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Land-Use Experiments in the Loch Laidon Catchment:

Tenth Report on Stream Water Quality to the Rannoch Trust

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

Cover photo: Looking over the Allt Riabhach na Bioraich Burn from the edge of the experimental area, with Loch Laidon in the distance. All photos © ECRC except Figure 6. © Lord Pearson of Rannoch.

EXECUTIVE SUMMARY

1. This is the tenth report presenting the results from the Stream Water Quality component of the Loch Laidon catchment land-use experiment which began in 1992. The experiment was established with the aim of examining the effects of cattle grazing on the aquatic and terrestrial habitats and biota of a moorland area of upland Scotland.

2. The integrated chemical and biological water quality monitoring programme now represents over fifteen continuous years of data. This is a unique record of surface water quality for this region of central Scotland and its scientific value will increase even further as monitoring continues.

3. The catchment of a small stream, the “Experimental Burn”, was fenced and cattle were introduced in a summer grazing regime whilst the neighbouring catchment and the “Control Burn” were left ungrazed by cattle.

4. Having established a seven year chemical and biological baseline the experimentally grazed area was enlarged in 2002 to include the Allt Riabhach na Bioraich Burn and cattle stocking densities were raised accordingly. This now augments the study by providing a pre and post grazing data series.

5. It is envisaged that the experimentally grazed area around the Allt Riabhach na Bioraich Burn will be increased in size in spring 2007 to include a greater proportion of the catchment.

6. Previously it was demonstrated that levels of phosphorus and nitrogen (in the form of soluble reactive phosphorus and nitrate) had increased in the Experimental Burn relative to that of the Control Burn during the monitoring period. The 2005 data continued to show these trends, especially with regards to nitrate. These changes are consistent with grazing effects on water chemistry.

7. Summer peak values of soluble reactive phosphorus have increased in magnitude in the Allt Riabhach na Bioraich Burn since grazing was commenced in 2002.

8. There is evidence that the concentrations of the biologically available nutrient soluble reactive phosphorus (SRP) have risen in all three burns since circa 2000. We have no immediate explanation for this effect, which must result either from changes in the chemistry of deposition or changes in climate.

9. In 2005 nitrate concentrations were largely recorded as being below detection limits. However, on average, levels continued to be slightly elevated in the Experimental Burn when compared to the Control Burn, a situation seen since 1998.

10. Cattle trampling and poaching remain apparent in the catchments and by the edges of the experimentally grazed burns. This may be having a significant effect on the hydrology of the grazed catchments by impeding infiltration, and might account for the trend in nitrate since 1998 described above.

11. Multivariate statistics applied to the macroinvertebrate and diatom assemblage time series data from the three burns did not demonstrate any significant temporal changes during the period of monitoring. Correspondingly the fish and aquatic macrophytes do not appear to have undergone any major changes that can be linked with the cattle grazing regime.

12. It is proposed that modifications are made to the electrofishing regime in the three burns in order to take account of the fact that productivity changes are unlikely to be revealed using the current methodology.

1 INTRODUCTION

In 1992 the Rannoch Trust instigated the Loch Laidon catchment land-use experiment, which is investigating the effects of summer cattle grazing on the terrestrial and aquatic upland environment. Situated in Perthshire, Scotland, the study area falls within a number of designations, including the Rannoch Moor Special Area of Conservation and Site of Special Scientific Interest, the Rannoch Lochs Special Protection Area and the Tayside Local Biodiversity Action Plan. The project presented and summarised here comprises the aquatic monitoring element of the experiment. Allott *et al* (1994) described the project rationale and background whilst progress reports (Monteith *et al.* 1995;Monteith *et al.* 1996;Monteith *et al.* 1997;Monteith *et al.* 1999;Shilland *et al.* 2001;Shilland *et al.* 2003;Shilland *et al.* 2004;Shilland *et al.* 2005) have provided annual reviews of the accumulating chemical and biological datasets. Results for the period January 2005 to December 2005 are discussed in the context of the longer time series.

2 METHODOLOGY

Chemical and biological sampling methodologies follow those of Allott *et al.* (1994). The sampling area is shown in Figure 1. Water chemistry spot samples have been collected at approximately monthly intervals from sites on the Control Burn and Experimental Burn since 1992 (Figure 2, Sites 1 & 2). Biological surveys of fish, aquatic macroinvertebrates, epilithic diatoms and aquatic macrophytes have been undertaken annually at these sites over the same period. A total of 33 cattle (1 bull, 16 cows and 16 calves) were introduced within the 105 ha fenced experimental plot (see Figure 2) from mid-July to late September 1993 and a similar grazing period was observed in subsequent years. Stocking levels were reduced by one cow and one calf in 1994.

In the report of Monteith *et al.* (1996) concerns were raised that:

(a) insufficient pre-impact assessment of the Experimental Burn had been carried out before cattle had been introduced,
(b) the Experimental Burn was not sufficiently similar to the Control Burn for rigorous comparisons to be made,
(c) the upper station on the Experimental Burn might be situated at too great an elevation to be sensitive to any change in grazing regime.

Responding to points (a) and (b) chemical monitoring began in summer 1995 on a second experimental system, the Allt Riabhach na Bioraich Burn, approximately 500 m further to the east and with physical characteristics more similar to the Control Burn. At this time the Allt Riabhach na Bioraich Burn was outwith the fenced area. Simultaneously, in response to point (c) a second chemistry sampling site was adopted on the original Experimental Burn, while, due to the long term interest in the acidity status of Loch Laidon and its predicted recovery from acidification, a further sampling site was established on the loch outflow. The additional sampling sites, numbered according to Figure 2, are therefore as follows:

3. A lower station on the Experimental Burn
4. A lower station on the Allt Riabhach na Bioraich Burn
5. An upper station on the Allt Riabhach na Bioraich Burn
6 The Loch Laidon Outflow

One further spot water chemistry sampling point, number seven, was added in September 2000 in a burn within a recently planted area of Woodland Grant Scheme forest, approximately 1.5 km North East of the Allt Riabhach na Bioraich Burn. Since 1996 the Allt Riabhach na Bioraich Burn has also been sampled for epilithic diatoms, aquatic macrophytes, aquatic macroinvertebrates and fish following the pre-existing protocols.

In 2002, having established a seven year pre-impact baseline, the experimentally fenced area was enlarged to 216 ha to include the Allt Riabhach na Bioraich Burn. Accordingly, stocking densities were increased overall, to 40 cattle in 2002 and then reduced slightly to 36 cattle in 2003. An area of approximately fifteen ha in the northwest corner of the enlarged experimentally fenced area was burnt in 2002. This inadvertently reduced cattle grazing pressure immediately adjacent to the burns as animals were attracted to this area of fresh plant growth (Thexton, *pers comm*.).

Aquatic macroinvertebrates were not surveyed in 1995 nor aquatic macrophytes in 2000. Biological sampling dates are provided in Appendix 19. Photographs of the survey stretches are shown in Figures 3 to 5 and the area of grazing can be seen clearly in Figure 6.

3 DATA ANALYSIS AND PRESENTATION

Data are held on a central Access database at the Environmental Change Research Centre (ECRC) and in this report are presented as raw data, graphs and summary statistics.

Selected water chemistry variables are presented as time series with values for two or three burns superimposed. Where appropriate, time series of the ratios of values for the Experimental and Control Burns are also overlaid. Common (natural) variability is thus controlled for. Any impact of grazing on water chemistry should be detected as a progressive departure from the normal distribution of the ratio (i.e. any deviation away from a horizontal line).

The following biotic and diversity indices have been used for macroinvertebrates:

Hill's N1 approximates to the number of abundant species.
Hill's N2 approximates to the number of very abundant species in the sample**.**
Hill's E5 is a measure of the evenness of species occurrences in a sample. E5 approaches zero as a single species becomes more dominant in the community.
Richness (rareftn 100) predicts the expected number of taxa in a sample of 100 individuals.
BMWP is a scoring system for macroinvertebrates based on a scale of 1 to 10 given to each taxonomic family. It provides an indication of water quality by assigning families very sensitive to organic pollution a score of 10, whilst those that thrive in organically polluted systems, such as bloodworms, are assigned a score of 0.
ASPT is the Average Score Per Taxon, based on the BMWP score divided by the number of taxa in the sample. A range of 6.3 to 6.7 is typical for a diverse fauna.

Diatom and aquatic macroinvertebrate diagrams show percentage abundances of individual species for each year of sampling. Macroinvertebrate species occurring with a minimum abundance of 1.5% are presented whereas the diatom graphs show species with a minimum abundance of 1%.

Multivariate statistical methods were applied to the epilithic diatom and aquatic macroinvertebrate data from the Control, Experimental and Allt Riabhach na Bioraich Burns to examine the extent of between year variability and test for the evidence of changes with time. It is necessary to demonstrate trends in the biological data which are unique to the grazed catchments in order to invoke biological responses. Detrended Canonical Correspondence Analysis (DCCA) was used to measure the time-constrained gradient lengths of species so that the most appropriate subsequent analysis could be determined. As this demonstrated very little turnover in species composition, the linear methods of Principal Components Analysis (PCA) and Redundancy Analysis (RDA) were selected. PCA is an indirect gradient approach that provides a sensitive measure of between sample variance in the species assemblage. RDA is a form of PCA in which the components are constrained to be linear combinations of explanatory variables. For the purpose of this study, “time”, coded as the year of sampling was applied as the single explanatory variable. Statistical significance of the results was tested using a restricted version of the Monte Carlo permutation test, running 999 permutations. All analyses were performed using the program CANOCO (ter Braak and Smilauer 1998). For a fuller explanation of the statistical methodologies see Patrick *et al.* (1995).

4 RESULTS

4.1 CHEMISTRY

Chemical data are summarised in Appendix 1 whilst full chemistry is shown in Appendices 2 to 8. The assessment below concentrates primarily on evidence for a trend in the ratio of certain chemical indicators between the Control and Experimental sites. Effort is also made, however, to examine the relationship between the chemistry of the Control Burn and the Allt Riabhach na Bioraich Burn.

4.1.1 COMPARISON OF THE CONTROL AND UPPER EXPERIMENTAL BURN

Due to its position higher up the catchment the upper chemical sampling station on the Experimental Burn is unlikely to respond strongly to grazing effects. It does however represent the longest time series available for chemical comparison. The relationships between concentrations of key chemical determinands in the Control and upper Experimental Burn are provided in Figures 8 to 12.

The strong seasonal variation in Control Burn;Experimental Burn ratios for conductivity and alkalinity, described in previous reports, persisted in 2005 (Figures 8 and 9). In both streams, concentrations are similar during most of the year except during periods of low summer flow, when alkalinity and conductivity tend to be higher in the Experimental Burn. We have suggested previously that this may be due to a stronger groundwater influence in that burn or slight differences in underlying geology. Figure 12 demonstrates this, showing that the alkalinity of the Experimental Burn is generally higher when the stage board readings are low. During the rest of the year when flows are higher soil, overland and sub-surface hydrological pathways would appear to dominate the chemistry of the burns.

Of note in the conductivity data for January 2005 is a peak in both streams, with measured concentrations the highest recorded for either burn during the monitoring period. This is due to a sea salt event and is reflected in the elevated levels of sodium and chloride in the same samples. Sea salt events, or “episodes”, occur when oceanic storms generate a sea water aerosol which is later deposited over land. This particular event was observed as far away as southern Norway where, as a result of the displacement of toxic aluminium ions from acidified catchment soils, it killed large numbers of fish (Bjørn Barlaup *pers. comm.*).

Nitrate concentrations at both sampling points were relatively low in 2005, but similar to those of the previous year (Figure 10). Levels were especially low in the Control Burn. Unlike 2004, however, the typical seasonal winter peak in nitrate was again evident at both sampling stations. In 1998 a switch occurred in the relationship between annual spring maximum nitrate concentrations of the two burns. Prior to then levels were generally higher in the Control Burn, but afterwards nitrate has generally been higher in the upper Experimental Burn. 2005 saw this trend continue.

Soluble reactive (i.e. biologically available) phosphorus (SRP) in 2005 also showed a seasonal variation, a pattern which has become clear since 2003 (Figure 11). Concentrations are greater in the Control Burn at the start of the year but higher in the lower Experimental Burn in the summer months. An unusually large peak in SRP was recorded at the Experimental Burn station in the last winter sample of 2005.

4.1.2 COMPARISON OF THE CONTROL AND LOWER EXPERIMENTAL BURN

The relationships of selected chemical determinands between the Control Burn and the Lower Experimental Burn are illustrated in Figures 13 to 20. The time series available from the lower sampling station on the Experimental Burn is shorter than that from the upper station but should be more sensitive to any land use changes as it encompasses a greater proportion of the catchment.

In 2005 concentrations of alkalinity in the lower Experimental and Control Burns were unremarkable in the context of the longer term data set. As regularly observed in previous years concentrations were very similar at the two sampling sites except for a larger summer peak in the Experimental burn (Figure 15). The 2005 data continue to support the conclusion reached in the last report (Shilland *et al.* 2005) that there is no long term rising trend in the ratio of alkalinity between the two sampling stations. Conductivity concentrations continued to be closely correlated with calcium levels in the lower Experimental Burn, with the exception of the January sea salt episode referred to above. Conductivity was similar in both burn locations for most of the year but rose higher during the summer in the lower Experimental Burn. Magnesium and potassium levels showed a similar annual pattern, with the sea salt event registering elevated magnesium levels at both monitoring points.

Figures 13 and 14 show time series graphs of the ratio and difference between nitrate at the two stations. 2005 data show a continued elevation of concentration in the Experimental Burn relative to the Control, a feature which has been apparent since 1998. Before this date concentrations were usually lower in the Experimental Burn. More samples from the Experimental Burn were above detection limits than in 2004 and 2005 also saw a winter nitrate peak not witnessed the previous year.

Soluble reactive phosphorus levels were very similar at both the Control and lower Experimental Burn stations throughout most of 2005 and peak values obtained were also the same The trend of increasing peak summer levels seen between 1998 and 2003 in the lower Experimental Burn relative to the Control has thus failed to continue in both 2004 and 2005 (Figure 20). Of note is that the high winter SRP peak seen in the upper Experimental station in 2005 is not apparent at the lower station.

4.1.3 COMPARISON OF THE ALLT RIABHACH NA BIORAICH WITH THE CONTROL AND LOWER EXPERIMENTAL BURN

The Allt Riabhach na Bioraich, the Control and the Lower Experimental burns are compared in time series plots of alkalinity, conductivity, nitrate, soluble reactive phosphorus and total organic carbon in Figures 21 to 25.

In common with the other two sampling stations the Allt Riabhach na Bioraich Burn continued to demonstrate distinct seasonality in measured concentrations of most chemical determinands in 2005. Conductivity, alkalinity and total organic carbon continued to be more similar in the Allt Riabhach na Bioraich Burn and Control Burn relative to the Experimental Burn.

4.1.4 COMPARISON OF THE ALLT RIABHACH NA BIORAICH WITH THE CONTROL BURN

Figures 26 to 33 show comparisons of the time series of selected chemical determinands between the Allt Riabhach na Bioraich Burn and the Control Burn. Where appropriate the ratio of values between the two sampling stations is also illustrated. The time series begin when monitoring started at the Control Burn in 1992 and ratios are shown from when sampling began at the Allt Riabhach na Bioraich Burn in the summer of 1995. The figures are marked to show when cattle grazing commenced in the Allt Riabhach na Bioraich Burn catchment during the summer of 2002.

Conductivity values are extremely close, both in the extent and magnitude of variability, at the two sample points throughout the entire monitoring period and there is no sign of this changing after the start of cattle grazing (Figure 32). Alkalinity, calcium and magnesium concentrations are also very similar between the two, exhibiting matching seasonal patterns of maxima and minima. For all three determinands levels on any given sampling date are usually just slightly less in the Control Burn than the lower Allt Riabhach na Bioraich Burn. The converse is true for potassium concentrations which, whilst still following the same pattern, tend to be lower in the Control Burn. Ratios for these four variables do not show any significant change after the establishment of the grazing regime in 2002.

Nitrate concentrations have generally been slightly higher in the Allt Riabhach na Bioraich Burn both before and after cattle grazing commenced in the catchment (Figures 26 and 27). Nitrate concentrations have mostly remained low in both burns since summer 2003 and no identifiable change is visible in either the difference or the ratio between them during the grazed period. SRP levels at the two locations have remained similar and both have experienced greater peak concentrations since the summer of 2001. Summer SRP peaks have increased in magnitude in the Allt Riabhach na Bioraich Burn since grazing started but the maximum concentrations recorded have been in the Control Burn.

4.2 BIOLOGY

4.2.1 EPILITHIC DIATOMS

Epilithic diatom data are illustrated in Figures 34, 35 and 36 and trend test statistics are shown in Table 1. Due to the length of time required for diatom analysis the results discussed here are from 2004.

Two species of diatom formed the majority of the 2004 sample in the Control Burn. *Brachysira vitrea* recorded its highest abundance in the study to date and replaced *Synedra minuscula* as the co-dominant taxon with the acid species *Tabellaria flocculosa. Eunotia* species such as *E. curvata, E naegelii and E. incisa* have become more common in the second half of the monitoring period and continued to be present in 2004, whereas the acid loving *E. exigua* maintained its decline. *Frustulia rhomboides* var. *saxonica* and *Brachysira brebissonii* both increased in relative abundance compared to previous years.

During the study the Experimental Burn diatom assemblage has been more variable than that of the other burns. In 2004 the large peak of *Tabellaria flocculosa* numbers observed the previous year did not persist and the species dropped from over 75% of the sample to about 25%. Levels of *Eunotia incisa, Frustulia rhomboides* var. *saxonica* and *Brachysira vitrea* rose. *Eunotia naegelii,* unusually for this burn, was the second most abundant taxon after *T. flocculosa*. Two species that have increased slightly in the latter stages of monitoring were barely present in 2004, *Eunotia curvata* and *Gomphonema gracile.* Similar to the Control Burn, the acid species *Eunotia exigua* has declined, especially in the last two years.

2004 saw a slight change in what has consistently been a stable, though undiverse, diatom assemblage in the Allt Riabhach na Bioraich Burn. *Tabellaria flocculosa* maintained its dominance but reduced in abundance relative to all previous years. *Brachysira vitrea* increased to its highest observed percentage to date, accounting for about a quarter of the sample. This increase was also observed in the Control Burn so is unlikely to be linked to the effects of cattle grazing. *Eunotia naegelii, Frustulia* *rhomboides* var. *saxonica* and *Peronia fibula* were the only other species to occur in any more than trace amounts.

Eigenvalues from the first axis of the PCA (λ_1^{PCA}) are shown in Table 1. These provide the maximum proportion of total between-year variance that can be explained by a single hypothetical linear variable. The table also shows RDA Axis 1 eigenvalues, which give the variance that can be explained by a time trend (λ_1^{RDA}). Variance explained by time at all three sites is small relative to variance on the first Principal Component. Monte Carlo permutation tests subsequently demonstrated that there is no significant linear trend in the species assemblages of any of the three burns at the $P < 0.05$ level. Interestingly the burn with the greatest likelihood of experiencing a time trend is the Control Burn. As with similar statistics performed in previous reports this result suggests that cattle grazing is not causing a progressive shift in the epilithic diatom species composition of the Experimental Burn or the Allt Riabhach na Bioraich Burn to date.

Table 1 Diatom trend test statistics

	λ_1^{PCA}	λ_1^{RDA}	$\lambda_1^{RDA}/\lambda_1^{PCA}$	**Restricted P Value**
Control Burn	0.33	0.08	0.24	0.06
Experimental Burn	0.20	0.08	0.40	0.28
Allt Riabhach na Bioraich Burn	0.28	0.05	0.18	0.65

4.2.2 MACROINVERTEBRATES

Macroinvertebrate data are provided in Appendices 9 to 11 and Figures 29, 30 and 31. Appendices 12 to 14 and Figures 32, 33 and 34 detail macroinvertebrate summary statistics.

The Control Burn's macroinvertebrate fauna has been variable throughout the period of study, with the assemblage of 2004 being especially unusual. In 2005 abundances of most species returned to levels more commonly seen previously. The acid sensitive mayfly *Baetis rhodani,* which was virtually absent in 2004, constituted nearly 20% of the sample in 2005. Chironomid levels dropped from an all time high of 30% in 2004 to around 10% in 2005 and the proportion of stoneflies, including *Amphinemura sulcicollis*, *Isoperla grammatica*, *Siphonoperla torrentium* and *Leuctra inermis*, which had dropped substantially in 2004, returned to approximately 25% of the sample. The beetles *Limnius volckmari* and *Oulimnius* sp, regularly present throughout monitoring, comprised a slightly smaller proportion of the assemblage than usual. Caddis species maintained a low abundance. Of note in the 2005 sample is the occurrence of the mayfly *Baetis muticus.* The overwintering nymph of this species is especially sensitive to low pH episodes during winter. Figure 40 and Appendix 12 demonstrate that the total number of taxa, Hill's N1 and species richness indices have reduced slightly since 2004. E5 Evenness went up, indicating that whilst diversity was slightly down no single species tended to dominate the sample.

In the Experimental Burn in 2005 no single taxa dominated the assemblage. The most abundant species were the mayfly *Leptophlebia verspatina*, the beetle *Oulimnius* sp., the caddisflies *Polycentropus flavomaculatus* and Limnephilidae, the non biting midge group Chironomidae and the biting black fly group Simuliidae. *L. verspatina* is a mayfly species that prefers a habitat including sediment and aquatic macrophytes which may explain why, in this project, it only occurs within the slower flowing Experimental Burn. Higher levels of the net spinning caddis *P. flavomaculatus* may be similarly explained by the slower current. Beetles of the genus *Oulimnius* occurred at a lower relative abundance than in many previous years as did the *Chironomidae* midges. Together the stoneflies and mayflies showed a slight increase in abundance relative to the previous three years. Total number of taxa, species richness and the Hill's diversity indices all recorded increases on 2004 (Figure 41, Appendix 13).

The 2005 assemblage recorded in the Allt Riabhach na Bioraich Burn was more similar in composition to previous years than that sampled in 2004, with Chironomid numbers, in particular, reverting to a more usual abundance of less than 10% of the sample. Stonefly abundances, especially *Amphinemura sulcicollis* and *Isoperla grammatica*, returned to levels more usual for the burn and constituted more than a third of the collected sample. The acid sensitive mayfly *Baetis rhodani* was present at a greater abundance than in any previous year. *Oulimnius* sp. and *Limnius volckmari* beetles together comprised around a fifth of the total assemblage. Caddis larvae were slightly less common than in many past years. Figure 42 and Appendix 14 show the summary statistics for the Allt Riabhach na Bioraich Burn and demonstrate that the number of taxa, Hill's diversity indices, Richness and BMWP all dropped for this site compared to 2004.

Table 2 presents statistical results from the analysis on the macroinvertebrate data. Detrended Canonical Correspondence Analysis gradient lengths were sufficient to demonstrate the suitability of using Principal Components Analysis for further investigation of the data for all three burns. The variance explained by time relative to variance on the Principal Component has increased compared to previous reports but is still not high. Time is not significant at the 0.01 level at any of the burns according to RDA and associated permutation tests.

Table 2 Macroinvertebrate trend test statistics

	λ_1^{PCA}	λ_1^{RDA}	$\lambda_1^{RDA}/\lambda_1^{PCA}$	**Restricted P Value**
Control Burn	0.31	0.18	0.58	0.04
Experimental Burn	0.33	0.16	0.48	0.04
Allt Riabhach na Bioraich Burn	0.33	0.19	0.58	0.09

4.2.3 AQUATIC MACROPHYTES

Appendices 15, 16 and 17 summarise aquatic macrophyte data for the three study burns, figures 43 to 45 show the results graphically and Figures 3 to 5 illustrate the survey stretches. Due to physical erosion of the restricted survey stretch available, sampling of the Experimental Burn ceased after 1999.

Mosses and liverworts continue to dominate the macrophyte floras of both the Control and Allt Riabhach na Bioraich Burns. In the Control Burn in 2005 the liverworts *Marsupella emarginata* var. *aquatica* and *Scapania undulata* and the moss *Racomitrium aciculare* all increased in abundance relative to 2004. *S. undulata* increased most markedly, recording the highest cover score since monitoring began at nearly 11 percent. This would seem to consolidate the trend whereby *S. undulata* has gradually replaced *M. emarginata* var. *aquatica* as the dominant species in the stream. *R. aciculare* abundance in 2005 was the second highest recorded at nearly 2 percent cover. Whilst still occurring at a low level, *S. undulata* also had its most abundant year on record in the Allt Riabhach na Bioraich Burn. *R. aciculare* was present in 2005 but at a very low abundance, similar to previous years.

4.2.4 FISH

Data for the brown trout populations (for 0+ and >0+ year old age classes) in the three study burns are presented in Figures 35 to 37 and Appendix 18. In 2005 trout continued to be the only species recorded. 0+ fish (fry) were found in all three burns demonstrating that spawning had occurred in each of the streams the previous year. Densities of both age classes were lower in the Control Burn than in the other study burns and were lower than most previous years with the exception of 2004. The Experimental Burn is the only site in which densities of parr (>0+) exceeded fry (0+). Densities of both age classes in the Experimental and Allt Riabhach na Bioraich burns fell in the mid-range of those previously recorded. There is no evidence that densities of either age class have been affected by the addition of cattle to the catchment from 2002 onwards. Similarly there is no evidence of differences in time trends of densities between the Experimental Burn and the Control Burn that could be ascribed to the presence of cattle.

There are some concerns as to the ability of the fish data to demonstrate changes in population status as a consequence of changing land-use practice. The populations in individual streams reflect a combination of local productivity, but more importantly productivity in the loch as a whole. Mature fish are not resident in the control streams, which means that for at least part of their life cycle they move into the loch. The accuracy with which they home to natal streams is currently unknown. Therefore any increases in productivity in a single stream could subsequently effect other streams in the vicinity. If an assessment of in-stream productivity was needed, then frequent repeat electrofishing would be required to assess performance of individuals in relation to environmental variables before they leave their streams of origin. It is possible that the current fish monitoring strategy will struggle to yield data of sufficient detail to track productivity changes and it may be the case that resources could be better allocated elsewhere, where there is an increased likelihood of detecting environmental change, i.e. through water quality monitoring or assessments lower down the food chain where confounding factors are reduced.

5 DISCUSSION

In 2005 the water chemistry data from all three experimentally monitored burns followed similar seasonal patterns to previous years and concentrations of most measured determinands lay within previously established limits. A sea salt event, in January 2005 produced large peaks in conductivity and marine ions (particularly sodium and chloride) across the sample locations.

Riparian cattle grazing can often lead to increases in the nutrients found in the nearby water courses (Hooda *et al.* 1997a, Hooda *et al.* 1997b, Lemly 1982, del Rosario, Betts, and Resh 2002, Scrimgeour and Kendall 2002). However, increasing peak levels of soluble reactive phosphorus (SRP) observed between 1998 and 2003 in the Experimental Burn relative to the Control Burn have subsequently ceased to occur. Indeed peak values have since been higher in the Control Burn. Peak summer SRP values have, however increased slightly each year in the Allt Riabhach na Bioraich Burn since the start of grazing in 2002 and may possibly be due to the presence of cattle. Overall levels of SRP continue to be slightly higher at all sites in the latter part of the monitoring period. Further years of monitoring are clearly necessary to determine whether this trend is likely to be associated with grazing.

For the second year running concentrations of nitrate were generally low and, with the exception of a winter peak, fell below detection limits in all three burns for much of the year. However, a switch is apparent, from around 1998, between higher levels occurring in the Control Burn to higher levels in the Experimental Burn. We have previously speculated that this may be due to the commonly seen poaching and trampling effects of cattle (Belsky, Matzke, and Uselman 1999;Scrimgeour and Kendall 2002;Sovell *et al.* 2000;Wohl and Carline 1996), which may have altered the hydrology of the Experimental catchment somewhat, leading to less rainfall nitrate being retained and biologically cycled within the catchment soils. This process is not yet detectable in the Allt Riabhach na Bioraich catchment. Nitrate values there were slightly higher than the Control Burn both before and after cattle were introduced to the area and do not appear to have changed significantly relative to the control. These tentative observations are of potentially great significance in furthering our understanding of how the introduction of cattle may influence the hydrochemistry of these environments, but monitoring needs to continue to allow us to be more confident of a real impact.

Nitrate can act as a nutrient in streams and if levels are increasing over time in the experimental burn we might expect to be able to detect biological changes, such as changes in the species composition of epilithic algae. However, similar to previous years, multivariate statistics performed on the diatom and invertebrate time series data did not demonstrate any significant temporal trends, and there was also no indication of change in fish and aquatic macrophyte populations. This suggests that longer term cattle grazing in the catchment of the Experimental Burn and post 2002 cattle grazing in the Allt Riabhach na Bioraich Burn catchment is having no discernable effect on year to year variation in these biological parameters. It is likely that physical factors, and particularly variation in flow and temperature, provide the dominant biotic control and it may be necessary to continue monitoring for several more years before more subtle biological shifts can be identified beneath this naturally driven “noise”. The statistics identified the Control Burn as being the most likely of the three streams to be showing both a diatom and invertebrate time trend, although not at a statistically significant level of 0.01.

The Loch Laidon land use experiment continues to accumulate a unique and invaluable long term biological and chemical dataset and fulfils the criteria Larsen *et al*. (1998) describe as being key to successful cattle grazing studies. The longer the experimental design is maintained the greater the power of the study to identify cattle induced trends, however subtle, within the project area.

6 ACKNOWLEDGEMENTS

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Figure 1 The Loch Laidon catchment indicating the boundaries of Rannoch Moor NNR and SSSI.

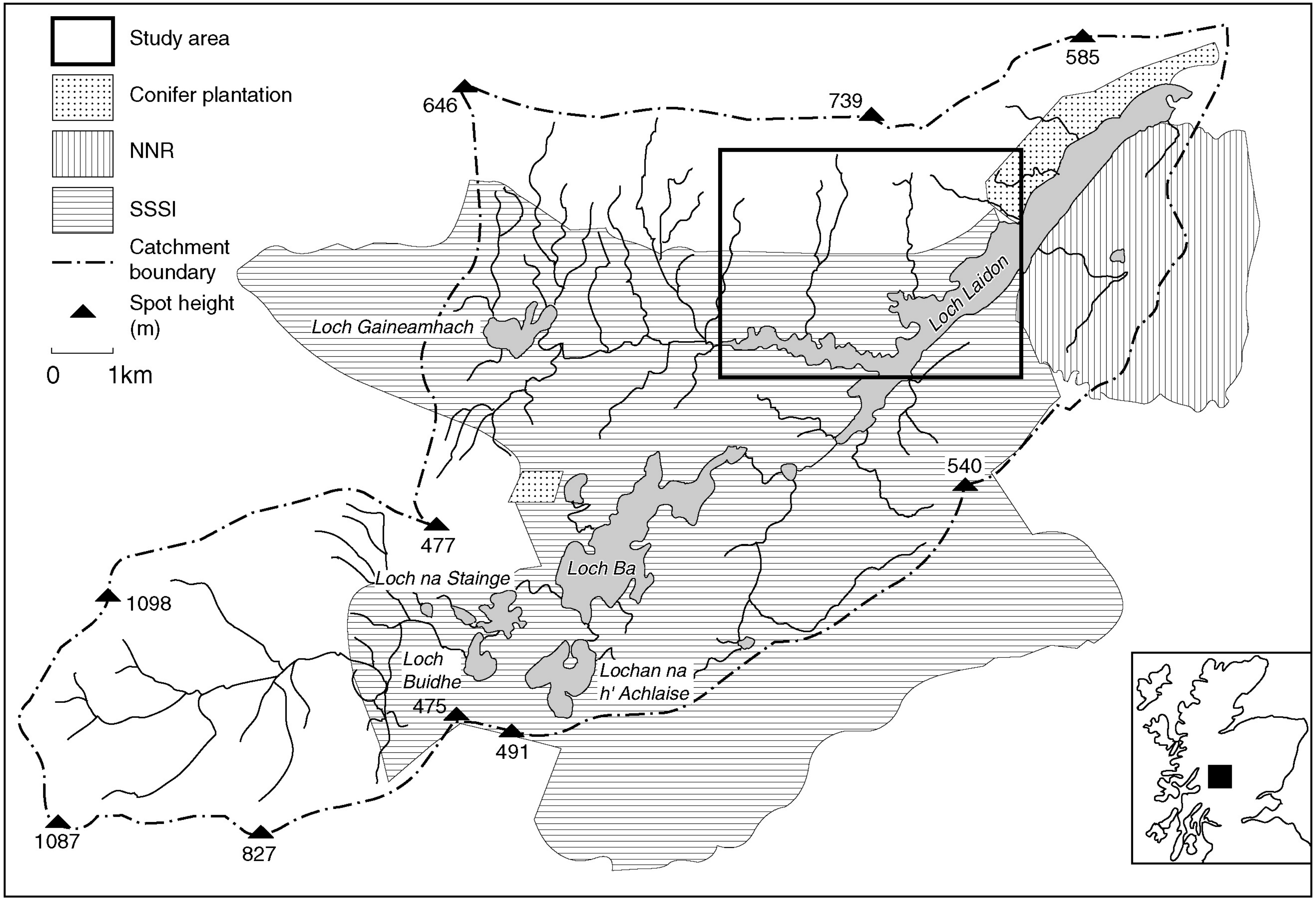
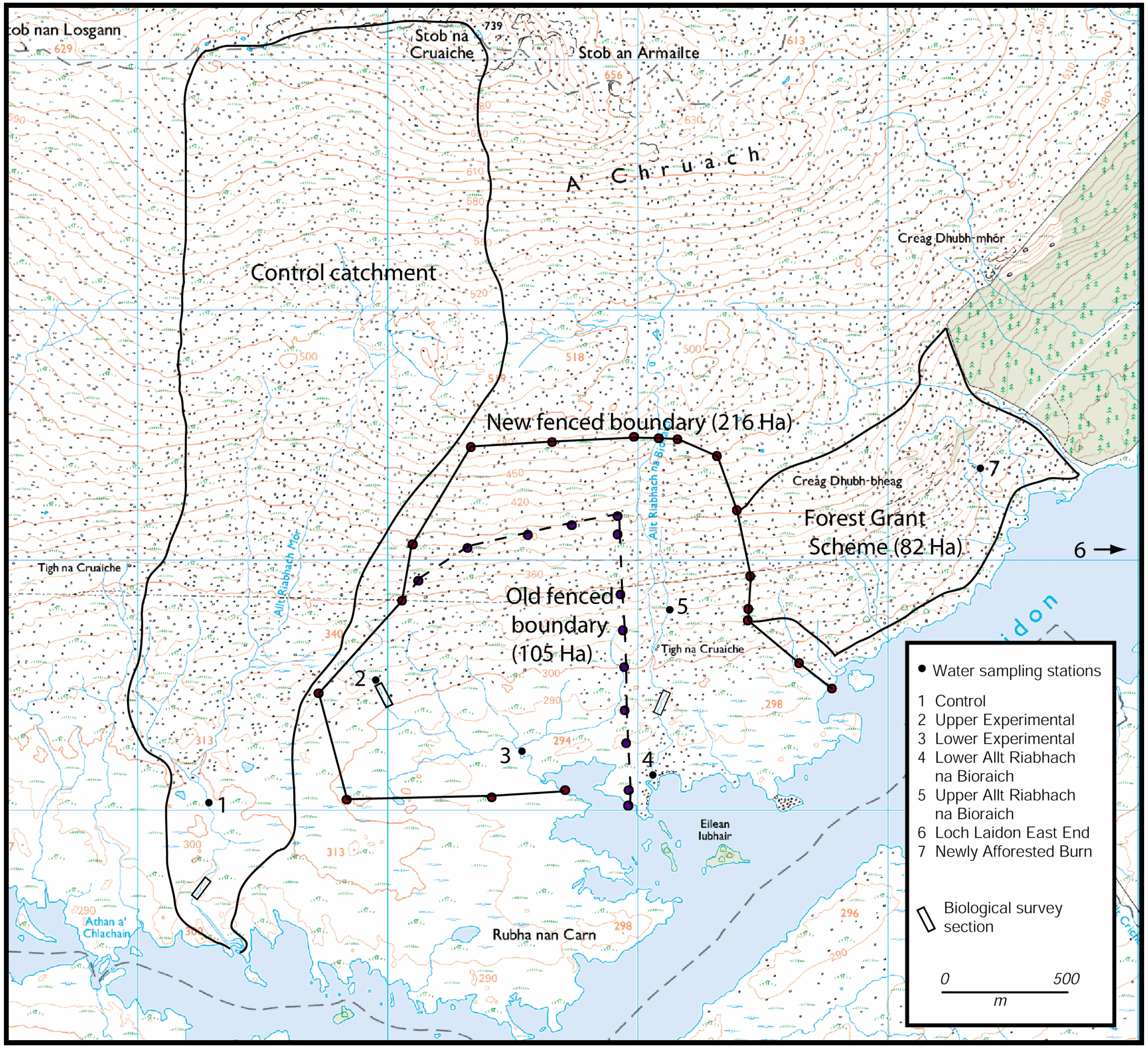


Figure 2 Loch Laidon study area.



