

**DEPARTMENT FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS.  
CEFAS LOWESTOFT LABORATORY, LOWESTOFT, SUFFOLK, ENGLAND.**

**2005 RESEARCH VESSEL, PROGRAMME.**

**REPORT: RV ENDEAVOUR; CRUISE 10/05.**

<b>STAFF:</b>	<b>Part A</b>	<b>Part B</b>
	J Thain (SIC)	J Thain (SIC)
	J Jones	J Jones
	A Kenny	W Reynolds
	E Garnacho	E Clarke
	P Roberts	R Dyer
	W Reynolds	J Bignall (Weymouth)
	S Feist (Weymouth)	G Stentiford (Weymouth)
	J Bignall (Weymouth)	R Hicks (Weymouth)
	F Goodsir (Lowestoft)	F Goodsir (Lowestoft)
	K Bateman (Weymouth)	S Lincoln
	S Lincoln	
	Laura Tollhurst	

All staff from Burnham Laboratory unless indicated otherwise.

**DURATION:**

17th June to 8<sup>th</sup> July, 2004.

**LOCATION:**

North Sea, Irish Sea, Celtic Sea and English Channel.

**AIMS:**

- 1.** To collect samples of demersal fish for chemical analysis from the North Sea, Eastern English Channel and Irish Sea in support of UK National Marine Monitoring Programme (NMMP), and OSPAR purposes.
- 2.** To collect fish samples at NMMP sites, for fish disease and genetic toxicological analysis (e.g. DNA adducts).
- 3.** To collect fish samples at NMMP sites for biochemical markers (e.g. EROD and bile metabolites analysis).

4. To collect water samples for NMMP biological effects studies and to deploy fractionation / bioassay techniques on water samples from offshore and near shore/estuarine locations.
5. To sample representative NMMP stations using grab, multicore and beam trawl for trace metal contaminants, sediment particle size analysis, PAHs and benthic fauna and other chemical contaminants as appropriate.
6. To collect samples of water in the Irish Sea and North Sea for DEFRA contract on the provision of advice in relation to radiological matters.

**NARRATIVE: (all times GMT)**

*ENDEAVOUR* sailed from Swansea at 1400 hrs on the 17<sup>th</sup> June and steamed to Carmathen Bay arriving there at 1830 hrs where the Granton trawl was deployed to collect fish for aims 1, 2 and 3. Overnight, *ENDEAVOUR* sailed to south Cardigan Bay and in the morning successfully trawled for fish at NMMP station 654. In the afternoon *ENDEAVOUR* moved north to the NMMP (665) Inner Cardigan Bay station and benthos was collected using the 2 m wooden beam trawl and sediment and benthos collected from a series of 10 Day grabs for aim 5. This was completed in the late afternoon when the Granton trawl was used to collect fish at this station. On the morning of the 19<sup>th</sup> June *ENDEAVOUR* was in position at the Off Cardigan NMMP station (665). The Granton trawl was deployed twice but very few fish were obtained and samples were obtained only for aim 1. By midday the ship was in position at North Cardigan Bay (NMMP 649) where fish were successfully obtained for all of aims 1,2 and 3.

Overnight, *ENDEAVOUR* steamed for Dundrum Bay and *en route* collected five water samples through the ship's clean water system for radiological analysis. At Dundrum Bay five deployments of the Granton trawl were made at the outer and inner stations in order to obtain sufficient fish for sampling re aims 1, 2 and 3. In addition, water samples were taken using the churn sampler for aim 4. *ENDEAVOUR* left Dundrum Bay in the late afternoon and steamed overnight to St Bees Head and *en route* collected seven water samples for aim 6.

On the 21<sup>st</sup> June the Granton trawl was deployed at two stations, St Bees Head (NMMP 769) and SE Isle of Man (NMMP 806) and sufficient fish were collected for aims 1, 2 and 3. Sediment samples were taken from the mid tow position at each site and water samples were taken with the churn sampler for aim 4. In addition, three water samples using the ship's seawater supply were collected from St Bees Head and Sellafield. The work was completed at 1830 hrs and the ship sailed to the Isle of Man. In the evening the ship's launch was used to pick up a scientist from the port of Douglas. Overnight the ship returned to the SE Isle of Man NMMP station on a route which allowed a further six water samples to be collected for aim 6.

