

From: William Austin <wena@st-andrews.ac.uk>  
Sent: 04 February 2014 14:22  
To: Jackson, Christopher A - L  
Cc: secretary@bsrg.org.uk  
Subject: BSRG application - Craig Smeaton, University of St Andrews

Dear BSRG,

I have been asked to send this reference to c.jackson@imperial.ac.uk, instead of 'secretary@bsrg.org.uk', to whom I sent the same reference last week. My apologies for any confusion I may have caused.

Best wishes, Bill

To whom it may concern:

I write to confirm that Craig Smeaton is a PhD student in his first year of study and under my supervision at the University of St Andrews.

Craig has identified an opportunity to enhance his PhD project with supplementary work on sediment provenance within a river catchment (River Strontian) that enters the coastal ocean (Loch Sunart) in NW Scotland. The experimental design is such that this work will provide complimentary evidence to help Craig understand the storage/transport history of particulate matter - with significance to his wider PhD goals, which are aimed at understanding the long-term role of these fjordic environments in carbon storage.

His BSRG application stands-alone from his NERC-funded PhD and I think both elements will add-value to each other, so that I am confident that he will deliver useful new results, which will integrate with his PhD work to improve our understanding of this important "missing" carbon store.

Yours sincerely, Bill Austin

Reader in Physical Geography (St Andrews)  
Professor of Marine Geology (SAMS)

## Steve Farrell Memorial Fund

### Craig Smeaton

School of Geography & Geosciences  
Irvine Building, University of St Andrews  
North Street, St Andrews, KY16 9AL  
Fife, Scotland, UK  
cs244@st-andrews.ac.uk

## Education

**2013 – PhD Environmental Geography** – University of St-Andrews.

**Project:** A long-term perspective on the cycling and storage of carbon in Scottish coastal waters (from source to sink). **Funding:** 50% NERC

**Supervisors:** Dr. W. Austin (StA), Dr. A. Davies (StA) & Dr. J. Howe (SAMS).

**2009-2010 –MSc (Distinction) Sustainable Catchment Management** – University of Dundee/ Flinders University of South Australia.

**Project:** Towards a Carbon Budget for a Facultative Waste Stabilisation Pond

**Supervisors:** Prof. H. Fallowfield (Flinders), Dr A Reeves (Dundee).

**2005-2009- BSc(Hons) 2:1 – Natural Resource Management** – University of Abertay

**Project:** Heavy Metal Soil Contamination in the Locality of a Municipal Waste Incinerator.

**Supervisors:** Dr K. Oduyemi

## Professional & Research Experience

**2010: SA Water** – Field & Laboratory Technician

**2009: NOAA(National Oceanic and Atmospheric Administration)** -*Research Intern*

**2009: SEPA(Scottish Environment Protection Agency)** – *Trainee*

**2008- 09 : VION Foods-** *Industrial Environmental Manager*

**2008 - :** SEPA(Scottish Environment Protection Agency)- *Rainfall Monitor*

**2008: Millard Consulting** - *Student Engineer*

## Publications

### Oral Presentation

**Smeaton, C,** Donaldson, J, Revees, A.D, Cromar, N.J., Buchanan, N.A., Fallowfield, H.J, (2011), Towards a carbon budget for facultative ponds, International Water Association's 9th Specialist Group Conference on Waste Stabilisation Ponds, 1- 3 August, 2011, Adelaide, South Australia

### Posters

**Smeaton,C,** Austin, W.E.N, Davies, A.L, Howe,J & Baltzer, A. (2013). Forgotten Carbon: A Carbon Inventory for Scottish Coastal Waters. PRiMEs 2013, Southampton,UK, November 6<sup>th</sup> -7<sup>th</sup>.

## Research Specific Training

Jan 2014 – NERC Understanding Environmental Statistics

Jan 2014 – Fieldwork Health & Safety + Risk Assessments

Oct 2014 – Laboratory Health & Safety

### Upcoming Training

Feb 2014 – Introduction to R

March 2014 – NERC Geophysics for Environmental Scientists

April 2014 – NERC Introduction to Field Spectroscopy

**Research Proposal:** Linking terrestrial Carbon Sources to Marine Sinks: A comparative study of four sediment provenance techniques within the aim of measuring sediment & carbon transport in a small coastal catchment.

There is currently a disparity in carbon research: deep ocean and terrestrial carbon are both intensely researched areas within both a Scottish and global context. In comparison, carbon research in coastal regions is sparse, but there is a growing awareness of key transfers in the carbon cycle at these locations, suggesting that they are key areas for understanding the global storage and cycling of carbon. The lack of research in the coastal zones has implications for all areas of carbon research: without a better understanding of carbon in our coastal waters, the understanding of carbon transfer from source to sink will remain incomplete.

