School of Ocean Sciences, University of Wales BANGOR, Menai Bridge, Gwynedd, LL59 5AB, United Kingdom

2006 RESEARCH VESSEL PROGRAMME

CRUISE REPORT: RV PRINCE MADOG CRUISE 30/06

LOCH SUNART: SURFACE SEDIMENT SAMPLING AND ARCTICA DREDGING (EU MILLENNIUM PROJECT)

24th- 29th September 2006

Loch Sunart, Sound of Mull, Tiree Passage, west Isle of Man

RV *Prince Madog* cruise 30/06

James Scourse
School of Ocean Sciences, University of Wales, Bangor
Menai Bridge, Anglesey, LL59 5AB

Abstract

This report describes a scientific research cruise to Loch Sunart and environs in the west of Scotland in order to support the research proposed within the EU Millennium project (part A). A supplementary programme of sampling (part B) was achieved on the passage back to Menai Bridge to collect samples to support a postgraduate research project (Paul Butler, funded by the Cemlyn Jones Trust). The aims of part A were threefold: 1. to recover samples of seabed sediment from a site within Loch Sunart previously occupied by RV *Marion Dufresne* in 2004, when CALYPSO giant piston cores and CASQ giant gravity corers were deployed, using box corers, gravity corer and multi-corer; 2. to collect surface water samples from a longitudinal transect along Loch Sunart; 3. to dredge for *Arctica islandica* (Bivalvia) at sites in and around Loch Sunart in order to start to construct a long *Arctica* chronology from the west coast of Scotland. The aim of part B was to dredge, if time and conditions allowed, for *Arctica islandica* (Bivalvia) at previously sampled sites to the west of the Isle of Man (Butler, 2005) which are now known to yield *Arctica* valves which can be successfully cross-matched.

Part A1 was successfully completed with excellent recovery of surface sediment samples via small box corer, gravity corer and multi-corer. The existing CALYPSO and CASQ cores collected in 2004 do not contain good quality surface samples, as is usually the case with these sampling methods. Supplemented by the surface samples collected on this cruise this will enable a complete sedimentary sequence for this site to be established, and the surface samples will also be critical for calibration of proxies used in the investigation of the longer records. The small box corer was subsampled by U-channel onboard and multi-corer slices taken for foraminiferal content and associated geochemistry, ^{210}Pb and ^{137}Cs content (for dating), and porewaters were extracted onboard in order to measure

dissolved inorganic carbon (DIC) $\delta^{13}C$ to characterise benthic foraminiferal microhabitats and calcification depths. The sediment samples collected, including gravity corer, have all been returned to the School of Geography and Geosciences, University of St Andrews. Multicore samples were also recovered from a site immediately outside Loch Sunart and surface sediments sampled. Part A2 was successfully completed with a suite a water samples collected for DIC $\delta^{13}C$ measurements in order to calibrate carbon isotope foraminiferal data. These samples were returned to the School of Ocean Sciences (SOS), University of Wales (Bangor) for analysis. Part A3 was less successful. Relatively few *Arctica islandica* specimens were recovered, and sampling was hampered by damage to the dredges, extensive creel pots in the vicinity of the planned dredging and, towards the end of the cruise, bad weather. An interesting by-product was the recovery of significant numbers of valves of the heavily calcified bivalve *Glossus humanus* (L.); though no live specimens were recovered, several articulated individuals were recovered and several with intact organic ligament, both suggesting recent time of death.

The *Arctica* specimens collected will be used as part of the EU Millennium project whose primary objective is the generation of high resolution, annually-resolved, climate time-series for the last 1000 years (**http://www.millenniumproject.net/**). The primary purpose is the construction of a 1,000 year sclerochronology for the west coast of Scotland using growth increments in the shell of *A.islandica*. *A. islandica* is potentially suitable for this purpose because it has a lifespan which is often greater than 100 years and because its shell contains series of annual growth increments in the hinge section and along the growth axes. It is likely that the small amount of material collected during this cruise will not enable this objective to be achieved. The sites for sampling were selected on the basis of earlier serendipitous collection of *Arctica* from the environs of Loch Sunart (following the advice of Dr W.E.N.Austin, University of St Andrews) and sites characterised by suitable sedimentary substrate based on an earlier complete side-scan sonar survey of the Loch by Dr R. Bates (University of St Andrews). These side-scan sonar data were available onboard during the cruise.

A total of two live, three dead articulated and 63 single valves were collected. The primary collection method was to dredge the seabed using the customized "*Arctica*" dredge which had been used successfully in a cruise to the North Sea in 2004 and Irish Sea in 2005. A single valve was also found within one of the multi-cores. In addition, six dead articulated and 68 single valves of *Glossus humanus* were recovered, two of the articulated valves from the box core and one valve in a multi-core. At one site significant quantities (four live, three dead articulated and 133 single valves) of *Glycymeris glycymeris* were recovered.

In due course the *Arctica* shells will be embedded in resin and sectioned and the internal growth increments in the hinge section and along the axis of maximum growth will be counted and measured. Correlations between increment patterns of shells of living animals and cross dating with dead shells will be used to construct the sclerochronology. In order to derive a first approximation for the dates of dead shells, selected specimens will be radiocarbon dated. It is probable that the *Glossus* and *Glycymeris* collections will form the basis of B.Sc and M.Sc projects within SOS. All shell material has been curated at SOS.

Part B was moderately successful. A total of six live *Arctica* and five single valves were recovered. These specimens have been curated at SOS and will be processed by Paul Butler as part of his Ph.D. research as described for the Sunart specimens above.

