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**UK Acid Waters Monitoring Network (UKAWMN)
Scottish Sites
Annual Summary Progress Report. April 12 - March 13**

**E. M. Shilland
March 2013**

UK ACID WATERS MONITORING NETWORK (UKAWMN) –

SCOTTISH SITES

ANNUAL SUMMARY PROGRESS REPORT April 2012 - March 2013

REPORT TO SEPA

Ewan M. Shilland

March 2013

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Cover photo: AWMN sampling at Loch Tinker, Aug 2012 © Charlotte Hall. All pictures © Ewan Shilland unless otherwise stated.

3 Allt a'Mharcaidh



Figure 1 Allt a'Mharcaidh biological survey section 19th Sept 2012

3.1 Summary Overview

Chemical and biological sample collection, analysis and data collation, quality control and archiving proceeded without any problems at Allt a'Mharcaidh during the period from April 2012 to March 2013.

3.2 Water Chemistry

Samples were collected by Marine Scotland (MS) early every month throughout the period April 2012 to March 2013, delivered to the analytical laboratories on schedule and are in the process of being analysed, quality controlled and archived in the UKAWMN central chemistry database at CEH Lancaster.

3.3 Epilithic Diatoms

Epilithic diatoms were retrieved by a team from ENSIS from three sampling points in the stream on the 8th of July 2012. The samples have been made into slides and are currently in the process of being analysed.

3.4 Macroinvertebrates

Aquatic macroinvertebrates were sampled on the 11th May 2012 by a team from QMuL. Five 1 minute kick samples were performed. The samples were counted and the data sent to ENSIS Ltd. The data is in the process of being quality screened before being added to the UKAWMN biological database at ENSIS.

3.5 Fish

Fish surveying was performed in the Autumn of 2012 by MS. The data have been added to the MS fish database.

3.6 Aquatic Macrophytes

Aquatic macrophytes were surveyed by a team from ENSIS on 19th of Sept 2012 after an unsuccessful earlier visit on 8th of July 2012 when the stream was in spate. Percentage cover scores were recorded and data will be added to the ENSIS biological database after microscope confirmation of bryophyte identifications.

3.7 Data Management and Reporting

No problems or hiatus occurred with the collation and transfer of data within methodological programmes, or to the UKAWMN databases, during the reporting period.

Work on the 2011-2012 annual report is underway and it should be uploaded to the AWMN web page in April 2013.

The UKAWMN website page detailing Allt a'Mharcaidh can be found here, and the most recent summary data appear on the right of the page:

http://awmn.defra.gov.uk/sites/site_02.php

Further publications from the contract period utilizing UKAWMN data from Allt a'Mharcaidh are detailed in section 3.8 below.

3.8 Allt a'Mharcaidh Recent UKAWMN Output

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Battarbee, R. W. (2012) Lake sediments and the Anthropocene. Chinese Academy of Sciences, Beijing. October 22nd 2012.

Battarbee, R. W. (2012) Lake sediments and the Anthropocene. University of Iceland, Reykjavik. November 9th 2012.

Battarbee, R. W. & Shilland, E. M. (2012) Acid Waters Monitoring Network to Upland Waters Monitoring Network: tracking water quality and biodiversity in the Uplands. Plenary 2. The FBA Annual Scientific Meeting 2012. Glasgow. 11th July 2012.

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Battarbee, R. W. (2012) Upland waters in the UK - plans for the future. West Midlands and North West England Freshwater Group, Bolton. 20th April 2012.

Battarbee, R. W. (2012) Lake sediments and the Anthropocene. Chinese Academy of Sciences, Lanzhou. October 25th 2012.

Battarbee, R. W. (2012) Acid Rain and acid lakes: an update. Cirencester Science and Technology Society, Royal Agricultural Society, Cirencester, June 13th 2012.

Battarbee, R. W. & Shilland, E. M. (2012) Acid Waters Monitoring Network (AWMN) to Upland Waters Monitoring Network (UWMN): tracking water quality and biodiversity in the Uplands. Joint EA/NE/CCW Lakes Workshop, Birmingham. Dec 4th 2012.

Battarbee, R. W., Evans, C. D., Shilland, E. M. & Monteith, D. T. (2012) An Upland Waters Monitoring Network for the UK. Tracking changes in water quality and biodiversity in upland streams and lakes across the UK. Joint British Ecological Society and IUCN UK Peatland Programme Symposium 2012. Investing in Peatlands - Demonstrating Success. Poster. Bangor University. 26-28th June 2012.

Evans, C. D., Curtis, C. J., Monteith, D. T. & Reynolds, B. (2012) An Assessment of the Draft Forestry-Acidification Guide. Report to the Environment Agency. 1-18. Centre for Ecology and Hydrology, Bangor.

Layer, K., Hildrew, A. G. & Woodward, G. (2012) Grazing and detritivory in 20 stream food webs across a broad pH gradient. *Oecologia* 1-13.