On the morning of the 22<sup>nd</sup> June additional fish were collected for aim 3 at the SE Isle of Man NMMP station using the Granton trawl. After completing this work a series of ten grabs and four multicore deployments and a tow through the NMMP position with the 2 m wooden beam for aim 5 was completed successfully. By mid afternoon, *ENDEAVOUR* was in position at the Morecambe Bay NMMP (796) station. Fish were successfully collected and samples taken for aims 1,2 and 3 and water samples taken with the churn sampler for aim 4.

*ENDEAVOUR* sailed overnight to the Burbo Bight and *en route* took a further three water samples for radiological analysis (aim 6). At the Burbo Bight NMMP station (NMMP 706) the Granton trawl was deployed seven times in order to collect sufficient fish for aims 1, 2 and 3. Following on from this, a series of five Day grabs were taken at the NMMP 705 station for sediment chemical analysis for aim 5. By mid afternoon, *ENDEAVOUR* had moved westwards to the Liverpool Bay NMMP station (715) where a series of ten Day grabs was completed and the 2 m wooden beam trawl was deployed to obtain samples for aim 5. During the evening, the Granton trawl was used to fish the nearby TREND fishing station where commercial fish species in length stratified size ranges were collected for chemical analysis (aim 1).

On the 24<sup>th</sup> June, *ENDEAVOUR* completed two fishing stations for aims 1, 2 and 3 at Liverpool Bay (NMMP 715) and Red Wharf Bay (NMMP 776). Four deployments of the Granton trawl were needed to obtain sufficient fish at station 715 and two tows were needed at station 776. Sediments and water were also taken from the mid tow positions using the Day grab and churn sampler respectively.

After completing the work in Red Wharf Bay *ENDEAVOUR* sailed for Weymouth and on the night of the 24<sup>th</sup> June collected six water samples for aim 6. *En route* to Weymouth investigative fishing tows using the Granton trawl were carried out at West Lundy, North Devon, South of Isles of Scilly and South Cornwall to the Eddystone. Sufficient dab for aims 1, 2 and 3 were caught on tows at West of Lundy and South of the Eddystone. *ENDEAVOUR* berthed at Weymouth at midday on the 27<sup>th</sup> June. Whilst in port liquid nitrogen was brought on board to replenish the sample storage dewars. Samples taken on the cruise were also transported to the Weymouth Laboratory on cardice. In the afternoon, approximately 15 staff from the Weymouth Laboratory visited the ship and were given guided tours by scientific staff and the ship's officers. In addition, the changeover of four staff took place and the ship sailed again on the late evening tide.

By morning on the 28<sup>th</sup> July, *ENDEAVOUR* had sailed into Lyme Bay and after three experimental tows with the Granton trawl sufficient dab for aims 1,2 and 3 were collected from a position to the north west of the Bay. In the evening, additional fish were collected from the South of Eddystone (sampled the previous day) for aim 1 and 3.

Overnight, *ENDEAVOUR* sailed eastwards and on the 29<sup>th</sup> June deployed the Granton trawl for investigative NMMP fishing at Poole Bay, Christchurch Bay and Off Newhaven. Sufficient dab were caught at the Off Newhaven position for NMMP purposes under aims 1, 2 and 3. This work was completed at 2245 hrs and the ship sailed to Rye Bay (NMMP

486).

On the morning of the 30<sup>th</sup> June, fish were successfully collected from the outer and inner Rye Bay trawling stations for aims 1, 3 and 4. Sediment and water for aim 4 were collected from the mid tow position using the Day grab and churn sampler respectively. *ENDEAVOUR* then proceeded along the Dover Straits inside the separation zone and northwards to the Outer Gabbard station (NMMP 475). A cable had been placed through the tow that had been fished in previous years. There was no alternative nearby tow available and since the ground looked clear it was decided to shoot the Granton trawl on half of the tow and extend the haul position southwards. Sufficient dab were obtained for aims 1, 2 and 3. Water and sediment were also taken from the mid tow position. The station was completed at 2340 hrs.