Keywords: *Arctica islandica*, *Glossus humanus*, Loch Sunart, sea loch, Irish Sea, sclerochronology

Personnel:

1. Professor James Scourse (School of Ocean Sciences, UWB, SIC)
2. Dr Alix Cage (School of Geography and Geosciences, University of St Andrews)
3. Dr Bill Austin (School of Geography and Geosciences, University of St Andrews)
4. Miss Keziah Stott (School of Geography and Geosciences, University of St Andrews)
5. Mr Andy Matkin (School of Ocean Sciences, UWB)
6. Miss Joanna Richardson (School of Ocean Sciences, UWB)
7. Mr David Reynolds (School of Ocean Sciences, UWB)
8. Dr John Howe (SAMS, Oban)
9. Dr Tracy Shimmield (SAMS, Oban)
10. Mr Charles Wilson (SAMS, Oban)
11. Miss Kate McIntyre (SAMS, Oban)

Overview

24.09.2006
Mobilisation at Menai Bridge in am.
1130 BST Departure.

25.09
1045 Arrival in Loch Sunart
1045 – 1100 Embarkation of BA, KS, JH, TS, CW and KM by rib from Laga Bay pontoon
1100 – 1200 Bathymetric and echo sound survey of MD site
1200 Anchored at MD site
1200 – 1430 Sediment sampling at MD site (box core, gravity core, multi-core)
1700 – 1730 JH, TS, CW and KM disembarked by rib to Laga Bay pontoon
1730 – 1800 Transit to Salen Bay

26.09
0800 – 0830 Transit to Laudale Narrows
0830 Rib launched for water sampling in inner loch basin
0830 – 0900 Transit to Salen Bay
0900 – 0930 Echo sound survey of SB site
0930 – 1030 Sampling at SB site: two *Arctica* dredges
1030 Rib recovered
1030 – 1215 Sampling at SB site: three *Arctica* dredges
1215 – 1245 Transit to Laga Bay
1245 Water sample at Laga Bay
1300 – 1400 Transit to Sound of Mull box (Maclean's Nose)
1400 – 1430 Sampling SM site: one *Arctica* dredge
1430 Water sample at SM site
1430 – 1545 Sampling SM site: three *Arctica* dredges
1545 – 1630 Transit to Morvern transect
1630 – 1700 Echo sound survey of M site
1700 – 1745 Sampling M site: two *Arctica* dredges (both barren)
1745 – 1830 Transit to Tobermory

27.09
0715 – 0830 Transit to Tiree Passage
0830 – 0900 Echo sound survey of TP site
0900 – 0915 Sampling TP site: one *Arctica* dredge. Severe damage to dredge
0915 – 1100 Transit to Morvern transect
1100 – 1115 Sampling M site: multi-corer

1130 Water sample at M site
1130 – 1215 Transit to MD site
1215 – 1345 Sampling MD site: Three *Arctica* dredges. Damage to reserve dredge
1430 BA and KS disembarked by rib to Laga Bay pontoon
1430 – 1700 Transit to Craignure whilst engineers repaired *Arctica* dredge

28.09 0700 – 2200 Transit to site D7, west Isle of Man
2200 – 0015 (29.09) Sampling D7 site: Seven *Arctica* dredges (two barren)

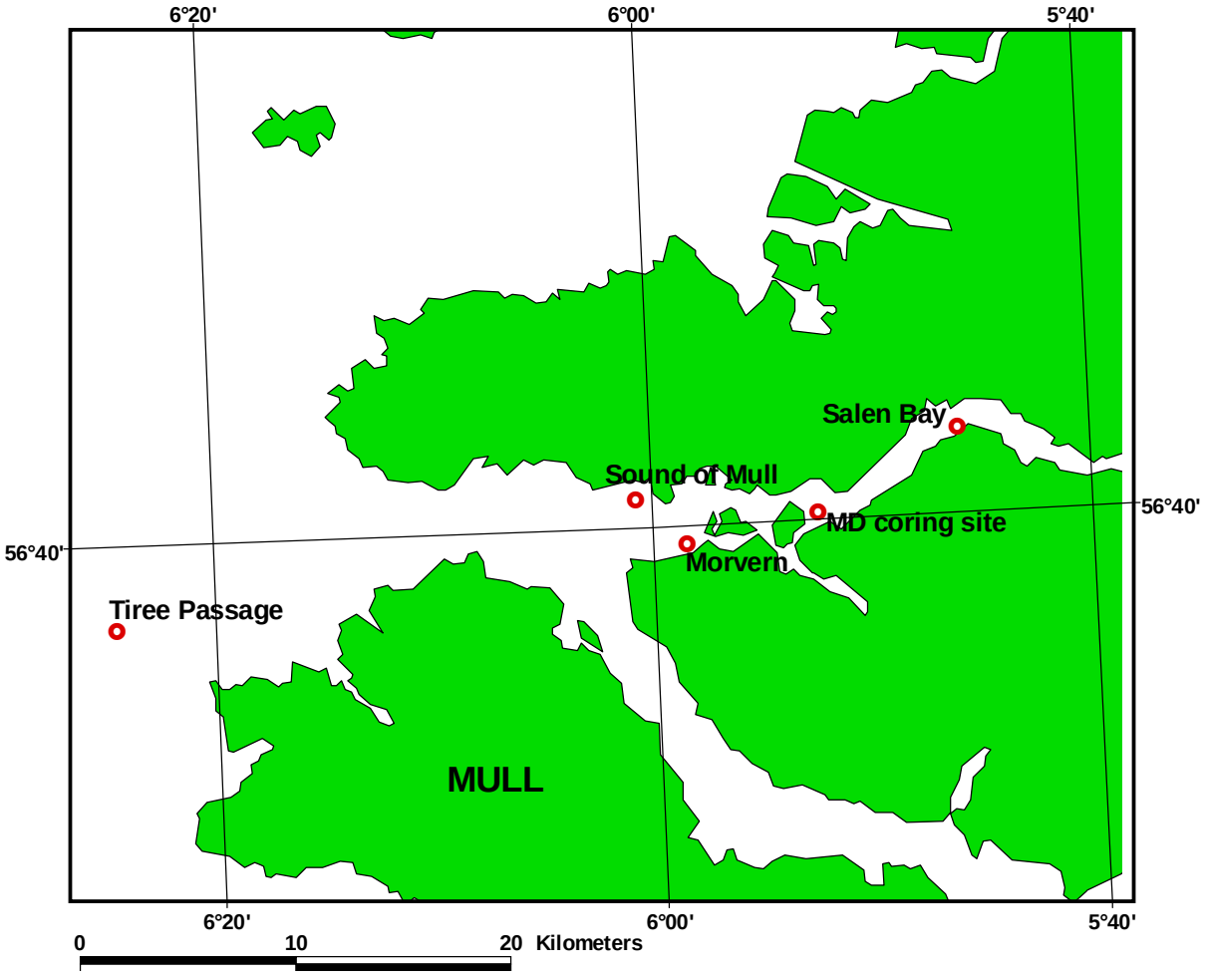
29.09 0015 – 0700 Transit to Menai Bridge. Demobilization.