Background map © Crown Copyright/database right 2006. An Ordnance Survey/EDINA supplied service.

Figure 3 Control Burn

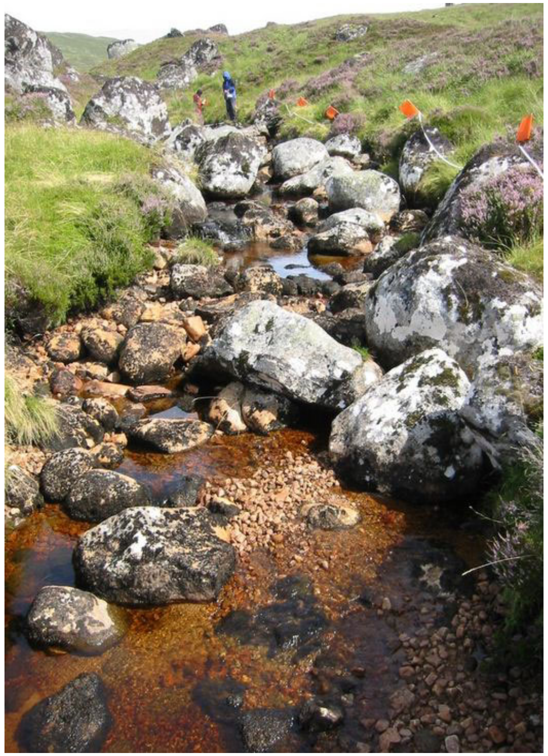


Figure 4 Experimental Burn

Figure 5 Allt Riabhach na Bioraich Burn

Figure 6 The experimentally grazed area

Figure 7 Cattle poaching of the bank of the Allt Riabhach na Bioraich Burn

Figure 8 The ratio of alkalinity and its temporal variability in spot samples between the Experimental and Control Burns, August 1992 – December 2005.

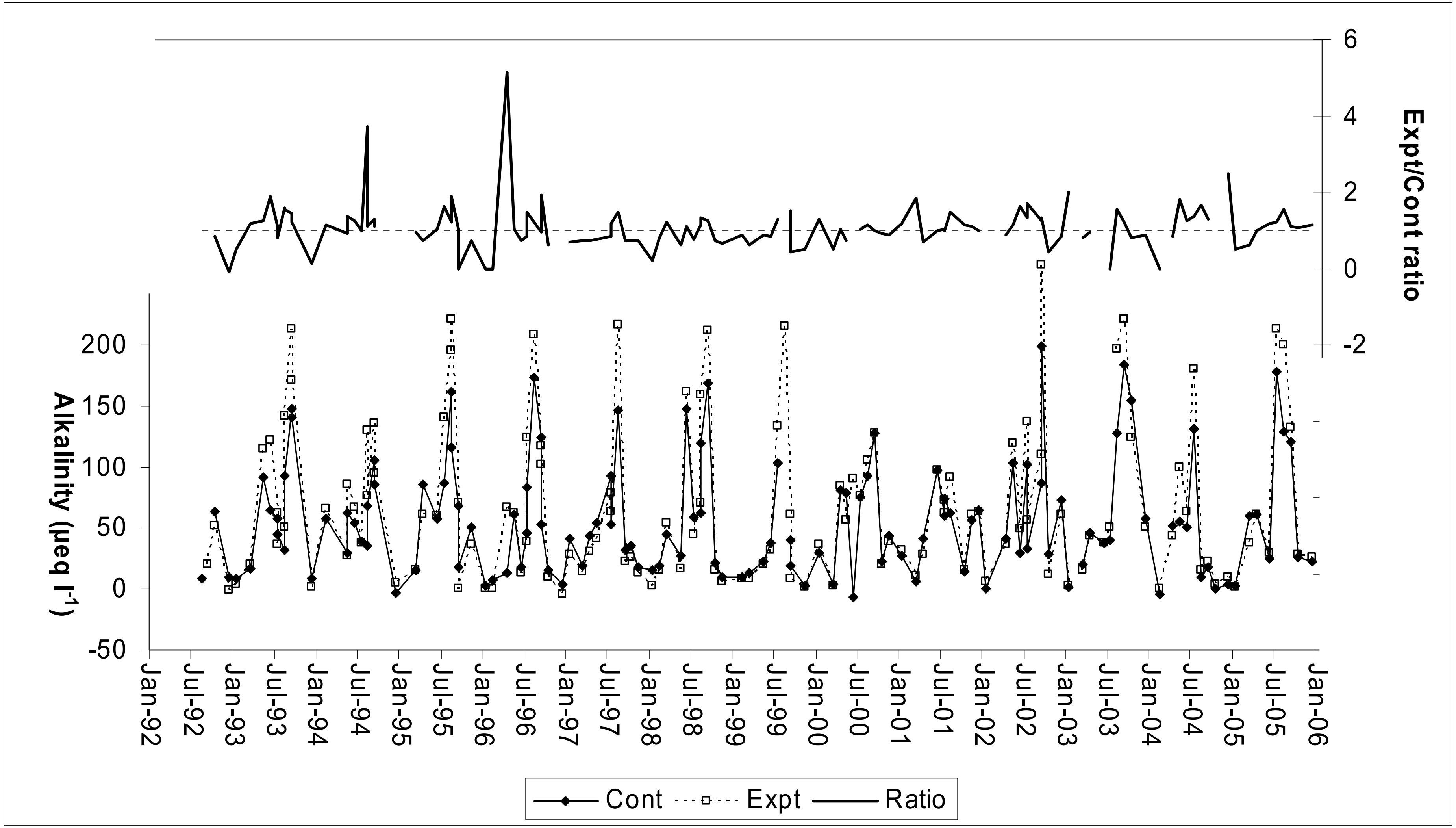


Figure 9 The ratio of conductivity and its temporal variability in spot samples between the Experimental and Control Burns, August 1992 – December 2005.

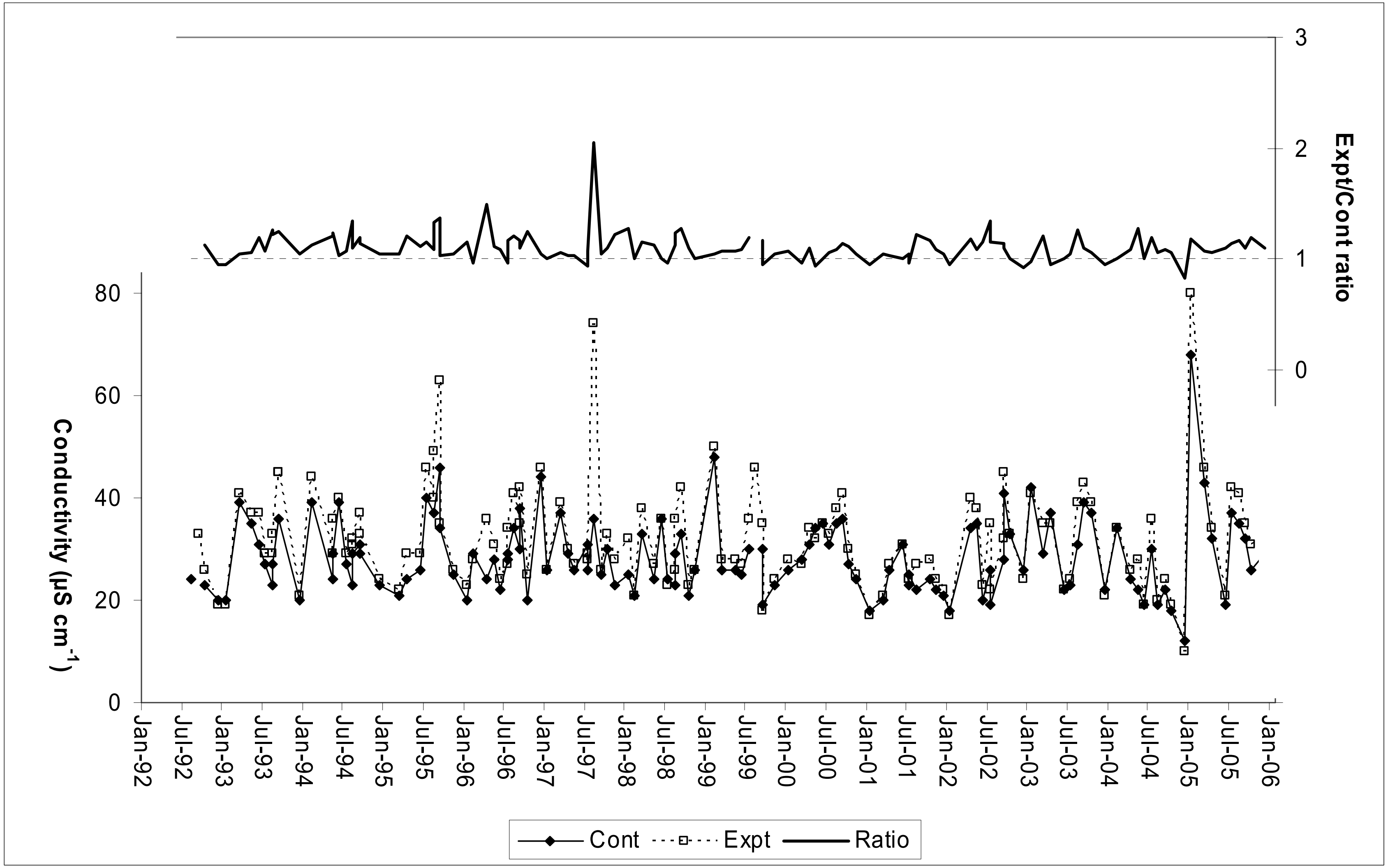


Figure 10 Temporal variability of nitrate in spot samples from the Experimental and Control Burns, August 1992-December 2005.

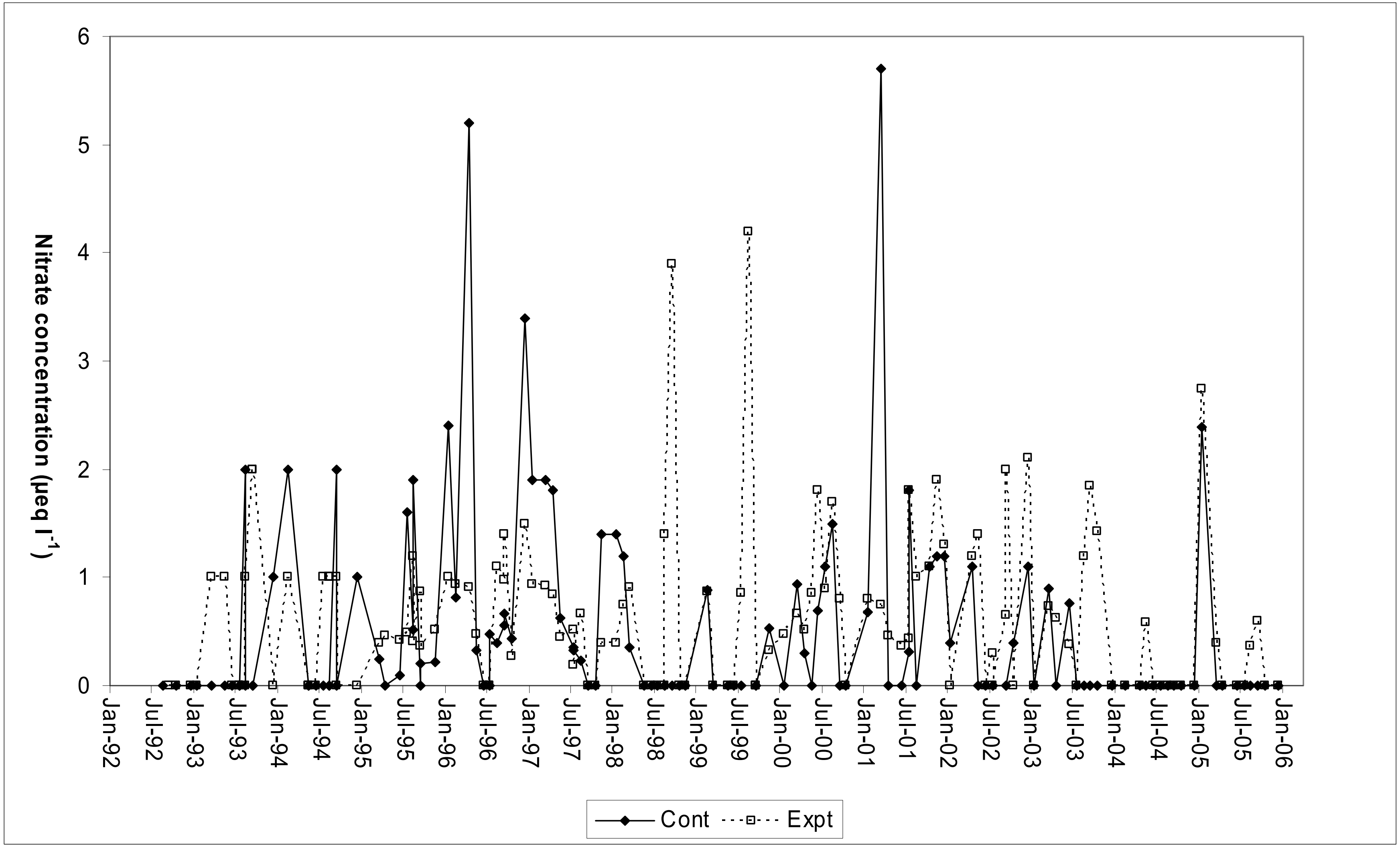


Figure 11 Temporal variability of soluble reactive phosphorus in spot samples from the Experimental and Control Burns, August 1992- December 2005

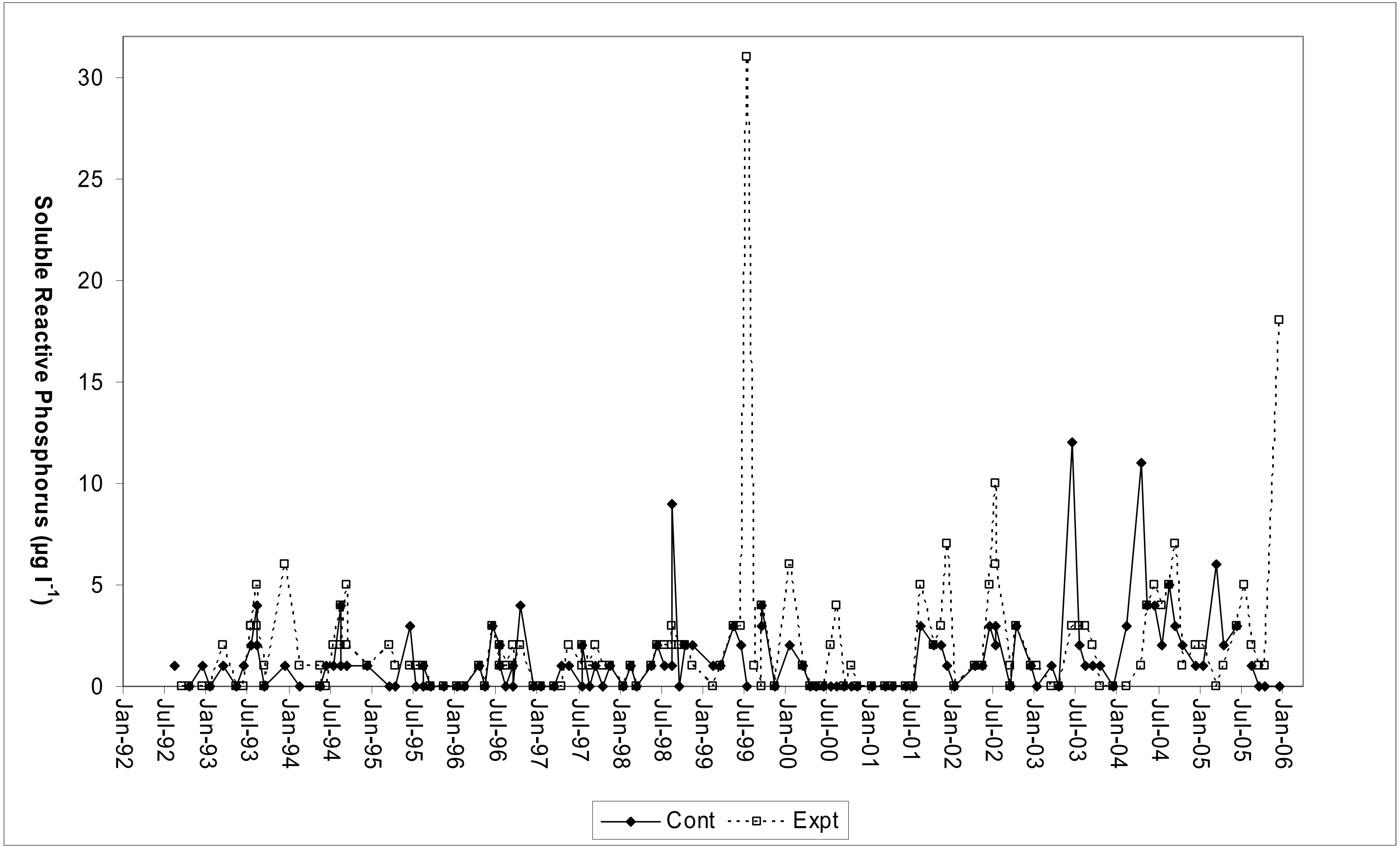


Figure 12 The relationship between the ratio of alkalinity in spot samples from the Experimental and Control Burns and the stage board height of the Control Burn over the period August 1992 – December 2005.

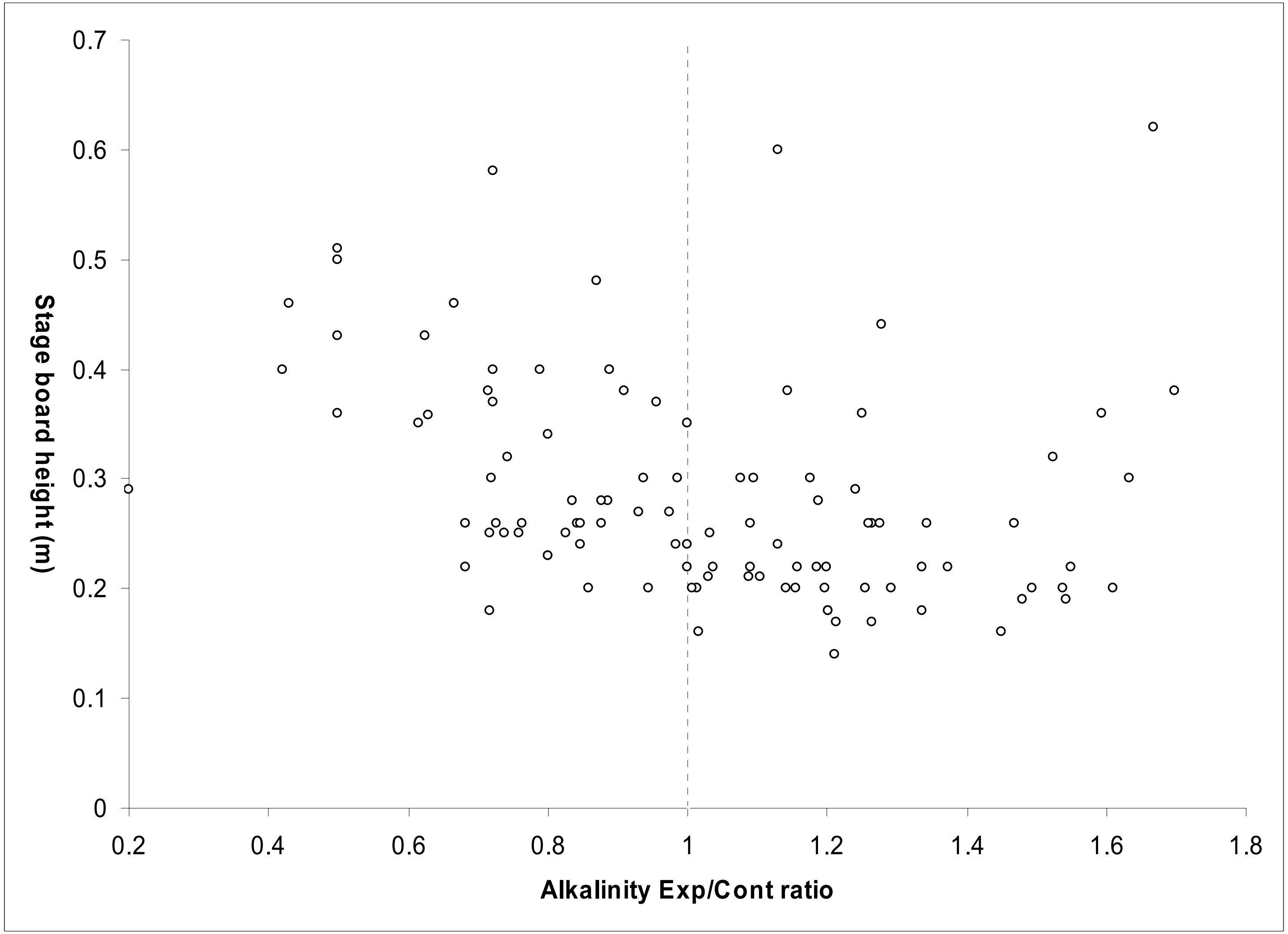
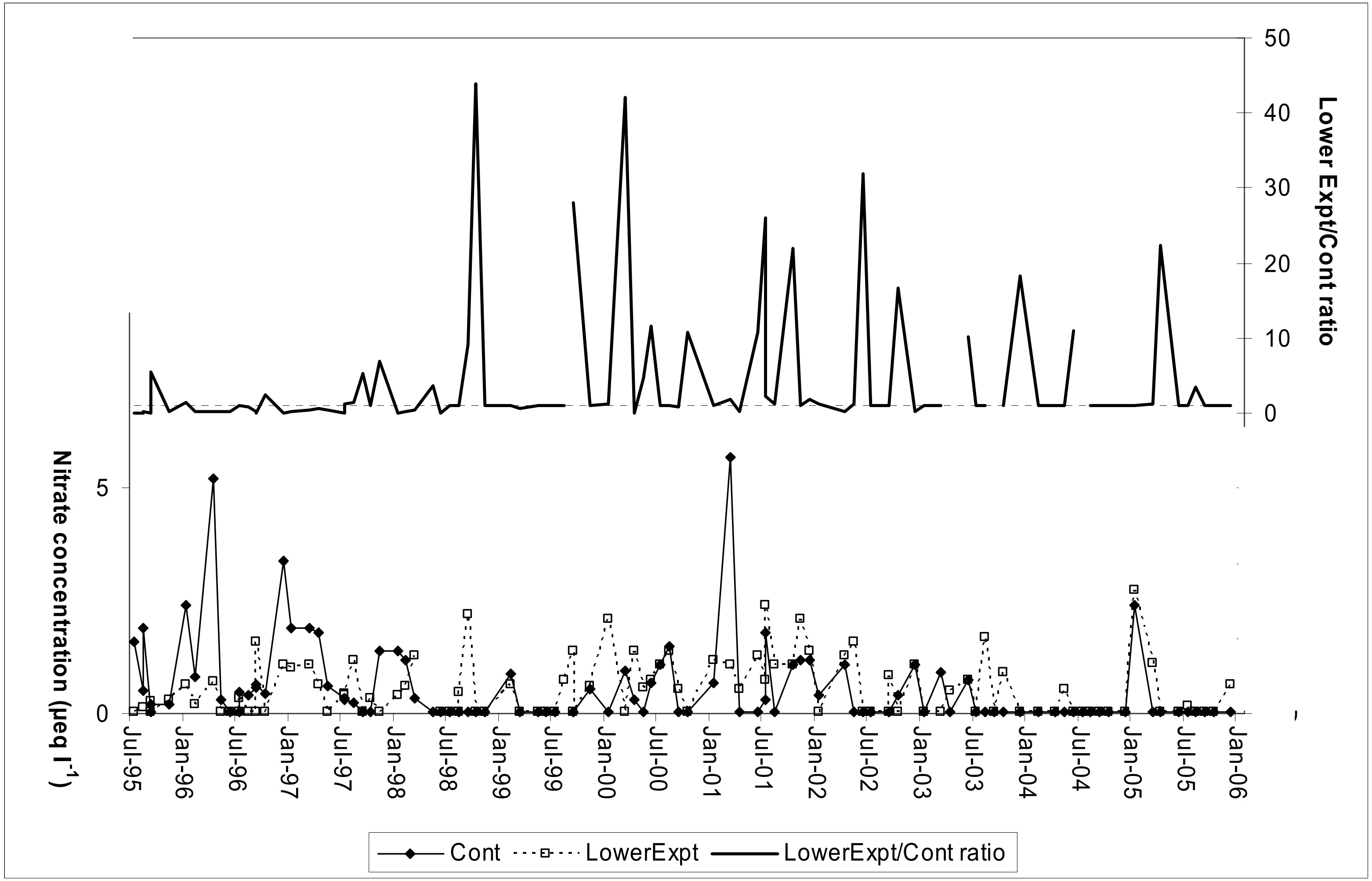


Figure 13 The ratio of nitrate and its temporal variability in spot samples between the Control and Experimental Burn (Lower site) June 1995 – December 2005.



N.B. 0 values converted to half nitrate detection limit for ratio calculations.

Figure 14 The temporal variability of nitrate in spot samples and the difference between the Control and Experimental Burn (Lower site) June 1995 – December 2005.

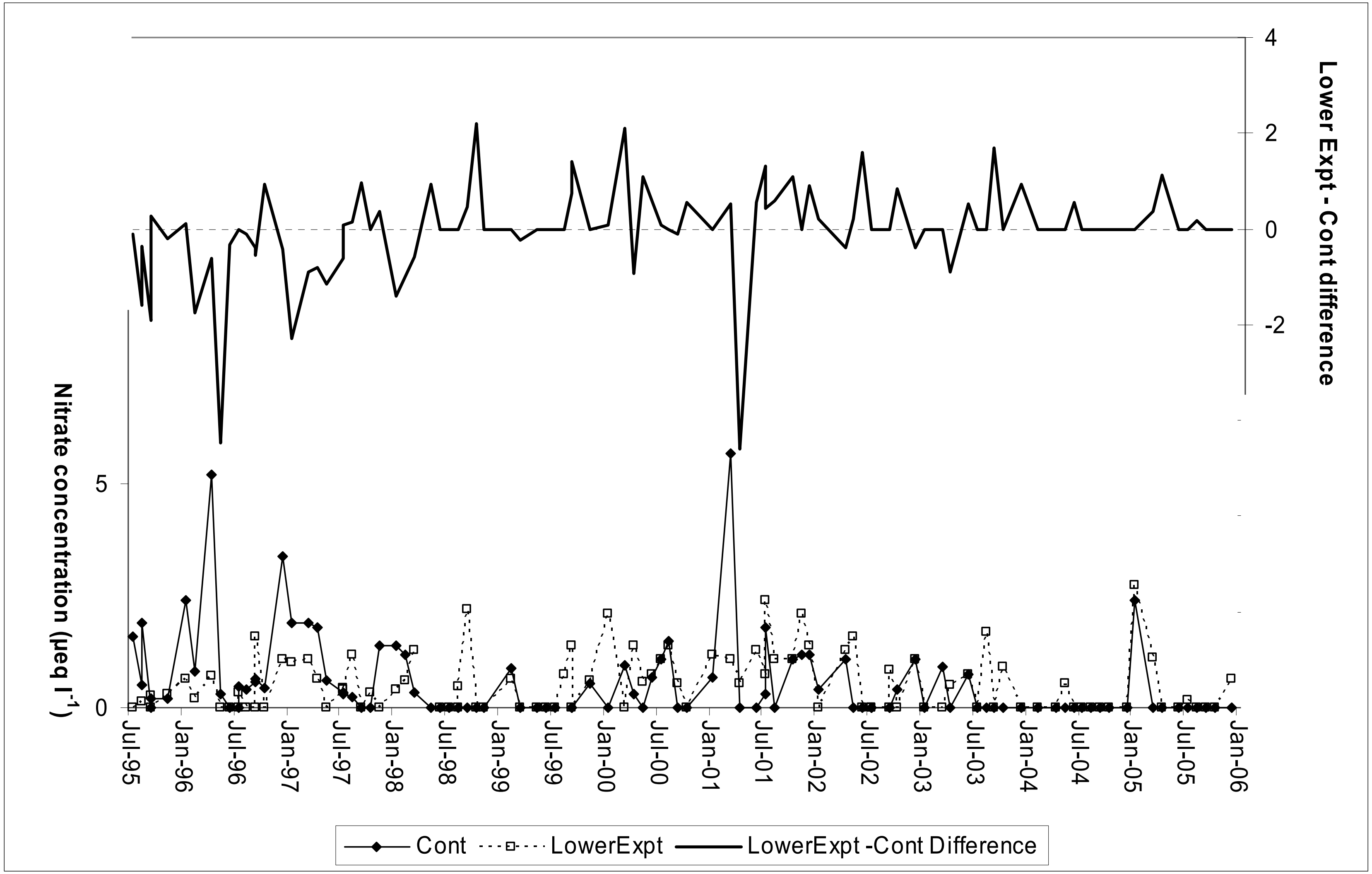


Figure 15 The ratio of alkalinity and its temporal variability in spot samples between the Control and Experimental Burn (Lower site) June 1995 – December 2005.

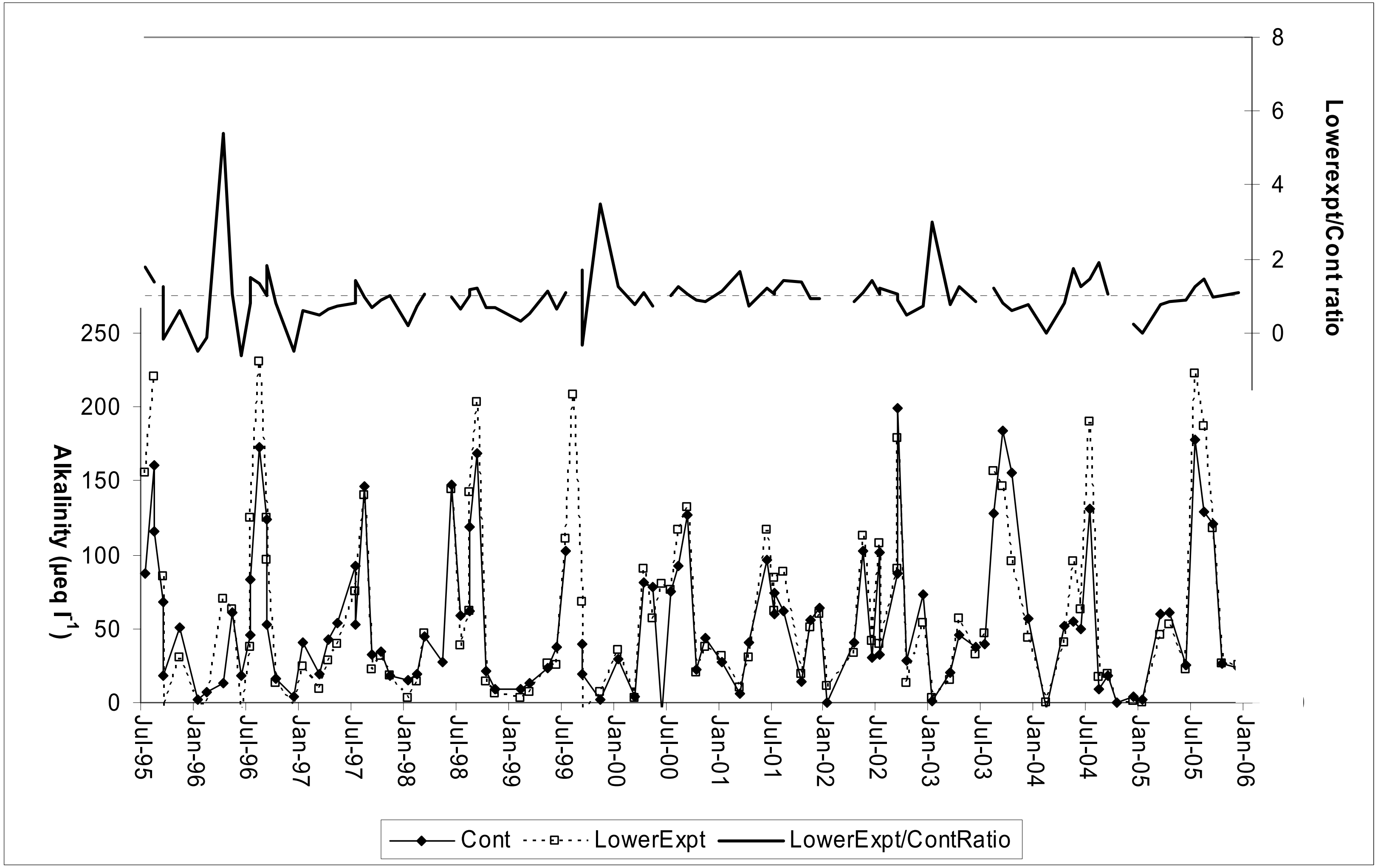


Figure 16 The ratio of calcium and its temporal variability in spot samples between the Control and Experimental Burn (Lower site) June 1995 – December 2005.

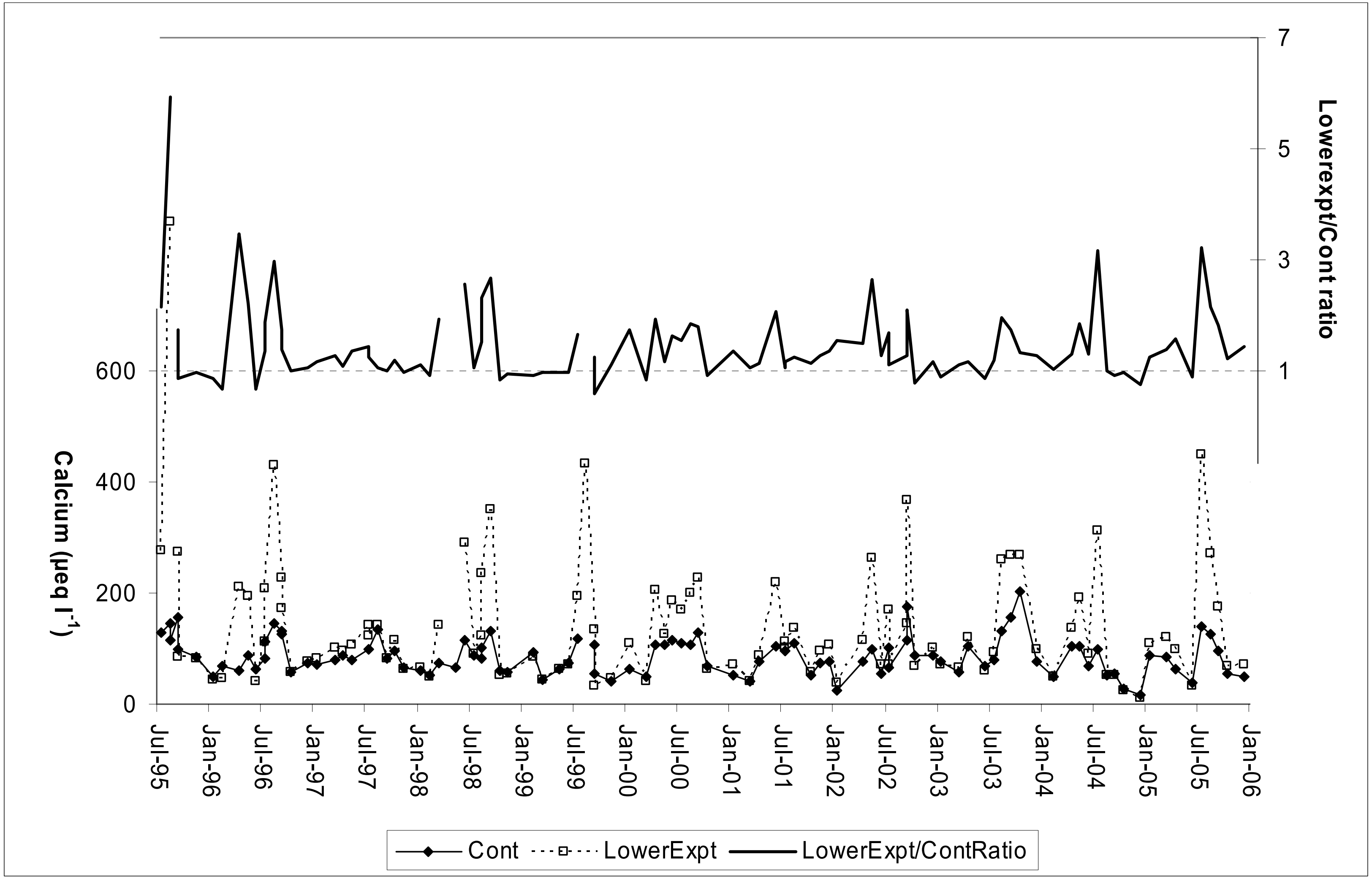


Figure 17 The ratio of magnesium and its temporal variability in spot samples between the Control and Experimental Burn (Lower site) June 1995 – December 2005.