Malcolm, I. A., Bacon, P., Middlemas, S., Fryer, R., Shilland, E. M. & Monteith, D. T. (2012) Relationships Between Hydrochemistry And The Presence Of Brown Trout (*Salmo Trutta*) In Headwater Streams Recovering From Acidification. 6th World Fisheries Congress: Sustainable Fisheries in a Changing World. Edinburgh, Scotland. 7th-11th May 2012.

RoTAP. (2012) Review of Transboundary Air Pollution: Acidification, Eutrophication, Ground Level Ozone and Heavy Metals in the UK. Contract Report to the Department for Environment, Food and Rural Affairs. 1-292. Centre for Ecology & Hydrology, Penicuik.

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Friberg, N., Bonada, N., Bradley, D. C., Dunbar, M. J., Edwards, F. K., Grey, J., Hayes, R. B., Hildrew, A. G., Lamouroux, N., Trimmer, M. & Woodward, G. (2011) Biomonitoring of Human Impacts in Freshwater Ecosystems: The Good, the Bad and the Ugly. *Advances in Ecological Research* 1-68.

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Neal, C., Rowland, P., Neal, M., Jarvie, H. P., Lawlor, A., Sleep, D. & Scholefield, P. (2011) Aluminium in UK rivers: a need for integrated research related to kinetic factors, colloidal transport, carbon and habitat. *Journal of Environmental Monitoring*, **13**, 2153-2164.

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Smith, P., Ashmore, M., Black, H., Burgess, P., Evans, C. D., Hails, R., Potts, S., Quine, T. & Thomson, A. (2011) Regulating services. In: *The UK National Ecosystem Assessment Technical Report.*, 1-61, UNEP-WCMC, Cambridge.

Stutter, M. I., Baggaley, N., Barry, C., Chapman, S., Dawson, J. J. C., Helliwell, R. C., Higgins, A., Howden, N., Jackson-Blake, L., Lumsdon, I., Malcolm, I. A., Sample, J., Potts, J. & Worrall, F. (1-7-2011) Assessment of the contribution of aquatic carbon fluxes to carbon losses from UK peatlands. Final Report for SNIFFER Project ER18. 1-194. SNIFFER, Edinburgh, Scotland.

Tipping, E. & Carter, H. T. (2011) Aluminium speciation in streams and lakes of the UK Acid Waters Monitoring Network, modelled with WHAM. *Science of the Total Environment*, **409**, 1550-1558.

Winterbottom, J. H. & Orton, S. E. (2011) United Kingdom Acid Waters Monitoring Network Invertebrate Survey. Twenty Fourth Year: 2011. Summary of species identification and abundance. 1-12. School of Biological Sciences, Queen Mary University of London, London.

4 Allt na Coire nan Con



Figure 2 Allt na Coire nan Con biological survey section 8th July 2012

4.1 Summary Overview

Chemical and biological sample collection, analysis and data collation, quality control and archiving proceeded without any problems at Allt na Coire nan Con during the period from April 2012 to March 2013.

4.2 Water Chemistry

With the exception of delayed samples in April and November 2012, samples were collected by Pete Madden from Forestry Commission Scotland early every month throughout the period April 2012 to March 2013, delivered to the analytical laboratories on schedule and are in the process of being analysed, quality controlled and archived in the UKAWMN central chemistry database at CEH Lancaster.

4.3 Epilithic Diatoms

Epilithic diatoms were retrieved by a team from ENSIS from three sampling points in the stream on the 8th of July 2012. The samples have been made into slides and are currently in the process of being analysed.

4.4 Macroinvertebrates

Aquatic macroinvertebrates were sampled on the 10th May 2012 by a team from QMuL. Five 1 minute kick samples were performed. The samples were counted and the data sent to ENSIS Ltd. The data is in the process of being quality screened before being added to the UKAWMN biological database at ENSIS.

4.5 Fish

Fish surveying was performed in the Autumn of 2012 by MS using in-house resources. The data have been added to the MS fish database.

4.6 Aquatic Macrophytes

Aquatic macrophytes were surveyed by a team from ENSIS on 8th of July 2012. Percentage cover scores were recorded and data will be added to the ENSIS biological database after microscope confirmation of bryophyte identifications.

4.7 Data Management and Reporting

No problems or hiatus occurred with the collation and transfer of data within methodological programmes, or to the UKAWMN databases, during the reporting period.

Work on the 2011-2012 annual report is underway and it should be uploaded to the AWMN web page in April 2013.

The UKAWMN website page detailing Allt na Coire nan Con can be found here, and the most recent summary data appear on the right of the page:

http://awmn.defra.gov.uk/sites/site_03.php

Further publications from the contract period utilizing UKAWMN data from Allt na Coire nan Con are detailed in section 4.8 below.