It had been noted on the previous day that there was a shortage of heparin on board for sampling fish blood and efforts were made to obtain a supply from the Lowestoft, Weymouth and Burham Laboratories. Consequently on the 1<sup>st</sup> July *ENDEAVOUR* completed the fishing at the Trend station close to Smiths Knoll in the morning and steamed to Lowestoft. On arrival there at 1300 hrs the Jet Boat was sent in to pick up the supplies of heparin. *ENDEAVOUR* then returned to the Smiths Knoll and trawled for fish for aim 1 at the alternative Trend station. Insufficient fish were caught at both the two Trend stations but an alternative tow close by was very successful and commercial fish in stratified lengths were collected for chemical analysis.

On the 2<sup>nd</sup> July the Granton trawl was deployed at both the Central Dogger (NMMP 287) and North East Dogger (NMMP 283) and fish were successfully obtained for aims 1, 2 and 3. After completing the North East Dogger station at 1900 hrs, *ENDEAVOUR* tracked northwards to enable four water samples to be collected for aim 6. Over the next two days, 3<sup>rd</sup> and 4<sup>th</sup> July, *ENDEAVOUR* fished with the Granton trawl at the West Dogger (286), North Dogger (284), Off Flamborough (344) and Off Humber (346) NMMP stations and collected fish for aims 1, 2 and 3. On the 4<sup>th</sup> July, the weather deteriorated and by evening was close to gale force and remained so overnight as the ship sailed to the Indefatigable Bank. As *ENDEAVOUR* fished at this station (NMMP 378) on the morning of the 5<sup>th</sup> July the weather improved. After completing this station at 1121 hrs *ENDEAVOUR* steamed to the Edge of Smiths Knoll to collect flounder and cod samples for aims 2 and 3.

Over the next two days (6<sup>th</sup> and 7<sup>th</sup> July), the Granton trawl was deployed successfully to collect fish for aims 1, 3 and 4 at Central Dogger (NMMP 287), NE Dogger (NMMP 283), North Dogger (NMMP 284), Inner Wash (NMMP 386), Outer Humber (NMMP 377), Amble (NMMP 244) and Tees (NMMP 294). All work was completed by 1700 hrs and *ENDEAVOUR* sailed for Lowestoft, berthing on the morning tide of the 8<sup>th</sup> July.

**Weather;** the weather was good throughout the 21 day cruise with the exception of one day off the Isles of Scilly and 2 days Off the Humber when the wind reached ca. 35-40 knots but this did not curtail operations and fishing.

**Fishing;** the Granton trawl was used for all fishing stations and was deployed on 123 occasions (ca. 270 miles in total haul distance). This was more than in previous years as a result of investigative tows carried out on the south coast of England and in the Celtic Sea and because of a lack numbers of dab in some areas.

## RESULTS

**Aim 1.** Samples of dab for chemical analysis were collected when caught in sufficient numbers (i.e. 50) and appropriate size at all NMMP sites. This amounted to 29 stations (see appendix 1) and coincided with sites where fish were caught for biological effects and fish disease studies. All samples were frozen and stored at -20 C. for chemical analysis at the Burnham Laboratory.

Samples of plaice and dab in five consecutive length stratified groups were collected for trend purposes from Liverpool Bay. Whiting were not collected as in previous years as they were not there in sufficient numbers and the size range was limited. Plaice only were collected from the Smith's Knoll trend site. All samples were frozen and stored at -20 C. for chemical analysis at the Burnham Laboratory.

There is a poor coverage of fishing stations in the NMMP programme in the Celtic Sea and the south coast of England; there is one station (Rye Bay) between Cardigan Bay in the Irish Sea and Outer Gabbard) in the southern North Sea. In order to address this several investigative trawls were carried out in the Celtic Sea, Off North Devon and along the south coast of England. This was very successful and sufficient dab were collected for aim 1 and in addition aim 2 and 3, at sites in West Lundy, South Eddystone, Inner Lyme Bay and Off Newhaven. These stations will be incorporated into future NMMP fish sampling work programmes.