Stations and samples

All samples labelled with prefix PM06

[insert location map]

All the stations identified in the cruise plan were sampled as part of A3, and can be identified as follows: Salen Bay: SB, Sediment sampling site (*Marion Dufresne*): MD, Sound of Mull box (Maclean's Nose): SM, Transect line (Morvern): M, Tiree Passage: TP.



Part A1

Site MD *Marion Dufresne* coring site

The original site cored by the *Marion Dufresne* in 2004 was at 56^{o} 40.19N, 05^{o} 52.12W in a recorded water depth of 38m. However, the preliminary survey at this location revealed a water depth of c. 60 m. The discrepancy probably relates to differences in the position of the echo sounder on the *Marion Dufresne* in relation to the deployment position stern starboard. A decision was taken not to sample in 60 m water but to move to a shallower proximal site in order to undertake sediment sampling compatible with the original coring location. The water depths (adjusted to correct for hull mounted echo sounder) recorded for the deployments indicated below were 52.8 m (box corer), 52.5 m (multi-corer) and 52.1 m (gravity corer). The sediment sampled was a grey silt-clay. Two articulated *G. humanus* valves infilled with sediment were recovered from the base of the box core.

Station	Latitude	Longitude	Sediment samples		
			Box core	Gravity core	Multi-core
MD	56° 40.20 N	5° 52.31 W	1 (BC01), 2 U-channels	1 (GC01), 2 metres	1 deployment, 4 full tubes (MC01, A, B, C, D)

Table 1. Sediment samples taken at site MD

Sample	Sediment depth, cm	Volume extracted (ml)	Notes (Ampoule number)	* Sediment contamination
MC01Bpw- bottom water	bottom water	4	135	0
MC01Bpw - 0-0.5	0-0.5	8	48	1
MC01Bpw- 0.5-1.0	0.5-1.0	9.5	128	0
MC01Bpw- 1.0-1.5	1.0-1.5	9.5	16	0
MC01Bpw- 1.5-2.0	1.5-2.0	9.5	78	1
MC01Bpw- 2.0-2.5	2.0-2.5	7.5	16	1
MC01Bpw- 2.5-3.0	2.5-3.0	8	131	1
MC01Bpw- 3.0-3.5	3.0-3.5	7	32	2
MC01Bpw- 3.5-4.0	3.5-4.0	8	35	3
MC01Bpw- 4.0-4.5	4.0-4.5	7	7	0
MC01Cpw- bottom water	bottom water	6	139	0
MC01Bpw- 4.5-5.0	4.5-5.0	10.5	25	0
MC01Bpw- 5.0-5.5	5.0-5.5	9.5	152	0
MC01Bpw- 5.5-6.0	5.5-6.0	7.5	151	0
MC01Bpw- 6.0-6.5	6.0-6.5	7.75	49	1
MC01Bpw- 6.5-7.0	6.5-7.0	6	74	3
MC01Bpw- 7.0-7.5	7.0-7.5	6	50	3
MC01Bpw- 7.5-8.0	7.5-8.0	5	138	1
MC01Bpw- 8.0-9	8.0-9	4.75	136	3
MC01Bpw- 9.0-10.0	9.0-10.0	3	6	1
MC01Bpw- 10.0-11.0	10.0-11.0	5	115	3
MC01Bpw- 11.0-12.0	11.0-12.0	2.5	134	0
MC01Bpw- 12.0-13.0	12.0-13.0	3.25	153	1
MC01Bpw- 13.0-14.0	13.0-14.0	2.75	123	0
MC01Bpw- 14.0-15.0	14.0-15.0	2.25	4	1
MC01Bpw- 15.0-17.0	15.0-17.0	2.5	89	1
MC01Bpw- 17.0-19.0	17.0-19.0	2.75	122	0
MC01Bpw- 19.0-21.0	19.0-21.0	0.9	93	0
MC01Bpw- 21.0-23.0	21.0-23.0	1	114	0
MC01Bpw- 23.0-25.0	23.0-25.0	0.5	108	0
MC01Dpw- bottom water	bottom water	11	40	0
MC01Dpw- bottom water	bottom water	10	58	0
MC01Dpw- 0.0-0.5	0.0-0.5	4	119	0
MC01Dpw- 0.5-1.0	0.5-1.0	2	71	0

Table 2. Multi-core porewater samples for DIC $\delta^{13}C$ taken at site MD

Site M Morvern

The multi-corer was also deployed once at site M (Morvern transect) in order to recover surface sediments for porewater extraction from a locality immediately outside Loch Sunart more influenced by open hydrographic conditions (MC02). The site location was 56° 39.694 N 5° 57.953' W in a water depth of 71.4 m. Three cores were recovered each containing 20 – 30 cm disturbed sediment containing major water inclusions. It was decided not to subsample the cores for porewaters given the level of disturbance but surface sediment samples were taken from each core (three samples). During sub-

sampling of the multi-core tubes two *Venerupis* sp. valves, one *A. islandica* valve and one *G. humanus* valve were recovered and retained.