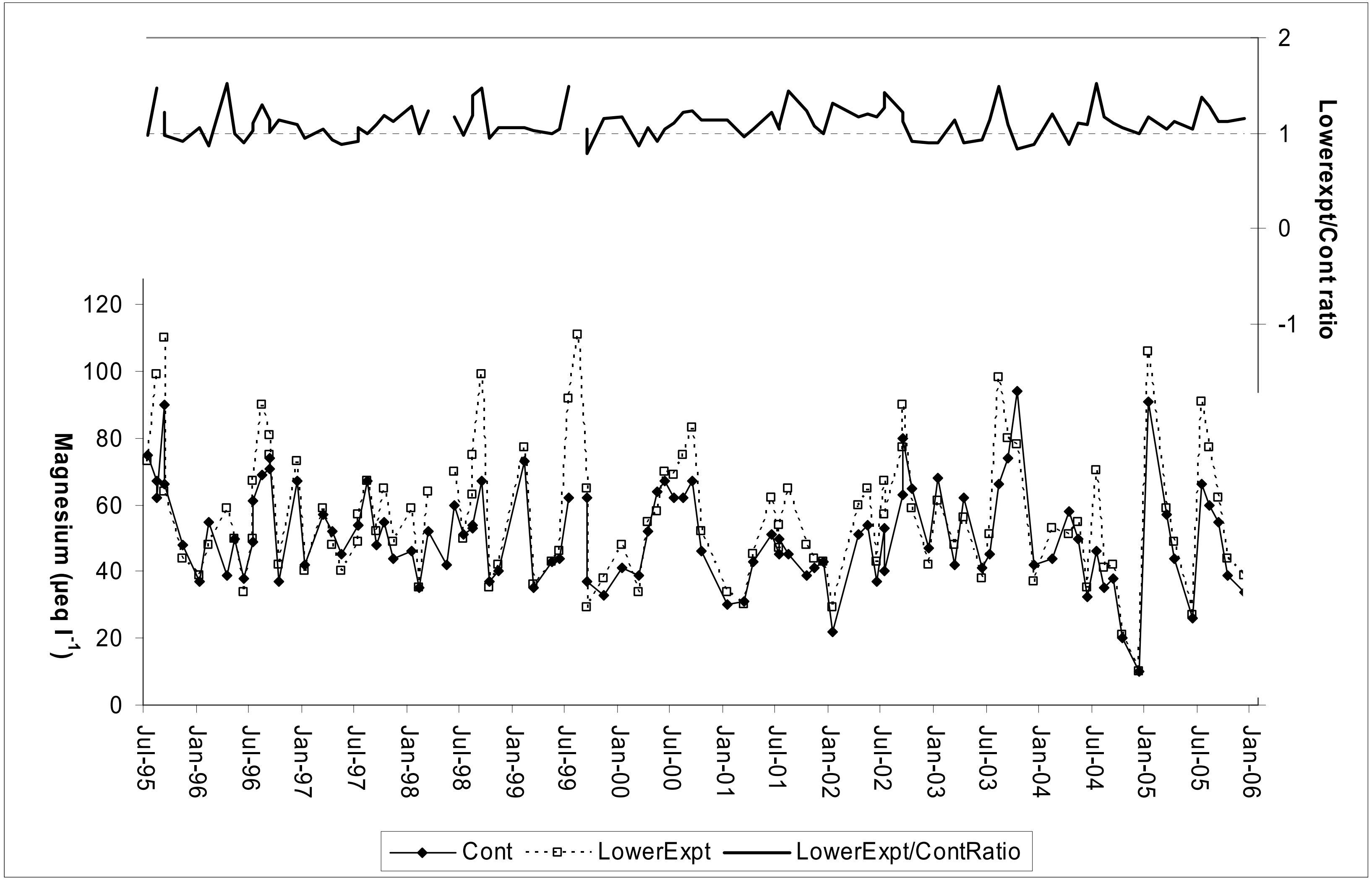


Figure 18 The ratio of potassium and its temporal variability in spot samples between the Control and Experimental Burn (Lower site) June 1995 – December 2005.

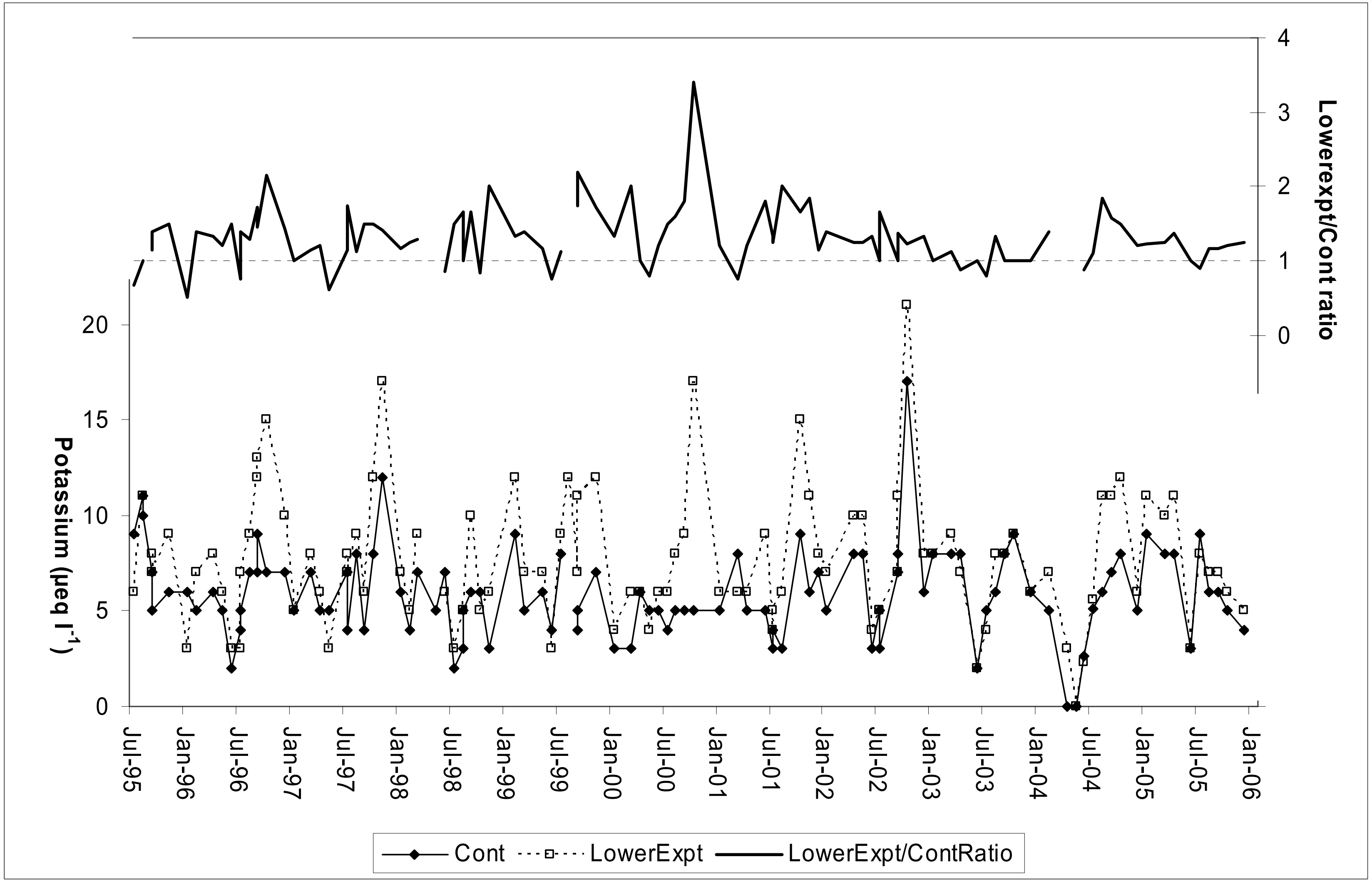


Figure 19 The ratio of conductivity and its temporal variability in spot samples between the Control and Experimental Burn (Lower site) June 1995 – December 2005

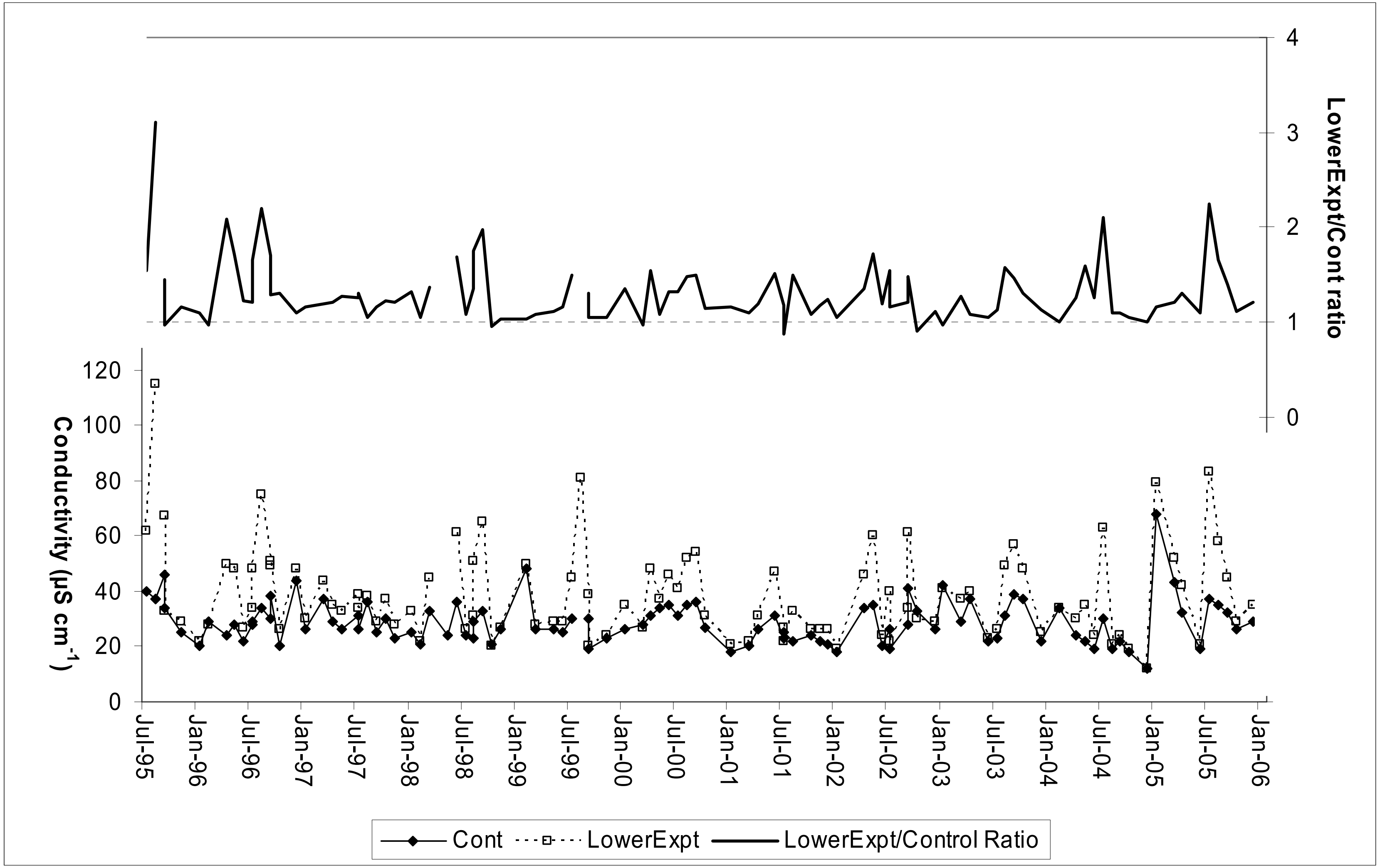
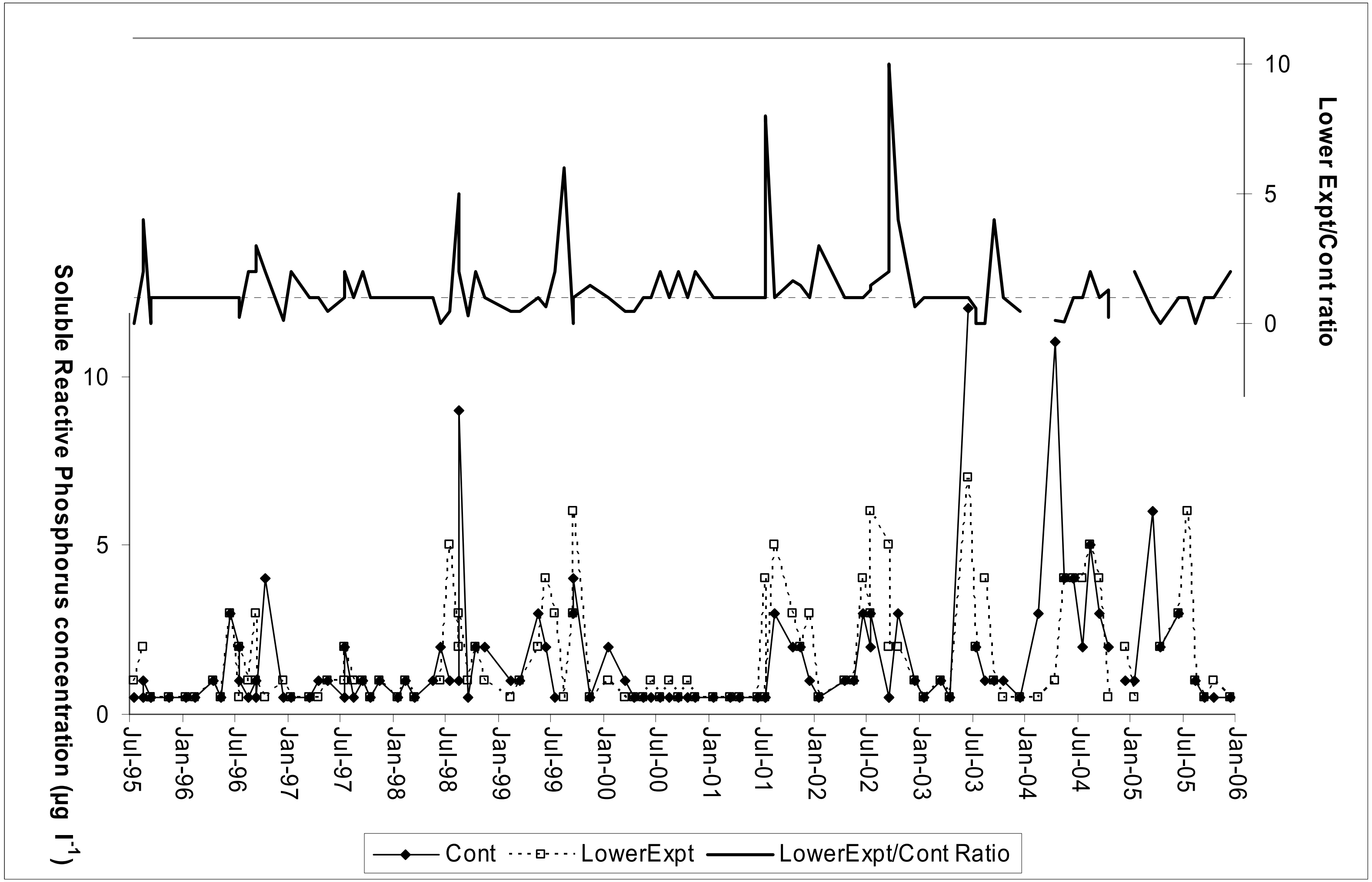


Figure 20 The ratio of soluble reactive phosphorus and its temporal variability in spot samples between the Control and Experimental Burn (Lower site) June 1995 – December 2005.



N.B. 0 values converted to half SRP detection limit for ratio calculations.

Figure 21 A comparison of alkalinity in spot samples from the Control Burn, Experimental Burn (Lower site) and the Allt Riabhach na Bioraich, June 1995 – December 2005.

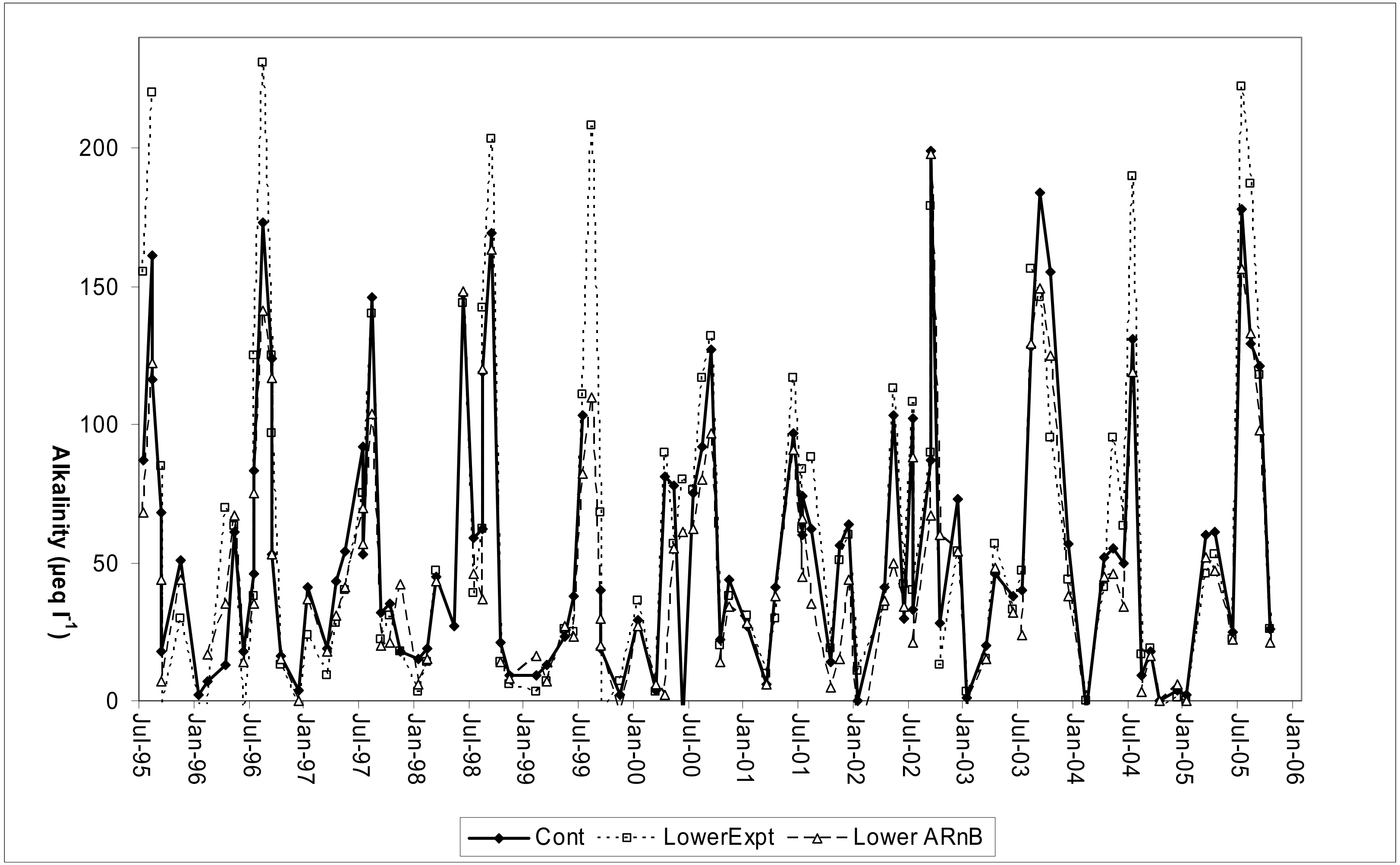


Figure 22 A comparison of conductivity of spot samples from the Control Burn, Experimental Burn (Lower site) and the Allt Riabhach na Bioraich, June 1995 – December 2005.

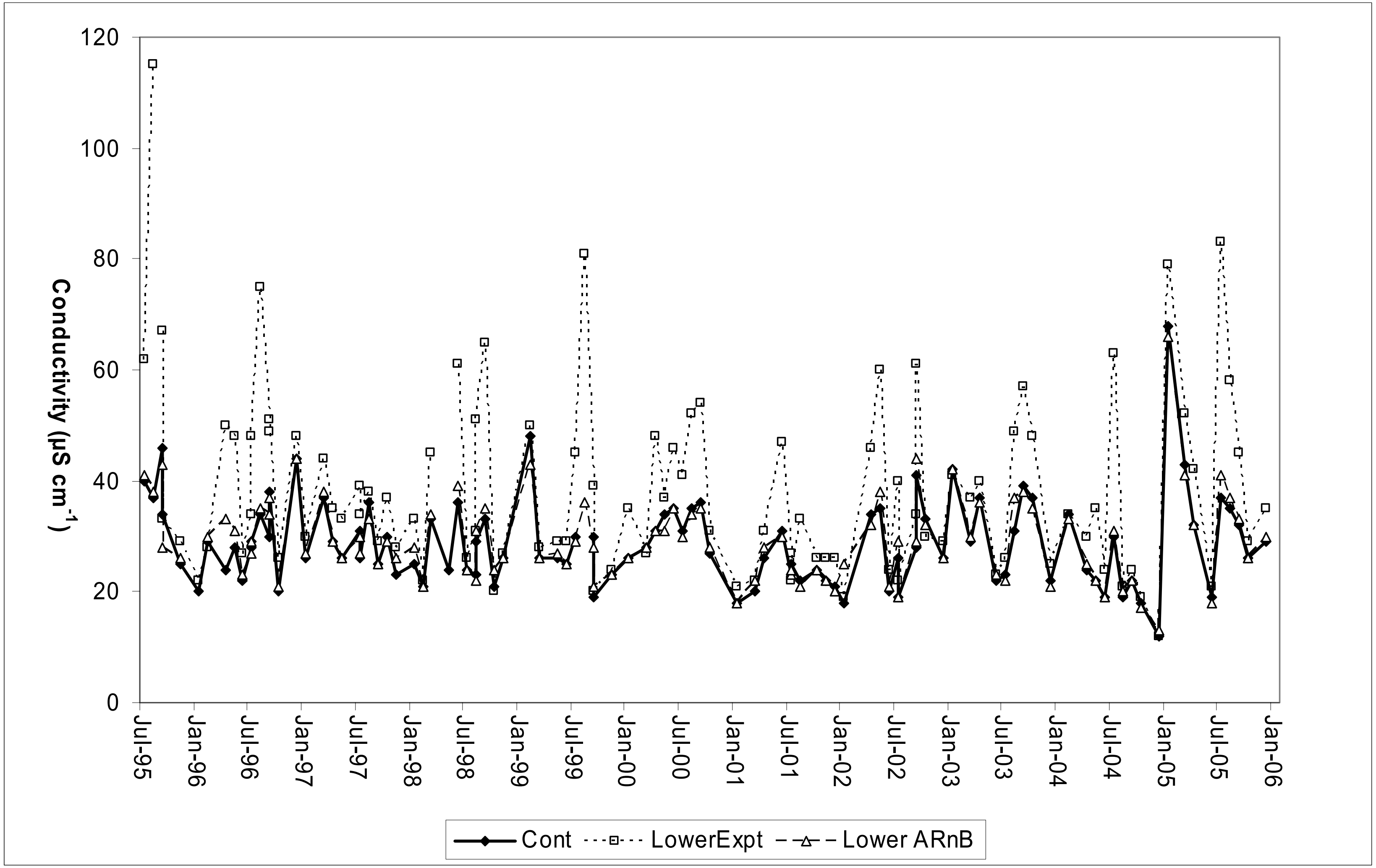


Figure 23 A comparison of nitrate concentrations of spot samples from the Control Burn, Experimental Burn (Lower site) and the Allt Riabhach na Bioraich, June 1995 – December 2005.

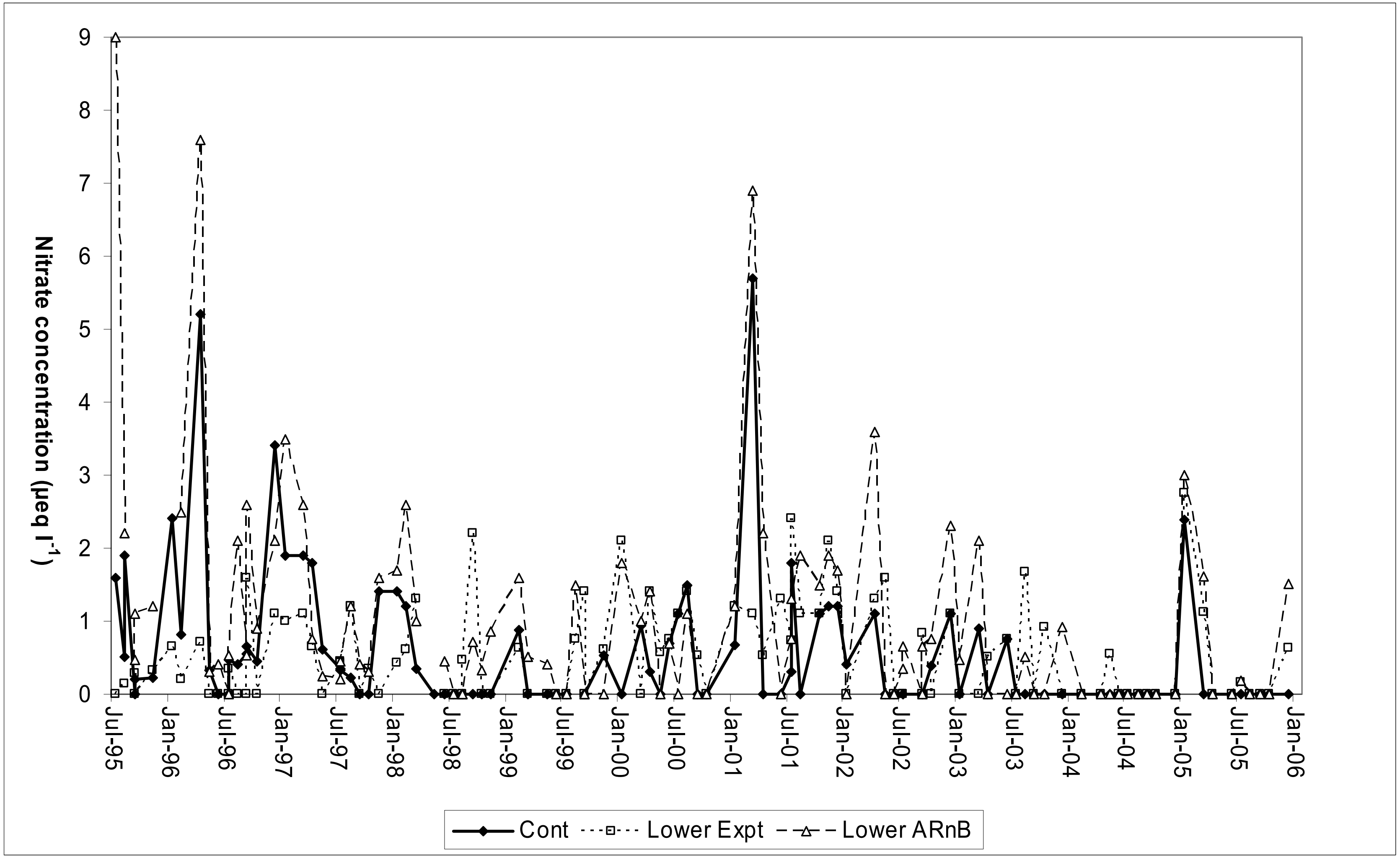


Figure 24 A comparison of soluble reactive phosphorus concentrations of spot samples from the Control Burn, Experimental Burn (Lower site) and the Allt Riabhach na Bioraich, June 1995 – December 2005.

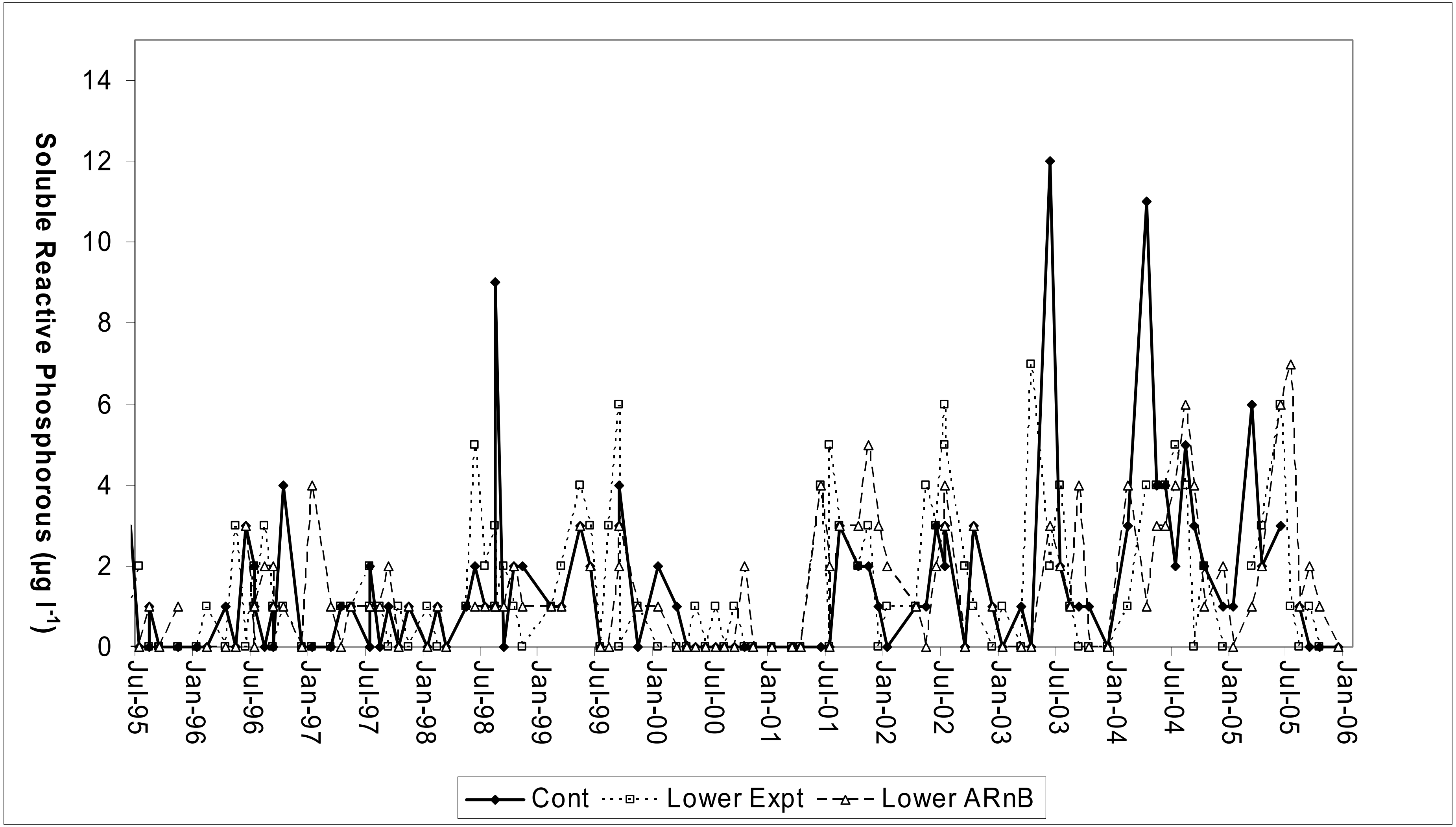


Figure 25 A comparison of total organic carbon concentrations of spot samples from the Control Burn, Experimental Burn (Lower site) and the Allt Riabhach na Bioraich, June 1995 – December 2005.

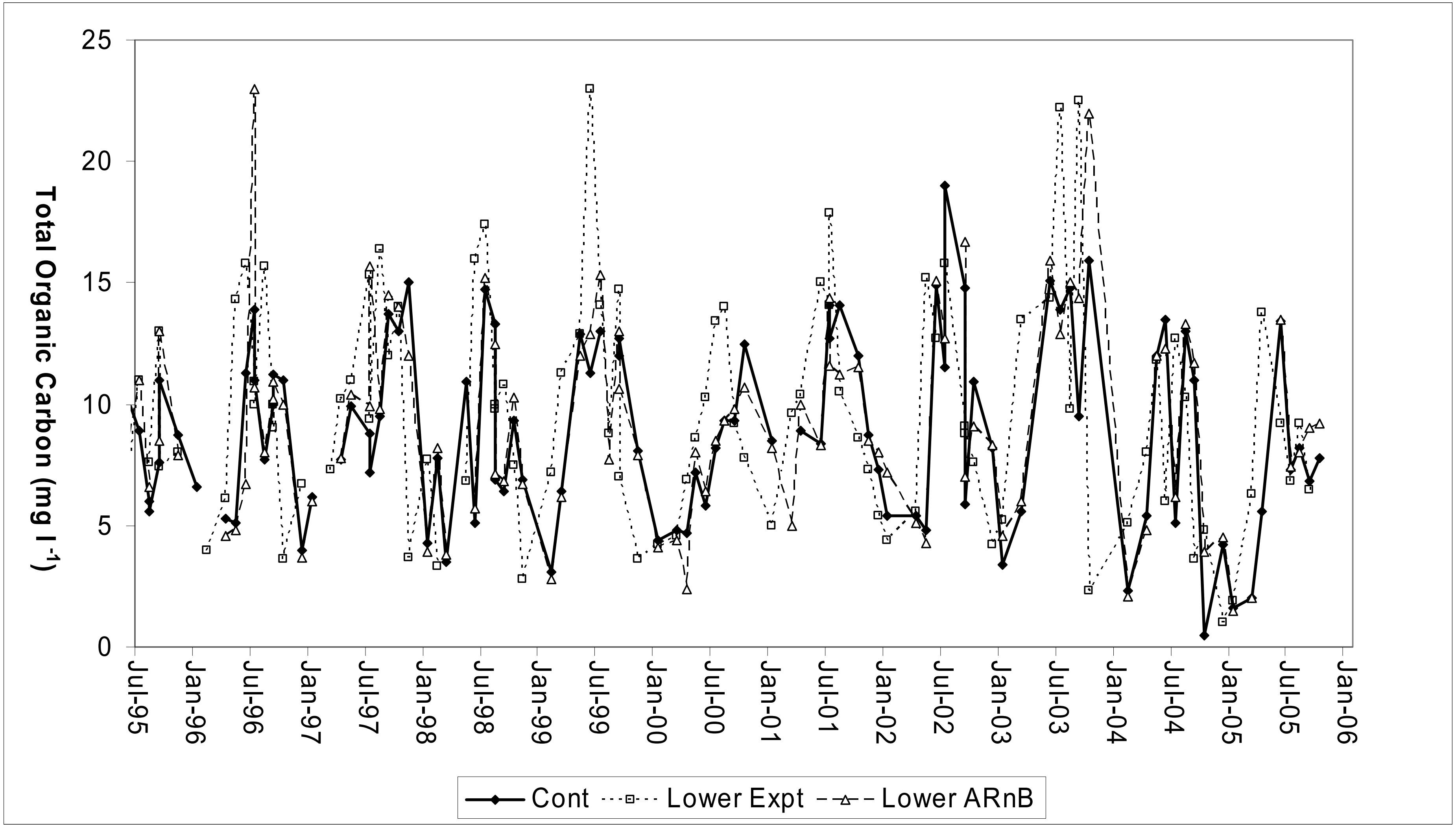
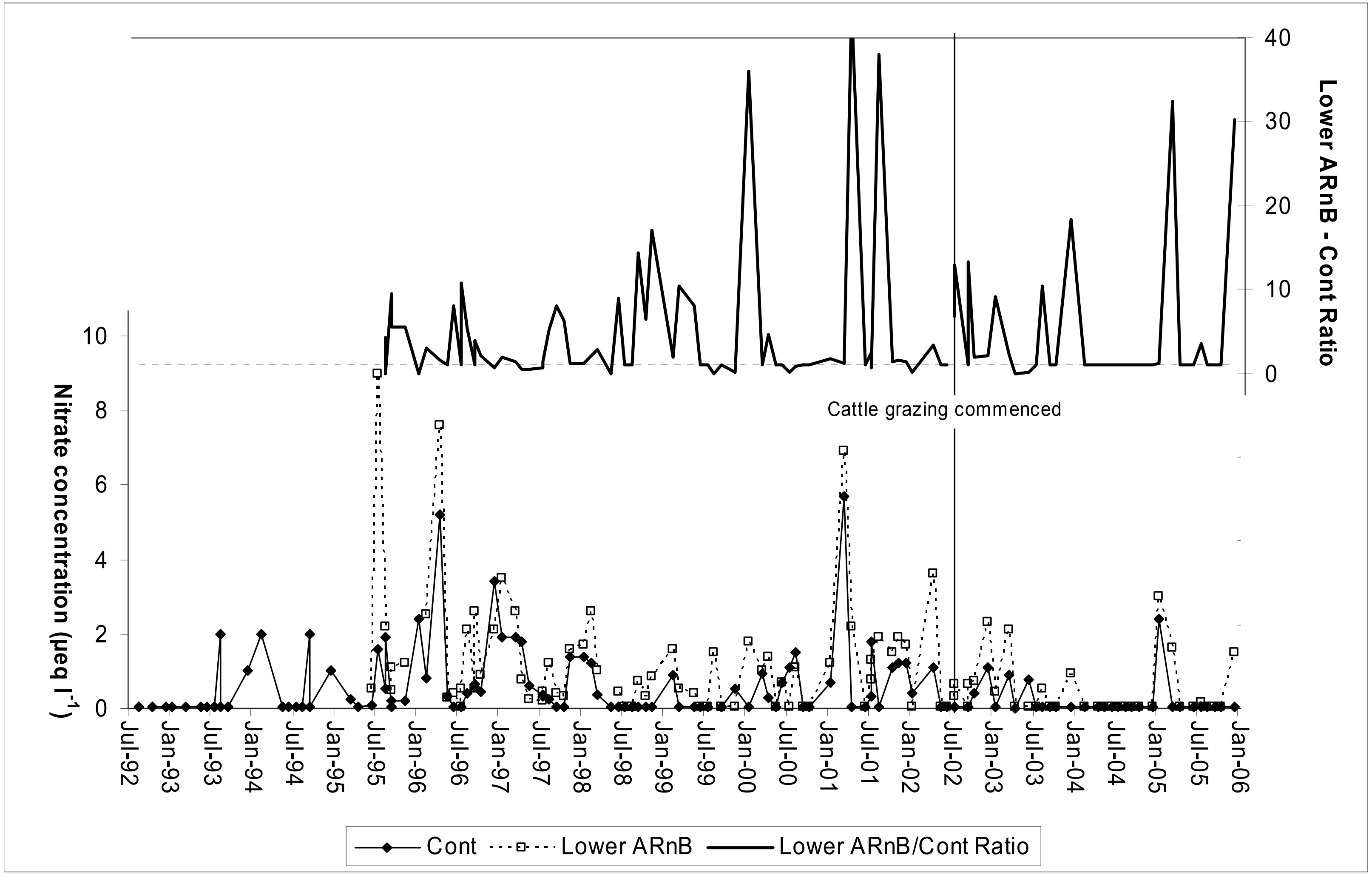


Figure 26 The ratio of nitrate and its temporal variability in spot samples between the Control and Allt Riabhach na Bioraich (Lower site) June 1995 – December 2005.