**Aim 2.** External and internal diseases of dab (*Limanda limanda*) were assessed at the following stations. Figures in parenthesis refer to numbers of dab sampled for histopathology and for external diseases respectively:

*Camarthan Bay (50, 0), Inner Cardigan Bay (50, 210), South Cardigan Bay (20, 182), North Cardigan Bay (20, 0), Dundrum Bay (12, 0), St Bee's (50, 247), SE Isle of Man (50, 233), Morecambe Bay (50, 471), Burbo Bight (50, 245), Liverpool Bay (50, 304), Red Wharf Bay (50, 322), Southern Bristol Channel (20, 0), South of Eddystone (50, 0), Lyme Bay (20, 0), Newhaven (50, 0), Rye Bay (50, 215), Thames Gabbard (20, 26), Central Dogger Bank (50, 215), NE Dogger Bank (50, 250), West Dogger Bank (50, 208), North Dogger Bank (50, 251), Flamborough (50, 208), Off Humber (50, 224), Indefatigable Bank (50, 210), Amble (50, 0) and Tees Bay (50, 207).*

In total, 5113 dab were screened for disease. Liver nodules were removed and will be further processed for histological diagnosis of lesion type (n = 84). Additionally, large tumours were excised and frozen for proteomic and genomic assessment of tumour-specific genes, proteins and metabolites. Those dab routinely sampled for histopathological changes in liver were further sampled for blood plasma and liver, which were subsequently frozen for proteomic and metabolomic assessment respectively. These

specimens will be retained in a tissue bank at the CEFAS Weymouth laboratory for cross-referencing to samples taken for histology and biomarker assessment. A subset of plasma samples from each fish taken for histopathology and biomarkers (n = 1112) will be analysed for VTG using an assay being developed at CEFAS Weymouth. Each plasma sample will have a cross reference to histopathology, and, where appropriate, biomarker data.

Dab from several sites (including Inner Cardigan, St. Bee's, Lyme Bay, Rye Bay, NE Dogger Bank, Amble, Off Tees) were sampled for population genetic analysis. Fin clips were collected from each fish sampled for external diseases. In addition, cross referenced otoliths were also taken from these fish. Samples will be worked up under a specific contract on population genetics of dab and flounder at CEFAS Weymouth.

Specific samples of liver were collected from baseline and external disease specimens for laser dissection microscopy at CEFAS Weymouth laboratory.

### ***Other fish species examined***

A number of additional fish species were collected from each haul for assessment of pathology and for parasites. These included plaice, red gurnard, grey gurnard, dover sole, dragonet, sea trout, sea bass, flounder, mackerel, John Dory, whiting, haddock, cod. In total, 96 cod were sampled for plasma, bile, CALUX and histopathology from several sites including Smith's Knoll (27) and Southern Bristol Channel (57). In order to identify further suitable biomarker species, Dragonet, Red Gurnard and Grey Gurnard were sampled from various sites within the North and Irish Seas.

A specific effort was made to sample flounder that appeared in several hauls in the Smith's Knoll area. Samples were collected for full histopathology, biomarkers and contaminants and will be used as an offshore reference for this species.

One species of crustacean, pink shrimp (*Pandalus spp.*) was collected from the Wash. Samples will be analysed for the presence of a pathogenic bacilliform virus known to infect other crustacean species at this site.

### ***Electron microscopy***

Samples of liver corresponding to each specimen of dab collected for baseline histopathology was also preserved for electron microscopy. Individual samples are fully cross referenced to all histopathology and biomarker specimens and will be selectively analysed at CEFAS Weymouth. Other selected samples were also collected and preserved for ultrastructural analysis under the scanning and transmission electron microscope. This included samples of hepatopancreas from pink shrimp (*Pandalus spp.*) for detection of bacilliform virus

**Aim 3.** Fish tissue was collected from dab at 27 locations (including NMMP) for biological effects investigations using biomarkers. Sections of dab liver were stored in liquid nitrogen for measurement of EROD activity, analysis of DNA adducts and bile was frozen for PAH analysis. The analysis will be carried out at the Burnham and Lowestoft Laboratories. In addition, hermit crabs were collected and frozen at  $-20\text{ C}$  from all fishing tows for targeted chemical analysis in support of the biomarker work programme and in support of the chemical contaminants and fish disease programme (aims 1 and 2). Opportunistically, 90 samples of blood plasma and bile were sampled from cod for subsequent VTG and DR CALUX assay on return to the Burnham laboratory.