Part A2

Water samples for DIC $\delta^{13}C$ were collected by rib in the inner basin of Loch Sunart and from the ship in the outer parts of the loch. All samples collected are shown in Table 3.

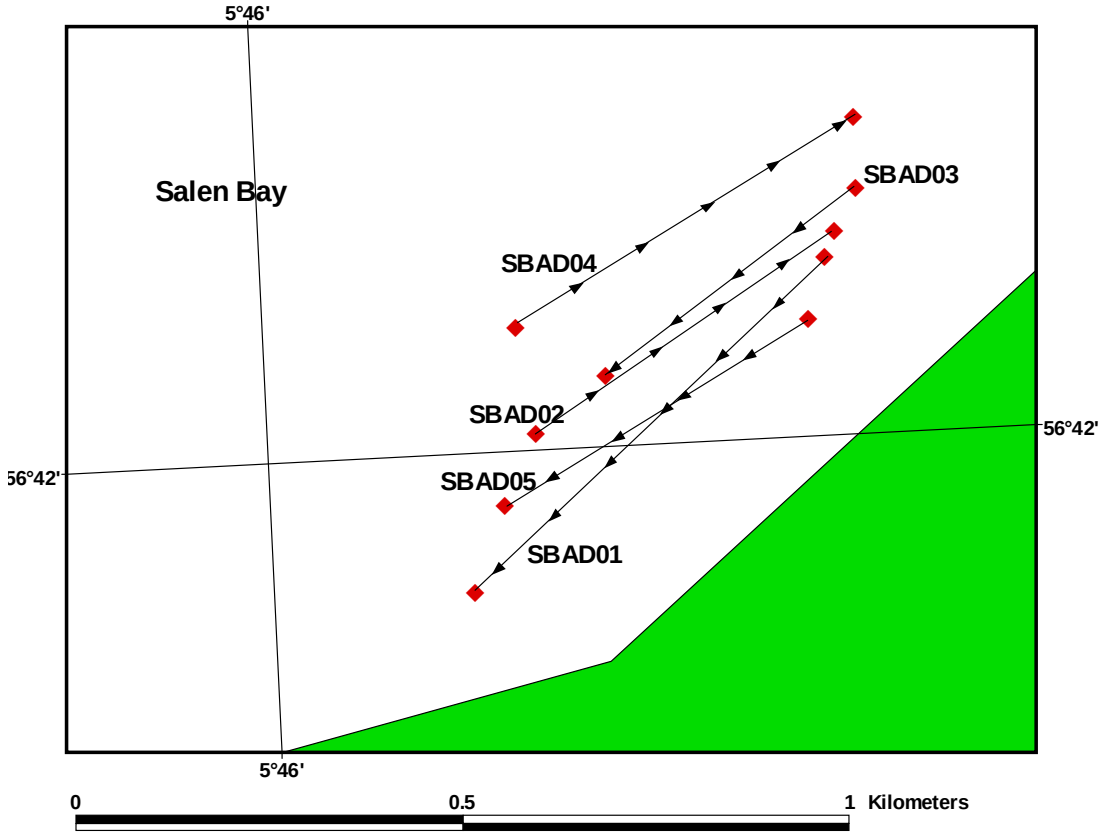
Sample	Sample position		Water depth	Sampling method	Notes (Ampoule number)
	Lat	Long			
PM06-DIC1	56 41.2	5 32.7	1	Water sampler	97
PM06-DIC2	56 41.2	5 32.7	0	Surface	65
PM06-DIC3	56 41.15	5 33.5	0	Surface	69
PM06-DIC4	56 41.15	5 33.5	5	Water sampler	130
PM06-DIC5	56 41.15	5 33.5	10	Water sampler	42
PM06-DIC6	56 41.125	5 35.6	0	Surface	77
PM06-DIC7	56 41.125	5 35.6	5	Water sampler	5
PM06-DIC8	56 41.125	5 35.6	18	Water sampler	101
PM06-DIC9	56 41.025	5 36.8	0	Surface	36
PM06-DIC10	56 41.025	5 36.8	5	Water sampler	133
PM06-DIC11	56 41.025	5 36.8	15	Water sampler	1
PM06-DIC12	56 41.025	5 36.8	41	Water sampler	56
PM06-DIC13	56 41.78	5 42.4	0	Surface	132
PM06-DIC14	56 41.78	5 42.4	5	Water sampler	111
PM06-DIC15	56 41.78	5 42.4	15	Water sampler	127
PM06-DIC16	56 42.145	5 45.199	5	Water sampler	218
PM06-DIC17	56 40.391	5 51.814	41	Water sampler	204
PM06-DIC18	56 40.391	5 51.814	0	Surface	221
PM06-DIC19	56 40. 566	6 00.066	5	Water sampler	252
PM06-DIC20	56 39.743	5 58.173	5	Water sampler	259
PM06-DIC21	56 36.5	6 0.5	bottom water	Water sampler	234

Table 3. Seawater samples for $\delta^{13}C$ DIC analyses. All samples 10 ml.