4.8 Allt na Coire nan Con Recent UKAWMN Output

Shilland, E. M. (2013) 25 Years of the Acid Waters Monitoring Network in Wales. Marine and Freshwater Evidence Workshop, Countryside Council for Wales HQ, Bangor. February 20th 2013.

Allott, T. E. H., Evans, M., Rothwell, J., Evans, C. D., Monteith, D. T., Crouch, T., Walker, J., Shilland, E. M. & Battarbee, R. W. (9-5-2012) Peatlands and water quality: degradation, restoration and the Water Framework Directive. Reducing the cost of the Water Framework Directive through Payments for Water Services. Valuing Nature Network Meeting. Leeds. 9th May 2012.

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Winterbottom, J. H. & Orton, S. E. (2011) United Kingdom Acid Waters Monitoring Network Invertebrate Survey. Twenty Fourth Year: 2011. Summary of species identification and abundance. 1-12. School of Biological Sciences, Queen Mary University of London, London.

5 Lochnagar



Figure 3 Lochnagar. Looking north from the south east corner of the loch, 10th Aug 2012.

5.1 Summary Overview

Chemical and biological sample collection, analysis and data collation, quality control and archiving proceeded without any problems at Lochnagar during the period from April 2012 to March 2013.

5.2 Water Chemistry

Samples were collected by ENSIS in early June, September and December 2012, delivered to the analytical laboratories on schedule and have been analysed, quality controlled and archived in the UKAWMN central chemistry database at CEH Lancaster. March 2013 samples have been collected and are in the process of being analysed.

5.3 Sediment Traps

Sediment traps were recovered and replaced on the 10th of August 2012 by a team from ENSIS. Diatoms in the sediment retrieved from the traps have been analysed and await quality screening before being added to the UKAWMN biological database at ENSIS.

5.4 Thermistors

Lake top and bottom thermistors were removed and replaced on the 10th of August 2012 by a team from ENSIS. Both had functioned well during the previous year and the data were added to the ENSIS thermistor water temperature database.

5.5 Epilithic Diatoms

Epilithic diatoms were retrieved by a team from ENSIS from three sampling points around the lake on the 10th of August 2012. The samples have been analysed and await quality screening before being added to the UKAWMN biological database at ENSIS.

5.6 Macroinvertebrates

Aquatic macroinvertebrates were sampled on the 12th May 2012 by a team from QMuL. Five 1 minute kick samples were performed. The samples were counted and the data sent to ENSIS Ltd. The data is in the process of being quality screened before being added to the UKAWMN biological database at ENSIS.

5.7 Fish

Fish surveying was performed in the Autumn of 2012 by MS. The data have been added to the MS fish database.

5.8 Aquatic Macrophytes

Aquatic macrophytes were surveyed by a team from ENSIS on 10th of August 2012 using both UKAWMN and CSM standard methodologies. Data will be added to the ENSIS biological database after microscope confirmation of bryophyte identifications.

5.9 Data Management and Reporting

No problems or hiatus occurred with the collation and transfer of data within methodological programmes, or to the UKAWMN databases, during the reporting period.

Work on the 2011-2012 annual report is underway and it should be uploaded to the UKAWMN web page in April 2013.

The UKAWMN website page detailing Lochnagar is here, and the most recent summary data appear on the right of the page: http://awmn.defra.gov.uk/sites/site_04.php

Further publications from the contract period utilizing UKAWMN data from Lochnagar are detailed in section 5.10 below.

5.10 Lochnagar Recent UKAWMN Output

Rose, N. L., Munthe, J. & McCartney, A. (2013) Winter peaks of methylmercury in deposition to a remote Scottish mountain lake. *Chemosphere*, **90**, 805-811.

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6 Loch Chon



Figure 4 Loch Chon. Looking north from the southern end of the loch, 6th Aug 2012. © Charlotte Hall

6.1 Summary Overview

Chemical and biological sample collection, analysis and data collation, quality control and archiving proceeded without any problems at Loch Chon during the period from April 2012 to March 2013.

6.2 Water Chemistry

Samples were collected by MS in early June, September and December 2012, delivered to the analytical laboratories on schedule and have been analysed, quality controlled and archived in the UKAWMN central chemistry database at CEH Lancaster. March 2013 samples have been collected and are in the process of being analysed.

6.3 Sediment Traps

Sediment traps were recovered and replaced on the 6th of August 2012 by a team from ENSIS. Diatoms in the sediment retrieved from the traps have been analysed and await quality screening before being added to the UKAWMN biological database at ENSIS.

6.4 Thermistors

Lake top and bottom thermistors were removed and replaced on the 6th of August 2012 by a team from ENSIS. Both had functioned well during the previous year and the data were added to the ENSIS thermistor water temperature database.

6.5 Epilithic Diatoms

Epilithic diatoms were retrieved by a team from ENSIS from three sampling points around the lake on the 6th of August 2012. The samples have been analysed and await quality screening before being added to the UKAWMN biological database at ENSIS.