N.B. 0 values converted to half nitrate detection limit for ratio calculations.

Figure 27 The temporal variability of nitrate in spot samples and the difference between the Control and Allt Riabhach na Bioraich (Lower site) June 1995 – December 2005.

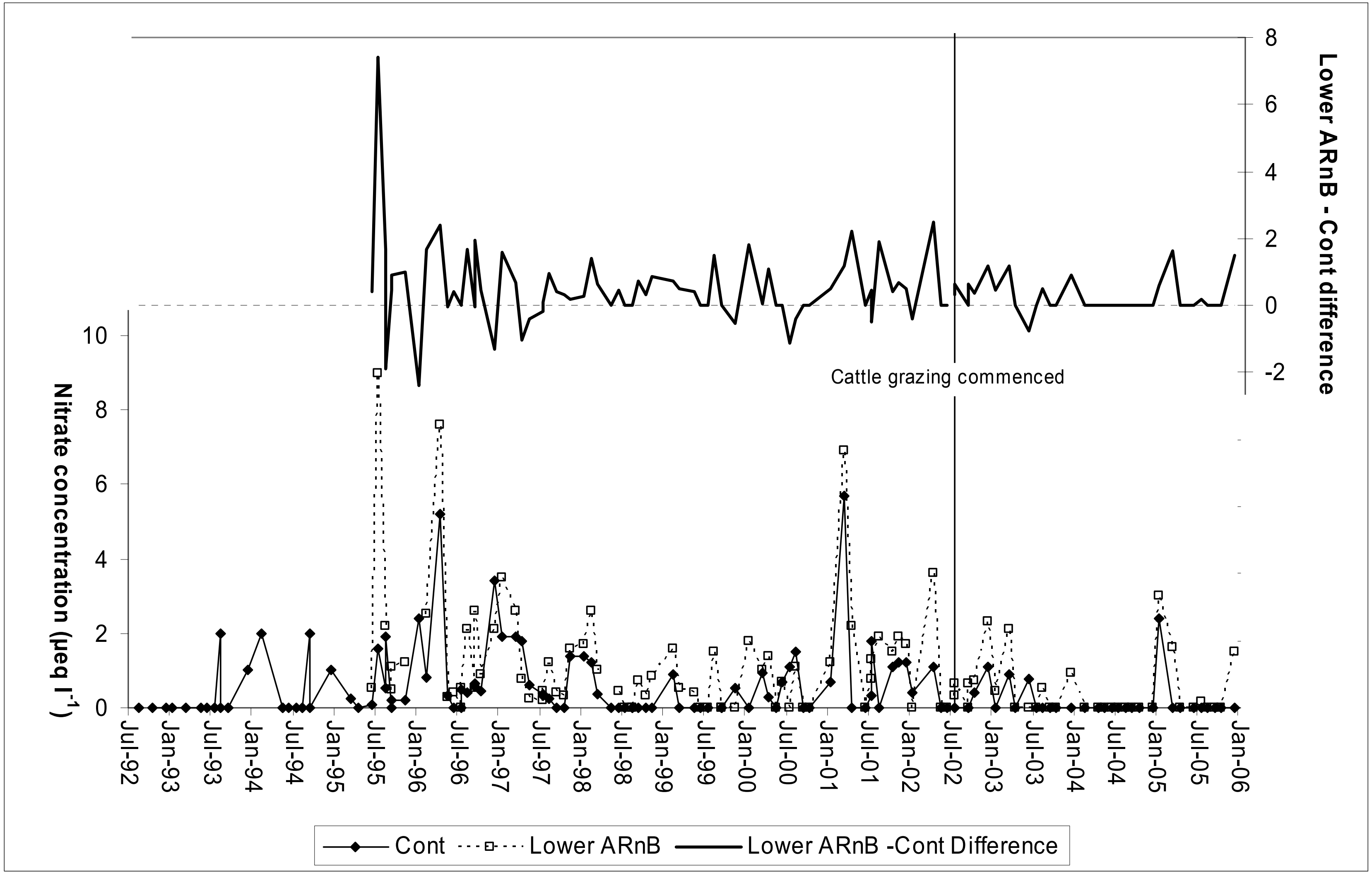


Figure 28 The ratio of alkalinity and its temporal variability in spot samples between the Control and Allt Riabhach na Bioraich (Lower site) June 1995 – December 2005.

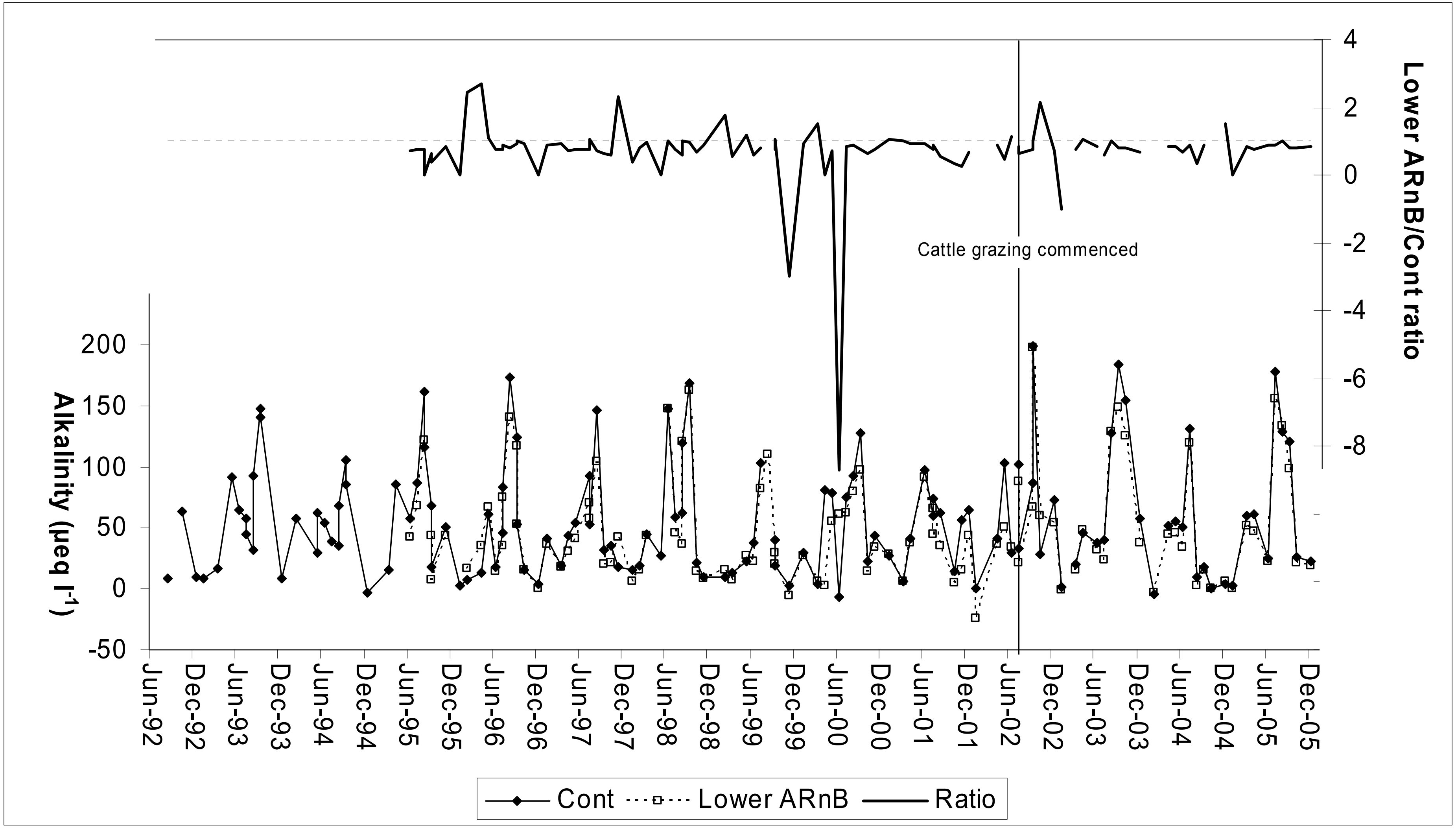


Figure 29 The ratio of calcium and its temporal variability in spot samples between the Control and Allt Riabhach na Bioraich (Lower site) June 1995 – December 2005.

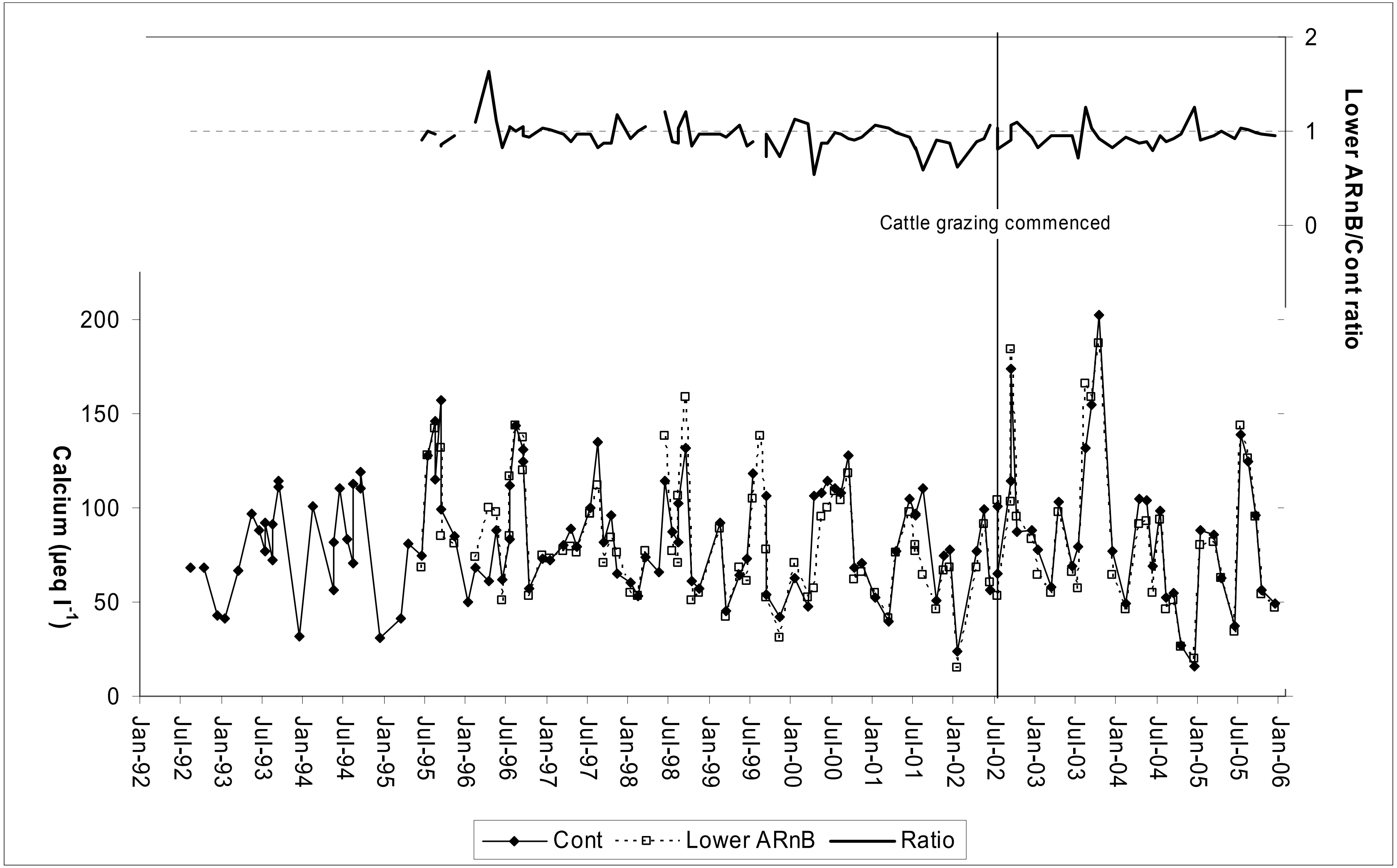


Figure 30 The ratio of magnesium and its temporal variability in spot samples between the Control and Allt Riabhach na Bioraich (Lower site) June 1995 – December 2005.

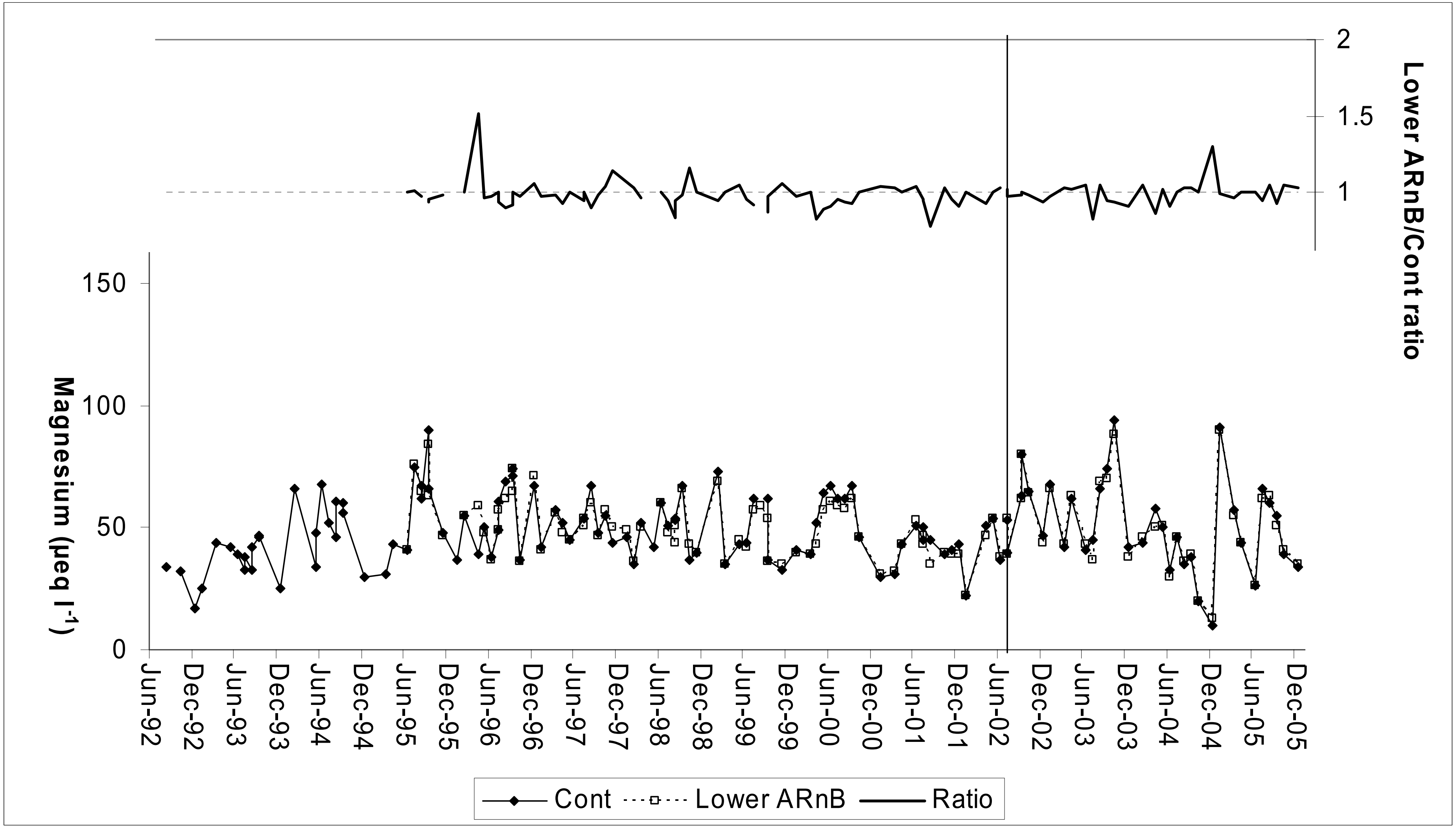


Figure 31 The ratio of potassium and its temporal variability in spot samples between the Control and Allt Riabhach na Bioraich (Lower site) June 1995 – December 2005.

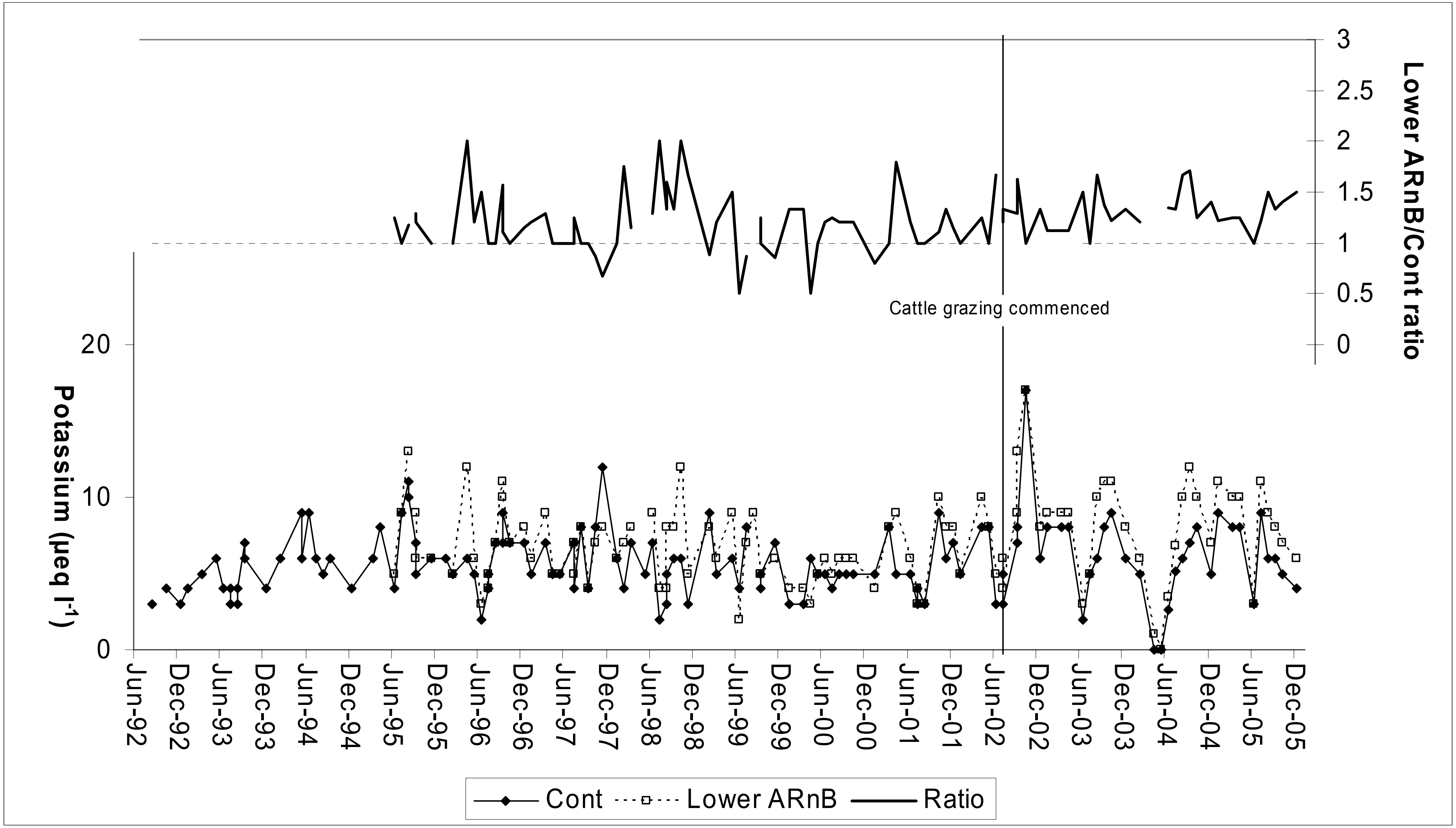


Figure 32 The ratio of conductivity and its temporal variability in spot samples between the Control and Allt Riabhach na Bioraich (Lower site) June 1995 – December 2005

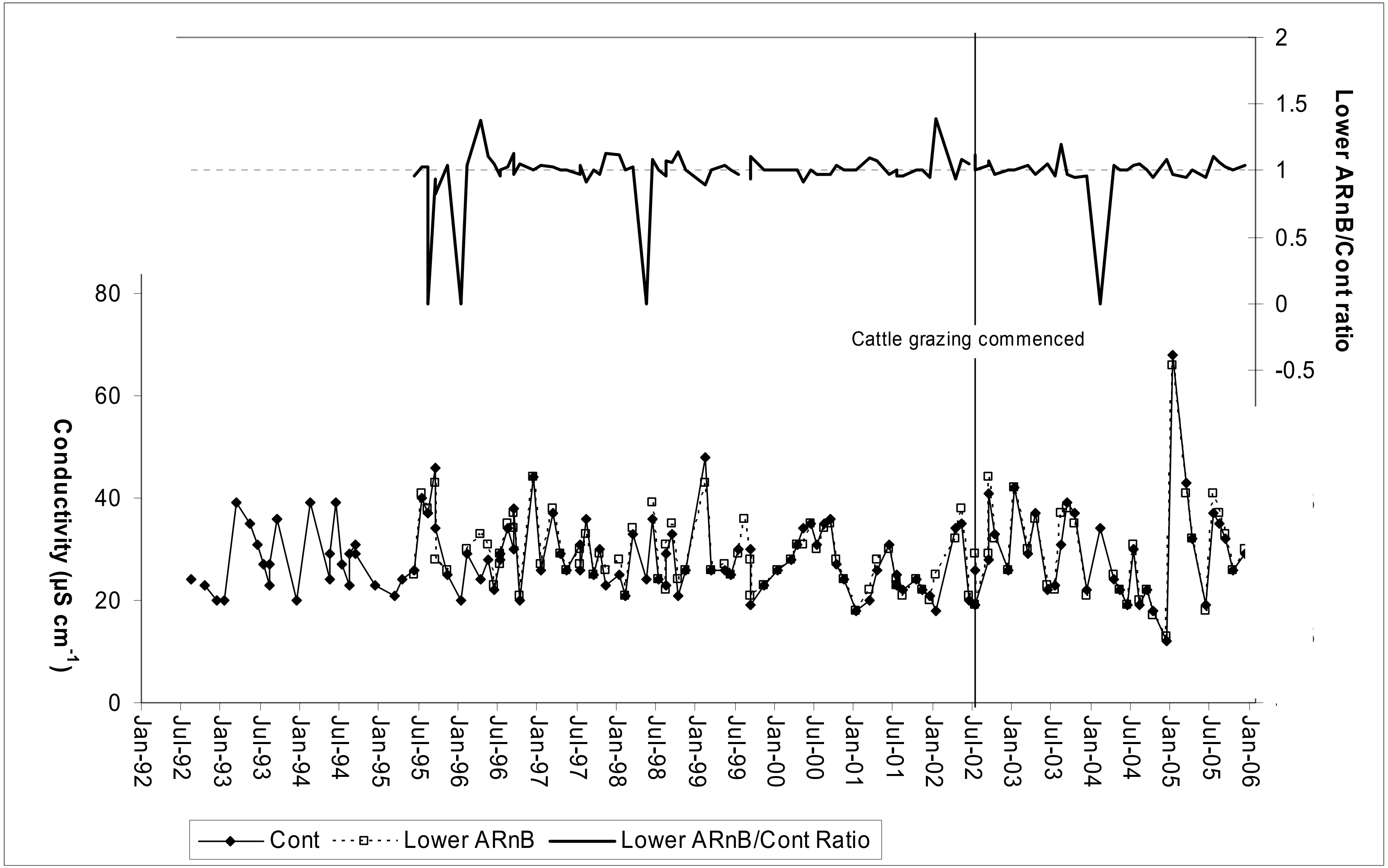


Figure 33 A comparison of soluble reactive phosphorus and its temporal variability in spot samples between the Control and Allt Riabhach na Bioraich (Lower site) June 1995 – December 2005.