Part A3

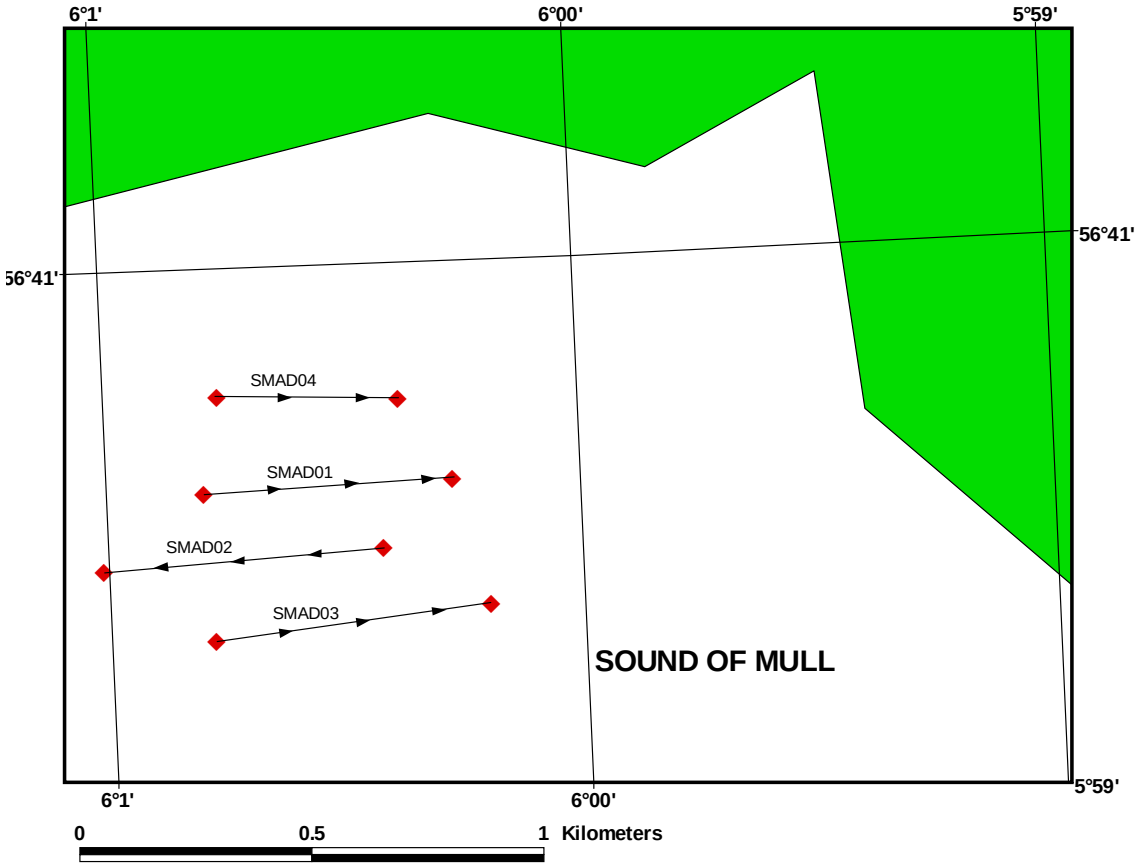
Site SB Salen Bay

This site had previously yielded *Arctica* valves in sampling by the RV *Envoy* (University of St Andrews) and had been surveyed by side-scan sonar. Prior to deployment of the *Arctica* dredge an echo sound survey was undertaken of this site, run in three lines parallel with the south shore of Loch Sunart opposite Salen Bay at varying distance from the shore. Water depths in increasing distance from the shore were 50-55 m, 60-65 m and 65-70 m. All transects showed flat seabed. The *Arctica* dredge was then deployed five times with limited success for *A. islandica* (two live, one dead articulated and three single valves) but 20 *G. humanus* valves were recovered as follows: SBAD01 (9 *G. humanus* valves, 1 live *A. islandica*), SBAD02 (1 live *A. islandica*, 1 *A. islandica* valve), SBAD03 (1 live *A. islandica*, 2 *A. islandica* valves), SBAD04 barren, SBAD05 (11 *G. humanus* valves).