My research sets out to address some of the main questions that are required to fill the gaps in our knowledge and generate a better understanding of carbon in the coastal environment. My main focuses is on linking terrestrial carbon sources to marine sinks, I am using the West Coast of Scotland as my test site with the main focus of the research is Loch Sunart (sink) and the river Strontian (source).

The research is split into three distinct sections firstly determining the carbon contained with the Lochs sediment followed by measuring the in Loch production of carbon and lastly determining the terrestrial carbon input into the Loch. This section can again be split with the aim of determining:

- The quantity of sediment entering the Loch
- The source location of the sediment
- The proportion of carbon within that sediment.

This application seeks funding to allow fieldwork to be undertaken to answer the first and second points. The funds will be used to determine the quantity of sediment being transported by the Strontian and to identify the source locations of the sediment.

Initial work has already been undertaken to identify sampling sites a GIS study has been undertaken which attempts to characterise the catchment it includes data on soil, geology, hydrology, land use and land cover. Key maps will be extracted from the study and will be used to pick sites for soil sampling.

The sites identified from the GIS Study will be sampled to essentially create a database of soil properties for the catchment; the initial fieldwork will involve taking a number of small undisturbed core samples (20-30cm) alongside this newer more experimental techniques for sediment provenance studies will be utilised. The first technique which will be utilised is *in-situ* magnetic susceptibility though magnetic susceptibility is a standard method for this type of research it is almost exclusively laboratory based only one study (Hatfield & Maher 2009) has used an *in-situ* methodology. The second method is much more experimental I intend to use Field Spectroscopy which uses advanced field based spectroscopy equipment to measure optical properties of the sediment.

Sediment traps will be placed throughout the catchment and within Loch Sunart with the aim of collecting sediment transported downstream. Three types of traps will be used a standard cone trap will be placed in Loch Sunart. The second type of trap that is a Integrated Time Suspended Sediment traps described by(Phillips et al. 2000); a number of these will be deployed throughout the catchment (Figure.01) these will allow the total sediment transported to be calculated alongside the quantities of sediment that each of Strontians tributaries supplies. The final type of trap is to measure the bed-load sediment, this trap is a modified drift net and frame that will be fixed to the riverbed(Figure.01).The traps will be collected monthly for a minimum of 12 months; depending on the quantities of sediment retrieved from the traps the Strontian may be directly pumped and filtered to provide a greater quantity of sediment for analysis, this would be undertaken several times to reflect the seasonality of sediment transport.

