16	2	5
Pycnocentrodes spp.	9	0	6	2	4	1	2	4
COLEOPTERA	**7**	**24**	**2**	**3**	**4**	**4**	**2**	**4**
Elmidae spp. adult	1	24	1	1	1	1	2	1
Elmidae spp. larvae	6	0	1	2	3	3	0	3
DIPTERA	**26**	**39**	**19**	**67**	**70**	**38**	**76**	**48**
Chironomidae	24	39	19	61	64	32	76	45
Eukiefferiella sp.	12	21	9	.	22	18	20	15
Cricotopus spp.	2	5	1	.	19	5	19	14
Orthocladinae sp. A	3	3	3	.	2	5	0	3
Tanytarsus vespertinus	0	11	2	.	5	4	3	3
Aphrophila neozelandica	2	0	0	6	5	5	0	4