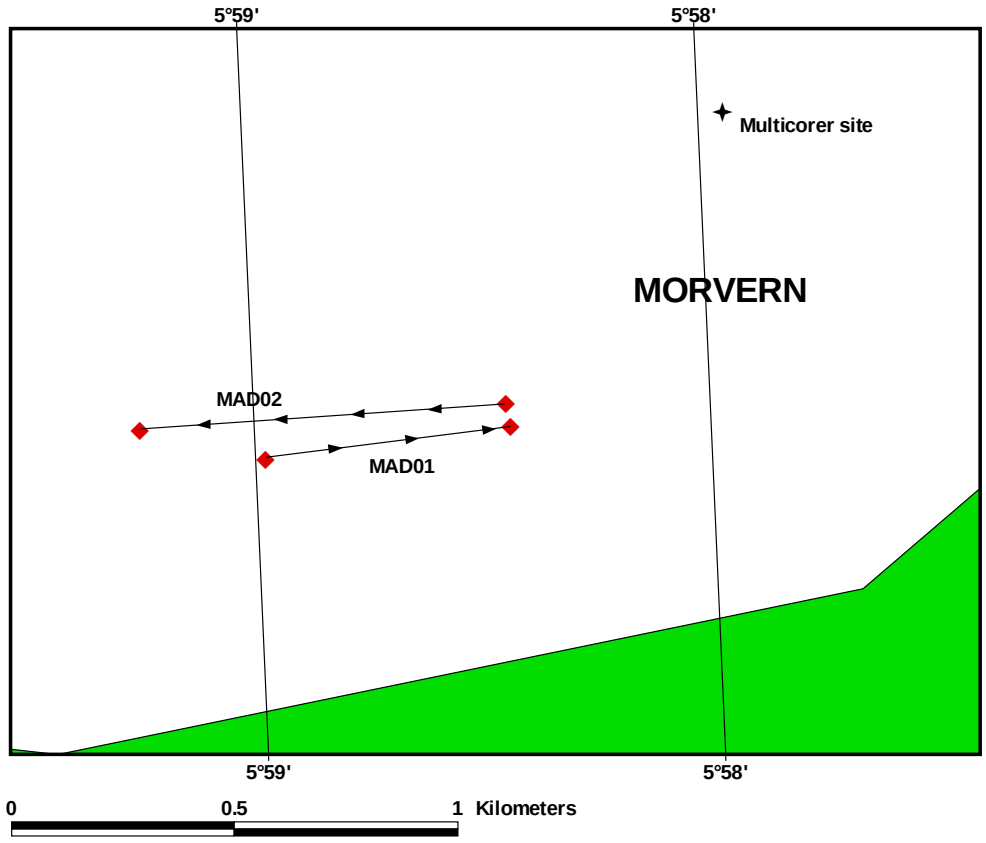
Site SM Sound of Mull

No prior recoveries of *Arctica* were known from this locality adjacent to Maclean's Nose on the south coast of the Ardnamurchan Peninsula, though suitable flat sedimentary seabed is indicated on side-scan sonar survey data. Prior to deployment of the *Arctica* dredge a box survey was undertaken of this site which supported the side-scan data in indicating flat seabed between 35 and 45 m water depth. The *Arctica* dredge was then deployed four times with poor results for *A. islandica* (1 *A. islandica* valve) but 3 articulated and 19 single *G. humanus* valves were recovered as follows: SMAD01 (16 *G. humanus* valves, 1 *A. islandica* valve), SMAD02 (1 articulated *G. humanus*), SMAD03 (1 articulated *G. humanus*, 1 *G. humanus* valve), SMAD04 (1 articulated *G. humanus*, 2 *G. humanus* valves). Three of the *G. humanus* specimens were paired articulated valves and many of the single valves had intact ligament suggesting recent death (as is the case with the specimens recovered from the base of the box core BC01). Trawl SMAD04 was fouled by a line of creel pots which were returned with no visible damage.



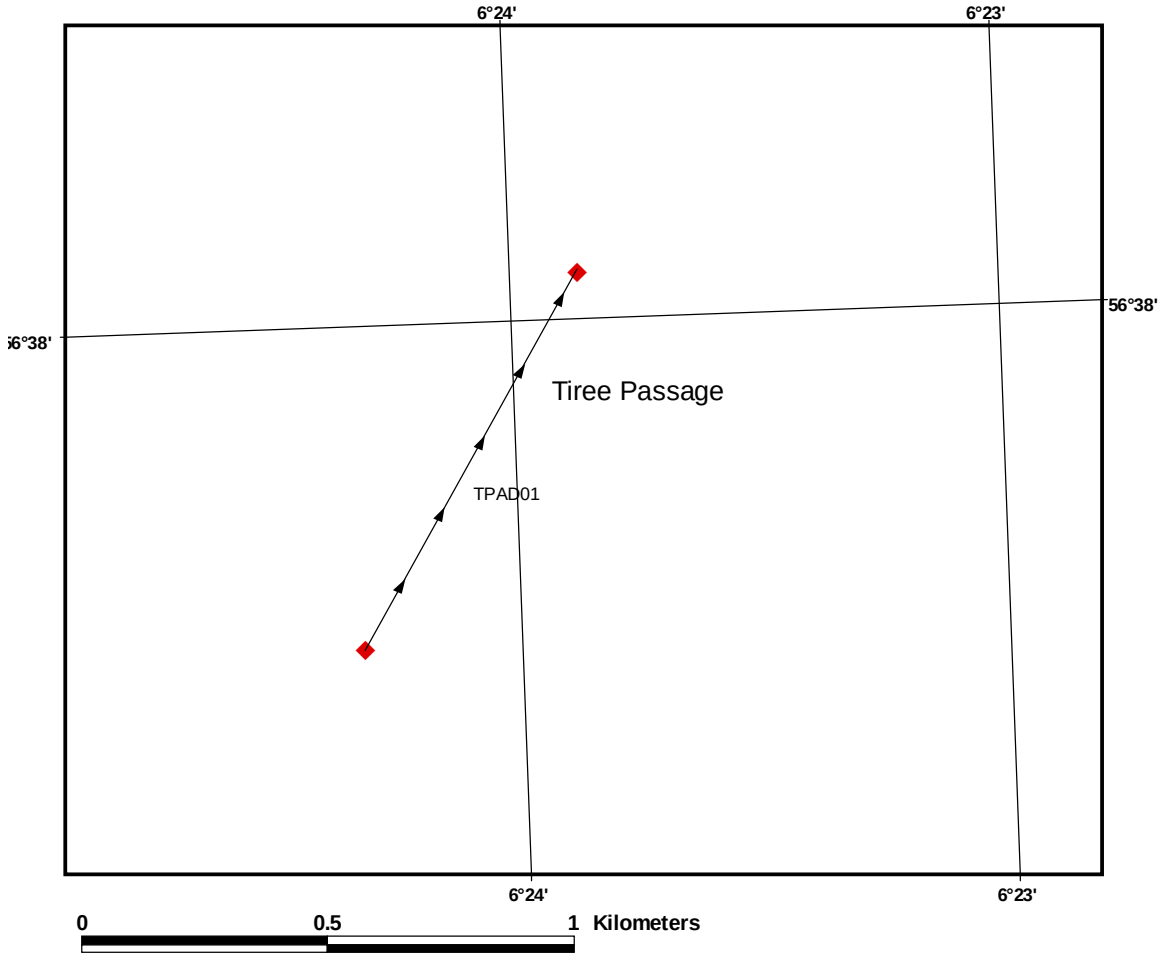
Site M Morvern

No prior recoveries of *Arctica* were known from this transect north of the mainland adjacent to Morvern, though suitable flat sedimentary seabed is indicated on side-scan survey data. The area was found to be densely populated with creel pot buoys so, given that during the final deployment in the SM box a line of pots had fouled the dredge, extreme caution was observed. A transect line free of buoys due west of the entrance into Loch nan drom buidhe was surveyed by echo sounder prior to deployment of the *Arctica* dredge. Flat seabed around 40 m was indicated. The *Arctica* dredge was deployed twice but failed to recover anything of interest.