6.6 Macroinvertebrates

Aquatic macroinvertebrates were sampled on the 5th May 2012 by a team from ENSIS. Five 1 minute kick samples were performed. The samples were stored, then counted and the data sent to ENSIS Ltd. The data is in the process of being quality screened before being added to the UKAWMN biological database at ENSIS.

6.7 Fish

Fish surveying was performed in the Autumn of 2012 by MS using in-house resources. The data have been added to the MS fish database.

6.8 Aquatic Macrophytes

Aquatic macrophytes were surveyed by a team from ENSIS on 6th of August 2012 using both UKAWMN and CSM standard methodologies. Data will be added to the ENSIS biological database after microscope confirmation of bryophyte identifications.

6.9 Data Management and Reporting

No problems or hiatus occurred with the collation and transfer of data within methodological programmes, or to the UKAWMN databases, during the reporting period.

Work on the 2011-2012 annual report is underway and it should be uploaded to the UKAWMN web page in April 2013.

The UKAWMN website page detailing Loch Chon is here, and the most recent summary data appear on the right of the page: http://awmn.defra.gov.uk/sites/site_05.php

Further publications from the contract period utilizing UKAWMN data from Loch Chon are detailed in section 3.10 below.

6.10 Loch Chon Recent UKAWMN Output

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7 Loch Tinker



Figure 5 Loch Tinker. Looking northeast from the southwest of the lake, 7^h Aug 2012.

7.1 Summary Overview

Chemical and biological sample collection, analysis and data collation, quality control and archiving proceeded without any problems at Loch Tinker during the period from April 2012 to March 2013.

7.2 Water Chemistry

Samples were collected by ENSIS in early June, September and December 2012, delivered to the analytical laboratories on schedule and have been analysed, quality controlled and archived in the UKAWMN central chemistry database at CEH Lancaster. March 2013 samples have been collected and are in the process of being analysed.

7.3 Sediment Traps

Sediment traps were recovered and replaced on the 7th of August 2012 by a team from ENSIS. Diatoms in the sediment retrieved from the traps have been analysed and await quality screening before being added to the UKAWMN biological database at ENSIS.

7.4 Thermistors

Lake top and bottom thermistors were removed and replaced on the 7th of August 2012 by a team from ENSIS. The top thermistor had functioned well during the previous year and the data were added to the ENSIS thermistor water temperature database. Unfortunately the bottom thermistor had failed and no data were recovered from that unit.

7.5 Epilithic Diatoms

Epilithic diatoms were retrieved by a team from ENSIS from three sampling points around the lake on the 7th of August 2012. The samples have been analysed and await quality screening before being added to the UKAWMN biological database at ENSIS.

7.6 Macroinvertebrates

Aquatic macroinvertebrates were sampled on the 5th May 2012 by a team from ENSIS. Five 1 minute kick samples were performed. The samples were stored before being counted and the data sent to ENSIS Ltd. The data is in the process of being quality screened before being added to the UKAWMN biological database at ENSIS.

7.7 Fish

Fish surveying was not performed at Loch Tinker in 2012.

7.8 Aquatic Macrophytes

Aquatic macrophytes were surveyed by a team from ENSIS on 7th of August 2012 using both UKAWMN and CSM standard methodologies. Data will be added to the ENSIS biological database after microscope confirmation of bryophyte identifications.

7.9 Data Management and Reporting

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8 Round Loch of Glenhead



Figure 6 Round Loch of Glenhead. Looking north from the south side of the lake, 3rd Aug 2012. © Charlotte Hall

8.1 Summary Overview

Chemical and biological sample collection, analysis and data collation, quality control and archiving proceeded without any problems at Round Loch of Glenhead during the period from April 2012 to March 2013.

8.2 Water Chemistry

Samples were collected by MS in early June, September and December 2012, delivered to the analytical laboratories on schedule and have been analysed, quality controlled and archived in the UKAWMN central chemistry database at CEH Lancaster. March 2013 samples have been collected and are in the process of being analysed.

8.3 Sediment Traps

Sediment traps were recovered and replaced on the 3rd of Aug 2012 by a team from ENSIS. Diatoms in the sediment retrieved from the traps have been analysed and await quality screening before being added to the UKAWMN biological database at ENSIS.

8.4 Thermistors

Lake top and bottom thermistors were removed and replaced on the 3rd of Aug 2012 by a team from ENSIS. Both had functioned well during the previous year and the data were added to the ENSIS thermistor water temperature database.

8.5 Epilithic Diatoms

Epilithic diatoms were retrieved by a team from ENSIS from three sampling points around the lake on the 3rd of Aug 2012. The samples have been analysed and await quality screening before being added to the UKAWMN biological database at ENSIS.

8.6 Macroinvertebrates

Aquatic macroinvertebrates were sampled on the 9th May 2012 by a team from QMuL. Five 1 minute kick samples were performed. The samples were counted and the data sent to ENSIS Ltd. The data is in the process of being quality screened before being added to the UKAWMN biological database at ENSIS.