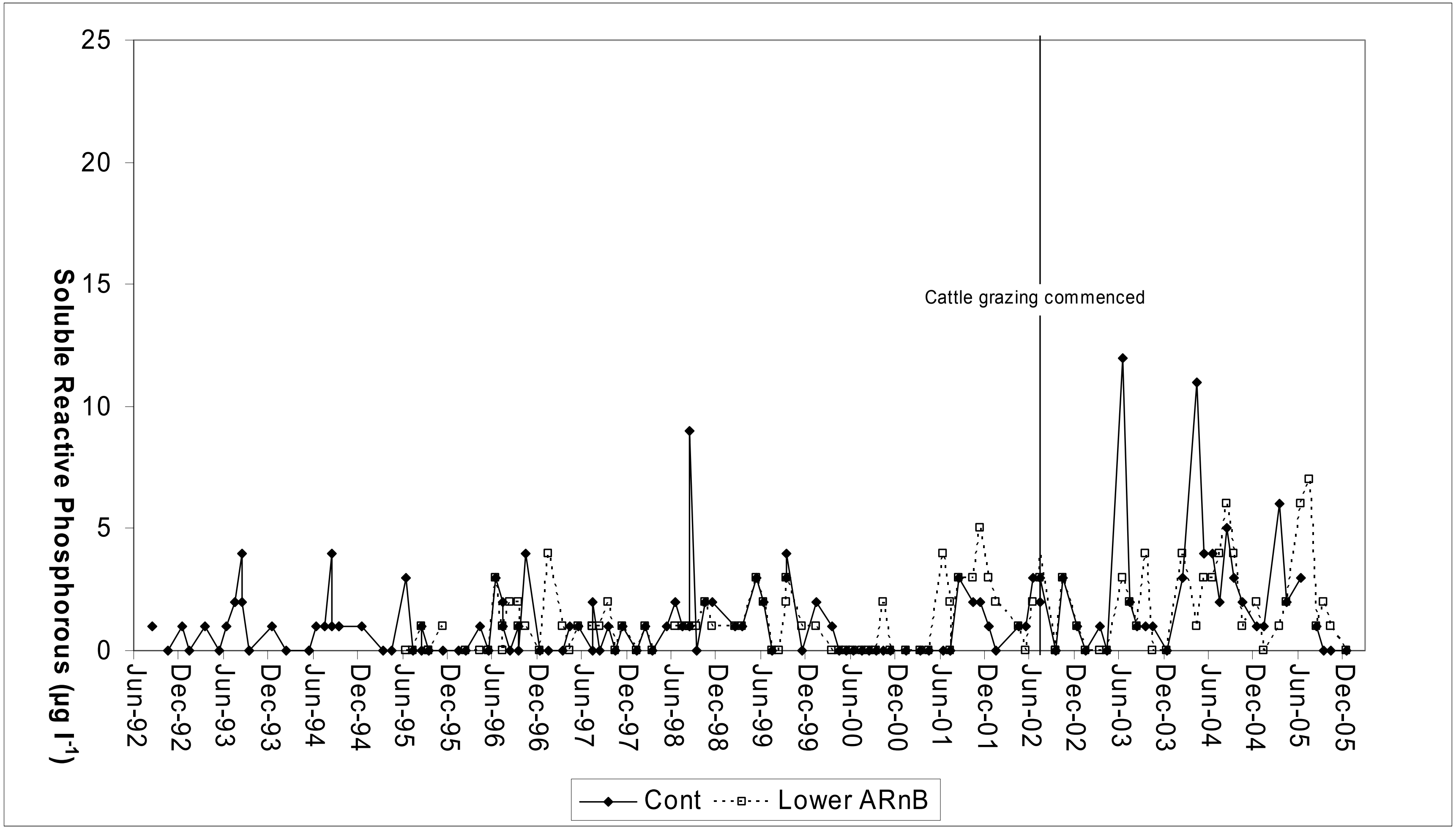


Figure 34 Control Burn diatom percentage abundances

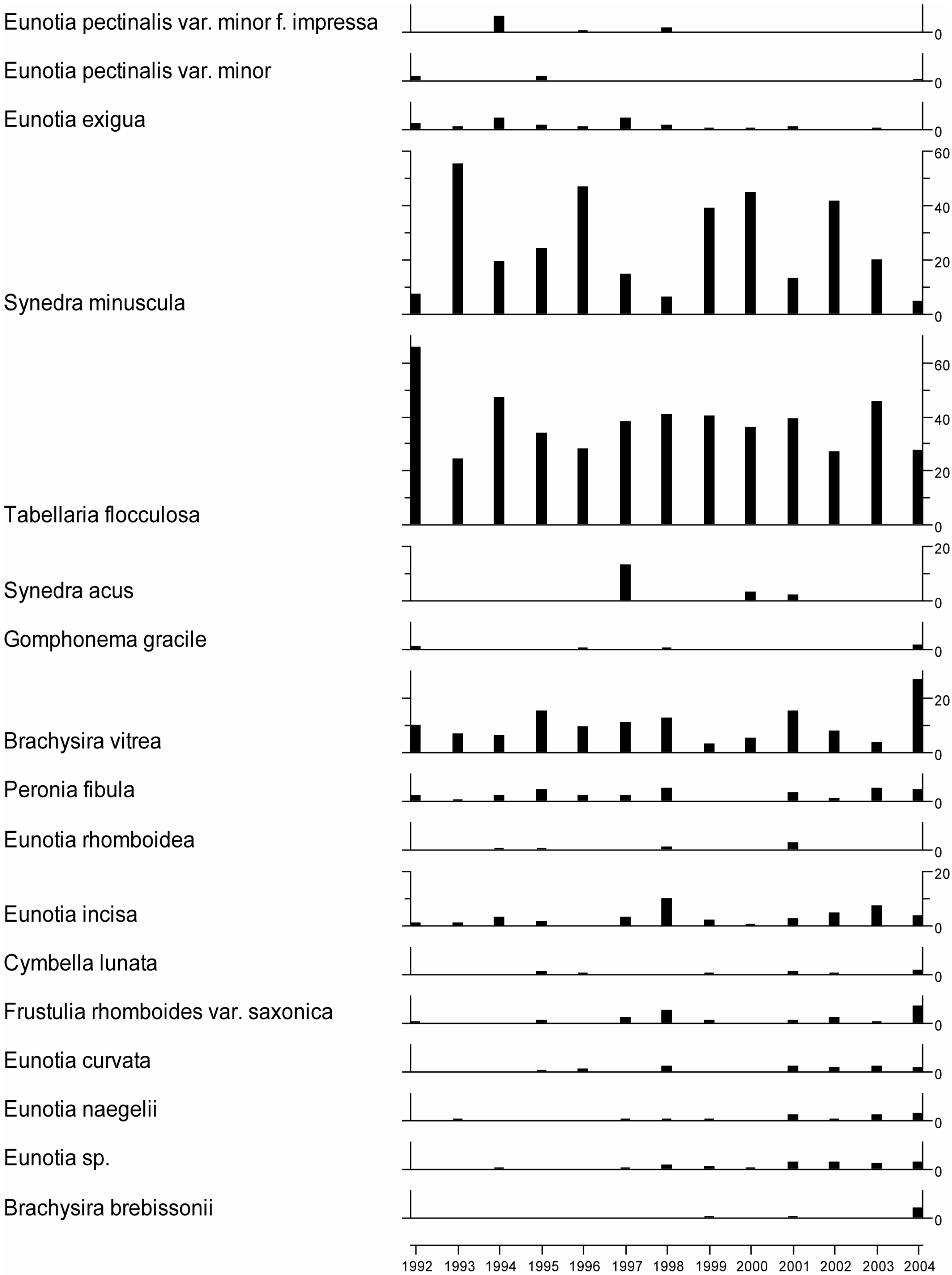


Figure 35 Experimental Burn diatom percentage abundances

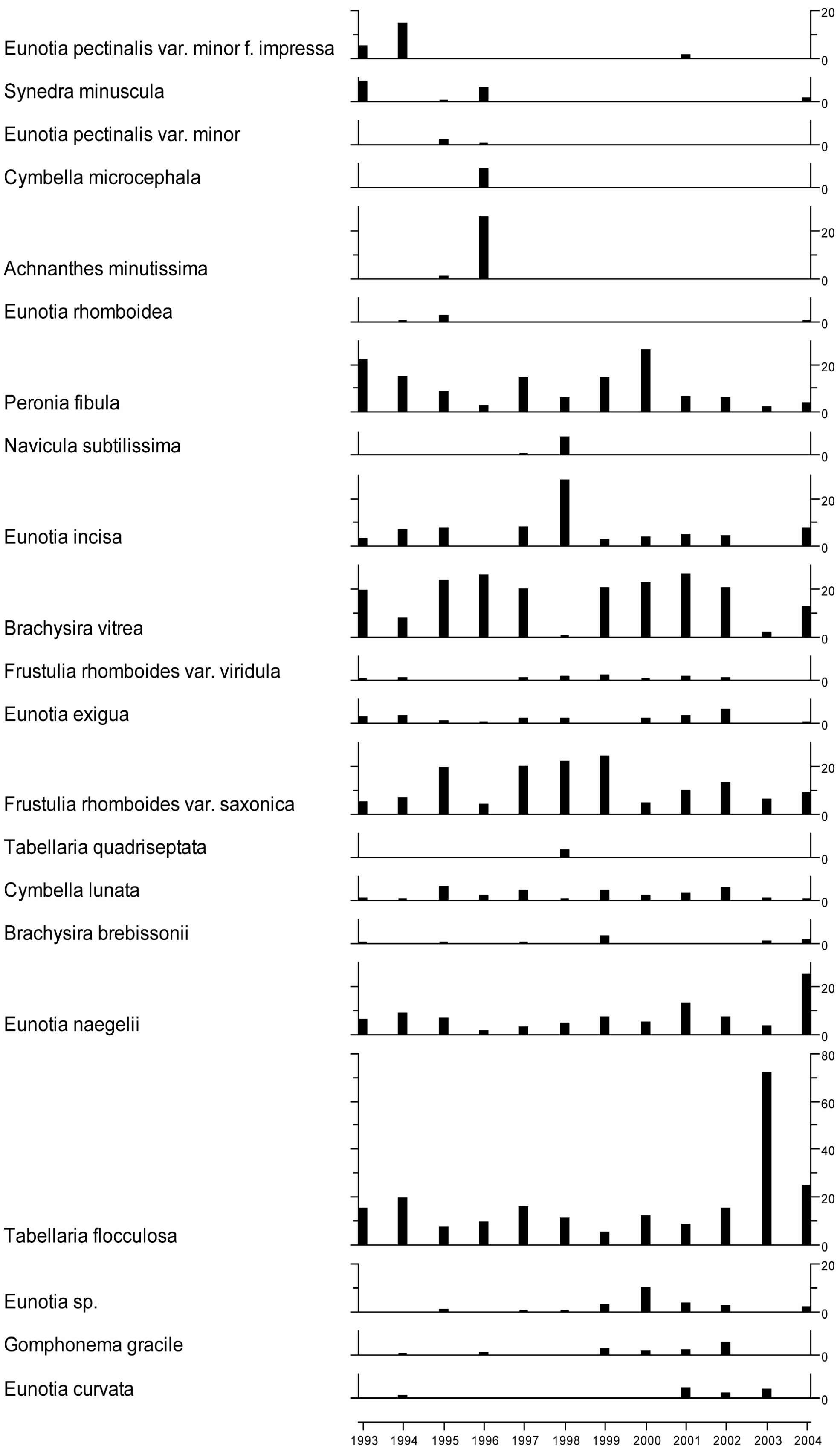


Figure 36 Allt Riabhach na Bioraich diatom percentage abundances

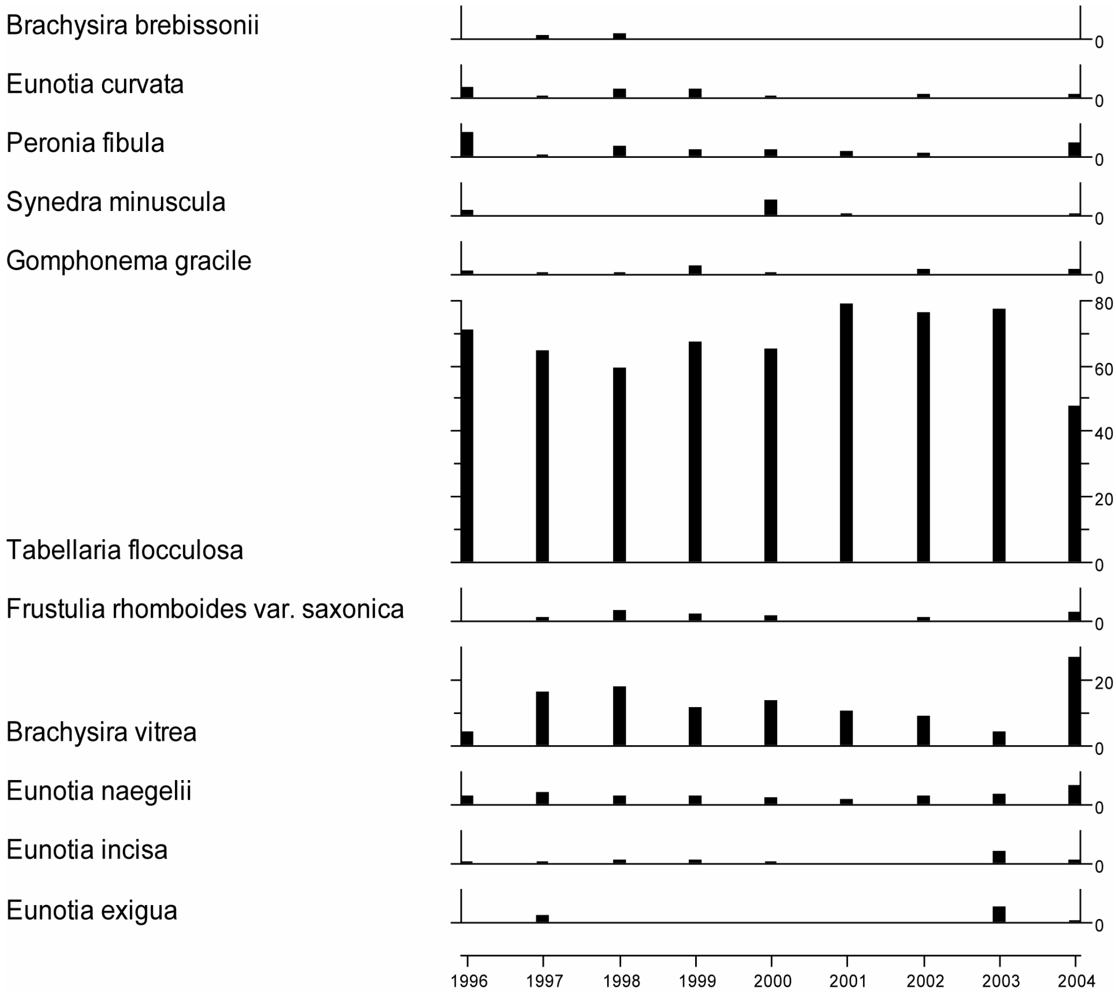


Figure 37 Control Burn macroinvertebrate percentage abundances

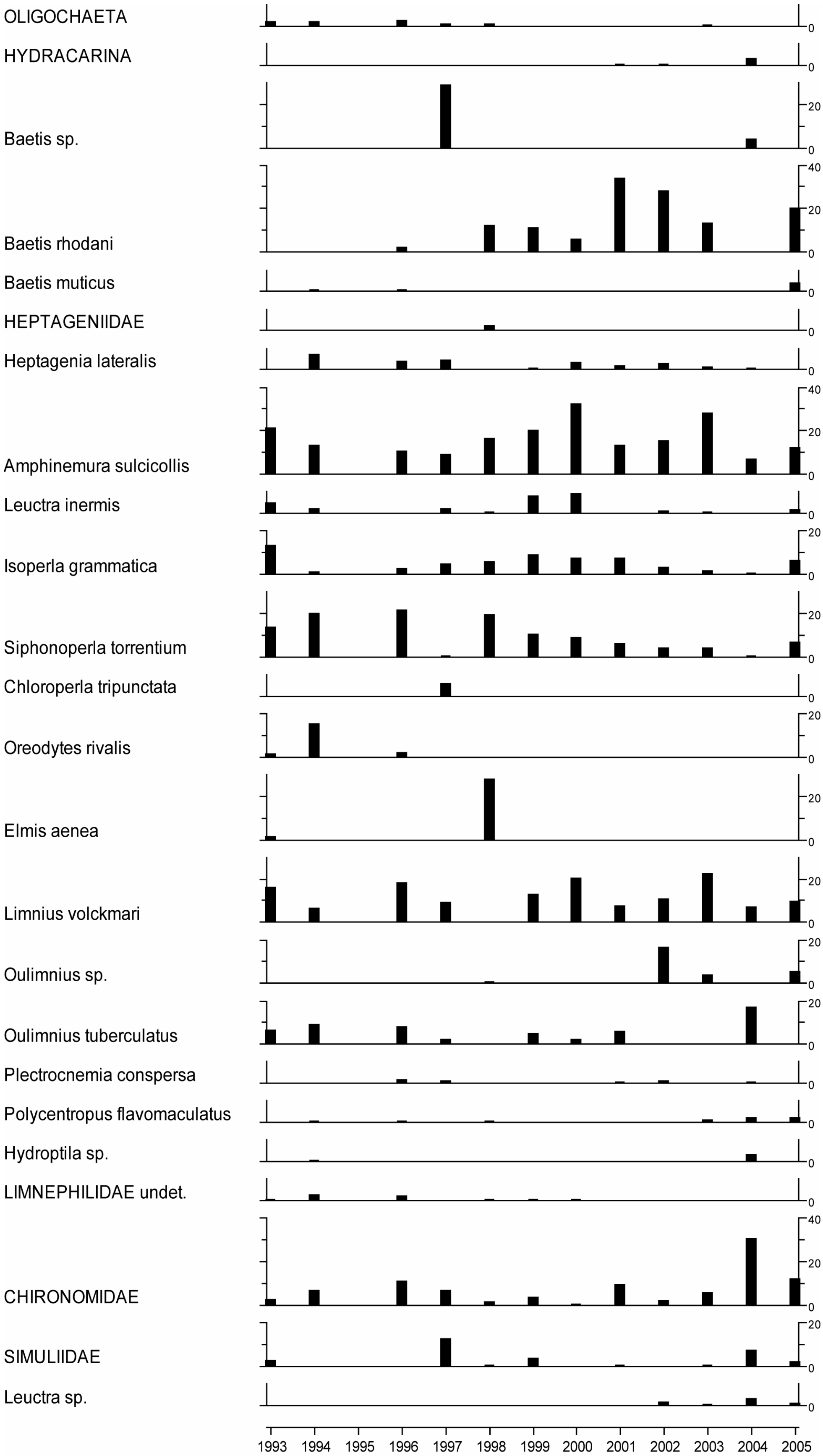


Figure 38 Experimental Burn macroinvertebrate percentage abundances

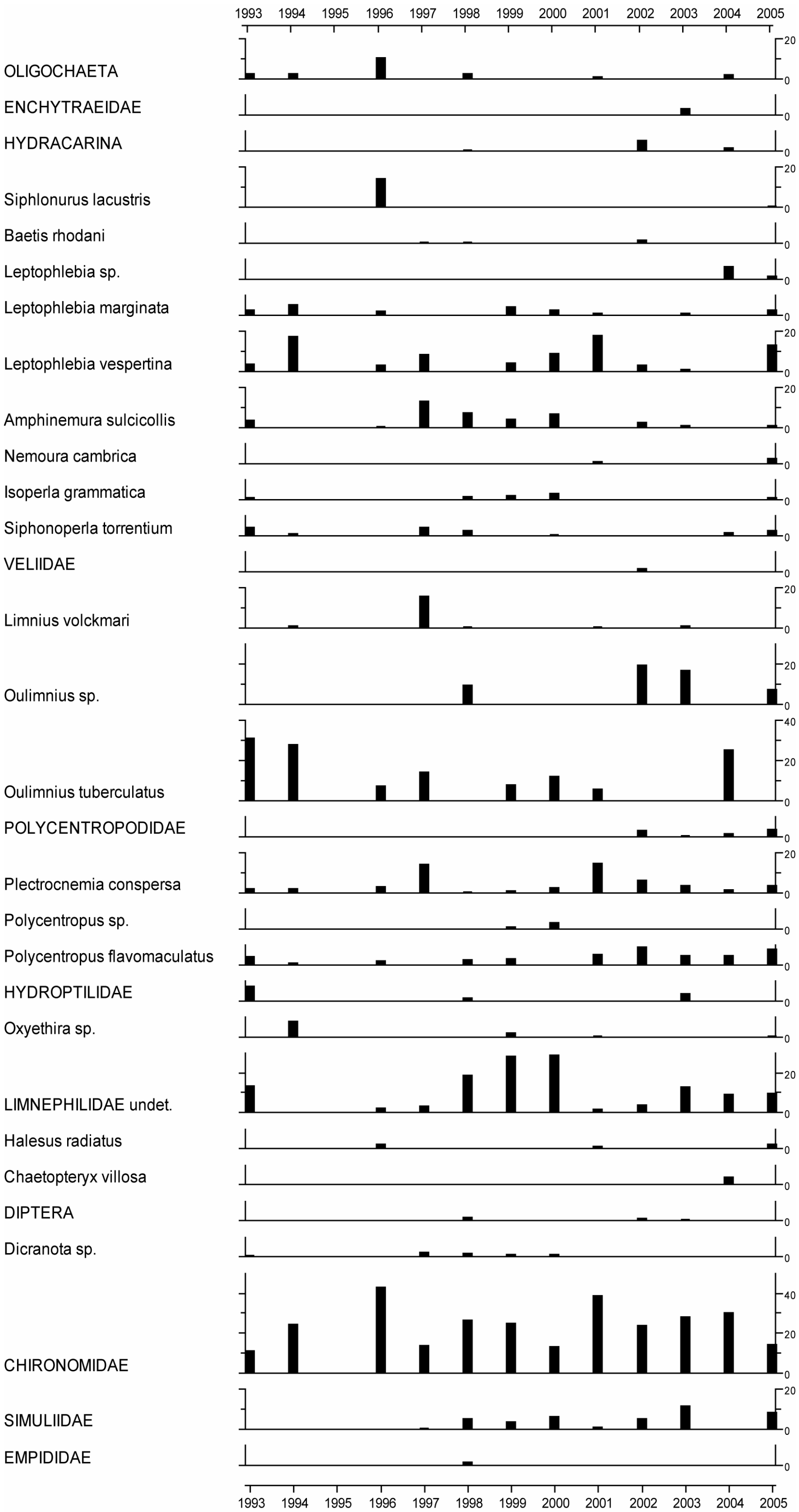


Figure 39 Allt Riabhach na Bioraich Burn macroinvertebrate percentage abundances

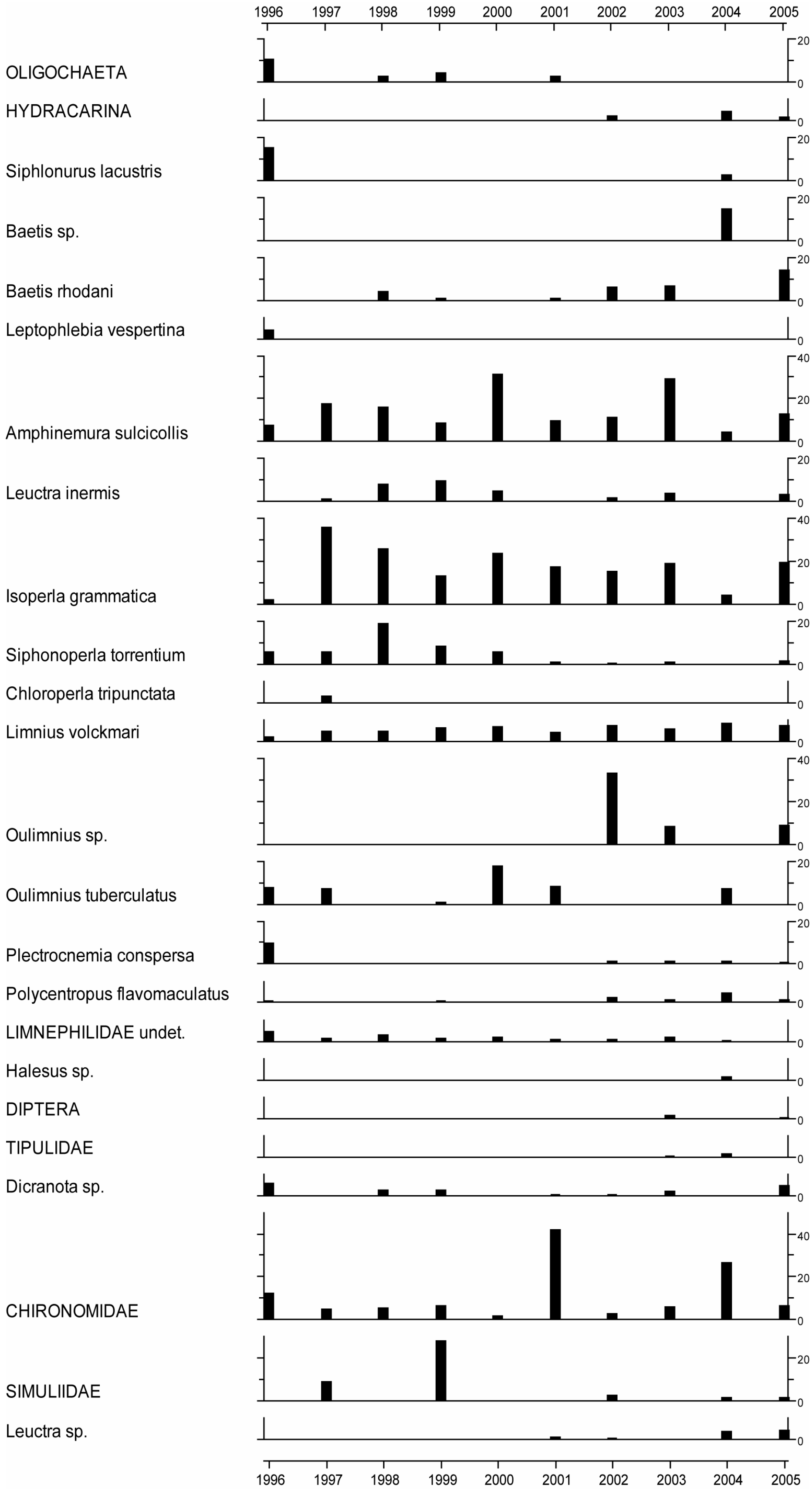


Figure 40 Selected Control Burn macroinvertebrate summary statistics

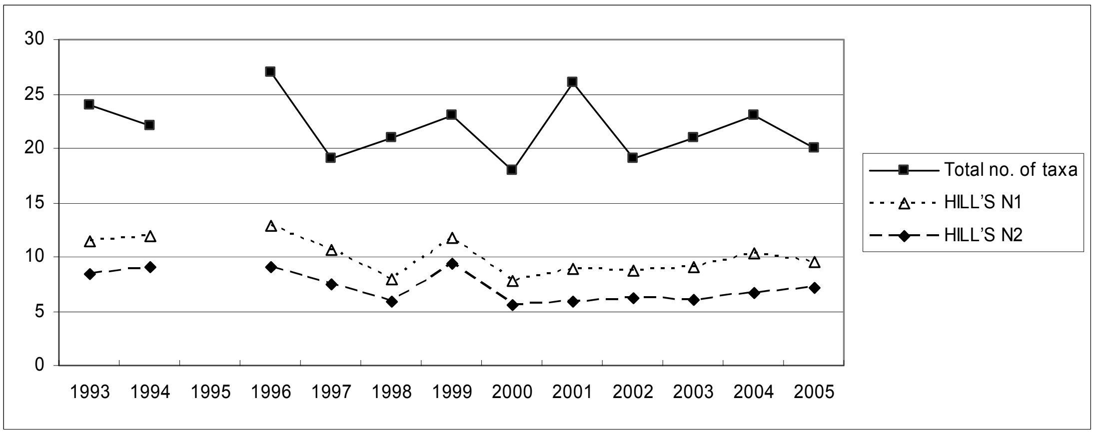


Figure 41 Selected Experimental Burn macroinvertebrate summary statistics

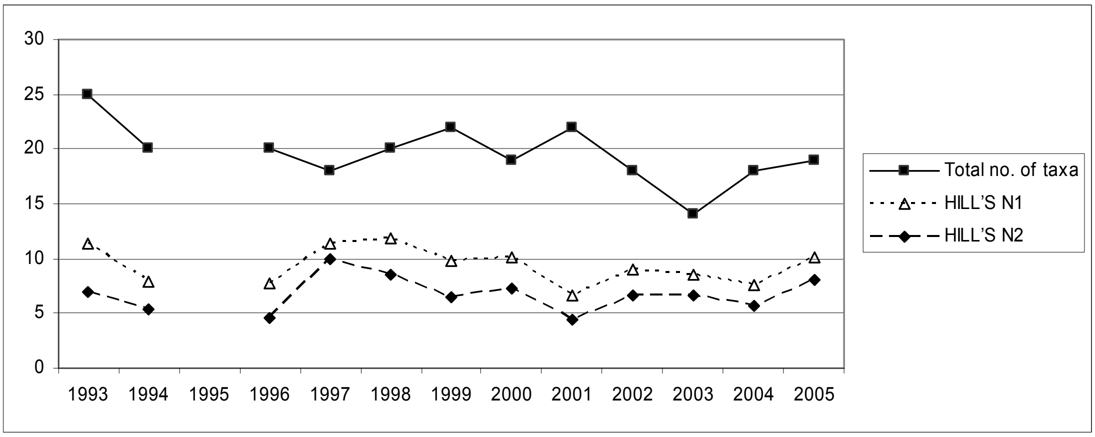


Figure 42 Selected Allt Riabhach na Bioraich macroinvertebrate summary statistics

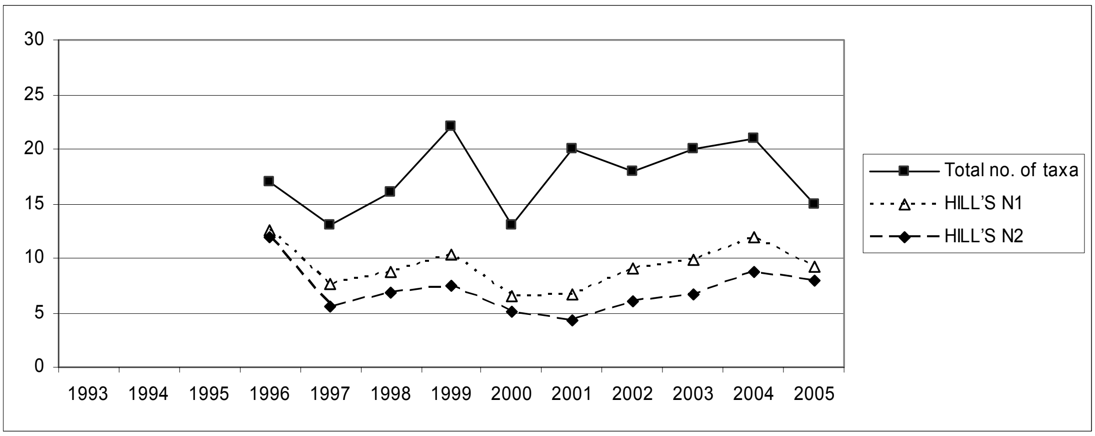
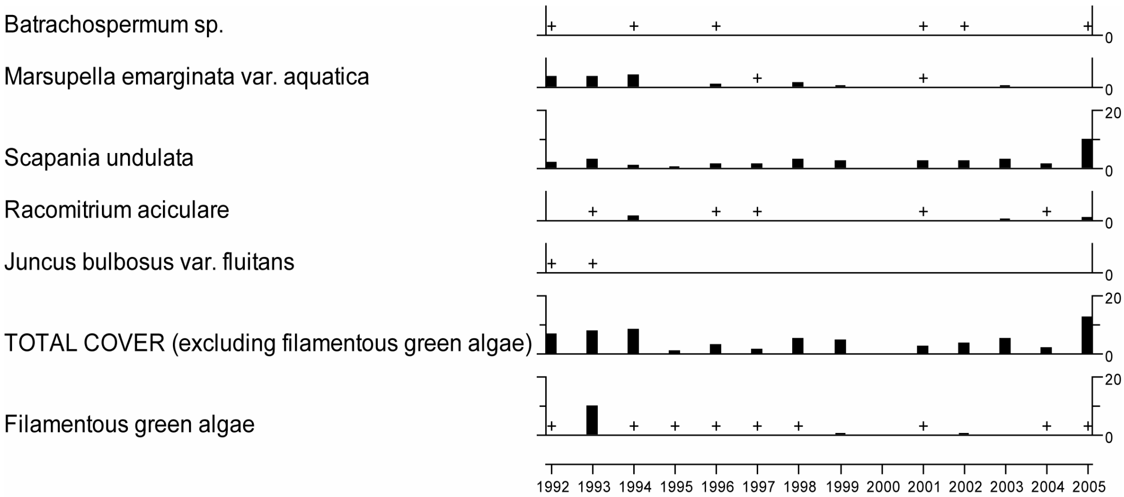
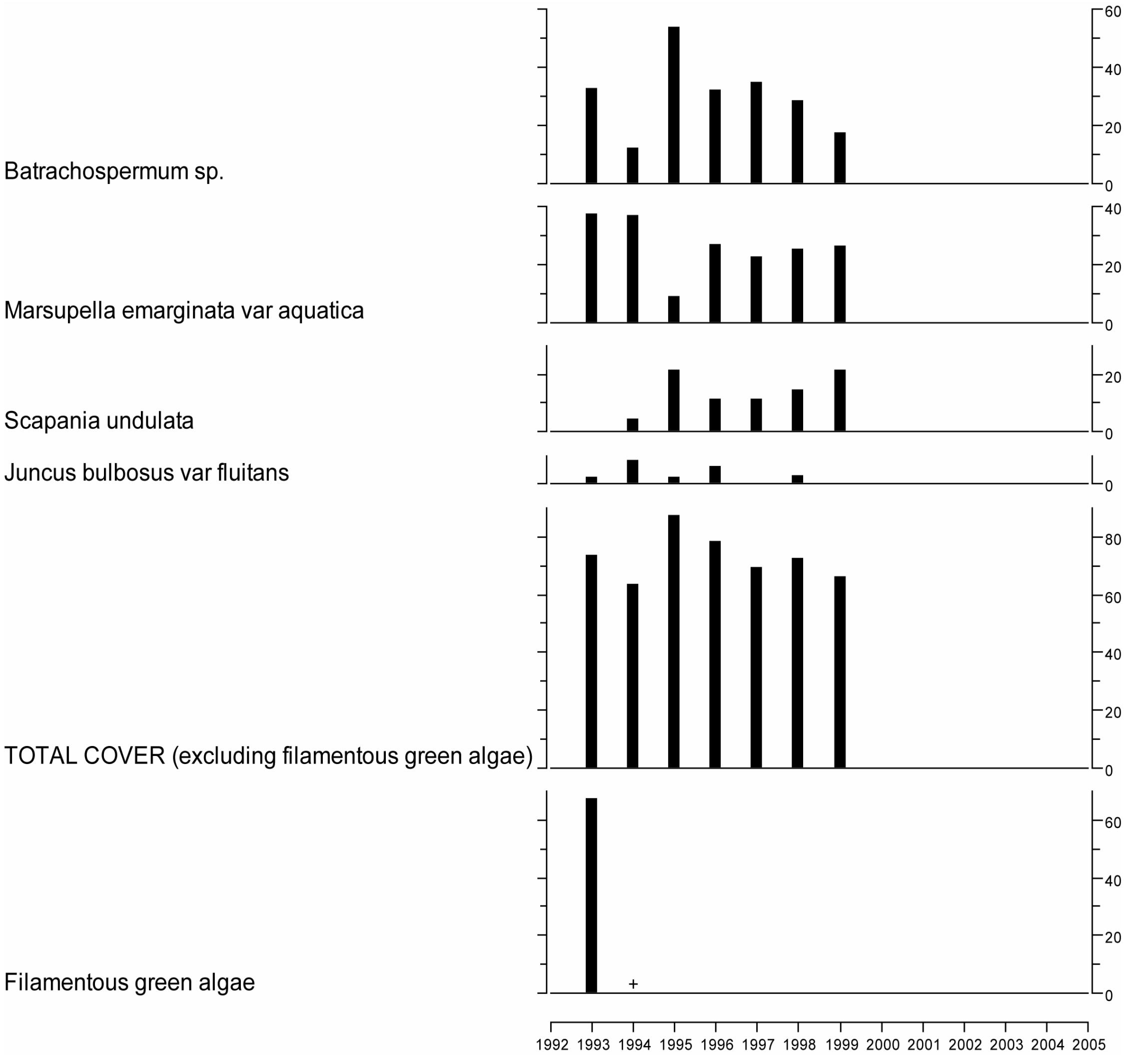


Figure 43 Control Burn Macrophyte percentage Abundances



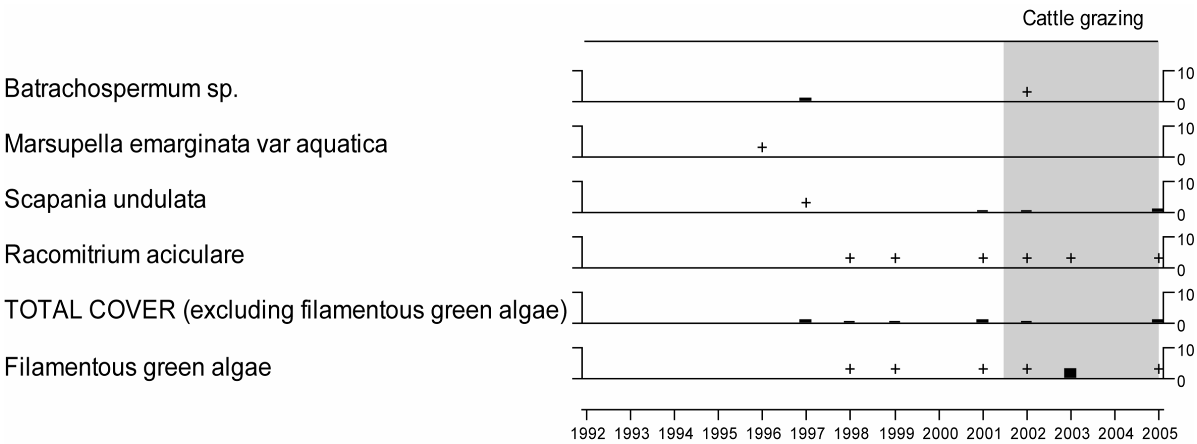
Sampling stretch 50m long.

Figure 44 Experimental Burn Macrophyte percentage Abundances



Sampling stretch 20m long. Sampling ceased in 1999.

Figure 45 Allt Riabhach na Bioraich Burn Macrophyte percentage Abundances



Sampling stretch 50m long.

Figure 46 Control Burn fish densities

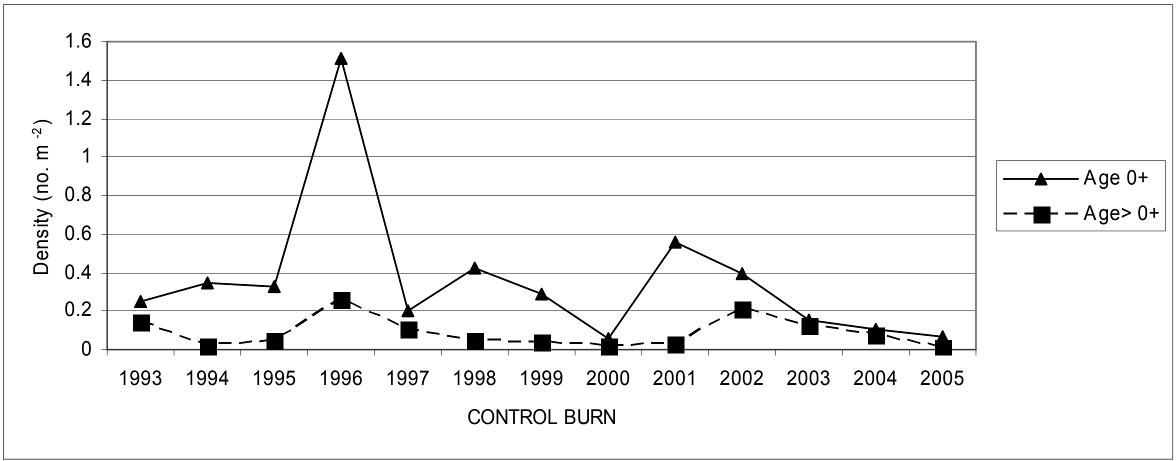


Figure 47 Experimental Burn fish densities

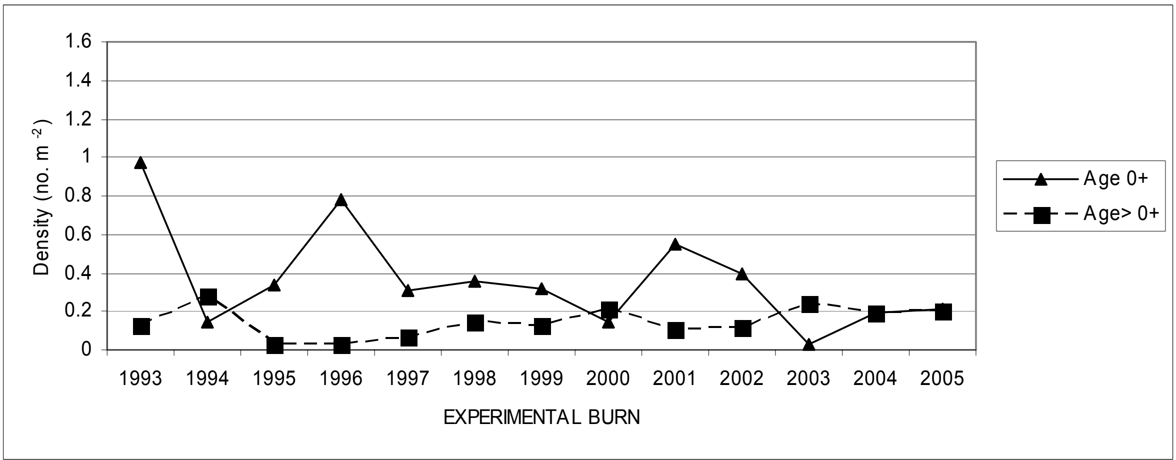
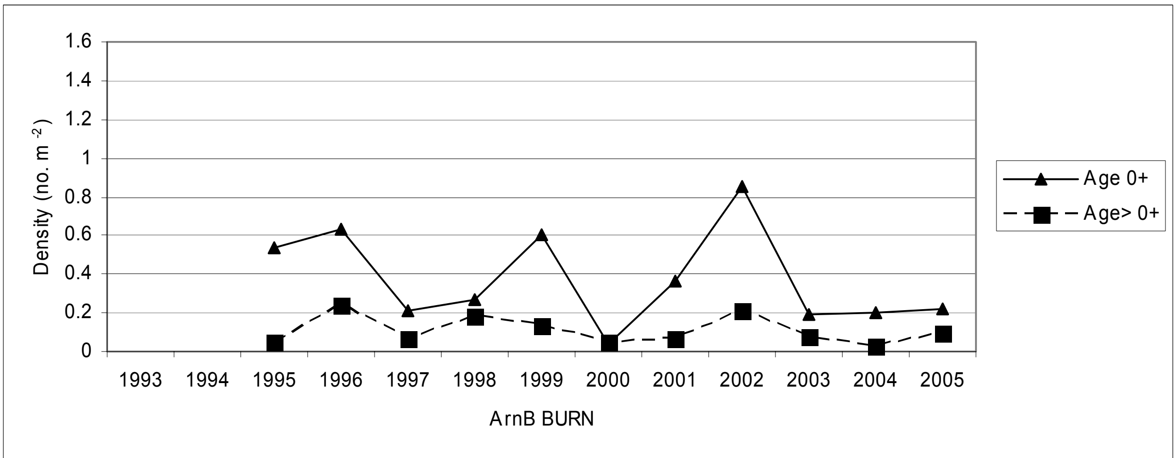


Figure 48 Allt Riabhach na Bioraich fish densities



8 APPENDICES

Appendix 1 Summary statistics of selected chemical determinands for individual years at all sampling stations