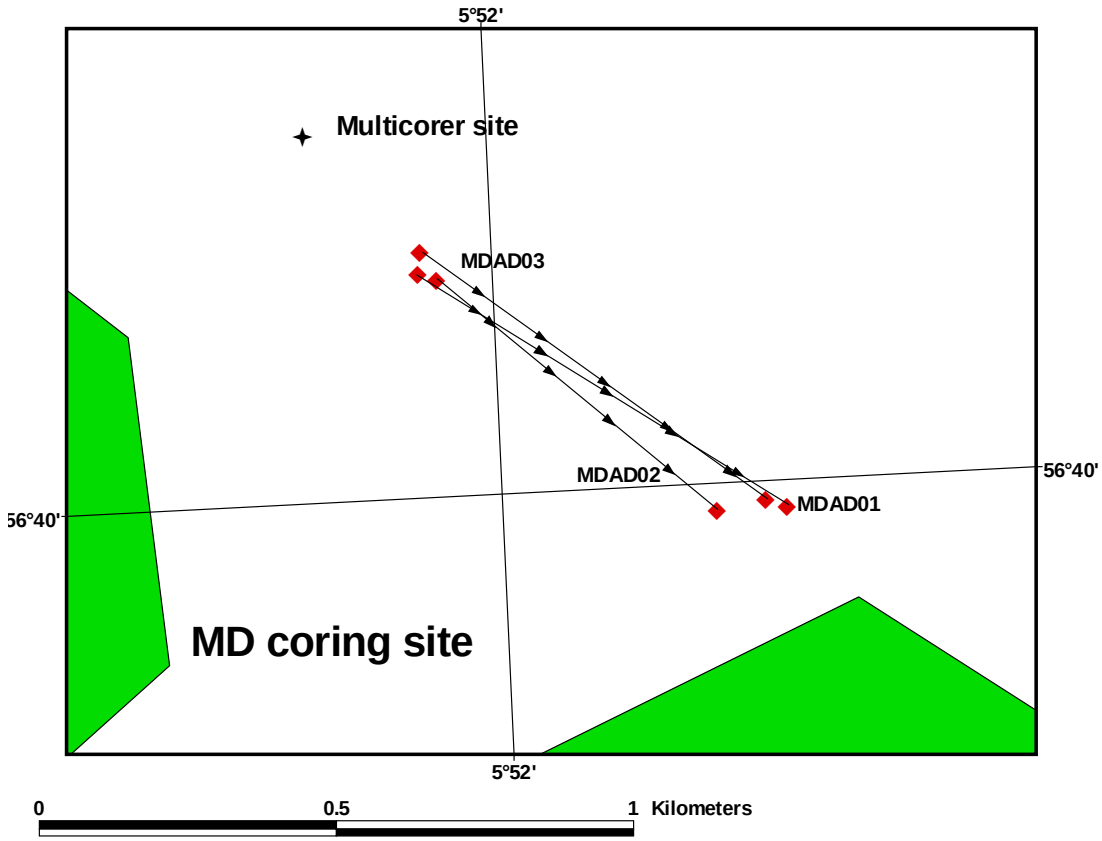
Site TP Tiree Passage

No known recoveries of *Arctica* were known from the bank immediately beneath the Tiree Passage oceanographic mooring, but given the likelihood of a sedimentary seafloor (from the hydrographic charts) and the existence of the Tiree Passage long instrumental series, it was felt worthwhile to sample at this location. In worsening weather conditions (Force 8 gale imminent) a box echo sound survey was undertaken around the mooring indicating sedimentary bottom conditions punctuated by rocky ridges. The *Arctica* dredge was deployed once (TPAD01), but was recovered in a severely damaged state with one set of teeth entirely missing. The dredge was full of very large boulders encrusted with epilithic organisms and large numbers of *Glycymeris glycymeris*, including 4 live specimens, 3 articulated valves and 133 single valves, one articulated *Paphia* sp. and 11 *Astarte* sp. valves and 1 articulated *Astarte* sp. Given this deployment had damaged one *Arctica* dredge beyond use, and the worsening weather conditions, it was decided not to redeploy at this site in case the reserve dredge was also damaged beyond use, but instead to return further inshore to undertake further multi-coring, *Arctica* dredging within Loch Sunart, and to effect repairs to the dredge.



Site MD *Marion Dufresne* coring site

The reserve *Arctica* dredge was deployed three times immediately to the ESE of the MD site sampled for sediments (Part A1), following echo sound survey, in the hope of recovering *A. islandica* valves from the same locality that will be yielding high resolution palaeoenvironmental data from the sediments. No *Arctica* were previously known from this site but side-scan survey data indicated flat sedimentary seabed. Large numbers of dead *Arctica* valves were recovered, making this the most successful of all the sites trawled during the cruise, alongside some *Glossus* and some other species as follows: MDAD01 (1 articulated *A. islandica*, 31 *A. islandica* valves, 1 articulated *G. humanus*, 12 *G. humanus* valves, 1 live *Acanthocardia aculeata* (spiny cockle), 1 *Modiolus modiolus* valve and 1 live *Mya* sp.), MDAD02 (1 articulated *A. islandica*, 25 *A. islandica* valves, 16 *G. humanus* valves), MDAD03 (2 *A. islandica* valves). The final deployment caused severe damage (base plate holding teeth ripped away on both sides) to the *Arctica* dredge. At this stage neither *Arctica* dredge was serviceable forcing the cessation of all trawling activity.