8.7 Fish

Fish surveying was performed in the Autumn of 2012 by MS. The data have been added to the MS fish database.

8.8 Aquatic Macrophytes

Aquatic macrophytes were surveyed by a team from ENSIS on 3rd of Aug 2012 using both UKAWMN and CSM standard methodologies. Data will be added to the ENSIS biological database after microscope confirmation of bryophyte identifications.

8.9 Loch and Outflow Level Probes

Level, temperature and conductivity loggers had functioned well over the monitoring period, and were downloaded by a team from ENSIS on 3rd of Aug 2012. Data were added to the ENSIS physical measurement database.

8.10 Data Management and Reporting

No problems or hiatus occurred with the collation and transfer of data within methodological programmes, or to the UKAWMN databases, during the reporting period.

Work on the 2011-2012 annual report is underway and it should be uploaded to the UKAWMN web page in April 2013.

The UKAWMN website page detailing Round Loch of Glenhead is here, and the most recent summary data appear on the right of the page:

http://awmn.defra.gov.uk/sites/site_07.php

Further publications from the contract period utilizing UKAWMN data from Round Loch of Glenhead are detailed in section 8.11 below.

8.11 Round Loch of Glenhead Recent UKAWMN Output

Shilland, E. M. (2013) 25 Years of the Acid Waters Monitoring Network in Wales. Marine and Freshwater Evidence Workshop, Countryside Council for Wales HQ, Bangor. February 20th 2013.

Tunaley, C. (2013) The extent to which geology influences the recovery of acidified upland lochs monitored by the Acid Waters Monitoring Network (AWMN). 81pp. Dissertation. University of Edinburgh, Edinburgh.

Allott, T. E. H., Evans, M., Rothwell, J., Evans, C. D., Monteith, D. T., Crouch, T., Walker, J., Shilland, E. M. & Battarbee, R. W. (9-5-2012) Peatlands and water quality: degradation, restoration and the Water Framework Directive. Reducing the cost of the Water Framework Directive through Payments for Water Services. Valuing Nature Network Meeting. Leeds. 9th May 2012.

Battarbee, R. W. (2012) Lake sediments and the Anthropocene. Chinese Academy of Sciences, Beijing. October 22nd 2012.

Battarbee, R. W. (2012) Lake sediments and the Anthropocene. University of Iceland, Reykjavik. November 9th 2012.

Battarbee, R. W. (2012) Lake sediments and the Anthropocene. Chinese Academy of Sciences, Nanjing. October 17th 2012.

Battarbee, R. W. & Shilland, E. M. (2012) The Acid Waters Monitoring Network. Defra BICCO-Net Start-up Meeting, Thetford. November 14th 2012.

Battarbee, R. W. (2012) Acid Rain and acid lakes: an update. Cirencester Science and Technology Society, Royal Agricultural Society, Cirencester, June 13th 2012.

Battarbee, R. W. & Shilland, E. M. (2012) Acid Waters Monitoring Network to Upland Waters Monitoring Network: tracking water quality and biodiversity in the Uplands. Plenary 2. The FBA Annual Scientific Meeting 2012. Glasgow. 11th July 2012.

Battarbee, R. W. (2012) Upland waters in the UK - plans for the future. West Midlands and North West England Freshwater Group, Bolton. 20th April 2012.

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Evans, C. D., Curtis, C. J., Monteith, D. T. & Reynolds, B. (2012) An Assessment of the Draft Forestry-Acidification Guide. Report to the Environment Agency. 1-18. Centre for Ecology and Hydrology, Bangor.

Malcolm, I. A., Bacon, P., Middlemas, S., Fryer, R., Shilland, E. M. & Monteith, D. T. (2012) Relationships Between Hydrochemistry And The Presence Of Brown Trout (*Salmo Trutta*) In Headwater Streams Recovering From Acidification. 6th World Fisheries Congress: Sustainable Fisheries in a Changing World. Edinburgh, Scotland. 7th-11th May 2012.

RoTAP. (2012) Review of Transboundary Air Pollution: Acidification, Eutrophication, Ground Level Ozone and Heavy Metals in the UK. Contract Report to the Department for Environment, Food and Rural Affairs. 1-292. Centre for Ecology & Hydrology, Penicuik.

Shilland, E. M., Irvine, L., Malcolm, I. A., Marazzi, L., Panizzo, V. N. & Salgado, J. (2012) The United Kingdom Acid Waters Monitoring Network Data Report for 2010-2011 (year 23). Report to the Department for Environment, Food and Rural Affairs (Contract EPG 1/3/160). 1-239. ENSIS Ltd. Environmental Change Research Centre, University College London, London.

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9 Loch Grannoch



Figure 7 Loch Grannoch. Looking north from the southern end of the lake, 4th August 2012.