Site Name	Year	pH			Alkalinity (µeq l-1)			Conductivity (µS cm-1)			Nitrate (µeq l-1)			Sulphate (µeq l-1)			Total Phosphorus (µg l-1)			Labile Aluminium (µeq l-1)		
		Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Control	1992	5.87	5.44	6.46	27.0	8	63	22.3	20	24	0.0	0	0	26.3	25	28				8.0	2	18
Control	1993	6.23	5.59	6.91	63.8	8	147	29.2	20	39	0.3	0	2	28.1	11	44	22.5	19.0	26.0	6.3	0	29
Control	1994	6.22	5.18	6.68	53.2	-3	105	29.3	23	39	0.5	0	2	33.9	23	85	18.9	2.5	58.0	4.4	0	17
Control	1995	6.42	5.72	7.02	73.3	16	161	32.2	21	46	0.6	0	2	62.0	18	175	3.1	2.5	6.0	4.6	0	28
Control	1996	6.03	5.39	6.9	50.0	2	173	28.8	20	44	1.1	0	5	40.5	18	62	3.3	2.5	10.0	3.8	0	10
Control	1997	6.32	5.65	6.94	53.3	18	146	28.9	23	37	0.8	0	2	25.9	13	43	2.9	2.5	6.0	5.3	0	10
Control	1998	6.19	5.61	6.82	62.9	9	169	26.8	21	36	0.2	0	1	22.3	13	35	3.3	2.5	11.0	4.9	0	16
Control	1999	5.86	5.29	6.53	30.9	2	103	28.4	19	48	0.3	0	1	25.4	10	54	5.0	2.5	6.0	4.0	2	7
Control	2000	6.33	5.46	6.75	54.5	-7	127	30.7	24	36	0.6	0	2	28.1	16	59	2.9	2.5	6.0	5.0	0	13
Control	2001	6.18	5.56	6.63	50.1	6	97	23.2	18	31	1.2	0	6	22.1	13	34	6.9	2.5	21.0	9.2	1	24
Control	2002	6.22	5.32	6.84	69.6	0	199	28.0	18	41	0.2	0	1	20.7	9	33	10.5	2.5	27.0	3.4	0	21
Control	2003	6.24	5.34	6.93	74.3	1	184	31.3	22	42	0.1	0	1	30.8	11	63	11.6	6.0	19.0	2.9	0	10
Control	2004	5.83	5.22	6.89	35.0	-4	131	22.2	12	34	0.0	0	0	14.6	9	26	8.8	4.0	12.0	8.0	0	16
Control	2005	6.27	5.48	6.81	69.4	2	178	35.7	19	68	0.2	0	2	22.8	7	47	6.6	2.0	10.0	3.9	0	8
Upper Experiment	1992	5.71	5.23	6.19	23.7	-1	52	26.0	19	33	0.0	0	0	43.7	23	82				0.3	0	1
Upper Experiment	1993	6.04	5.29	6.6	85.2	1	213	33.2	19	45	0.6	0	2	24.2	8	45	20.5	19.0	22.0	2.7	0	9
Upper Experiment	1994	6.19	5.47	6.78	72.5	5	136	33.5	24	44	0.5	0	1	26.8	13	51	18.9	0.0	60.0	2.9	0	7
Upper Experiment	1995	6.14	5.21	6.81	88.8	0	221	37.7	22	63	0.3	0	1	74.2	13	302	3.0	2.5	6.0	2.6	0	7
Upper Experiment	1996	5.86	5.16	6.75	61.5	-4	208	32.7	23	46	0.7	0	2	37.4	16	75	2.6	2.5	3.0	4.0	0	13
Upper Experiment	1997	5.90	5.46	6.5	53.4	13	216	34.0	26	74	0.5	0	1	42.0	9	233	2.5	2.5	2.5	2.3	0	10
Upper Experiment	1998	5.92	5.44	6.46	68.8	3	212	30.0	21	42	0.6	0	4	18.6	9	29	2.8	2.5	6.0	1.9	0	5
Upper Experiment	1999	5.79	5.29	6.49	54.0	1	215	32.4	18	50	0.7	0	4	21.1	7	46	4.7	2.5	6.0	3.1	0	10
Upper Experiment	2000	6.09	5.33	6.43	63.7	2	128	32.3	25	41	1.0	0	2	21.0	10	32	4.3	2.5	6.0	5.0	0	9
Upper Experiment	2001	6.03	5.58	6.31	53.4	11	97	24.5	17	31	0.9	0	2	18.7	10	39	6.4	2.5	11.0	4.0	0	12
Upper Experiment	2002	6.08	5.5	6.51	85.2	6	266	30.9	17	45	0.7	0	2	16.5	6	26	12.2	2.5	21.0	3.7	0	10
Upper Experiment	2003	6.06	5.36	6.6	82.4	2	221	33.2	21	43	0.7	0	2	25.1	10	48	14.5	6.0	35.0	1.8	0	5
Upper Experiment	2004	5.89	5.33	6.66	48.8	0	180	24.0	10	36	0.0	0	0	12.7	8	24	10.4	6.0	18.0	4.0	0	14
Upper Experiment	2005	6.13	5.42	6.64	80.9	1	213	40.2	21	80	0.4	0	3	20.6	6	49	8.6	3.0	15.0	1.8	0	3
Lower Experiment	1995	6.13	5.13	6.77	97.4	-3	220	61.2	29	115	0.0	0	0	291.2	55	749	5.3	2.5	11.0	1.8	0	4
Lower Experiment	1996	5.82	4.98	6.67	62.3	-11	231	42.2	22	75	0.4	0	2	105.1	21	278	3.1	2.5	6.0	4.6	0	12
Lower Experiment	1997	5.91	5.54	6.67	46.2	9	140	34.7	28	44	0.4	0	1	51.8	28	80	5.6	2.5	17.0	2.4	0	7
Lower Experiment	1998	5.85	5.44	6.34	67.4	3	203	38.1	20	65	0.4	0	2	88.4	20	232	3.2	2.5	6.0	7.5	0	42
Lower Experiment	1999	5.70	4.97	6.29	49.9	-6	208	38.3	20	81	0.4	0	1	67.0	10	312	5.4	2.5	8.0	4.2	0	9
Lower Experiment	2000	6.15	5.63	6.39	64.9	3	132	39.9	27	54	0.9	0	2	77.8	18	128	4.3	2.5	6.0	3.9	0	13
Lower Experiment	2001	6.03	5.6	6.37	55.2	10	117	28.1	21	47	1.2	1	2	52.4	19	133	5.3	2.5	6.0	5.4	0	16
Lower Experiment	2002	6.02	5.65	6.37	68.4	11	179	36.5	19	61	0.5	0	2	72.5	13	199	12.4	2.5	24.0	3.2	0	11
Lower Experiment	2003	5.92	5.4	6.21	66.2	3	156	38.4	23	57	0.4	0	2	78.2	20	178	11.9	6.0	18.0	6.4	0	16
Lower Experiment	2004	5.80	5.2	6.76	47.1	-2	190	29.1	12	63	0.0	0	0	50.1	9	210	10.8	7.0	18.0	5.7	2	11
Lower Experiment	2005	6.05	5.38	6.57	77.7	0	222	49.3	21	83	0.6	0	3	102.9	10	351	7.8	3.0	10.0	2.6	0	6
Lower ARnB	1995	6.16	5.41	6.8	54.5	7	122	33.5	25	43	2.3	0	9	84.2	26	156	3.4	2.5	6.0	3.2	0	8
Lower ARnB	1996	5.97	5.26	6.69	51.7	0	141	31.3	21	44	1.8	0	8	46.8	22	88	2.7	2.5	4.0	7.4	1	29
Lower ARnB	1997	6.02	5.64	6.63	44.1	18	104	29.0	25	38	1.1	0	4	30.5	20	49	2.9	2.5	6.0	4.0	0	10
Lower ARnB	1998	5.95	5.46	6.52	60.0	6	163	28.4	21	39	0.8	0	3	33.2	18	62	2.5	2.5	2.5	3.2	0	12
Lower ARnB	1999	5.79	5.02	6.56	34.3	-6	110	28.7	21	43	0.6	0	2	29.3	14	51	3.8	2.5	6.0	4.3	0	20
Lower ARnB	2000	6.02	5.47	6.59	43.8	2	97	30.2	24	35	0.7	0	2	32.4	20	47	4.3	2.5	6.0	5.8	2	15
Lower ARnB	2001	5.97	5.3	6.45	37.3	5	91	23.2	18	30	2.0	0	7	27.1	18	37	5.2	2.5	6.0	7.3	0	15
Lower ARnB	2002	5.97	4.59	6.6	58.4	-24	198	29.5	19	44	0.9	0	4	27.6	10	45	12.8	2.5	25.0	6.2	0	22
Lower ARnB	2003	5.99	5.25	6.62	62.1	-1	149	31.6	21	42	0.4	0	2	39.3	14	59	11.3	5.0	19.0	14.6	2	76
Lower ARnB	2004	5.71	5.17	6.66	29.6	-3	119	22.4	13	33	0.0	0	0	17.4	10	27	13.6	8.0	35.0	6.9	1	23
Lower ARnB	2005	6.06	5.36	6.63	60.9	0	156	36.0	18	66	0.8	0	3	30.9	9	48	7.7	3.0	10.0	4.8	0	14
Upper ARnB	1995	6.19	5.56	6.59	44.3	9	84	30.8	23	41	2.8	0	8	76.8	20	158	3.4	2.5	6.0	2.3	0	8
Upper ARnB	1996	5.94	5.28	6.67	37.8	-1	114	28.4	20	43	1.7	0	7	42.6	21	82	2.8	2.5	4.0	5.0	1	11
Upper ARnB	1997	6.05	5.63	6.51	48.6	7	202	29.4	24	46	1.1	0	4	25.6	17	44	2.9	2.5	6.0	7.3	0	28
Upper ARnB	1998	6.02	5.54	6.68	44.5	6	130	25.3	20	32	0.6	0	2	23.0	14	33	3.1	2.5	6.0	6.8	0	27
Upper ARnB	1999	5.82	5.22	6.46	27.1	-2	85	27.9	19	45	0.4	0	2	24.8	15	39	4.1	1.0	10.0	3.7	0	13
Upper ARnB	2000	6.14	5.54	6.51	40.0	5	79	28.4	23	32	0.7	0	2	26.7	17	46	4.3	2.5	6.0	2.2	0	6
Upper ARnB	2001	6.02	5.44	6.38	36.9	4	71	21.9	18	27	1.7	0	7	23.3	14	36	9.7	2.5	35.0	8.5	0	22
Upper ARnB	2002	6.13	5.32	6.91	52.8	0	152	25.9	17	36	0.6	0	3	19.7	10	33	12.9	2.5	28.0	6.2	0	14
Upper ARnB	2003	6.03	5.23	6.57	49.0	-2	119	28.8	20	41	0.4	0	2	29.1	14	55	13.8	6.0	25.0	6.0	1	18
Upper ARnB	2004	5.75	5.17	6.67	26.4	-5	94	21.7	13	32	0.0	0	0	14.9	9	24	11.0	7.0	19.0	7.4	1	20
Upper ARnB	2005	6.07	5.24	6.6	45.0	-3	106	33.3	18	67	0.8	0	3	28.1	8	79	7.3	3.0	11.0	3.9	1	7
Laidon Outflow	1995	5.93	5.71	6.15	19.0	14	24	23.5	23	24	2.0	2	2	39.0	35	43	2.5	2.5	2.5	1.0	0	2
Laidon Outflow	1996	5.92	5.52	6.27	19.4	6	35	25.8	18	32	3.7	2	6	49.5	34	91	3.1	2.5	6.0	2.1	0	7
Laidon Outflow	1997	5.91	5.51	6.31	14.7	2	26	29.0	25	33	2.3	1	5	30.9	27	34	3.4	2.5	10.0	2.4	0	8
Laidon Outflow	1998	5.93	5.63	6.15	19.0	10	28	24.8	22	28	1.9	1	3	28.5	24	34	4.3	2.5	17.0	2.6	1	6
Laidon Outflow	1999	5.87	5.48	6.09	17.2	2	23	27.6	24	36	1.3	0	3	25.3	12	31	4.3	2.5	6.0	1.9	0	12
Laidon Outflow	2000	5.86	5.3	6.11	13.8	-1	23	30.5	25	39	1.3	1	2	28.6	22	34	5.0	2.5	17.0	2.0	0	5
Laidon Outflow	2001	6.02	5.67	6.31	25.1	10	34	22.2	20	24	3.7	2	8	27.6	22	32	6.7	2.5	14.0	1.5	0	3
Laidon Outflow	2002	5.96	5.64	6.27	20.0	10	33	29.6	21	41	1.4	0	3	28.9	25	37	9.6	2.5	25.0	4.4	0	9
Laidon Outflow	2003	5.99	5.83	6.28	21.2	12	36	27.1	24	30	2.0	1	3	30.9	29	34	10.8	6.0	20.0	2.0	0	6
Laidon Outflow	2004	5.93	5.5	6.26	20.6	9	33	24.1	22	27	0.9	0	4	22.9	19	29	16.6	10.0	27.0	5.0	0	15
Laidon Outflow	2005	5.92	5.59	6.15	18.8	4	34	36.1	26	52	1.3	0	3	28.9	23	39	6.3	3.0	11.0	1.2	0	4
Forest	2000	6.29	5.72	7.27	123.7	19	330	36.0	22	58	0.7	0	2	25.7	14	45	5.7	2.5	12.0	13.7	0	33
Forest	2001	5.78	5.4	6	28.1	9	47	20.8	16	25	0.7	0	2	18.9	10	36	7.1	2.5	17.0	7.6	0	34
Forest	2002	5.82	5.48	6.1	43.3	5	111	26.5	17	36	0.2	0	1	16.8	8	31	11.0	2.5	26.0	15.1	1	51
Forest	2003	5.70	5.42	6	45.4	4	126	28.4	18	41	0.2	0	2	23.8	7	45	12.4	7.0	17.0	6.7	1	16
Forest	2004	5.69	5.39	6.03	22.0	0	65	21.1	13	32	0.0	0	0	13.7	9	24	12.1	8.0	24.0	12.8	3	24
Forest	2005	5.63	5.09	6.14	27.0	-7	100	33.6	20	74	0.0	0	0	19.6	6	49	7.6	2.0	12.0	4.9	1	13

Appendix 2 Water chemistry for the Control Burn August 1992 – December 2005

Date	pH	Alk 2	Cond	Na	NH4	K	Mg	Ca	Cl	NO3	SO4	PO4-P	Total P	Al-NL	Al-L	Abs-250	TOC
12/08/92	5.44	8	24	106		3	34	68	94	0	26	1		70	18	0.74	
30/10/92	6.46	63	23	112		4	32	68	99	0	28	0		29	4	0.32	5
06/12/92	5.7	10	20	104		3	17	43	103	0	25	1		33	2	0.25	3.5
04/01/93	5.63	8	20	105		4	25	41	101	0	44	0		21	3	0.27	3.8
30/03/93	5.91	17	39	203		5	44	67	278	0	41	1		20	3	0.17	3.1
03/05/93	6.57	91	35	177		6	42	97	186	0	35	0		9	5	0.17	3.3
18/06/93	6.38	64	31	145		4	39	88	130	0	30	1	19	15	29	0.55	9.4
10/07/93	6.31	57	27	141		4	33	77	129	0	19	2	26	71	1	0.61	9.1
25/07/93	6.06	45	27	134		3	38	92	117	0	16	2		72	0	0.78	11
09/08/93	5.91	32	23	114		3	33	72	98	2	11	4		92	13	0.88	
22/08/93	6.54	92	27	148		4	42	91	141	0	18	2		39	4	0.48	
04/09/93	6.76	147	36	168		7	46	111	151	0	26	0		17	1	0.29	
29/09/93	6.91	141	36	161		6	47	114	155	0	31	0		26	5		
06/12/93	5.59	8	20	99		4	25	32	86	1	38	1		37	5	0.459	6.7
18/02/94	6.34	57	39	210	0	6	66	101	211	2	41	0	5	14	0	0.132	
01/05/94	6.03	29	24	141	0	9	34	56	123	0	25	0	10	36	8	0.309	4.4
12/05/94	6.48	62	29	161	0	6	48	82	143	0	30	0		22	5	0.213	3.2
10/06/94	6.39	54	39	201	0	9	68	110	174	0	85	1		30	4	0.283	
08/07/94	5.98	39	27	151	0	6	52	83	111	0	35	1		80	0	0.632	
07/08/94	6.12	35	23	140	0	5	46	71	109	0	26	4	58	60	2		
25/08/94	6.47	68	29	152	0	5	61	113	118	0	27	1		41	1		
03/09/94	6.68	105	31	163	0	6	60	110	125	2	24	1	2.5	28	7	0.339	5.5
22/09/94	6.5	86	29	152	0	6	56	119	123	0	23	1		26	17	0.385	7.5
29/12/94	5.18	-3	23	108	0	4	30	31	126	1	23	1		24	0	0.198	4
27/03/95	5.86	16	21	121	0	6	31	41	122	0	22	0	2.5	29	2	0.239	4.8
27/04/95	6.61	85	24	133	0	8	43	81	107	0	20	0	2.5	16	0	0.204	4.8
02/06/95	6.38	58	26	137	0	4	41	75	103	0	18	3	3	29	28	0.49	9.9
15/07/95	6.65	87	40	178	0	9	75	128	127	2	96	0	2.5	29	1	0.34	8.9
06/08/95	7.02	161	37	195	0	11	67	146	143	1	44	0		21	0	0.285	6
25/08/95	6.77	116	37	186	0	10	62	115	144	2	37	1	2.5	20	1	0.262	5.6
04/09/95	6.51	68	46	188	0	7	90	157	118	0	175	0	6	34	3	0.313	7.6
24/09/95	5.72	18	34	156	0	5	66	99	108	0	107	0		62	4	0.469	11
11/11/95	6.27	51	25	124	0	6	48	85	95	0	39	0	2.5	65	2	0.43	8.7
10/01/96	5.39	2	20	100	3	6	37	50	78	2	59	0	2.5	44	5	0.297	6.6
27/02/96	5.49	7	29	152	0	5	55	68	166	1	60			28	2	0.238	
03/04/96	5.72	13	24	124	3	6	39	61	112	5	49	1	2.5	28	0	0.243	5.3
02/05/96	6.26	61	28	136	0	5	50	88	113	0	49	0	2.5	30	4	0.251	5.1
12/06/96	5.68	18	22	109	0	2	38	62	88	0	21	3	10	70	2	0.586	11.3
04/07/96	6.21	46	28	131	0	4	49	83	93	0	47	2	2.5	48	10	0.513	13.9
27/07/96	6.54	83	29	143	0	5	61	112	102	0	31	1	2.5	48	2	0.551	11
18/08/96	6.9	173	34	160	0	7	69	144	110	0	26	0	2.5	24	0	0.386	7.7
07/09/96	6.61	124	30	159	0	7	71	131	114	1	24	1	2.5	31	5	0.496	10
28/09/96	6.34	53	38	164	0	9	74	125	163	1	62	0	2.5	58	5	0.486	11.2
30/10/96	5.69	16	20	94	0	7	37	57	79	0	18	4		69	10	0.564	11
03/12/96	5.49	4	44	219	3	7	67	73	296	3	40	0	2.5	38	1	0.165	4
28/01/97	6.25	41	26	128	2	5	42	72	102	2	43	0	2.5	40	0	0.301	6.2
10/03/97	6.93	19	37	190	0	7	57	80	228	2	41	0					
30/04/97	6.2	43	29	170	0	5	52	89	162	2	25	1	2.5	46	0	0.384	7.7
21/05/97	6.35	54	26	142	1	5	45	79	118	1	19	1	2.5	52	4	0.487	9.9
05/07/97	6.55	92	31	160	4	7	54	100	121	0	29	0	2.5	29	10	0.41	8.8
30/07/97	6.2	53	26	135	0	4	54	100	104	0	13	2	2.5	86	4	0.87	7.2
19/08/97	6.94	146	36	169	0	8	67	135	122	0	24	0	2.5	32	9	0.447	9.5
07/09/97	6.02	32	25	130	0	4	48	82	106	0	17	1	2.5	88	4	0.708	13.7
05/10/97	6.06	35	30	143	0	8	55	96	145	0	20	0	2.5	58	10	0.607	13
14/11/97	5.65	18	23	119	1	12	44	65	101	1	28	1	6	73	7	0.64	15
05/01/98	5.91	15	25	139	0	6	46	60	159	1	29	0	2.5	34	2	0.213	4.3
05/02/98	5.86	19	21	105	0	4	35	53	94	1	27	1	2.5	44	0	0.313	7.8
21/03/98	6.31	45	33	174	0	7	52	74	192	0	29	0	2.5	20	5	0.161	3.5
07/05/98	5.94	27	24	137	0	5	42	66	115	0	15	1	2.5	45	8	0.525	10.9
20/06/98	6.75	147	36	177	0	7	60	114	120	0	35	2	2.5	1	13	0.204	5.1
20/07/98	6.24	59	24	125	0	2	51	87	82	0	13	1	2.5	66	1	0.716	14.7
09/08/98	6.23	62	23	129	0	3	53	82	79	0	13	1	2.5	59	16	0.704	13.3
29/08/98	6.63	119	29	143	0	5	54	102	92	0	19	9	11	29	2	0.365	6.9
27/09/98	6.82	169	33	151	0	6	67	132	108	0	23	0	2.5	21	2		6.4
25/10/98	5.82	21	21	101	0	6	37	61	89	0	18	2	2.5	51	3	0.49	9.3
25/11/98	5.61	9	26	129	0	3	40	57	146	0	24	2	2.5	34	2	0.327	6.9
12/02/99	5.76	9	48	258	0	9	73	92	337	1	37	1	6	15	2	0.112	3.1
25/03/99	5.74	13	26	147	1	5	35	45	161	0	20	1	2.5	28	4	0.289	6.4
10/05/99	5.81	23	26	149	0	6	43	64	133	0	27	3	6	53	4	0.58	12.9
17/06/99	6.09	38	25	146	0	4	44	73	134	0	10	2	6	63	4	0.552	11.3
12/07/99	6.53	103	30	168	0	8	62	118	127	0	18	0		57	2	0.617	13
01/09/99	6.04	40	30	146	0	4	62	106	120	0	54	3	6	59	7	0.581	12
26/09/99	5.62	19	19	104	0	5	37	54	81	0	16	4	6	50	3	0.612	12.7
06/11/99	5.29	2	23	115	0	7	33	42	126	1	21	0	2.5	30	6	0.357	8.1
20/01/00	6.11	29	26	141	0	3	41	63	145	0	26	2	2.5	33	0	0.197	4.4
05/03/00	5.46	4	28	168	0	3	39	48	185	1	27	1	2.5	26	1	0.192	4.8
14/04/00	6.59	81	31	166	0	6	52	106	158	0	21	0	2.5	16	7	0.209	4.7
31/05/00	6.53	78	34	188	0	5	64	108	149	0	59	0	2.5	26	13	0.336	7.2
17/06/00	6.56	-7	35	190	0	5	67	114	181	1	31	0	2.5	32	0	0.25	5.8
12/07/00	6.7	75	31	169	0	4	62	110	147	1	26	0	2.5	25	11	0.354	8.2
05/08/00	6.6	92	35	175	2	5	62	108	146	2	38	0	2.5	30	3	0.391	9.3
04/09/00	6.75	127	36	170	0	5	67	128	154	0	18	0	6	20	6	0.425	9.3
08/10/00	5.75	22	27	142	0	5	46	68	144	0	16	0	2.5	67	9	0.613	12.5
21/11/00	6.24	44	24	132	0	3	43	71	116	1	19	0	2.5	44	0	0.407	8.2
09/01/01	6.01	27	18	102	0	5	30	52	75	1	22	0	21	50	1	0.413	8.5
08/03/01	5.56	6	20	95	1	8	31	40	92	6	32	0	10	41	1	0.227	
26/04/01	6.23	41	26	130	1	5	43	77	115	0	32	0	6	26	24	0.416	8.9
06/06/01	6.63	97	31	150	0	5	51	105	103	0	34	0	2.5	18	9	0.387	8.4
03/07/01	6.3	60	23	125	0	3	45	96	75	0	17	0	6	86	4	0.769	14.1
23/07/01	6.39	74	25	123	3	4	50	97	90	2	15	0	2.5	40	14	0.645	12.7
19/08/01	6.31	62	22	108	0	3	45	110	70	0	13	3	6	37	23	0.725	14.1
07/10/01	5.58	14	24	111	0	9	39	51	112	1	15	2	6	44	9	0.548	12
14/11/01	6.32	56	22	107	0	6	41	75	88	1	19	2	2.5	32	3	0.379	8.7
10/12/01	6.42	64	21	113	0	7	43	78	86	1	22	1	6	33	4	0.356	7.3
22/01/02	5.32	0	18	94	0	5	22	24	99	0	15	0	2.5	25	0	0.237	5.4
04/04/02	6.25	41	34	201	0	8	51	77	215	1	32	1	2.5	16	0	0.252	5.4
07/05/02	6.65	103	35	194	0	8	54	99	164	0	26	1	6	11	0	0.204	4.8
12/06/02	5.87	30	20	121	0	3	37	56	78	0	13	3	6	64	0	0.755	14.9
14/07/02	6.56	102	26	144	0	5	53	101	100	0	13	2	11	22	8	0.541	11.5
31/07/02	5.81	33	19	99	0	3	40	65	57	0	9	3	17	53	21	0.933	19
01/09/02	6.49	87	28	148	0	7	63	114	116	0	17	0	27			0.635	14.8
29/09/02	6.84	199	41	170	0	8	80	174	126	0	21	0	6	17	0	0.276	5.9
21/10/02	5.94	28	33	141	0	17	65	87	182	0	33	3	6	25	1	0.42	10.9
08/12/02	6.42	73	26	122	0	6	47	88	99	1	28	1	21	30	1	0.375	8.2
26/01/03	5.34	1	42	203	0	8	68	78	272	0	36	0	17	28	0	0.184	3.4
03/03/03	5.99	20	29	154	2	8	42	58	157	1	46	1	6	32	5	0.261	5.6
28/04/03	6.31	46	37	191	4	8	62	103	183	0	63	0	10	30	2	0.368	
11/06/03	5.95	38	22	118	0	2	41	69	85	0	11	12	19	47	10	0.792	15.1
24/07/03	5.9	40	23	122	2	5	45	79	89	0	24	2	11	51	3	0.621	13.9
10/08/03	6.69	128	31	161	0	6	66	132	116	0	21	1	9	27	1	0.472	14.8
08/09/03	6.93	184	39	170	0	8	74	155	128	0	27	1	13	12	1	0.249	9.5
27/10/03	6.74	155	37	174	0	9	94	202	159	0	24	1	8	7	2	0.191	15.9
16/12/03	6.35	57	22	119	0	6	42	77	97	0	25	0		26	2	0.298	
11/02/04	5.22	-4	34	171	0	5	44	49	219	0	26	3	7	20	3	0.143	2.3
09/04/04	6.42	52	24	138	0	0	58	105	124	0	21	11	8	34	10	0.314	5.4
20/05/04	6.24	55	22	112	0	0	50	104	88	0	9	4	9	51	14	0.664	12
16/06/04	6.16	50	19	103	0	2.6	32.5	68.8	62	0	11	4	10	61	12	0.762	13.5
14/07/04	6.89	131	30	141	0	5.1	46.3	98.2	88	0	18	2	10	19	7	0.1	5.1
10/08/04	5.29	9	19	80	0	6	35	52	58	0	12	5		41	16	0.836	13
13/09/04	5.6	18	22	90.5	0	7	38	55	86	0	10	3	12	41	8	0.635	11
05/10/04	5.26	0	18	67	0	8	20	27	86	0	10	2	4	18	2	0.285	0.5
14/12/04	5.37	4	12	50	0	5	10	16	47	0	14	1	10	10	0	0.31	4.2
26/01/05	5.48	2	68	349	0	9	91	88	489	2	47	1	8	7	6	0.077	1.6
02/03/05	6.43	60	43	216	1	8	57	86	259	0	29	6	10	6	5	0.119	2
20/04/05	6.47	61	32	173	0	8	44	63	164	0	21	2	4	24	6	0.301	5.6
06/06/05	5.68	25	19	101	0	3	26	37	66	0	7	3	5	47	5	0.744	13.4
14/07/05	6.81	178	37	181	0	9	66	139	136	0	22		6	16	2	0.353	7.3
15/08/05	6.77	129	35	154	0	6	60	125	137	0	24	1	8	10	1	0.411	8.2
07/09/05	6.73	121	32	147	0	6	55	96	126	0	18	0	9	5	2	0.377	6.8
04/10/05	5.99	26	26	127	0	5	39	56	148	0	13	0	7	35	0	0.357	7.8
06/12/05	6.03	23	29	142	0	4	34	49	167	0	24	0	2	23	8	0.212	

Appendix 3 Water chemistry for the Experimental Burn (Upper site) September 1992 - December 2005

Date	pH	Alk 2	Cond	Na	NH4	K	Mg	Ca	Cl	NO3	SO4	PO4-P	Total P	Al-NL	Al-L	Abs-250	TOC
18/09/92	5.71	20	33	136		3	36	113	152	0	82	0		21	1	0.41	
30/10/92	6.19	52	26	130		3	32	61	128	0	26	0		15	0	0.27	4.4
06/12/92	5.23	-1	19	93		2	14	27	88	0	23	0		27	0	0.26	3.4
04/01/93	5.43	4	19	98		2	21	31	86	0	35	0		12	0	0.27	3.8
30/03/93	5.86	20	41	230		5	44	64	296	1	45	2		9	3	0.17	2.9
03/05/93	6.42	115	37	204		7	44	95	192	1	29	0		5	2	0.26	4.2
18/06/93	6.33	122	37	202		4	44	100	156	0	16	0	19	19	9	0.51	8.2
10/07/93	6.05	62	29	164		4	35	76	139	0	18	3	22	46	1	0.7	9.5
25/07/93	5.71	36	29	156		2	42	73	130	0	12	3		48	9	0.86	13
09/08/93	5.93	51	29	151		4	42	76	131	0	8	5		54	0	0.88	
22/08/93	6.36	142	33	186		6	60	108	159	1	14	3		28	2	0.65	
04/09/93	6.47	213	45	210		7	68	159	171	2	22	1		10	2	0.41	
29/09/93	6.6	171	45	209		15	64	135	207	2	28	0		20	0		
06/12/93	5.29	1	21	105		3	24	26	87	0	39	6		24	2	0.492	6.8
18/02/94	6.3	66	44	243	0	6	75	109	246	1	49	1	0	5	0	0.096	
01/05/94	5.88	27	29	183	0	4	44	58	159	0	28	1	13	26	7	0.414	5.4
12/05/94	6.36	85	36	202	7	7	58	90	176	0	26	0		19	4	0.279	5
10/06/94	6.25	67	40	224	0	5	62	100	200	0	51	0		22	2	0.292	
08/07/94	5.75	38	29	178	0	3	53	75	122	1	24	2		45	1	0.836	
07/08/94	6.78	130	31	181	0	13	78	137	141	1	19	4	60	17	6		
25/08/94	6.29	76	32	177	0	7	71	111	141	1	18	2		28	3		
03/09/94	6.51	136	37	200	0	12	81	136	153	1	16	5	2.5	18	3	0.488	7.6
22/09/94	6.27	95	33	186	0	7	66	123	160	0	13	2		21	0		7.3
29/12/94	5.47	5	24	125	0	6	39	36	139	0	24	1		35	3	0.238	4.6
27/03/95	5.74	15	22	129	0	5	32	40	121	0	21	2	2.5	18	1	0.26	5.3
27/04/95	6.1	61	29	168	0	15	48	80	158	0	24	1	2.5	30	1	0.284	6.6
02/06/95	6.26	60	29	169	0	5	47	68	129	0	13	1	2.5	35	7	0.548	11
15/07/95	6.46	140	46	202	0	6	86	154	138	0	94	1	2.5	12	2	0.343	8.5
06/08/95	6.51	195	40	219	0	8	86	164	155	1	30	1		15	1	0.417	8.6
25/08/95	6.81	221	49	225	0	7	99	176	171	0	35	1	2.5	9	0	0.266	6.1
04/09/95	6.22	70	63	239	0	8	134	208	125	1	302	0	6	14	0	0.239	6.8
24/09/95	5.21	0	35	167	0	5	66	84	115	0	112	0		37	5	0.494	12
11/11/95	5.91	37	26	139	0	4	47	72	98	1	37	0	2.5	32	6	0.473	8.7
10/01/96	5.31	0	23	126	2	6	42	47	96	1	68	0	2.5	35	5	0.305	6.6
27/02/96	5.28	0	28	152	0	4	51	55	166	1	56			19	8	0.237	
03/04/96	6.29	67	36	189	4	12	62	105	172	1	75	1	2.5	15	0	0.17	4.7
02/05/96	6.06	62	31	159	2	6	51	83	132	0	44	0	2.5	21	3	0.311	6.5
12/06/96	5.41	13	24	127	0	2	36	47	103	0	17	3	3	41	2	0.627	12.6
04/07/96	5.83	39	27	144	0	3	51	77	104	0	32	1	2.5	23	13	0.586	19.8
27/07/96	6.24	124	34	168	0	4	71	128	122	0	19	2	2.5	20	2	0.52	12.7
18/08/96	6.75	208	41	198	0	7	89	169	140	1	20	1	2.5	14	1	0.464	9.7
07/09/96	6.13	117	35	174	0	9	78	130	136	1	16	2	2.5	27	4	0.677	14
28/09/96	6.31	102	42	194	0	9	78	128	183	1	42	1	2.5	18	1	0.372	9.3
30/10/96	5.53	10	25	118	0	10	41	53	112	0	20	2		46	8	0.505	10
03/12/96	5.16	-4	46	227	0	7	72	73	305	2	40	0	2.5	25	1	0.166	3.9
28/01/97	5.95	28	26	142	2	4	39	58	106	1	43	0	2.5	26	1	0.371	7.4
10/03/97	5.68	14	39	204	0	6	57	70	241	1	38	0					
30/04/97	5.88	31	30	178	0	5	49	72	168	1	17	0	2.5	27	0	0.37	7.5
21/05/97	5.98	41	27	152	0	3	43	67	125	0	13	2	2.5	33	0	0.55	11.2
05/07/97	6.12	79	29	166	6	8	50	87	114	1	14	1	2.5	30	10	0.59	12
30/07/97	6.02	63	28	155	0	4	58	93	112	0	9	2	2.5	39	0	0.841	17.7
19/08/97	6.5	216	74	229	0	10	95	380	148	1	233	1	2.5	25	0	0.638	14
07/09/97	5.69	23	26	140	0	4	52	73	116	0	12	2	2.5	59	6	0.766	15
05/10/97	5.76	26	33	158	0	9	64	86	183	0	14	1	2.5	46	1	0.541	12
14/11/97	5.46	13	28	143	0	16	51	59	127	0	27	1	2.5	50	3	0.697	16
05/01/98	5.44	3	32	167	0	5	61	62	214	0	29	0	2.5	25	0	0.195	4
05/02/98	5.64	15	21	110	0	3	35	45	93	1	27	1	2.5	26	0	0.361	8.2
21/03/98	6.19	54	38	185	0	6	58	80	208	1	26	0	2.5	9	5	0.135	3.4
07/05/98	5.63	17	27	146	0	4	43	53	129	0	13	1	2.5	30	5	0.507	10.9
20/06/98	6.46	161	36	194	0	6	65	119	129	0	20	2	2.5	16	0	0.271	6.9
20/07/98	5.89	45	23	130	0	1	52	74	77	0	9	2	2.5	46	1	0.773	16.3
09/08/98	6.05	70	26	140	0	4	62	86	86	0	10	2	2.5	43	3	0.751	16.5
29/08/98	6.33	159	36	172	0	7	76	129	117	1	15	3	6	24	0	0.437	9
27/09/98	6.43	212	42	189	2	8	96	169	145	4	17	2	2.5	35	3	0.529	11
25/10/98	5.56	15	23	109	0	9	43	55	103	0	17	2	2.5	38	0	0.522	9.8
25/11/98	5.46	6	26	136	0	4	42	52	144	0	22	1	2.5	39	4	0.371	7.9
12/02/99	5.7	8	50	278	0	7	83	93	363	1	36	0	6	13	2	0.119	3.7
25/03/99	5.56	8	28	167	2	5	37	42	177	0	20	1	2.5	29	0	0.358	7.9
10/05/99	5.67	20	28	168	0	6	44	55	153	0	18	3	6	49	1	0.608	14.3
17/06/99	5.84	32	27	164	0	2	46	60	143	0	7	3	6	47	1	0.613	12.3
12/07/99	6.21	133	36	196	0	6	87	129	138	1	11	31		50	5	0.93	19.3
03/08/99	6.49	215	46	222	0	10	100	167	158	4	20	1	6	34	10	0.639	13.3
01/09/99	6.07	61	35	173	0	5	70	109	157	0	46	0	2.5	18	2	0.431	9.7
26/09/99	5.32	8	18	92	0	9	33	41	75	0	10	4	6	30	6	0.624	13.7
06/11/99	5.29	1	24	129	0	10	36	45	134	0	22	0	2.5	22	1	0.354	5.9
20/01/00	6.01	37	28	167	0	3	47	70	167	0	32	6	6	13	0	0.171	3.9
05/03/00	5.33	2	27	161	0	5	35	40	171	1	25	1	2.5	19	0	0.19	4.5
14/04/00	6.31	84	34	191	0	6	54	104	182	1	19	0	2.5	7	3	0.186	4.7
31/05/00	6.16	56	32	193	0	3	56	84	155	1	30	0	2.5	24	9	0.444	9.6
17/06/00	6.43	90	35	207	0	5	68	100	177	2	18	0	2.5	15	9	0.347	8.1
12/07/00	6.36	76	33	189	0	4	67	104	158	1	19	2	6	23	6	0.503	12
05/08/00	6.3	105	38	194	2	5	73	110	154	2	26	4	6	23	1	0.546	13.6
04/09/00	6.34	128	41	200	0	7	83	129	182	1	10	0	6	22	9	0.624	13
08/10/00	5.62	20	30	160	0	13	54	64	171	0	13	1	2.5	37	7	0.628	11.9
21/11/00	6.01	39	25	139	0	5	42	56	125	1	18	0	6	21	6	0.406	8.3
09/01/01	5.98	32	17	100	0	4	31	49	69	1	18	0	6	22	2	0.383	7.9
08/03/01	5.58	11	21	109	1	5	31	40	100	1	39	0	2.5	29	0	0.327	
26/04/01	5.96	28	27	147	2	5	45	65	135	0	28	0	6	21	10	0.414	9.7
06/06/01	6.3	97	31	164	1	4	53	95	119	0	16	0	6	12	4	0.388	9.2
03/07/01	5.98	62	24	137	0	3	48	78	84	0	12	0	11	54	0	0.792	15.1
23/07/01	6.22	73	24	135	2	4	54	78	90	2	11	0	6	35	3	0.69	14.3
19/08/01	6.12	91	27	127	1	5	64	93	90	1	10	5	6	13	12	0.693	15.5
07/10/01	5.6	16	28	112	0	15	48	51	137	1	15	2	6	30	0	0.488	11.5
14/11/01	6.31	61	24	119	0	11	48	76	107	2	17	3	6	16	4	0.361	10
10/12/01	6.28	63	22	114	0	8	46	72	94	1	21	7	8	12	5	0.338	7.6
22/01/02	5.5	6	17	106	0	6	28	32	111	0	16	0	6	21	2	0.246	5.9
04/04/02	6	36	40	252	0	9	58	76	288	1	26	1	2.5	13	0	0.215	4.9
07/05/02	6.38	119	38	227	0	9	61	104	190	1	20	1	6	10	0	0.24	4.8
12/06/02	5.99	49	23	148	0	4	46	61	86	0	8	5	11	28	0	0.752	15.9
14/07/02	6.36	137	35	168	0	5	75	115	115	0	12	10	13	7	10	0.625	14
31/07/02	5.9	56	22	116	0	4	62	78	67	0	6	6	21	29	8	0.94	20
01/09/02	6.34	110	32	159	0	6	83	122	138	1	11	1	2.5	23	0	0.669	16.6
29/09/02	6.51	266	45	200	0	9	96	173	163	2	16	0	19	4	6	0.289	8.5
21/10/02	5.55	12	33	148	0	23	68	73	199	0	26	3	21	11	8	0.448	12
08/12/02	6.22	61	24	132	0	6	45	73	102	2	24	1	20	22	3	0.362	8.4
26/01/03	5.36	2	41	198	0	5	61	61	259	0	35	1	18	17	5	0.176	4.5
03/03/03	5.95	16	35	184	2	7	47	55	192	1	48	0	6	31	3	0.239	5.3
28/04/03	6.05	44	35	202	3	6	54	77	193	1	37	0	13	16	4	0.357	
11/06/03	5.8	38	22	135	0	1	40	55	81	0	10	3	35	23	1	0.8	14.5
21/07/03	5.86	50	24	132	2	4	51	77	87	0	18	3	12	20	0	0.674	14.4
10/08/03	6.45	197	39	189	0	7	102	174	127	1	14	3	11	18	1	0.645	15.7
08/09/03	6.6	221	43	197	0	7	89	171	156	2	18	2	13	6	0	0.278	8.9
27/10/03	6.32	124	39	196	5	9	93	181	209	1	22	0	8	2	1	0.117	14.6
16/12/03	6.15	50	21	118	0	4	39	67	89	0	24	0		15	1	0.33	
12/02/04	5.33	0	34	178	0	6	54	53	227	0	24	0	6	13	4	0.138	2.2
09/04/04	6.19	44	26	151	0	1	58	85	138	0	18	1	8	14	1	0.296	5.3
20/05/04	6.44	100	28	159	9	1	75	144	117	0	11	4	10	15	0	0.423	9.4
16/06/04	6.21	63	19	113	0	2	30	51	64	0	8	5	11	26	2	0.644	12.5
14/07/04	6.66	180	36	165.9	0	4.3	64.5	120.5	102	0	13	4	11	10	5	0.208	5.9
10/08/04	5.41	15	20	93	0	7	41	60	66	0	11	5		23	14	0.795	12.7
13/09/04	5.68	23	24	98.9	0	7	38	53	101	0	8	7	18	14	5	0.556	9.9
05/10/04	5.44	4	19	75	0	11	23	31	95	0	10	1	7	10	3	0.26	4
14/12/04	5.65	10	10	48	0	4	9	15	43	0	11	2	12	5	2	0.284	3.8
26/01/05	5.42	1	80	404	0	8	107	105	527	3	49	2	8	0	1	0.041	1.2
02/03/05	6.2	38	46	249	0	7	57	72	294	0	31	0	15	3	2	0.11	1.9
20/04/05	6.32	61	34	195	1	9	44	52	186	0	13	1	5	16	3	0.298	5.7
06/06/05	5.67	29	21	123	1	3	27	31	80	0	6	3	6	23	3	0.742	13.6
14/07/05	6.49	213	42	195	0	6	82	144	130	0	14	5	10	16	0	0.53	9.9
15/08/05	6.64	200	41	181	0	5	80	147	148	0	19	2	9	3	2	0.332	7.8
07/09/05	6.52	132	35	161	0	6	63	104	139	1	14	1	12	7	3	0.45	8.3
04/10/05	5.92	28	31	138	0	4	44	53	170	0	11	1	9	10	2	0.259	6.3
06/12/05	6	26	32	160	0	4	37	50	181	0	28	18	3	10	0	0.189	