**Aim 4.** Twenty 60 l bulk water samples were taken from NMMP sites and additional sites and extracted on-board using SPE cartridges for concentrating contaminants and subsequent bioassay back at the Burnham laboratory. Seventeen water samples were taken at inshore sites for extraction and subsequent analysis of pharmaceutical contaminants. Sediment samples were collected from 27 NMMP and additional stations using the Day grab. These sediments were frozen and will be analysed for chemical contaminants to support the chemical contaminants in fish NMMP programme and to support biological effects studies.

**Aim 5.** Ten sediment samples were collected for the determination of metal and organic contaminants and benthic fauna, from each of 3 NMMP sites, Cardigan Bay (NMMP 655), Liverpool Bay (NMMP 715) and SE Isle of Man (NMMP 805). Chemical analysis and identification of the benthos will be carried out back at the Burnham Laboratory. In addition, benthos samples were collected at these three sites using a 2-m beam.

**Aim 6.** Water samples were taken in the Irish Sea and North Sea for radiological analysis. A total of 38 water samples was collected through the ship's sea water supply, each sample consisting of two twenty-five litre carboys for  $^{137}\text{C}$  analysis and one one-litre polybottle for  $^3\text{H}$  analysis. The water samples were stored for subsequent analysis at the Lowestoft Laboratory.

### **Cetacean sightings:**

During the ship's passage the following cetaceans were sighted.

20<sup>th</sup> June 2005, 1240 hrs at 54 06 84 N 05 37 09W

Three whales (*Orcinus orca*), two adults and one young whale 100 m from the ship heading south.

### **Noteworthy observations:**

The following unusual fish were caught;

Lamprey, (*Petromyzon marinus*) all ca 30 cms.

1 at South Cardigan Bay (52 10.90 N 04 29.87 W)

1 at Burbo Bight (53 28.24 N 03 20.47 W)

3 at Smith's Knoll Bank (52 46.48 N 02 17.25 E)

Sea trout, (*Salmo trutta*) all 28 to 31 cms.

1 at St Bees (54 30.71 N 03 47.63 W)

3 at Trend Liverpool Bay (53 23.76 N 03 37.55 W)

1 at Liverpool Bay (53 28.32 N 03 41.91 W)

1 at Burbo Bight (53 28.24 N 03 20.47 W)

Twait Shad, (*Alosa fallax*) all between 42 to 45 cms.

4 at Smith's Knoll Bank (52 46.48 N 02 17.25 E)

**Acknowledgements:** I would like to acknowledge the active and excellent support and help of the Captain, Fishing Skipper, officers and crew in completing the above programme of work

John Thain (**Scientist In Charge**) - signed  
8<sup>th</sup> July 2005.

**SEEN IN DRAFT:**

Captain A Reading (**Master**) - signed

B Salter (**Fishing Skipper**) - signed

**INITIALLED:**

Jacqueline Jones (**Contract Leader for CEFAS NMMP**)

Andrew Kenny (**Monitoring and Assessment Topic Area Leader and Coordinator**)

**DISTRIBUTION:**

Basic list: +



J Thain (SIC)  
K Bateman  
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F Goodsir  
R Hicks  
J Jones  
A Kenny  
S Lincoln  
B Lyons  
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P Roberts  
G Stentiford