9.1 Summary Overview

Chemical and biological sample collection, analysis and data collation, quality control and archiving proceeded without any problems at Loch Grannoch during the period from April 2012 to March 2013.

9.2 Water Chemistry

Samples were collected by MS in early June, September and December 2012, delivered to the analytical laboratories on schedule and have been analysed, quality controlled and archived in the UKAWMN central chemistry database at CEH Lancaster. March 2013 samples have been collected and are in the process of being analysed.

9.3 Sediment Traps

Sediment traps were recovered and replaced on the 4th of August 2012 by a team from ENSIS. Diatoms in the sediment retrieved from the traps have been analysed and await quality screening before being added to the UKAWMN biological database at ENSIS.

9.4 Thermistors

Lake top and bottom thermistors were removed and replaced on the 4th of August 2012 by a team from ENSIS. Both had functioned well during the previous year and the data were added to the ENSIS thermistor water temperature database.

9.5 Epilithic Diatoms

Epilithic diatoms were retrieved by a team from ENSIS from four sampling points around the lake on the 4th of August 2012. The samples have been analysed and await quality screening before being added to the UKAWMN biological database at ENSIS.

9.6 Macroinvertebrates

Aquatic macroinvertebrates were sampled on the 9th April 2012 by a team from ENSIS. Five 1 minute kick samples were performed. The samples were stored, then counted and the data sent to ENSIS Ltd. The data is in the process of being quality screened before being added to the UKAWMN biological database at ENSIS.

9.7 Fish

Fish surveying was performed in the autumn of 2012 by MS using in-house resources. The data have been added to the MS fish database.

9.8 Aquatic Macrophytes

Aquatic macrophytes were surveyed by a team from ENSIS on 4th of August 2012 using both UKAWMN and CSM standard methodologies. Data will be added to the ENSIS biological database after microscope confirmation of bryophyte identifications.

9.9 Data Management and Reporting

No problems or hiatus occurred with the collation and transfer of data within methodological programmes, or to the UKAWMN databases, during the reporting period.

Work on the 2011-2012 annual report is underway and it should be uploaded to the UKAWMN web page in April 2013.

The UKAWMN website page detailing Loch Grannoch is here, and the most recent summary data appear on the right of the page: http://awmn.defra.gov.uk/sites/site_08.php

Further publications from the contract period utilizing UKAWMN data from Loch Grannoch are detailed in section 9.10 below.

9.10 Loch Grannoch Recent UKAWMN Output

Shilland, E. M. (2013) 25 Years of the Acid Waters Monitoring Network in Wales. Marine and Freshwater Evidence Workshop, Countryside Council for Wales HQ, Bangor. February 20th 2013.

Allott, T. E. H., Evans, M., Rothwell, J., Evans, C. D., Monteith, D. T., Crouch, T., Walker, J., Shilland, E. M. & Battarbee, R. W. (9-5-2012) Peatlands and water quality: degradation, restoration and the Water Framework Directive. Reducing the cost of the Water Framework Directive through Payments for Water Services. Valuing Nature Network Meeting. Leeds. 9th May 2012.

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Battarbee, R. W. (2012) Lake sediments and the Anthropocene. University of Iceland, Reykjavik. November 9th 2012.

Battarbee, R. W. (2012) Lake sediments and the Anthropocene. Chinese Academy of Sciences, Lanzhou. October 25th 2012.

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Evans, C. D., Curtis, C. J., Monteith, D. T. & Reynolds, B. (2012) An Assessment of the Draft Forestry-Acidification Guide. Report to the Environment Agency. 1-18. Centre for Ecology and Hydrology, Bangor.

Malcolm, I. A., Bacon, P., Middlemas, S., Fryer, R., Shilland, E. M. & Monteith, D. T. (2012) Relationships Between Hydrochemistry And The Presence Of Brown Trout (*Salmo Trutta*) In Headwater Streams Recovering From Acidification. 6th World Fisheries Congress: Sustainable Fisheries in a Changing World. Edinburgh, Scotland. 7th-11th May 2012.

RoTAP. (2012) Review of Transboundary Air Pollution: Acidification, Eutrophication, Ground Level Ozone and Heavy Metals in the UK. Contract Report to the Department for Environment, Food and Rural Affairs. 1-292. Centre for Ecology & Hydrology, Penicuik.

Shilland, E. M., Irvine, L., Malcolm, I. A., Marazzi, L., Panizzo, V. N. & Salgado, J. (2012) The United Kingdom Acid Waters Monitoring Network Data Report for 2010-2011 (year 23). Report to the Department for Environment, Food and Rural Affairs (Contract EPG 1/3/160). 1-239. ENSIS Ltd. Environmental Change Research Centre, University College London, London.