Appendix 4 Water chemistry for the Experimental Burn (Lower site) July 1995 - December 2005

Date	pH	Alk 2	Cond	Na	NH4	K	Mg	Ca	Cl	NO3	SO4	PO4-P	Total P	Al-NL	Al-L	Abs-250	TOC
15/07/1995	6.63	155	62	210	0	6	73	276	148	0	206	1	2.5	12	0	0.348	7.7
06/08/1995	6.77	220	115	287	0	11	99	868	154	0	749	2		18	2	0.524	11
04/09/1995	6.36	85	67	245	0	8	110	275	144	0	337	0	11	16	0	0.28	7.6
24/09/1995	5.13	-3	33	165	0	7	64	86	120	0	109	0		33	4	0.514	13
11/11/1995	5.76	30	29	139	0	9	44	82	113	0	55	0	2.5	51	3	0.384	7.4
10/01/1996	5.26	-1	22	119	2	3	39	43	82	1	69	0	2.5	40	2	0.369	8
27/02/1996	5.28	-1	28	148	0	7	48	46	165	0	51			19	12	0.167	
03/04/1996	6.31	70	50	185	0	8	59	211	168	1	188	1	2.5	11	0	0.149	4
02/05/1996	6.03	63	48	167	0	6	50	195	134	0	175	0	2.5	18	3	0.299	6.1
12/06/1996	4.98	-11	27	128	0	3	34	41	109	0	21	3	4	36	2	0.7	14.3
04/07/1996	5.89	38	34	151	0	3	50	113	111	0	79	0	2.5	26	6	0.538	15.8
27/07/1996	6.15	125	48	184	3	7	67	209	140	0	111	2	6	18	6	0.488	10.9
18/08/1996	6.67	231	75	227	0	9	90	430	148	0	278	1	2.5	14	1	0.477	10
07/09/1996	6.02	125	51	193	0	12	81	228	147	0	118	3	3.5	41	2	0.75	15.7
28/09/1996	6.3	97	49	206	0	13	75	172	199	2	94	1	2.5	12	1	0.35	9
30/10/1996	5.49	13	26	122	0	15	42	57	113	0	27	0		49	10	0.479	10
03/12/1996	5.41	-2	48	230	3	10	73	77	309	1	50	1	2.5	22	10	0.155	3.6
28/01/1997	5.87	24	30	145	2	5	40	83	114	1	75	0	2.5	24	1	0.328	6.7
10/03/1997	5.54	9	44	207	0	8	59	101	243	1	77	0					
30/04/1997	5.77	28	35	179	2	6	48	96	174	1	48	0	2.5	25	1	0.344	7.3
21/05/1997	6.11	40	33	154	0	3	40	107	128	0	65	1	2.5	31	0	0.474	10.2
05/07/1997	6.08	75	39	176	3	8	49	143	127	0	80	1	2.5	21	7	0.502	11
30/07/1997	6.02	75	34	169	3	7	57	124	135	0	38	2	16	29	3	0.731	15.3
19/08/1997	6.67	140	38	173	3	9	67	142	124	1	39	1	2.5	29	0	0.445	9.4
07/09/1997	5.72	22	29	149	3	6	52	81	125	0	28	1	2.5	64	4	0.766	16.4
05/10/1997	5.74	31	37	171	0	12	65	115	194	0	39	0	2.5	36	2	0.519	12
14/11/1997	5.55	18	28	144	0	17	49	63	134	0	29	1	17	43	4	0.613	14
05/01/1998	5.44	3	33	170	0	7	59	67	215	0	36	0	2.5	20	0	0.176	3.7
05/02/1998	5.64	14	22	115	0	5	35	48	100	1	32	1	2.5	28	2	0.323	7.7
21/03/1998	6	47	45	210	2	9	64	142	241	1	95	0	2.5	13	4	0.131	3.3
20/06/1998	6.26	144	61	209	0	6	70	291	132	0	232	1	2.5	4	13	0.27	6.8
20/07/1998	5.75	39	26	137	0	3	50	91	86	0	29	5	6	42	42	0.759	16
09/08/1998	5.85	62	31	143	0	5	63	124	85	0	51	2	2.5	50	2	0.808	17.4
29/08/1998	6.21	142	51	178	0	5	75	235	118	0	145	3	6	31	0	0.47	9.8
27/09/1998	6.34	203	65	207	3	10	99	351	149	2	218	1	2.5	32	2	0.482	10
25/10/1998	5.58	14	20	100	0	5	35	51	89	0	20	2	2.5	57	6	0.496	10.8
25/11/1998	5.44	6	27	143	0	6	42	54	151	0	26	1	2.5	31	4	0.351	7.5
12/02/1999	5.47	3	50	255	0	12	77	84	336	1	36	0	6	15	1	0.082	2.8
25/03/1999	5.51	7	28	163	1	7	36	44	174	0	24	1	2.5	28	4	0.32	7.2
10/05/1999	5.75	26	29	168	0	7	43	63	161	0	30	2	6	40	1	0.474	11.3
17/06/1999	5.71	25	29	169	0	3	46	72	155	0	26	4	6	31	9	0.607	12.9
12/07/1999	5.87	111	45	207	0	9	92	195	150	0	75	3		109	7	1.195	23
03/08/1999	6.25	208	81	246	0	12	111	432	156	1	312	0	2.5	31	3	0.684	14.1
01/09/1999	6.29	68	39	175	0	7	65	133	164	1	67	3	6	19	0	0.38	8.8
26/09/1999	4.97	-6	20	88	0	11	29	32	74	0	10	6	8	30	8	0.691	14.7
06/11/1999	5.46	7	24	131	0	12	38	47	137	1	23	0	6	34	5	0.352	7
20/01/2000	5.99	36	35	168	0	4	48	110	171	2	71	1	6	11	2	0.149	3.6
05/03/2000	6.39	3	27	158	0	6	34	40	171	0	27	0	2.5	22	0	0.161	4.2
14/04/2000	6.38	90	48	200	0	6	55	205	184	1	128	0	2.5	7	3	0.191	4.6
31/05/2000	6.11	57	37	200	0	4	58	127	165	1	78	0	2.5	22	13	0.31	6.9
17/06/2000	6.2	80	46	217	0	6	70	185	186	1	105	1	2.5	31	1	0.356	8.6
12/07/2000	6.37	76	41	200	0	6	69	170	169	1	86	0	6	15	9	0.468	10.3
05/08/2000	6.23	117	52	215	2	8	75	201	178	1	114	1	6	24	6	0.535	13.4
04/09/2000	6.27	132	54	217	2	9	83	228	189	1	114	0	6	31	2	0.64	14
08/10/2000	5.63	20	31	161	0	17	52	63	170	0	18	1	2.5	52	1	0.58	9.2
21/11/2000	5.93	38	28	142	0	7	43	77	130	1	37	0	6	24	2	0.374	8
09/01/2001	5.95	31	21	103	0	6	34	71	76	1	41	0	6	37	2	0.347	7.8
08/03/2001	5.61	10	22	107	1	6	30	42	100	1	39	0	6	21	2	0.235	5
26/04/2001	5.95	30	31	149	0	6	45	88	137	1	51	0	2.5	21	8	0.421	9.6
06/06/2001	6.31	117	47	199	5	9	62	218	140	1	133	0	6	22	0	0.4	10.4
03/07/2001	5.95	62	27	137	0	4	47	101	83	1	41	4	6	42	16	0.791	15
23/07/2001	6.26	84	22	144	3	5	54	112	96	2	41	0	6	16	7	0.632	14.1
19/08/2001	6.04	88	33	126	1	6	65	137	90	1	52	5	6	15	12	0.73	17.9
07/10/2001	5.6	19	26	117	2	15	48	58	130	1	19	3	6	31	6	0.49	10.5
14/11/2001	6.37	51	26	114	0	11	44	95	103	2	46	2	2.5	19	1	0.334	8.6
10/12/2001	6.21	60	26	119	0	8	43	106	97	1	61	3	6	13	0	0.338	7.3
22/01/2002	5.71	11	19	112	0	7	29	37	117	0	18	0	2.5	21	0	0.227	5.4
04/04/2002	5.96	34	46	249	0	10	60	115	282	1	73	1	2.5	14	0	0.185	4.4
07/05/2002	6.37	113	60	239	0	10	65	263	193	2	199	1	6	10	0	0.234	5.6
12/06/2002	5.89	42	24	145	0	4	43	71	93	0	23	4	6	30	0	0.712	15.2
14/07/2002	6.23	108	40	168	0	5	67	169	120	0	81	3	12	11	11	0.598	12.7
31/07/2002	5.65	40	22	117	0	5	57	72	69	0	13	6	22	50	6	0.949	
01/09/2002	6.19	90	34	160	0	7	77	144	143	0	50	5	6	28	5	0.663	15.8
29/09/2002	6.31	179	61	201	0	11	90	367	153	1	181	2	22	16	8	0.362	9.1
21/10/2002	5.78	13	30	141	0	21	59	69	181	0	30	2	21	20	1	0.329	8.8
08/12/2002	6.09	54	29	137	0	8	42	102	112	1	57	1	24	22	1	0.326	7.6
26/01/2003	5.4	3	41	202	0	8	61	70	254	0	39	0	18	24	4	0.165	4.2
03/03/2003	5.7	15	37	187	2	9	48	65	200	0	63	1	6	20	3	0.2	5.2
28/04/2003	6.16	57	40	201	0	7	56	120	195	1	67	0	13	14	0	0.324	
11/06/2003	5.68	33	23	126	0	2	38	60	88	0	20	7	16	26	9	0.733	13.5
21/07/2003	5.81	47	26	131	2	4	51	94	94	0	36	2	9	26	9	0.643	14.4
10/08/2003	5.99	156	49	198	2	8	98	259	135	2	117	4	12	101	16	1.215	22.2
08/09/2003	6.21	146	57	196	0	8	80	268	157	0	178	1	13	19	7	0.373	9.8
27/10/2003	6.08	95	48	195	0	9	78	269	204	1	126	0	8	3	10	0.115	22.5
16/12/2003	6.21	44	25	121	0	6	37	99	95	0	58	0		19	0	0.305	
11/02/2004	5.36	0	34	177	0	7	53	50	225	0	28	0	7	12	6	0.139	2.3
09/04/2004	6.1	41	30	152	0	3	51	138	139	0	59	1	8	15	2	0.287	5.1
20/05/2004	6.41	95	35	154	0	0	55	192	119	0	67	4	11	24	6	0.423	8
16/06/2004	6.12	63	24	125	0	2.3	35.3	90	69	0	43	4	12	34	2	0.619	11.8
14/07/2004	6.76	190	63	185.7	0	5.6	70.1	312	110	0	210	4	10	6	6	0.204	6
10/08/2004	5.45	17	21	89	0	11	41	52	68	0	12	5		28	11	0.778	12.7
13/09/2004	5.57	19	24	100.7	0	11	42	51	100	0	11	4	18	26	10	0.53	10.3
05/10/2004	5.2	-2	19	76	0	12	21	26	91	0	9	0	9	14	5	0.302	3.6
14/12/2004	5.25	1	12	55	0	6	10	12	50	0	12	2	11	9	3	0.347	4.8
26/01/2005	5.38	0	79	406	29	11	106	109	513	3	61	0	8	1	3	0.038	1
02/03/2005	6.26	46	52	248	0	10	59	120	292	1	82		10	3	0	0.103	1.9
20/04/2005	6.18	53	42	203	1	11	49	100	195	0	86	2	5	17	4	0.34	6.3
06/06/2005	5.51	22	21	118	2	3	27	33	78	0	10	3	7	38	6	0.747	13.8
14/07/2005	6.53	222	83	230	0	8	91	449	138	0	351	6	7	12	1	0.504	9.2
15/08/2005	6.57	187	58	189	0	7	77	270	155	0	158	1	10	3	4	0.315	6.8
07/09/2005	6.34	118	45	163	0	7	62	176	138	0	100	0	10	15	1	0.458	9.2
04/10/2005	5.78	26	29	140	0	6	44	69	169	0	28	1	10	16	3	0.28	6.5
06/12/2005	5.92	25	35	163	0	5	39	70	181	1	50	0	3	11	1	0.184	

Appendix 5 Water chemistry for the Allt Riabhach na Bioraich (Lower site) June 1995 - December 2005

Date	pH	Alk 2	Cond	Na	NH4	K	Mg	Ca	Cl	NO3	SO4	PO4-P	Total P	Al-NL	Al-L	Abs-250	TOC
02/06/1995	6.15	42	25	137	0	5	41	68	109	1	26	0	2.5	53	0	0.431	8.8
15/07/1995	6.35	68	41	175	0	9	76	128	121	9	104	0	2.5	30	8	0.436	11
06/08/1995	6.8	122	38	207	0	13	65	142	148	2	80	1		15	3	0.287	6.6
04/09/1995	6.19	44	43	182	0	9	84	132	118	0	156	0	6	39	0	0.347	8.5
24/09/1995	5.41	7	28	150	0	6	63	85	107	1	96	0		66	8	0.517	13
11/11/1995	6.03	44	26	130	0	6	47	81	94	1	43	1	2.5	65	0	0.411	7.9
27/02/1996	5.68	17	30	155	1	5	55	74	166	2	64			29	1	0.213	
03/04/1996	6.07	35	33	153	6	12	59	100	135	8	88	0	2.5	29	2	0.194	4.6
02/05/1996	5.98	67	31	139	0	6	48	98	115	0	60	0	2.5	32	2	0.241	4.8
12/06/1996	5.52	14	23	115	0	3	37	51	91	0	23	3	4	40	29	0.563	6.7
04/07/1996	5.92	35	27	130	0	4	49	85	96	0	46	0	2.5	47	14	0.553	23
27/07/1996	6.36	75	29	140	0	5	57	117	100	1	34	1	2.5	42	4	0.532	10.7
18/08/1996	6.69	141	35	158	0	7	62	144	108	2	39	2	2.5	24	2	0.398	8
07/09/1996	6.34	117	34	162	0	11	65	137	117	1	40	2	2.5	35	4	0.485	10.2
28/09/1996	6.21	53	37	169	0	10	74	120	174	3	57	1	2.5	46	9	0.484	10.9
30/10/1996	5.61	15	21	97	0	7	36	53	80	1	22	1		90	7	0.525	10
03/12/1996	5.26	0	44	218	0	8	71	75	293	2	42	0	2.5	35	7	0.16	3.7
28/01/1997	6.09	37	27	129	2	6	41	73	104	4	49	4	6	45	0	0.305	6
10/03/1997	5.64	18	38	184	0	9	56	77	218	3	46	1					
30/04/1997	5.92	31	29	154	0	5	48	79	149	1	27	0	2.5	43	1	0.382	7.8
21/05/1997	6.09	41	26	144	4	5	45	76	120	0	25	1	2.5	52	7	0.501	10.4
05/07/1997	6.23	70	30	148	3	7	51	97	108	0	35	1	2.5	55	0	0.48	9.9
30/07/1997	6.18	57	27	136	0	5	54	97	104	0	27	1	2.5	70	8	0.769	15.7
19/08/1997	6.63	104	33	163	0	8	60	112	120	1	22	1	2.5	32	0	0.478	9.8
07/09/1997	5.68	20	25	125	0	4	47	71	103	0	20	2	2.5	89	10	0.74	14.5
05/10/1997	5.75	21	29	143	0	7	57	84	145	0	24	0	2.5	82	5	0.644	14
14/11/1997	6.02	42	26	139	0	8	50	76	114	2	30	1	2.5	57	5	0.561	12
05/01/1998	5.46	6	28	146	1	6	49	55	168	2	31	0	2.5	31	0	0.209	3.9
05/02/1998	5.72	15	21	115	3	7	36	53	102	3	30	1	2.5	47	1	0.346	8.2
21/03/1998	6.05	43	34	171	2	8	50	77	183	1	40	0	2.5	24	2	0.149	3.8
20/06/1998	6.48	148	39	180	0	9	60	138	120	0	62	1	2.5	23	0	0.228	5.7
20/07/1998	5.94	46	24	129	0	4	48	77	81	0	18	1	2.5	85	3	0.735	15.2
09/08/1998	5.89	37	22	123	0	4	44	71	82	0	20	1	2.5	55	9	0.634	12.5
29/08/1998	6.36	120	31	156	0	8	51	106	101	0	34	1	2.5	27	1	0.35	7.1
27/09/1998	6.52	163	35	159	0	8	66	159	109	1	51	1	2.5	21	0	0.312	6.8
25/10/1998	5.49	14	24	109	0	12	43	51	107	0	20	2	2.5	49	12	0.513	10.3
25/11/1998	5.56	8	26	134	0	5	40	55	145	1	26	1	2.5	45	4	0.318	6.7
12/02/1999	5.8	16	43	238	0	8	69	89	299	2	38	1	2.5	16	0	0.098	2.8
25/03/1999	5.56	7	26	142	0	6	35	42	158	1	23	1	2.5	39	0	0.274	6.2
10/05/1999	5.89	27	27	149	0	9	45	68	139	0	28	3	6	51	0	0.558	12
17/06/1999	5.74	23	25	142	0	2	42	61	129	0	14	2	2.5	52	20	0.617	12.9
12/07/1999	6.2	82	29	168	0	7	57	105	124	0	27	0		82	2	0.752	15.3
03/08/1999	6.56	110	36	179	0	9	59	138	145	2	51	0	6	24	0	0.372	7.7
01/09/1999	5.83	30	28	136	0	5	54	78	110	0	40	2	2.5	61	10	0.647	13
26/09/1999	5.5	20	21	108	0	5	36	52	88	0	21	3	6	68	5	0.563	10.6
06/11/1999	5.02	-6	23	110	0	6	35	31	119	0	22	1	2.5	18	2	0.303	7.9
20/01/2000	5.86	27	26	140	0	4	40	71	140	2	33	1	2.5	31	2	0.19	4.1
05/03/2000	5.47	6	28	163	0	4	39	52	182	1	29	0	2.5	24	2	0.188	4.4
14/04/2000	5.47	2	31	188	0	3	43	57	215	1	27	0	2.5	10	5	0.108	2.4
31/05/2000	6.31	55	31	174	0	5	57	95	145	0	47	0	2.5	34	15	0.364	8
17/06/2000	6.27	61	35	187	0	6	61	100	179	1	40	0	2.5	34	3	0.269	6.4
12/07/2000	6.33	62	30	163	0	5	59	109	139	0	31	0	6	29	12	0.397	8.5
05/08/2000	6.48	80	34	174	3	6	58	104	143	1	45	0	6	26	3	0.389	9.3
04/09/2000	6.59	97	35	169	0	6	62	118	152	0	27	0	6	24	4	0.439	9.8
08/10/2000	5.47	14	28	144	0	6	46	62	146	0	20	2	6	83	9	0.636	10.7
21/11/2000	5.92	34	24	127	0	4	40	66	117	1	25	0	6	40	3	0.414	8.3
09/01/2001	5.92	28	18	97	0	4	31	55	73	1	25	0	6	47	0	0.372	8.2
08/03/2001	5.51	6	22	98	2	8	32	41	97	7	36	0	6	21	8	0.222	5
26/04/2001	6.03	38	28	141	3	9	43	76	123	2	37	0	2.5	35	11	0.47	10
06/06/2001	6.45	91	30	151	2	6	53	98	108	0	36	4	6	23	4	0.371	8.3
03/07/2001	5.95	45	23	125	1	3	43	77	79	1	22	2	2.5	95	14	0.788	14.4
23/07/2001	6.32	66	24	126	2	4	47	80	86	1	20	0	5	46	2	0.563	11.6
19/08/2001	6.06	35	21	108	1	3	35	64	82	2	23	3	6	24	15	0.474	11.2
07/10/2001	5.3	5	24	99	0	10	40	46	107	2	18	3	6	51	6	0.541	11.5
14/11/2001	6.04	15	22	108	0	8	39	67	88	2	25	5	6	34	4	0.379	8.5
10/12/2001	6.07	44	20	109	0	8	39	68	86	2	29	3	6	22	9	0.371	8
22/01/2002	4.59	-24	25	101	0	5	22	15	112	0	17	2	6	15	0	0.314	7.2
04/04/2002	6.01	36	32	191	3	10	47	68	200	4	36	1	2.5	18	5	0.237	5.1
07/05/2002	6.27	50	38	215	0	8	54	91	217	0	42	0	6	9	0	0.176	4.3
12/06/2002	5.8	34	21	123	0	5	38	60	79	0	15	2	6	63	2	0.772	15.1
14/07/2002	6.31	88	29	142	0	6	54	104	98	0	22	3	19	32	9	0.61	12.7
31/07/2002	5.53	21	19	97	0	4	39	53	55	1	10	4	18	57	22	0.928	
01/09/2002	6.17	67	29	153	0	9	62	103	121	0	21	0	2.5	40	3	0.673	16.7
29/09/2002	6.6	198	44	180	4	13	80	184	133	1	45	0	20	8	3	0.275	7
21/10/2002	6.24	60	32	155	0	17	64	95	163	1	31	3	25	12	6	0.376	9.1
08/12/2002	6.19	54	26	133	0	8	44	83	110	2	37	1	23	16	12	0.365	8.3
26/01/2003	5.25	-1	42	197	0	9	66	64	273	0	36	0	19	28	4	0.189	4.6
03/03/2003	5.84	15	30	155	2	9	43	55	161	2	45	0	5	38	5	0.27	6
28/04/2003	6.2	48	36	189	3	9	63	98	183	0	57	0	12	31	6	0.375	
11/06/2003	5.75	32	23	120	0	3	43	66	89	0	14	3	14	47	15	0.831	15.9
24/07/2003	5.56	24	22	108	0	5	37	57	79	0	25	2	12	52	19	0.6	12.9
10/08/2003	6.33	129	37	169	0	10	69	166	120	1	59	1	9	39	76	0.473	15
08/09/2003	6.62	149	38	174	0	11	70	159	137	0	51	4	11	11	2	0.276	14.4
27/10/2003	6.35	125	35	170	0	11	88	187	160	0	38	0	8	7	2	0.178	22
16/12/2003	6	38	21	112	0	8	38	64	95	1	29	0		34	2	0.326	
12/02/2004	5.2	-3	33	162	0	6	46	46	206	0	24	4	8	20	2	0.138	2.1
09/04/2004	6.13	45	25	130	0	1	50	91	122	0	27	1	8	27	1	0.301	4.8
20/05/2004	6.06	46	22	112	0	0	51	93	87	0	13	3	9	59	9	0.665	12
16/06/2004	5.97	34	19	105	0	3.5	29.6	55.1	69	0	16	3	10	57	10	0.675	12.3
14/07/2004	6.66	119	31	143.6	0	6.8	46.3	94	92	0	25	4	35	25	3	0.226	6.2
10/08/2004	5.17	3	20	80	0	10	36	46	60	0	15	6		41	23	0.848	13.3
13/09/2004	5.51	16	22	89.6	0	12	39	51	85	0	11	4	20	46	5	0.671	11.7
05/10/2004	5.26	0	17	66	0	10	20	26	81	0	10	1	9	20	4	0.292	3.9
14/12/2004	5.45	6	13	54	0	7	13	20	52	0	16	2	10	16	5	0.333	4.5
26/01/2005	5.36	0	66	333	0	11	90	80	463	3	47	0	8	6	5	0.069	1.5
02/03/2005	6.2	52	41	204	0	10	55	82	244	2	39	1	10	10	2	0.132	2
20/04/2005	6.23	47	32	171	0	10	44	63	171	0	29	2	4	25	6	0.299	
06/06/2005	5.6	22	18	98	2	3	26	34	64	0	9	6	7	48	4	0.739	13.5
14/07/2005	6.63	156	41	179	0	11	62	144	131	0	48	7	10	23	1	0.442	7.4
15/08/2005	6.6	133	37	162	0	9	63	126	144	0	31	1	10	10	5	0.411	8
07/09/2005	6.36	98	33	155	0	8	51	95	135	0	33	2	10	24	0	0.388	9
04/10/2005	5.76	21	26	132	0	7	41	54	156	0	16	1	7	52	14	0.36	9.2
06/12/2005	5.79	19	30	142	0	6	35	47	169	2	26	0	3	22	6	0.206	

Appendix 6 Water chemistry for the Allt Riabhach na Bioraich (Upper site) June 1995 - December 2005

Date	pH	Alk 2	Cond	Na	NH4	K	Mg	Ca	Cl	NO3	SO4	PO4-P	Total P	Al-NL	Al-L	Abs-250	TOC
02/06/95	6.17	38	23	139	0	7	39	60	105	0	20	0	2.5	49	2	0.457	9.4
15/07/95	6.56	63	40	174	0	9	77	125	119	8	107	1	2.5	33	1	0.446	11
06/08/95	6.59	84	30	186	0	10	53	108	137	6	43	1		53	1	0.488	9
04/09/95	6.22	35	41	177	0	6	82	127	112	1	158	0	6	40	2	0.348	8.4
24/09/95	5.56	9	28	146	0	5	62	86	105	1	94	0		60	8	0.488	11
11/11/95	6.06	37	23	124	0	5	45	71	92	1	39	0	2.5	59	0	0.392	7.9
10/01/96	5.42	3	20	106	4	5	39	49	83	2	60	3	4	44	5	0.301	6.7
27/02/96	5.71	13	29	152	0	5	53	68	159	2	58			30	2	0.196	
03/04/96	6.02	23	31	145	0	8	58	88	127	7	82	0	2.5	27	4	0.193	4.3
02/05/96	6.04	40	27	134	0	6	44	72	111	0	48	0	2.5	33	11	0.236	4.8
12/06/96	5.55	16	22	112	0	2	36	52	89	0	23	3	4	59	8	0.546	11.1
04/07/96	5.99	32	26	130	0	4	50	79	94	0	42	0	2.5	54	4	0.533	17.5
27/07/96	6.3	67	27	134	0	6	56	103	100	0	30	1	2.5	39	7	0.528	11
18/08/96	6.67	114	30	154	0	6	63	117	108	2	26	2	2.5	27	1	0.412	8.1
07/09/96	6.48	88	29	148	0	10	60	110	113	1	24	0	2.5	32	6	0.487	10.1
28/09/96	6.2	45	37	167	0	10	73	116	165	3	57	1	2.5	43	2	0.504	11.2
30/10/96	5.62	14	20	97	0	6	36	53	80	1	21	1		70	4	0.514	10
03/12/96	5.28	-1	43	218	2	7	69	75	290	2	40	1	2.5	36	6	0.16	4
28/01/97	6.06	28	25	125	2	5	41	64	101	4	44	6	6	41	0	0.293	5.9
10/03/97	5.63	7	36	182	0	8	53	66	218	2	39						
30/04/97	5.99	27	28	153	0	5	47	71	145	0	23	0	2.5	44	1	0.39	7.8
21/05/97	6.2	37	25	137	0	3	43	70	115	0	20	1	2.5	51	13	0.48	10.1
05/07/97	6.28	58	27	141	0	4	49	82	105	0	27	1	2.5	50	1	0.46	9.6
30/07/97	6.19	49	29	137	0	5	55	97	101	0	19	1	2.5	67	6	0.83	16.9
19/08/97	6.51	202	46	199	0	8	98	175	138	2	17	1	2.5	27	5	0.688	15
07/09/97	5.76	21	25	125	0	4	46	68	104	0	18	1	2.5	90	28	0.714	14.1
05/10/97	5.81	21	29	140	0	7	56	81	144	1	22	0	2.5	85	4	0.64	13
14/11/97	6.06	36	24	134	1	9	47	72	110	2	27	1	2.5	64	8	0.561	12
05/01/98	5.67	8	26	145	0	6	47	55	164	2	31	1	2.5	34	1	0.209	3.8
05/02/98	5.75	14	21	103	0	5	33	48	93	2	27	1	2.5	47	0	0.333	7.6
21/03/98	6.02	31	32	164	0	7	46	60	176	1	30	1	2.5	23	1	0.144	3.4
07/05/98	5.76	19	24	127	0	4	39	55	108	0	16	1	2.5	43	8	0.501	10.1
20/06/98	6.52	101	32	166	0	8	53	86	115	1	33	1	2.5	13	6	0.238	5.8
20/07/98	6.08	43	23	125	0	4	47	71	78	0	15	1	2.5	67	3	0.709	14.1
09/08/98	6.01	39	20	118	0	3	42	64	72	0	14	1	2.5	58	17	0.648	12.6
29/08/98	6.46	83	25	137	0	5	38	514	90	0	21	1	2.5	12	27	0.38	7.1
27/09/98	6.68	130	29	150	0	8	60	110	104	0	21	5	6	24	3	0.326	6.8
25/10/98	5.69	15	20	100	0	6	36	51	89	0	19	3	6	52	6	0.473	10.5
25/11/98	5.54	6	26	138	0	5	42	54	153	1	26	0	2.5	51	3	0.31	6.7
12/02/99	5.67	6	45	248	0	7	71	82	315	2	38	0	2.5	18	2	0.099	3.1
25/03/99	5.62	8	25	144	0	7	35	40	160	0	22	1	2.5	37	1	0.263	6
10/05/99	5.84	24	28	149	0	8	45	64	136	0	25	3	10	51	0	0.566	12.5
17/06/99	5.95	17	29	178	0	6	39	55	191	1	25	1	2.5	19	3	0.242	5.3
12/07/99	6.24	63	26	157	0	5	51	84	119	0	15	0		64	13	0.729	14.6
03/08/99	6.46	85	30	167	0	8	54	98	137	0	23	0	2.5	32	6	0.438	8.5
01/09/99	5.8	28	27	135	0	4	55	85	108	0	39	4	6	75	2	0.665	14
26/09/99	5.59	15	19	100	0	5	34	47	82	0	15	8	1	50	6	0.577	11.1
06/11/99	5.22	-2	22	112	0	6	31	35	117	1	21	0	6	44	0	0.328	7.3
20/01/00	5.93	19	25	138	0	4	38	53	145	2	27	1	2.5	28	1	0.19	4.3
05/03/00	5.54	5	28	165	0	4	40	50	185	1	27	0	2.5	27	2	0.173	4
14/04/00	6.34	54	29	159	0	6	49	87	158	0	23	0	6	21	3	0.207	4.7
31/05/00	6.28	48	30	168	0	5	58	88	142	0	46	0	2.5	47	2	0.389	8.5
17/06/00	6.45	44	31	179	0	4	54	82	171	1	28	0	2.5	36	0	0.276	6.1
12/07/00	6.33	46	28	158	0	4	55	96	139	1	24	0	6	37	0	0.402	8.4
05/08/00	6.38	60	31	173	2	6	55	89	145	1	37	1	6	33	6	0.44	11.9
04/09/00	6.51	79	32	162	0	5	58	99	149	0	17	0	6	28	6	0.466	11
08/10/00	5.57	15	27	139	0	6	46	62	144	0	18	1	2.5	67	2	0.626	10.4
21/11/00	6.05	30	23	128	0	4	39	62	117	1	20	0	6	36	0	0.399	8.1
09/01/01	5.97	23	18	100	0	4	30	51	75	1	22	0	6	49	2	0.371	8.6
08/03/01	5.47	4	22	98	2	8	32	40	100	7	36	0	10	20	8	0.2	4.5
26/04/01	5.99	30	25	133	0	6	43	98	116	2	33	0	2.5	25	20	0.447	9.5
06/06/01	6.38	71	27	144	1	5	48	83	103	0	30	2	2.5	19	14	0.416	8.8
03/07/01	6.07	45	22	121	0	3	42	73	76	0	19	32	35	96	5	0.852	14.8
23/07/01	6.29	58	22	119	1	4	47	75	77	2	17	0	2.5	43	0	0.641	12.4
19/08/01	6.1	44	20	102	0	3	40	66	63	1	14	2	6	40	22	0.686	13.6
07/10/01	5.44	9	23	99	0	9	39	46	106	1	18	2	6	37	14	0.539	11
14/11/01	6.31	39	20	106	0	7	36	63	86	2	20	5	6	38	0	0.374	8.7
10/12/01	6.22	46	20	110	0	7	38	63	85	1	24	15	20	28	0	0.343	6.9
22/01/02	5.32	0	17	98	0	7	24	31	103	0	16	0	6	26	4	0.259	5.9
04/04/02	6.02	27	30	190	4	10	46	60	199	3	33	0	2.5	21	14	0.265	5.6
07/05/02	6.36	59	30	179	0	8	44	71	155	0	23	0	6	11	3	0.233	5
12/06/02	5.85	32	21	124	0	4	38	56	78	0	12	3	12	52	11	0.741	14.7
14/07/02	6.33	70	26	141	0	5	49	82	100	0	13	3	14	26	13	0.618	13.7
31/07/02	5.63	23	18	99	0	4	39	55	55	0	10	5	18	70	12	0.893	
01/09/02	6.23	59	25	142	0	6	59	94	115	0	15	0	6	43	2	0.664	15.7
29/09/02	6.91	152	36	165	0	9	73	131	130	0	18	0	16	19	0	0.313	7.4
21/10/02	6.35	54	32	154	0	20	63	91	169	0	27	2	28	16	2	0.316	
08/12/02	6.27	52	24	130	0	8	46	75	103	3	30	2	20	27	1	0.382	8.3
28/01/03	5.23	-2	41	202	0	9	64	64	274	1	36	0	18	30	11	0.183	2.7
03/03/03	5.82	13	29	153	2	9	42	51	158	2	43	0	6	17	18	0.265	6.6
28/04/03	6.26	41	35	187	3	8	61	91	181	0	55	0	14	33	2	0.379	
11/06/03	5.81	31	22	119	0	2	43	64	89	0	14	2	25	57	5	0.813	15.6
21/07/03	5.61	21	21	114	0	6	38	67	83	0	27	0	14	58	12	0.6	13.3
10/08/03	6.3	83	28	156	0	8	58	96	114	0	19	1	12	50	1	0.582	14.3
08/09/03	6.57	119	32	158	0	8	64	109	127	0	21	1	13	15	2	0.288	9.6
27/10/03	6.45	99	31	164	0	11	85	146	156	1	22	0	8	8	2	0.187	24.4
16/12/03	6.22	36	20	113	0	7	36	59	95	0	25	0		31	1	0.288	
11/02/04	5.17	-5	32	161	0	5	46	45	206	0	24	0	7	13	1	0.138	2.1
09/04/04	6.18	33	23	128	0	2	47	73	121	0	21	2	8	26	7	0.309	5.2
20/05/04	6.11	43	22	113	0	0	52	90	89	0	9	3	9	56	8	0.657	12.4
16/06/04	6.05	41	19	101	0	3.1	31	66	59	0	12	3	11	59	16	0.757	13.1
14/07/04	6.67	94	27	140.5	0	6.7	41.3	72.3	90	0	17	4	10	25	5	0.271	6.6
10/08/04	5.26	8	20	80	0	10	36	49	59	0	15	5		44	20	0.824	12.7
13/09/04	5.57	17	22	89.2	0	11	40	52	85	0	10	4	19	53	3	0.651	11.6
06/10/04	5.26	0	17	64	0	9	20	25	80	0	10	1	10	18	4	0.29	3.8
14/12/04	5.49	7	13	55	0	7	14	20	52	0	16	5	14	16	3	0.33	4.4
26/01/05	5.24	-3	67	335	0	11	90	76	464	3	45	0	9	8	7	0.071	1.4
02/03/05	6.25	36	38	200	0	10	51	65	239	2	26	1	11	8	3	0.13	2
20/04/05	6.23	41	29	165	0	9	39	49	159	0	19	1	4	30	3	0.298	5.7
06/06/05	5.64	21	18	92	1	3	24	32	60	0	8	3	8	44	4	0.675	12.3
14/07/05	6.49	106	33	166	0	9	53	88	129	0	19	5	7	24	2	0.436	8.1
15/08/05	6.6	96	32	149	0	7	56	98	137	0	20	0	8	18	1	0.446	8.7
07/09/05	6.51	77	29	139	0	6	46	70	125	0	79	2	9	23	7	0.399	7.3
04/10/05	5.8	17	25	129	0	7	38	48	153	0	14	0	7	36	4	0.353	7.3
06/12/05	5.85	14	29	141	0	5	33	42	169	2	23	0	3	20	4	0.206	