Station	Latitude			Longitude			Numbers of *A.islandica* (Ai), *G. humanus* (Gh) and *G. glycymeris* (Gg) specimens collected		
							Live	Dead, single valves	Dead, paired
SB	56°	42.00	N	5°	45.50	W	2 Ai	3 Ai, 20 Gh	1 Ai
SM	56°	40.50	N	6°	0.25	W	-	1 Ai, 19 Gh	3 Gh
M	56°	39.35	N	5°	58.00	W	-	-	-
TP	56°	37.75	N	6°	24.00	W	4 Gg	133 Gg	3 Gg
MD	56°	40.00	N	5°	52.00	W	-	59 Ai, 28 Gh	2 Ai, 1 Gh
						Totals	**2 Ai, 4 Gg**	**63 Ai, 67 Gh, 133 Gg**	**3 Ai, 4 Gh, 3 Gg**

Table 4*. Station positions in and around Loch Sunart (listed in the order in which they were sampled) and number of specimens collected at each.*

Part B

Arctica dredged from station D7 to the west of the Isle of Man in 2005 by Paul Butler have shown to demonstrate good cross-matches. This site was sampled using a repaired *Arctica* dredge during the return passage to Menai Bridge in order to boost the sample size from this site. The site was not surveyed since it had already been successfully sampled. The *Arctica* dredge was deployed seven times (two trawls barren), yielding low numbers of *Arctica* as follows: D7AD01 (2 live, 1 valve), D7AD02 (1

live, 1 valve), D7AD03 (1 valve), D7AD04 (1 valve), D7AD05 (3 live, 1 valve). D7AD04 in addition contained 2 live *A. aculeata.*

Station	Latitude	Longitude	Numbers of *A.islandica* specimens collected		
			Live	Dead, single valves	Dead, paired
D7	54° 08.50 N	4° 54.50 W	6	5	-

Table 1*. Station position west Isle of Man and number of specimens collected.*

Appendix A – Position, time and depth of tows

Two rows are shown for each tow, representing the start and finish of dredging or trawling, from the end of the deployment process to the start of the recovery process. All tows used the *Arctica* dredge. Three metres have been added to the depths in the ship's log to compensate for the draft of the ship. The stations are shown in the order in which they were sampled.

Station SB

Date	Tow #	Depth (m)		Latitude			Longitude	
26/09/2006	SBAD01	54.9	56	41.967	N	5	45.316	W
26/09/2006	SBAD01	50.2	56	41.788	N	5	45.753	W
26/09/2006	SBAD02	68.1	56	41.896	N	5	45.668	W
26/09/2006	SBAD02	64.9	56	42.028	N	5	45.278	W
26/09/2006	SBAD03	55.8	56	42.057	N	5	45.249	W
26/09/2006	SBAD03	66.0	56	41.934	N	5	45.575	W
26/09/2006	SBAD04	71.0	56	41.971	N	5	45.686	W
26/09/2006	SBAD04	62.0	56	42.106	N	5	45.247	W
26/09/2006	SBAD05	58.8	56	42.010	N	5	45.291	W
26/09/2006	SBAD05	60.3	56	41.847	N	5	45.711	W

Station SM

Date	Tow #	Depth (m)		Latitude			Longitude	
26/09/2006	SMAD01	39.0	56	40.583	N	6	00.802	W
26/09/2006	SMAD01	42.1	56	40.590	N	6	00.277	W

26/09/2006	SMAD02	42.1	56	40.512	N	6	00.428	W
26/09/2006	SMAD02	42.0	56	40.497	N	6	01.019	W
26/09/2006	SMAD03	44.2	56	40.413	N	6	00.790	W
26/09/2006	SMAD03	43.1	56	40.442	N	6	00.208	W
26/09/2006	SMAD04	36.2	56	40.695	N	6	00.767	W
26/09/2006	SMAD04	34.0	56	40.684	N	6	00.384	W

Station M

Date	Tow #	Depth (m)		Latitude			Longitude	
26/09/2006	MAD01	49.0	56	39.301	N	5	58.986	W
26/09/2006	MAD01	54.2	56	39.327	N	5	58.448	W
26/09/2006	MAD02	58.9	56	39.355	N	5	58.457	W
26/09/2006	MAD02	61.0	56	39.342	N	5	59.259	W

Station TP

Date	Tow #	Depth (m)		Latitude			Longitude	
27/09/2006	TPAD01	51.7	56	37.554	N	6	24.352	W
27/09/2006	TPAD01	53.4	56	37.961	N	6	23.902	W

Station MD

Date	Tow #	Depth (m)		Latitude			Longitude	
27/09/2006	MDAD01	58.6	56	40.071	N	5	52.132	W
27/09/2006	MDAD01	31.7	56	39.846	N	5	51.541	W
27/09/2006	MDAD02	51.7	56	40.065	N	5	52.101	W
27/09/2006	MDAD02	33.9	56	39.845	N	5	51.656	W
27/09/2006	MDAD03	57.5	56	40.091	N	5	52.125	W
27/09/2006	MDAD03	32.5	56	39.853	N	5	51.575	W

Station D7

Date	Tow #	Depth (m)		Latitude			Longitude	
28/09/2006	1 (barren)	61.0	54	08.588	N	4	54.178	W
28/09/2006	1 (barren)	61.0	54	08.319	N	4	54.265	W
28/09/2006	D7AD01	61.4	54	08.221	N	4	54.281	W
28/09/2006	D7AD01	61.4	54	08.191	N	4	54.291	W
28/09/2006	D7AD02	61.4	54	07.957	N	4	54.286	W
28/09/2006	D7AD02	61.9	54	08.191	N	4	54.291	W
28/09/2006	4 (barren)	62.0	54	08.320	N	4	54.282	W
28/09/2006	4 (barren)	62.1	54	08.602	N	4	54.026	W
28/09/2006	D7AD03	61.2	54	08.578	N	4	53.825	W
28/09/2006	D7AD03	59.3	54	08.349	N	4	54.102	W

28/09/2006	D7AD04	62.2	54	08.231	N	4	54.286	W
28/09/2006	D7AD04	64.6	54	08.020	N	4	54.601	W
28/09/2006	D7AD05	65.6	54	08.070	N	4	54.583	W
28/09/2006	D7AD05	58.5	54	08.350	N	4	54.052	W