Shilland, E. M., Irvine, L. & Malcolm, I. A. (2012) UK Acid Waters Monitoring Network (UKAWMN) - Allt na Coire nan Con, Loch Chon and Loch Grannoch. Annual Summary Progress Report to Forest Research. April 2011 - March 2012. 1-41. ENSIS Ltd, Environmental Change Research Centre, University College London, London.

Battarbee, R. W., Simpson, G. L., Bennion, H. & Curtis, C. J. (2011) A reference typology of low alkalinity lakes in the UK based on pre-acidification diatom assemblages from lake sediment cores. *Journal of Paleolimnology*, **45**, 489-505.

Evans, C. D., Monteith, D. T., Simpson, G. L., Shilland, E. M., Curtis, C. J., Battarbee, R. W., Patrick, S. T., Reynolds, B. & Helliwell, R. C. (2011) The UK Acid Waters Monitoring Network: (20 years of research in 20 minutes...). 19th ICP Integrated Monitoring Task Force Meeting. Rome, Italy. 4-6th May 2011.

Evans, C. D., Monteith, D. T., Fowler, D., Cape, J. N. & Brayshaw, S. (2011) Hydrochloric Acid: An Overlooked Driver of Environmental Change. *Environmental Science & Technology*, **45**, 1887-1894.

Fjellheim, A., Johannessen, A. & Svanevik Lndes, T. (2011) International Cooperative Programme on Assessment and Monitoring of Acidification of Rivers and Lakes. Biological intercalibration: Invertebrates 1511. 1-27. NIVA, Oslo, Norway.

Friberg, N., Bonada, N., Bradley, D. C., Dunbar, M. J., Edwards, F. K., Grey, J., Hayes, R. B., Hildrew, A. G., Lamouroux, N., Trimmer, M. & Woodward, G. (2011) Biomonitoring of Human Impacts in Freshwater Ecosystems: The Good, the Bad and the Ugly. *Advances in Ecological Research* 1-68.

Kernan, M., Battarbee, R. W., Curtis, C. J., Evans, C. D., Monteith, D. T., Shilland, E. M. & Simpson, G. L. (2011) Recovery of acidified lakes and streams in the UK, 1988-2009. 8th

International Conference on Acid Deposition. Acid Rain 2011. Beijing, China. 15th-18th June 2011.

Neal, C., Rowland, P., Neal, M., Jarvie, H. P., Lawlor, A., Sleep, D. & Scholefield, P. (2011) Aluminium in UK rivers: a need for integrated research related to kinetic factors, colloidal transport, carbon and habitat. *Journal of Environmental Monitoring*, **13**, 2153-2164.

Pla-Rabes, S., Flower, R. J., Shilland, E. M. & Kreiser, A. M. (2011) Assessing microbial diversity using recent lake sediments and estimations of spatio-temporal diversity. *Journal of Biogeography*, **38**, 2033-2040.

Rose, N. L., Morley, D., Appleby, P. G., Battarbee, R. W., Alliksaar, T., Guilizzoni, P., Jeppesen, E., Korhola, A. & Punning, J. M. (2011) Sediment accumulation rates in European lakes since AD 1850: trends, reference conditions and exceedence. *Journal of Paleolimnology*, **45**, 447-468.

Shilland, E. M., Irvine, L. & Malcolm, I. A. (2011) UK Acid Waters Monitoring Network (UKAWMN) - Allt na Coire nan Con, Loch Chon and Loch Grannoch. Annual Summary Progress Report to Forest Research. April 2010 - March 2011. 1-41. ENSIS Ltd, Environmental Change Research Centre, University College London, London.

Shilland, E. M., Irvine, L. & Malcolm, I. A. (2011) The United Kingdom Acid Waters Monitoring Network Data Report for 2009-2010 (year 22). Report to the Department for Environment, Food and Rural Affairs (Contract EPG 1/3/160). 1-237. ENSIS Ltd. Environmental Change Research Centre, University College London, London.

Smith, P., Ashmore, M., Black, H., Burgess, P., Evans, C. D., Hails, R., Potts, S., Quine, T. & Thomson, A. (2011) Regulating services. In: *The UK National Ecosystem Assessment Technical Report*, 1-61, UNEP-WCMC, Cambridge.

Tipping, E. & Carter, H. T. (2011) Aluminium speciation in streams and lakes of the UK Acid Waters Monitoring Network, modelled with WHAM. *Science of the Total Environment*, **409**, 1550-1558.

10 Dargall Lane



Figure 8 Dargall Lane biological survey section 19th Sept 2012

10.1 Summary Overview

Chemical and biological sample collection, analysis and data collation, quality control and archiving proceeded without any problems at Dargall Lane during the period from April 2012 to March 2013.

10.2 Water Chemistry

Samples were collected by MS early every month throughout the period April 2012 to March 2013, delivered to the analytical laboratories on schedule and are in the process of being analysed, quality controlled and archived in the UKAWMN central chemistry database at CEH Lancaster.