Appendix 7 Water chemistry for the Loch Laidon outflow September 1995 - December 2005

Date	pH	Alk 2	Cond	Na	NH4	K	Mg	Ca	Cl	NO3	SO4	PO4-P	Total P	Al-NL	Al-L	Abs-250	TOC
24/09/1995	6.15	24	24	150	0	4	39	69	136	2	43	1		20	0	0.225	7.1
11/11/1995	5.71	14	23	118	0	6	37	60	101	2	35	2	2.5	38	2	0.331	6.2
10/01/1996	5.57	7	18	102	2	5	32	49	86	3	38	0	2.5	35	0	0.303	6.4
27/02/1996	5.66	14	22	120	3	5	38	62	105	4	47			29	1	0.271	
03/04/1996	6.08	35	32	148	1	8	61	99	129	6	91	0	2.5	31	3	0.209	4.7
02/05/1996	5.83	16	26	129	1	5	41	68	117	5	52	0	2.5	19	2		4.5
12/06/1996	5.75	16	27	132	2	5	41	68	117	3	47	3	4	32	3	0.271	6.1
27/07/1996	6.19	21	26	130	0	4	44	83	116	4	48	0	2.5	33	1	0.218	5
18/08/1996	6.27	27	25	130	3	5	44	87	115	4	47	0	2.5	14	0	0.214	5.2
07/09/1996	6.2	28	26	134	2	6	46	93	116	4	48	0	2.5	13	3	0.21	4.7
28/09/1996	6.25	26	27	137	0	5	44	76	121	4	50	0	2.5	20	1	0.231	5.2
30/10/1996	5.81	17	27	133	0	5	44	67	120	2	42	1		52	2	0.382	7.8
03/12/1996	5.52	6	28	145	0	7	44	53	160	2	34	1	6	30	7	0.269	5.9
28/01/1997	5.78	15	26	125	2	5	40	58	135	5	31	0	2.5	15	1	0.173	3.8
10/03/1997	5.51	2	32	171	0	5	45	55	196	2	34						
30/04/1997	5.79	8	33	177	0	6	45	55	199	1	33	0	2.5	15	8	0.152	3.3
21/05/1997	5.54	3	30	167	5	6	42	51	188	2	31	1	2.5	22	0	0.174	4.2
05/07/1997	5.84	16	30	159	7	6	41	58	170	2	31	0		21	1	0.202	4.3
30/07/1997	6	15	29	159	0	6	41	61	162	2	32	9	10	16	5	0.197	4.8
19/08/1997	6.22	24	29	155	2	5	42	72	154	2	31	0	2.5	14	1	0.209	4.9
07/09/1997	6.08	20	29	155	0	5	42	69	153	2	31	1	2.5	27	1	0.263	5.9
05/10/1997	5.99	18	27	141	0	5	44	73	134	2	27	1	2.5	35	2	0.362	8.1
14/11/1997	6.31	26	25	137	2	7	39	63	128	3	28	1	2.5	22	3	0.323	7.2
05/01/1998	5.83	17	23	126	0	6	38	57	116	3	34	1	17	39	1	0.325	6
05/02/1998	5.75	13	23	119	0	5	34	50	116	2	28	1	2.5	43	1	0.249	5.7
21/03/1998	5.85	15	23	131	0	5	34	49	128	2	31	1	2.5	27	2	0.197	4.7
20/06/1998	5.9	15	27	156	0	9	41	56	161	2	29	1	2.5	18	3	0.168	4.1
20/07/1998	6.15	23	28	153	0	5	43	63	148	1	29	1	2.5	19	6	0.243	5.4
09/08/1998	6.06	26	26	142	0	4	41	62	126	3	28	0	2.5	29	2	0.293	7
29/08/1998	6.07	22	24	125	0	3	36	57	115	1	25	1	2.5	20	3	0.344	7
27/09/1998	6.08	28	22	122	0	4	38	69	105	2	24	1	2.5	26	1	0.373	7.7
25/10/1998	5.94	21	24	126	0	4	39	63	116	2	28	3	6	30	2	0.377	9.7
25/11/1998	5.63	10	28	147	0	5	43	60	165	1	29	1	2.5	34	5	0.285	6.6
12/02/1999	5.89	20	32	176	0	5	47	68	200	2	31	0	6	13	2	0.098	2.8
25/03/1999	5.48	2	36	203	0	5	45	47	243	1	31	1	6	28	1	0.149	3.9
10/05/1999	5.88	14	26	168	0	5	37	50	188	1	27	1	2.5	20	1	0.169	3.8
17/06/1999	5.81	23	24	142	0	3	42	58	130	0	12	2	6	49	12	0.579	11.7
12/07/1999	5.95	16	27	166	0	5	38	54	171	1	25	0		15	0	0.257	6.6
03/08/1999	6.09	19	26	153	0	4	38	59	156	1	24	0	2.5	18	0	0.255	5.8
01/09/1999	5.84	20	27	150	0	4	37	57	144	1	24	2	6	25	1	0.267	5.2
26/09/1999	5.99	23	25	133	0	4	37	64	132	3	27	2	2.5	23	0	0.34	7.2
06/11/1999	5.93	18	25	139	0	5	41	66	143	2	27	1	2.5	27	0	0.317	7
20/01/2000	5.65	8	27	155	0	3	40	56	174	2	30	2	6	17	2	0.127	3.3
05/03/2000	5.3	-1	39	225	0	5	55	55	272	1	34	1	2.5	23	5	0.102	2.9
14/04/2000	5.65	6	32	194	0	6	43	58	220	1	28	0	6	9	0	0.1	2.5
31/05/2000	5.88	10	30	179	0	5	48	66	206	1	28	0	2.5	22	4	0.114	2.6
17/06/2000	5.97	16	31	191	0	6	45	65	199	1	29	0	2.5	18	4	0.137	3.6
12/07/2000	5.97	15	30	178	0	4	43	57	186	1	29	0	6	9	5	0.357	4.2
05/08/2000	6.07	17	30	174	2	5	38	52	186	2	29	0	2.5	14	0	0.16	4.4
04/09/2000	6.11	22	31	168	0	4	38	60	186	1	30	0	2.5	7	0	0.17	4.4
08/10/2000	6.04	23	30	171	0	5	43	67	175	1	27	1	2.5	31	0	0.332	6.1
21/11/2000	5.93	22	25	135	0	5	36	61	134	2	22	0	17	27	0	0.312	6.3
09/01/2001	5.87	23	22	118	0	5	33	59	110	3	27	0	6	28	2	0.221	5.5
08/03/2001	5.67	10	20	100	3	5	26	41	99	8	26	0	11	13	2	0.23	4.6
26/04/2001	5.96	18	22	116	2	4	28	53	114	3	29	0	2.5	15	0	0.206	5
06/06/2001	5.97	19	23	126	4	5	29	51	115	3	31	2	6	15	2	0.207	5.2
03/07/2001	6.31	34	24	131	4	7	31	66	119	3	32	2	14	18	1	0.273	5.4
23/07/2001	6.27	32	24	143	7	15	32	60	129	5	31	0	2.5	12	0	0.277	7.1
19/08/2001	6	27	22	112	1	3	31	58	95	3	27	1	6	24	0	0.349	7.8
07/10/2001	6.05	27	24	115	0	5	34	57	107	4	28	3	10	26	3	0.379	8.7
14/11/2001	6.15	33	21	104	1	6	31	70	97	3	22	1	2.5	17	3	0.325	7.3
10/12/2001	5.96	28	20	107	0	8	32	59	101	2	23	3	6	22	2	0.3	6.5
22/01/2002	5.64	10	21	129	0	8	32	46	130	2	28	5	6	27	1	0.287	6.4
04/04/2002	5.78	11	39	233	0	7	55	64	284	1	37	0	2.5	5	6	0.095	2.8
07/05/2002	5.97	15	41	247	0	8	55	69	280	1	36	0	6	8	0	0.101	2.9
12/06/2002	5.87	15	34	202	0	6	48	60	209	0	29	1	11	17	4	0.251	6.7
14/07/2002	6.04	20	31	179	0	6	45	79	180	1	27	2	6	11	6	0.299	6.9
31/07/2002	5.92	20	28	172	0	5	40	56	164	1	25	1	11	15	9	0.318	
01/09/2002	6.05	24	25	161	0	5	42	64	146	1	25	0	2.5	17	0	0.352	8.4
29/09/2002	6.03	29	26	157	0	6	43	74	145	2	25	0	6	9	9	0.365	8.3
21/10/2002	6.27	33	26	147	1	5	43	74	139	2	27	3	25	19	3	0.362	7.7
08/12/2002	5.98	23	25	138	4	6	39	62	132	3	30	1	20	21	6	0.356	8.7
26/01/2003	5.83	15	30	157	0	7	48	66	171	3	33	1	20	24	2	0.184	6.2
03/03/2003	5.83	12	30	154	3	6	42	51	177	3	31	1	8	17	1	0.217	5.4
28/04/2003	5.92	13	29	160	4	6	42	52	182	2	32	1	12	11	2	0.171	
11/06/2003	5.96	19	27	151	3	7	38	53	153	1	30	1	12	16	0	0.288	6.2
21/07/2003	5.94	25	26	144	3	7	37	62	141	1	30	1	7	10	4	0.276	7.5
10/08/2003	6.15	21	24	139	1	5	38	60	135	2	29	0	6	24	6	0.27	10.8
08/09/2003	6.28	30	26	138	2	7	39	69	134	2	30	0	12	12	0	0.272	13.1
27/10/2003	6.13	36	25	137	0	7	52	101	135	2	29	0	9	12	1	0.279	24.5
16/12/2003	5.91	20	27	150	0	6	43	68	151	2	34	0		29	2	0.3	
12/02/2004	5.72	9	27	143	0	4	36	47	159	1	26	0	11	31	2	0.201	3.2
09/04/2004	6.04	23	27	151	0	0	41	67	169	0	29	1	11	20	2	0.169	3.1
20/05/2004	5.97	20	24	136	0	2	37	53	141	1	22	3	10	17	5	0.225	4.6
16/06/2004	6.17	27	25	134	0	5.8	26.5	59.7	125	0	22	4	11	19	3	0.263	5.7
14/07/2004	6.11	25	24	124.8	0	4.6	26.6	46.3	113	0	23	3	27	15	2	0.199	4.6
10/08/2004	6.26	33	23	119	0	5	28	54	101	4	23	3		14	2	0.29	4.7
13/09/2004	6.03	26	23	111.5	0	5	31	52	91	2	20	3	17	33	0	0.439	7.8
06/10/2004	5.5	10	22	100	0	6	27	43	102	0	19	2	26	39	15	0.456	5.4
14/12/2004	5.59	12	22	109	0	6	26	37	100	0	22	2	20	36	14	0.441	5.7
26/01/2005	6.15	34	47	229	0	7	57	84	284	3	35	1	10	8	0	0.093	1.5
02/03/2005	5.59	4	52	281	1	8	74	64	365	0	39	1	11	5	4	0.086	1.4
20/04/2005	5.65	4	40	228	0	7	55	43	276	2	30	1	4	12	0	0.116	3
06/06/2005	5.87	18	38	197	0	7	45	49	239	1	29	1	3	14	2	0.167	4.2
14/07/2005	6	19	32	180	0	6	39	47	200	1	26	2	9	23	0	0.245	5.2
15/08/2005	6.03	23	31	169	0	6	36	55	192	1	27	2	6	9	1	0.228	4.9
07/09/2005	6.07	23	30	157	0	6	37	51	177	1	27	0	6	12	2	0.269	5.6
04/10/2005	5.97	21	26	143	0	5	36	49	151	1	23	0	5	17	1	0.329	6.9
06/12/2005	5.96	23	29	139	0	8	34	54	169	2	24	0	3	17	1	0.215	

Appendix 8 Water chemistry for the recently planted forest site September 2000 - December 2005

Date	pH	Alk 2	Cond	Na	NH4	K	Mg	Ca	Cl	NO3	SO4	PO4-P	Total P	Al-NL	Al-L	Abs-250	TOC
04/09/2000	7.27	330	58	196	0	12	71	295	157	2	45	0	2.5	5	33	0.068	2.4
08/10/2000	5.89	22	28	160	0	5	46	56	173	0	14	0	2.5	39	8	0.227	6.3
21/11/2000	5.72	19	22	124	0	3	35	46	115	0	18	0	12	58	0	0.437	8.1
09/01/2001	5.73	16	16	87	0	3	24	38	60	1	19	0	17	51	3	0.374	7.9
08/03/2001	5.61	9	21	98	0	6	31	43	95	0	36	0	6	29	0	0.3	6.2
26/04/2001	5.79	19	25	143	4	5	40	57	127	0	32	0	2.5	59	2	0.385	8.8
06/06/2001	5.92	41	24	140	2	2	40	59	101	0	19	3	6	42	14	0.397	8.9
03/07/2001	5.74	37	20	113	0	1	39	63	64	0	12	2	6	108	0	0.752	15.2
23/07/2001	5.89	38	20	107	1	2	43	64	70	2	10	0	6	73	4	0.732	14.8
19/08/2001	5.77	47	20	106	0	3	48	73	69	1	10	14	16	42	34	0.771	17.9
07/10/2001	5.4	9	24	102	0	8	41	52	115	1	15	2	2.5	52	5	0.535	10.9
14/11/2001	5.91	30	19	96	0	6	35	60	80	1	17	2	2.5	31	6	0.408	9.4
10/12/2001	6	35	19	102	0	5	34	55	77	1	19	4	6	32	8	0.4	8.3
22/01/2002	5.52	5	17	101	0	5	27	36	106	0	16	0	2.5	22	1	0.263	6
04/04/2002	5.48	9	36	229	0	8	47	58	255	1	31	0	2.5	14	17	0.224	5.3
07/05/2002	5.76	39	33	210	0	10	43	58	189	0	16	2	6	26	10	0.316	7.3
12/06/2002	5.7	29	26	131	0	3	40	54	80	0	10	2	6	64	10	0.758	
14/07/2002	5.93	71	27	145	0	4	54	80	99	0	10	4	16	36	19	0.646	14.8
31/07/2002	5.67	31	19	95	0	2	45	65	52	0	8	4	18	58	15	0.856	
01/09/2002	6.06	75	25	139	0	3	65	97	118	0	12	0	2.5	41	7	0.619	14.1
29/09/2002	6	111	30	152	0	3	77	94	132	0	12	1	6	8	51	0.385	9.7
21/10/2002	6.1	27	30	146	2	10	57	81	163	0	26	2	26	27	15	0.283	7.9
08/12/2002	5.97	36	22	122	0	5	38	60	97	1	27	1	24	35	6	0.371	8.9
26/01/2003	5.42	4	41	206	0	6	66	77	272	0	35	0	17	22	5	0.18	4.6
03/03/2003	5.66	10	32	171	2	7	43	51	180	0	45	0	7	38	1	0.232	5.2
28/04/2003	5.74	19	33	184	4	4	50	65	189	0	44	0	13	27	5	0.257	
11/06/2003	5.7	28	21	119	0	1	37	53	81	0	9	2	14	48	15	0.668	12.7
21/07/2003	5.68	29	18	97	1	2	37	57	64	0	16	5	10	30	16	0.511	11.8
10/08/2003	5.59	107	30	149	2	5	79	109	102	2	7	6	16	126	5	1.028	19.5
08/09/2003	5.65	126	32	142	0	3	73	109	123	0	12	0	15	23	8	0.304	11.5
27/10/2003	5.89	54	31	162	0	4	72	121	185	0	22	0	7	5	2	0.115	21.7
16/12/2003	6	32	18	108	0	4	32	58	85	0	24	0		36	3	0.318	
11/02/2004	5.4	0	32	165	0	6	50	53	208	0	24	0	8	17	3	0.143	2.3
09/04/2004	5.91	20	23	133	0	0	40	59	127	0	21	2	8	26	13	0.271	5.1
20/05/2004	6.01	38	22	129	0	0	41	64	107	0	9	2	9	42	14	0.44	8.2
16/06/2004	5.92	37	18	104	0	2	25.6	58.7	62	0	10	1	12	50	24	0.597	11.1
14/07/2004	6.03	65	22	115	0	2	31.2	50.3	73	0	9	3	10	43	15	0.115	9.5
10/08/2004	5.39	12	19	80	0	4	36	54	60	0	14	2		43	16	0.754	12.3
13/09/2004	5.52	15	23	92.5	0	5	40	55	93	0	9	3	16	51	17	0.599	10.8
06/10/2004	5.43	4	18	70	0	9	23	35	88	0	11	2	10	16	8	0.279	4.1
14/12/2004	5.59	7	13	62	0	5	15	22	53	0	16	1	24	17	5	0.38	4.9
26/01/2005	5.09	-7	74	376	0	8	93	92	525	0	49	0	8	3	13	0.042	1
02/03/2005	5.52	5	41	227	1	7	49	55	282	0	31	1	11	9	7	0.091	1.8
20/04/2005	5.83	22	29	175	0	7	34	36	177	0	15	1	4	35	2	0.251	5.2
06/06/2005	5.55	18	20	113	0	2	23	29	75	0	7	2	5	48	3	0.666	11.5
14/07/2005	5.59	100	30	158	0	3	51	66	108	0	6	1	10	58	6	0.507	10
15/08/2005	6.14	59	27	142	0	3	41	67	133	0	20	0	9	4	1	0.264	6.6
07/09/2005	5.93	30	27	138	0	3	43	60	129	0	12	1	12	38	3	0.379	7.7
04/10/2005	5.48	9	26	130	0	3	39	48	164	0	11	0	7	39	4	0.297	7.5
06/12/2005	5.54	7	28	145	0	3	31	38	170	0	25	0	2			0.194	

Appendix 9 Macroinvertebrate taxon list and total abundances – Control Burn.

TAXON	1993	1994	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
NEMATODA			1									
OLIGOCHAETA	22	6	8	3	5	2	1	3	3	2	3	2
TUBIFICIDAE												1
LUMBRICULIDAE										1		
LUMBRICIDAE										1		2
HYDRACARINA						1		4	6		18	3
SIPHLONURIDAE										1		
Siphlonurus lacustris								1	4	2	5	3
Ameletus inopinatus	11	4			1	1	3					1
BAETIDAE									4	2		
Baetis sp.				52							23	3
Baetis rhodani	5		7		39	30	20	142	138	34		140
Baetis muticus	3	2	3				1	1				28
HEPTAGENIIDAE					9					1	1	
Heptagenia sp.									2			
Heptagenia lateralis	3	18	11	9	2	3	13	10	16	4	5	2
Ecdyonurus sp.					1							
Ecdyonurus dispar				1								
Leptophlebia marginata			1			1						
Brachyptera risi								1				
Protonemura praecox							1					
Amphinemura sulcicollis	168	32	27	17	52	54	103	57	76	69	38	85
Nemurella picteti				1								
LEUCTRIDAE					1							
Leuctra inermis	41	6	1	5	3	22	30	2	8	2	3	14
Leuctra hippopus		1										
Perlodes microcephala	2					1						
Isoperla grammatica	106	4	8	9	20	25	25	32	17	5	6	44
Siphonoperla torrentium	109	48	54	2	61	29	30	29	23	12	6	50
Chloroperla tripunctata				11								
Velia sp.											1	
Oreodytes rivalis	18	36	7	1								
Platambus maculatus		1										
HYDROPHILIDAE									1			
Hydraena gracilis								2				
Elodes sp.	1											
Elmis aenea	17		1		88	2	1	1			2	
Limnius volckmari	129	16	46	17		34	65	32	54	56	37	67
Oulimnius sp.					3				83	11		41

TAXON	1993	1994	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Oulimnius tuberculatus	55	22	21	5		14	8	27			91	
Rhyacophila sp.								1		2		3
Rhyacophila dorsalis	1		1	2		4	2	1			1	2
POLYCENTROPODIDAE									4			12
Plectrocnemia conspersa	6	1	5	3	2			4	8	1	6	4
Plectrocnemia geniculata		2										
Polycentropus sp.						2						
Polycentropus flavomaculatus		2	3		4			1	2	4	13	16
Tinodes sp.											1	
Hydropsyche siltalai	1				1					1		4
HYDROPTILIDAE										2		1
Hydroptila sp.		2									19	
Oxyethira sp.		1										4
LIMNEPHILIDAE undet.	10	7	6		3	3	4	1	3		4	4
Potamophylax sp.										1		
Halesus sp.								1				
Chaetopteryx villosa											2	
DIPTERA					2				1	2		4
TIPULIDAE	2	1						2	1	3	7	4
Dicranota sp.	8	2	3	3	1	5	1	8	4	3		6
Psychodidae	1											
CHIRONOMIDAE	26	17	28	13	6	11	4	40	12	15	157	85
SIMULIIDAE	23		1	23	3	11	1	5	3	2	39	19
EMPIDIDAE						2		1			1	
Leuctra sp.									9	2	19	12
Esolus sp.												1

Appendix 10 Macroinvertebrate taxon list and total abundances – Experimental Burn.

TAXON	1993	1994	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
NEMATODA	2		1	1								
Pisidium sp.		1										
OLIGOCHAETA	14	10	26		3			3	1		8	1
ENCHYTRAEIDAE										4		
LUMBRICIDAE												2
HYDRACARINA					1			1	8		7	1
COLLEMBOLA					1				1			2
Siphlonurus lacustris			35				1		1			2
Baetis sp.		1									1	
Baetis rhodani				1	1	1			3			1
Baetis muticus	9		3									
Leptophlebia sp.									1		21	4
Leptophlebia marginata	16	19	6			7	5	3		2		6
Leptophlebia vespertina	20	61	9	9		7	15	42	5	2		25
Protonemura meyeri	1											
Amphinemura sulcicollis	20	1	2	14	7	7	12	1	4	2	1	3
Nemurella picteti				1								
Nemoura sp.							1					
Nemoura avicularis		2				1			1	1		
Nemoura cambrica	2		1			1		3				6
Leuctra inermis	1											
Leuctra hippopus					1		1	1				
Leuctra nigra	1											
Isoperla grammatica	7				2	4	6	1	1			3
Siphonoperla torrentium	23	5		5	3	1	2				6	6
ODONATA												1
Pyrrhosoma nymphula	1	1				1						
Cordulegaster boltonii	1											
VELIIDAE									3			
Velia sp.											2	
Dytiscidae undet. (larvae)		1		1								
Agabus guttatus	1											
Anacaena globulus			1									
Limnius volckmari	2	5		17	1	1	1	2		2	2	
Oulimnius sp.					9				27	20		14
Oulimnius tuberculatus	151	98	19	15		12	20	14			78	
POLYCENTROPODIDAE									5	1	7	8

TAXON	1993	1994	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Plectrocnemia conspersa	13	9	9	15	1	2	5	35	9	5	6	8
Plectrocnemia geniculata		1										
Polycentropus sp.						2	6					
Polycentropus flavomaculatus	23	6	6		3	5		13	13	6	16	15
Polycentropus irroratus												3
HYDROPTILIDAE	38				2				1	5		
Hydroptila sp.			1								2	
Oxyethira sp.		29				4		2			1	2
LIMNEPHILIDAE undet.	66	2	7	4	17	41	47	5	6	15	29	19
Potamophylax rotundipennis					1							
Halesus sp.							1					1
Halesus radiatus			6					4				5
Halesus digitatus								1				
Chaetopteryx villosa											14	
DIPTERA					2				2	1		
TIPULIDAE	1			1				1		1	3	1
Dicranota sp.	6	2	1	3	2	2	3	1				1
CHIRONOMIDAE	56	86	104	15	24	36	22	89	33	33	93	27
SIMULIIDAE	2		1	1	5	6	11	3	8	14	1	16
Simulium latipes		3										
EMPIDIDAE					2	1					1	
Clinocera sp.							1					
Leuctra sp.									1		5	
GERRIDAE								1				
Hydropsyche sp.								1				

Appendix 11 Macroinvertebrate taxon list and total abundances – Allt Riabhach na Bioraich Burn

TAXON	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
NEMATODA	1									
OLIGOCHAETA	12		5	12	1	13	1		2	2
NAIDIDAE							1			
TUBIFICIDAE										1
ENCHYTRAEIDAE								2		
LUMBRICULIDAE							2	1		
Stylodrilus heringianus								2		
LUMBRICIDAE								1		
HYDRACARINA						2	6		14	9
COLLEMBOLA								1		
Siphlonurus sp.							1			
Siphlonurus lacustris	17					3			9	
Ameletus inopinatus										1
Baetis sp.									45	1
Baetis rhodani			8	4		8	16	21		57
HEPTAGENIIDAE									1	
Heptagenia lateralis	2	1	2	1	2					
Leptophlebia sp.									1	
Leptophlebia vespertina	5									
Brachyptera risi				1						
Amphinemura sulcicollis	9	23	28	25	99	45	27	85	14	51
Nemoura sp.		2								
Nemoura cambrica				1						
Leuctra inermis		2	14	27	17	3	5	12	1	14
Isoperla grammatica	3	46	45	36	74	79	37	55	14	76
Siphonoperla torrentium	7	8	33	24	20	8	3	4	2	9
Chloroperla tripunctata		5								
Cordulegaster boltonii								1		
Dytiscidae undet. (larvae)	1									
Oreodytes rivalis	1									
Oreodytes sanmarkii				1		1				
Elodes sp.										1
Limnius volckmari	3	7	9	18	22	20	19	18	27	31
Oulimnius sp.			1				79	25		36
Oulimnius tuberculatus	9	10		4	56	40			23	
Sialis fuliginosa								1		
Rhyacophila sp.						3				2

TAXON	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Rhyacophila dorsalis				1		2	1			
Rhyacophila obliterata									1	
POLYCENTROPODIDAE									1	1
Plectrocnemia conspersa	11	1	1	1	2	3	4	4	5	4
Polycentropus flavomaculatus	1			3			6	4	15	7
Hydroptila sp.									1	
Oxyethira sp.									2	
LIMNEPHILIDAE undet.	6	3	6	5	8	6	4	8	3	2
Ecclisopteryx guttulata			1							
Halesus sp.									6	
Halesus radiatus								2		2
Halesus digitatus						2				
Chaetopteryx villosa									2	
DIPTERA			1	1				6		4
TIPULIDAE							1	3	6	
Dicranota sp.	7		5	9		5	3	8		20
CHIRONOMIDAE	14	7	10	18	6	186	8	18	81	26
SIMULIIDAE		12	1	76	1	2	7	1	7	8
EMPIDIDAE								2	2	
Leuctra sp.						6	3	1	13	19

Appendix 12 Control Burn macroinvertebrate summary statistics

Year	1993	1994	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total Count	768	231	256	178	307	257	314	409	428	241	508	667
Total no. of taxa	24	22	27	19	21	23	18	26	19	21	23	20
RICHNESS (rareftn 100)	17	17	18	15	12	17	13	15	14	17	17	14
HILL'S N1	11.5	11.9	12.8	10.6	8.0	11.8	7.8	8.9	8.7	9.0	10.3	9.5
HILL'S N2	8.4	9.0	9.0	7.5	5.9	9.3	5.6	5.8	6.2	6.0	6.6	7.2
EVENNESS (E5)	0.71	0.73	0.68	0.68	0.69	0.76	0.67	0.61	0.68	0.63	0.60	0.73
BMWP	110	99	125	88	88	118	93	108	88	104	116	101
ASPT	6.4	6.6	6.6	6.3	6.3	6.6	6.1	6.7	6.8	6.5	6.4	6.7

Appendix 13 Experimental Burn macroinvertebrate summary statistics

Year	1993	1994	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total Count	477	231	247	110	96	142	162	227	134	114	313	183
Total no. of taxa	25	20	20	18	20	22	19	22	18	14	18	19
RICHNESS (rareftn 100)	18	14	14	16	19	19	16	13	16	13	13	16
HILL'S N1	11.3	7.9	7.7	11.4	11.9	9.8	10.1	6.6	9.0	8.5	7.6	10.1
HILL'S N2	6.9	5.4	4.6	10.0	8.5	6.4	7.3	4.5	6.7	6.7	5.6	8.1
EVENNESS (E5)	0.57	0.64	0.54	0.87	0.69	0.61	0.69	0.67	0.71	0.76	0.70	0.78
BMWP	108	83	82	67	94	84	93	80	79	52	88	79
ASPT	6.4	5.5	5.9	6.1	6.3	6.5	7.0	5.7	6.6	5.2	5.9	6.6

Appendix 14 Allt Riabhach na Bioraich Burn macroinvertebrate summary statistics

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total Count	109	128	171	268	315	437	234	286	316	384
Total no. of taxa	17	13	16	22	13	20	18	20	21	15
RICHNESS (rareftn 100)	17	12	13	16	10	13	15	16	17	12
HILL'S N1	12.6	7.6	8.8	10.3	6.6	6.7	9.1	9.9	11.9	9.2
HILL'S N2	11.9	5.5	6.8	7.5	5.1	4.2	6.0	6.7	8.7	8.0
EVENNESS (E5)	0.94	0.67	0.74	0.69	0.73	0.57	0.62	0.64	0.70	0.84
BMWP	89	78	83	105	75	95	80	85	121	80
ASPT	6.9	7.1	6.4	6.6	6.1	6.3	6.7	6.1	6.7	6.7

Appendix 15 Control Burn aquatic macrophyte percentage cover

	1992	1993	1994	1995	1996	1997	1998	1999	2001	2002	2003	2004	2005
Batrachospermum sp.	+	0.7	+		+				+	+			+
Marsupella emarginata var *aquatica*	4.4	4.0	4.9	0.4	1.5	0.2	1.9	1.2	+	0.6	1.0	0.5	0.7
Scapania undulata	2.8	3.7	1.7	0.9	2.0	1.9	3.7	3.3	2.9	3.2	3.8	2.1	10.7
Racomitrium aciculare	0.3	+	2.1	0.4	+	+		0.7	0.1	0.6	1.1	+	1.7
Juncus bulbosus var *fluitans*	0.1	+											
TOTAL COVER (excluding filamentous green algae)	7.6	8.4	8.7	1.7	3.5	2.2	5.6	5.2	3.0	4.4	5.9	2.6	13.1
Filamentous green algae	+	10.7	+	0.1	+	+	+	1.3	+	0.8	0.3	+	+

Sampling stretch 50m long.

Appendix 16 Experimental Burn aquatic macrophyte percentage cover

	1993	1994	1995	1996	1997	1998	1999
Batrachospermum sp.	33.3	12.7	54.2	32.8	35.0	28.8	17.8
Marsupella emarginata var *aquatica*	38.0	37.3	9.4	27.4	23.2	25.7	26.7
Scapania undulata		5.0	21.7	12.0	11.8	15.2	22.1
Juncus bulbosus var *fluitans*	2.6	9.0	2.7	6.6		3.3	0.2
TOTAL COVER (excluding filamentous green algae)	73.9	64.0	88.0	78.8	70.0	73.0	66.8
Filamentous green algae	68.0	+					

Sampling stretch 20m long. Sampling ceased in 1999.

Appendix 17 Allt Riabhach na Bioraich Burn aquatic macrophyte percentage cover

	1996	1997	1998	1999	2001	2002	2003	2004	2005
Batrachospermum sp.		1.6	0.3	0.3	0.4	+			
Marsupella emarginata var *aquatica*	+								
Scapania undulata	0.4	0.2	0.7	0.5	0.9	1.0	0.4	0.3	1.5
Racomitrium aciculare			0.2	0.2	0.2	0.2	0.2		0.1
TOTAL COVER (excluding filamentous green algae)	0.4	1.8	1.2	1.0	1.5	1.2	0.6	0.3	1.6
Filamentous green algae	0.4		+	+	+	0.2	3.9		+

Sampling stretch 50m long.

Appendix 18 Fish population data

Site	Year	Area Fished (m^2)	Density (no. m^{-2})	
			Age 0+	**Age> 0+**
Control Burn	1993	115	0.25	0.14
Control Burn	1994	115	0.35	0.02
Control Burn	1995	118	0.33	0.05
Control Burn	1996	87	1.51	0.26
Control Burn	1997	109	0.20	0.11
Control Burn	1998	101	0.42	0.05
Control Burn	1999	117.5	0.29	0.04
Control Burn	2000	114	0.06	0.02
Control Burn	2001	116	0.56	0.03
Control Burn	2002	106	0.40	0.21
Control Burn	2003	104	0.15	0.13
Control Burn	2004	120	0.11	0.08
Control Burn	2005	135	0.07	0.01
Experimental Burn	1993	32	0.97	0.13
Experimental Burn	1994	32	0.14	0.28
Experimental Burn	1995	36	0.34	0.03
Experimental Burn	1996	38	0.78	0.03
Experimental Burn	1997	45	0.31	0.07
Experimental Burn	1998	44	0.36	0.14
Experimental Burn	1999	31.2	0.32	0.13
Experimental Burn	2000	42	0.14	0.21
Experimental Burn	2001	45	0.55	0.11
Experimental Burn	2002	32	0.40	0.12
Experimental Burn	2003	38	0.03	0.24
Experimental Burn	2004	47	0.19	0.19
Experimental Burn	2005	44	0.21	0.20
ARnB Burn	1995	79	0.54	0.05
ARnB Burn	1996	57	0.63	0.24
ARnB Burn	1997	73	0.21	0.07
ARnB Burn	1998	71	0.27	0.18
ARnB Burn	1999	63	0.60	0.13
ARnB Burn	2000	75	0.04	0.05
ARnB Burn	2001	73	0.36	0.07
ARnB Burn	2002	63	0.85	0.21
ARnB Burn	2003	65	0.19	0.08
ARnB Burn	2004	77	0.20	0.03
ARnB Burn	2005	73	0.22	0.10

Appendix 19 Biology sampling dates

Sampling Year	Fish	Macroinvertebrates	Epilithic Diatoms	Aquatic Macrophytes
1992 *			15 Aug	15 Aug
1993	29 Sept	3 May	29 Sept	29 Sept
1994	27 Sept	12 may	25 Aug	25 Aug
1995	27 Sept	No sample	25 Aug	25 Aug
1996	24 Sept	15 May	28 Aug	28 Aug
1997	17 Sept	21 May	23 July	23 July
1998	1 Oct		1 Aug	1 Aug
1999	6 Oct		19 Aug	19 Aug
2000	20 Nov		4 Aug	4 Aug
2001	28 Sept	18 May	30 Jul	30 Jul
2002	24 Sept	15 May	28 Aug	28 Aug
2003	16 Sept	2 May	10 Aug	10 Aug
2004	2 Nov	13 May	12 Aug	12 Aug
2005	20 Oct	10 May	21 Aug	21 Aug

* Only control burn sampled in 1992