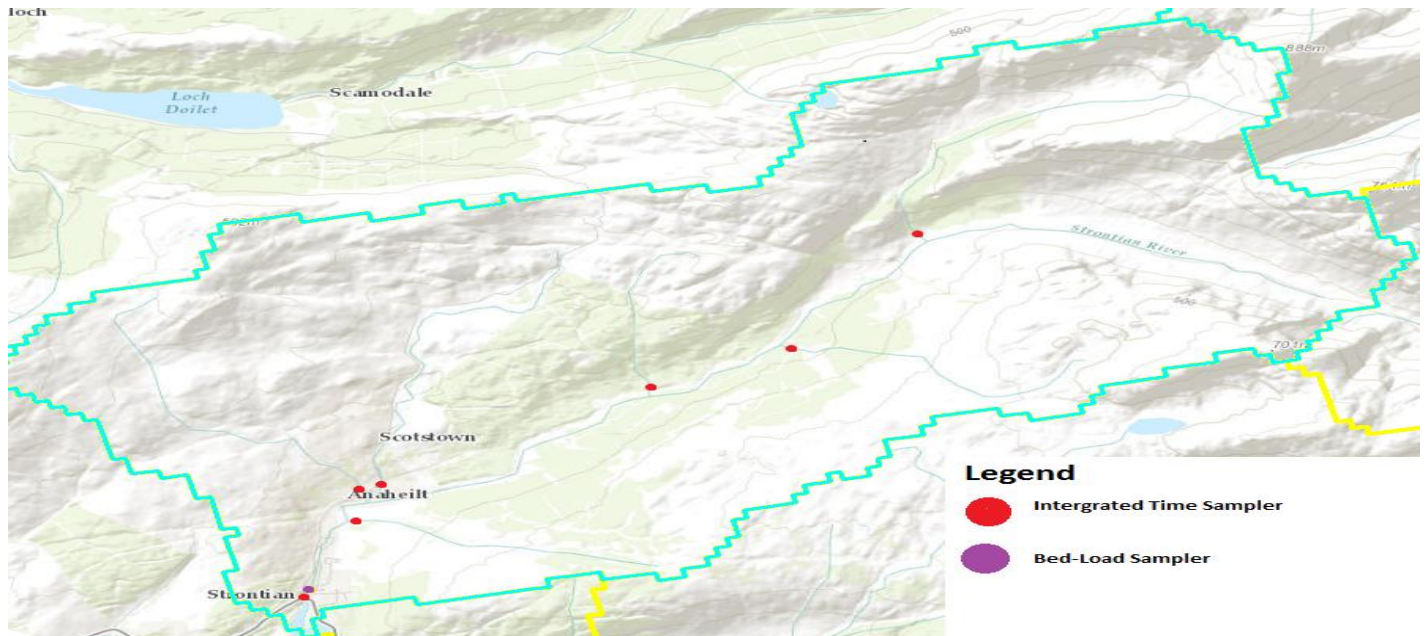


Figure.01 Proposed Sites for Sediment Traps (Source: CEH.com).

In addition to the sediment collection a number of hydrological and meteorological measurements will also be taken. The catchment has an existing gauging site operated by the Scottish Environment Protection Agency which measures both the stage and discharge of the river, data from this gauge is freely available. The gauge will be complemented by multiple rain gauges to measure precipitation, the area is has no official Met Office station so we plan to feed the data collected into the Met Offices citizen science project WOW. Through this combined approach the hydrological characteristics of the catchment will be calculated which will in turn allow a greater accuracy in determining sediment transported from the catchment.

The samples will be returned to the laboratory for trace element analysis using ICP-MS techniques to yield a large selection of trace element data for later comparison; secondary particle size analysis will be carried out using a Coulter LS230 Laser granulometer. The MS and FS data will be processed and used within a multivariate data analysis framework, with the possibility of further environmental magnetics analyses in a dedicated laboratory at the University of St-Andrews, enabling for example the comparison of laboratory-based (mass-specific) MS and in-situ MS analyses of the same materials.

The data collected from each technique will be subjected to multivariate and spatial statistical analysis to both to determine the provenance of the sediment collected in the riverine and marine sediment traps and which technique or mix of techniques are best suited for small coastal catchments.

## Summary

This study will allow the carbon sources within the catchment to be identified as well as quantifying how much sediment and carbon each source contributes to the catchments total sediment loss. This combined with the work that will be carried out in Loch Sunart will be the first steps to a better understanding of carbon in the coastal environment.

References; **Hatfield, R.G. & Maher, B.A., 2009.** Fingerprinting upland sediment sources : particle size specific magnetic linkages between soils , lake sediments and suspended sediments. *Earth Surface Processes and Landforms*, 34(10), pp.1359–1373.**Phillips, J.M., Russell, M.A. & Walling, D.E., 2000.** Time-integrated sampling of fluvial suspended sediment : a simple methodology for small catchments. *Hydrological Processes*, 14(November 1999), pp.2589 – 2602.

## Budget

**Accommodation**                      **Quote from** <http://www.sunartcamping.co.uk/prices.html>  
Sunart Campsite    £8 per Night  
Expected 2 Nights a Month for sample collection  
2 weeks for soil sampling phase and trap deployment  
Total of 36 nights

**Sub Total:** £288

**Travel**    **Quote from** <https://www.hertz.co.uk>  
Car Rental - 3days    £45.52  
Need car for 3 days once a month for 12 months

**Sub-Total:** £546.24

**Materials for sediment trap construction**      **Quote from** [http:// www.screwfix.com](http://www.screwfix.com)  
6m of ABS/PVC Piping (100mm Diameter)  
Funnel x 5  
2m of 40mm tubing  
End Cap x 10

**Sub Total:** £46.50

**Bed-load Sampler**    **Quote from** <http://www.nhbs.com/>  
Frame    £58.26  
250 Micron Net    £44.01

**Sub Total:** £102.27

**Total:** £983.01

### Costs Not Accounted For

Barrington Instruments (<http://www.barrington.com/>) have agreed free use of their latest field magnetic susceptibility probe on the condition that I produce a single page case study of how the probe was used. The field spectroscopy equipment will be provided from the NERC field spectroscopy facility in Edinburgh they provided equipment, software and training to NERC funded researchers, since I am partially NERC funded I have access to the latest field spectroscopy equipment.

This budget does not account for accommodation or travel these cost will be accommodated by my existing fieldwork budget. I currently plan to carry out other fieldwork in the area as part of my larger PhD project at the times designated for sample collection, therefore I will be travelling and staying in this area and these additional costs will be absorbed by the limited funds available to support my PhD project, which is focussed on the sea-loch (sink) component of the system.

The University of St-Andrews already owns coring equipment, rain gauges pumps and filtration units therefore this equipment does not have to be purchased/hired/loaned. The river discharge data is also freely available from SEPA.

In conjunction with this funding an application has been made to the British Society for Geomorphology to fund the laboratory cost of this research. I understand that you cannot cover the full amount accounted for in the budget but any help would be appreciated.