10.3 Epilithic Diatoms

Epilithic diatoms were retrieved by a team from ENSIS from three sampling points in the stream on the 7th of July 2012. The samples have been made into slides and are currently in the process of being analysed.

10.4 Macroinvertebrates

Aquatic macroinvertebrates were sampled on the 9th May 2012 by a team from QMuL. Five 1 minute kick samples were performed. The samples were counted and the data sent to ENSIS Ltd. The data is in the process of being quality screened before being added to the UKAWMN biological database at ENSIS.

10.5 Fish

Fish surveying was performed in the autumn of 2012 by MS using in-house resources. The data have been added to the MS fish database.

10.6 Aquatic Macrophytes

Aquatic macrophytes were surveyed by a team from ENSIS on 4^{19h} of Sept 2012 after an unsuccessful visit on 4th of July 2012 when the stream was in spate. Percentage cover scores were recorded and data will be added to the ENSIS biological database after microscope confirmation of bryophyte identifications.

10.7 Data Management and Reporting

No problems or hiatus occurred with the collation and transfer of data within methodological programmes, or to the UKAWMN databases, during the reporting period.

Work on the 2011-2012 annual report is underway and it should be uploaded to the AWMN web page in April 2013.

The UKAWMN website page detailing Dargall Lane can be found here, and the most recent summary data appear on the right of the page:

http://awmn.defra.gov.uk/sites/site_09.php

Further publications from the contract period utilizing UKAWMN data from Dargall Lane are detailed in section 10.8 below.

10.8 Dargall Lane Recent UKAWMN Output

Shilland, E. M. (2013) 25 Years of the Acid Waters Monitoring Network in Wales. Marine and Freshwater Evidence Workshop, Countryside Council for Wales HQ, Bangor. February 20th 2013.

Allott, T. E. H., Evans, M., Rothwell, J., Evans, C. D., Monteith, D. T., Crouch, T., Walker, J., Shilland, E. M. & Battarbee, R. W. (9-5-2012) Peatlands and water quality: degradation, restoration and the Water Framework Directive. Reducing the cost of the Water Framework Directive through Payments for Water Services. Valuing Nature Network Meeting. Leeds. 9th May 2012.

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11 Loch Coire Fionnaraich



Figure 9 Loch Coire Fionnaraich. Looking southeast from the north west end of the catchment, 9th Aug 2012.

11.1 Summary Overview

Chemical and biological sample collection, analysis and data collation, quality control and archiving proceeded without any problems at Loch Coire Fionnaraich during the period from April 2012 to March 2013.

11.2 Water Chemistry

Samples were collected by ENSIS in early June, September and December 2012, delivered to the analytical laboratories on schedule and have been analysed, quality controlled and archived in the UKAWMN central chemistry database at CEH Lancaster. March 2013 samples have been collected and are in the process of being analysed.

11.3 Sediment Traps

Sediment traps were recovered and replaced on the 9th of Aug 2012 by a team from ENSIS. Diatoms in the sediment retrieved from the traps have been analysed and await quality screening before being added to the UKAWMN biological database at ENSIS.

11.4 Thermistors

Lake top and bottom thermistors were removed and replaced on the 9th of Aug 2012 by a team from ENSIS. Both had functioned well during the previous year and the data were added to the ENSIS thermistor water temperature database.

11.5 Epilithic Diatoms

Epilithic diatoms were retrieved by a team from ENSIS from three sampling points around the lake on the 9th of Aug 2012. The samples have being analysed and await quality screened before being added to the UKAWMN biological database at ENSIS.

11.6 Macroinvertebrates

Aquatic macroinvertebrates were sampled on the 10th May 2012 by a team from QMuL. Five 1 minute kick samples were performed. The samples were counted and the data sent to ENSIS Ltd. The data is in the process of being quality screened before being added to the UKAWMN biological database at ENSIS.

11.7 Fish

Fish surveying was performed in the autumn of 2012 by MS. The data have been added to the MS fish database.

11.8 Aquatic Macrophytes

Aquatic macrophytes were surveyed by a team from ENSIS on 18th of Sept 2012 using both UKAWMN and CSM standard methodologies. Surveying was cancelled on the earlier visit of 9th of Aug 2012 due to staff illness. Data will be added to the ENSIS biological database after microscope confirmation of bryophyte identifications.

11.9 Data Management and Reporting

No problems or hiatus occurred with the collation and transfer of data within methodological programmes, or to the UKAWMN databases, during the reporting period.

Work on the 2011-2012 annual report is underway and it should be uploaded to the UKAWMN web page in April 2013.

The UKAWMN website page detailing Loch Coire Fionnaraich is here, and the most recent summary data appear on the right of the page:

http://awmn.defra.gov.uk/sites/site_25.php

Further publications from the contract period utilizing UKAWMN data from Loch Coire Fionnaraich are detailed in section 11.10 below.

11.10 Loch Coire Fionnaraich Recent UKAWMN Output

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