## **APPENDIX 1: NMMP FISHING STATIONS**

### **Samples taken on cruise CEFAS Endeavour 10 / 05**

A total of 123 tows (ca. 270 land miles) were made with the Granton trawl

<b>NMMP Number</b>	<b>Location</b>	<b>Mid tow Lat. Long.</b>	<b>Dab Sampled</b>	<b>No of tows</b>
244	Amble	55 16.01 N 01 15.26 W	Y	3
243	Farne	55 29.71 N 01 07.59 W	N	-
283	North East Dogger	55 18.05 N 02 53.82 E	Y	3
284	North Dogger	55 04.08 N 02 05.40 E	Y	3
286	West Dogger	54 46.76 N 01 17.69 E	Y	3
287	Central Dogger	54 30.00 N 02 42.53 E	Y	3
294	Tees Bay	54 45.25 N 01 08.31 W	Y	2
344	Off Flamborough	54 14.72 N 00 29.91 E	Y	4
346	Off Humber	54 03.92 N 01 47.46 E	Y	3
377	Outer Humber	53 19.37 N 00 25.47 E	Y	4
378	Indefatigable Bank	53 33.40 N 02 04.92 E	Y	3
387	Inner Wash	53 08.50 N 01 33.30 E	Y	2
475	Outer Gabbard	52 01.86 N 02 06.57 E	Y	3
486	Rye Bay	50 46.74 N 00 46.83 E	Y	5
New	Off Newhaven	50 45.59 N 00 00.00 E	Y	5
New	Inner Lyme Bay	50 36.86 N 02 55.82 W	Y	4
New	South Eddystone	50 06.44 N 04 06.06 W	Y	3
New	West Lundy	51 09.79 N 05 26.67 W	Y	3
605	Celtic Deep	51 10.29 N 05 43.75 W	N	-
616	Camarthen Bay	51 32.82 N 04 35.13 W	Y	3
649	North Cardigan Bay	52 42.44 N 04 32.29 W	Y	4
654	South Cardigan Bay	52 10.90 N 04 29.87 W	Y	4
656	Inner Cardigan Bay	52 18.00 N 04 16.35 W	Y	3
665	Outer Cardigan Bay	52 23.76 N 04 53.72 W	Y	3
706	Burbo Bight	53 28.24 N 03 20.47 W	Y	5
715	Liverpool Bay	53 28.32 N 03 41.91 W	Y	4
769	St Bees Head	54 30.71 N 03 47.63 W	Y	3
776	Red Wharf Bay	53 22.46 N 04 12.84 W	Y	2
796	Morecambe Bay	53 55.31 N 03 23.23 W	Y	2
805	SE Isle of Man	54 03.36 N 03 52.47 W	Y	6
815	Outer Dundrum Bay	54 04.81 N 05 37.29 W	Y	4
Trend	Smith's Knoll	52 48.67 N 02 45.33 E	N	2
Trend	Alternative Smith' Knoll	52 43.91 N 02 27.51 E	N	1
Trend	Smith's Knoll Bank	52 46.48 N 02 17.25 E	Y	7
Trend	Liverpool Bay	53 23.76 N 03 37.55 W	Y	2
Not App	Investigative tows	N. Devon and S. Coast	N	12

## **APPENDIX 2: RADIOLOGICAL WATER SAMPLING STATIONS.**

### **Samples taken on cruise CEFAS Endeavour 10 / 05**

A total of 38 water samples were taken for radiological analysis.

<b>Date</b>	<b>Time (BST)</b>	<b>Latitude</b>	<b>Longitude</b>	<b>Tritium (25L)</b>	<b>Caesium (1L)</b>
18/06/2005	19:49			2	1
19/06/2005	18:11	52.48.033 N	04.17.256 W	2	1
19/06/2005	22:05	52.56.900 N	04.51.528 W	2	1
20/06/2005	01:45	53.29.800 N	05.02.500 W	2	1
20/06/2005	04:14	53.51.041 N	05.10.986 W	2	1
20/06/2005	06:19	54.05.178 N	05.31.487 W	2	1
20/06/2005	18:36	53.54.762 N	06.03.592 W	2	1
20/06/2005	23:37	54.14.706 N	04.55.605 W	2	1
21/06/2005	03:05	54.41.200 N	04.31.000 W	2	1
21/06/2005	04:37	54.42.924 N	04.09.317 W	2	1
21/06/2005	06:07	54.41.320 N	03.45.686 W	2	1
21/06/2005	07:00	54.36.345 N	03.52.863 W	2	1
21/06/2005	12:09	54.26.331 N	03.41.702 W	2	1
21/06/2005	12:38	54.24.486 N	03.34.255 W	2	1
21/06/2005	13:20	54.16.891 N	03.29.621 W	2	1
21/06/2005	22:31	53.59.561 N	04.26.829 W	2	1
22/06/2005	00:35	53.47.600 N	04.08.817 W	2	1
22/06/2005	03:27	53.37.265 N	03.37.675 W	2	1
22/06/2005	04:39	53.44.875 N	03.44.335 W	2	1
22/06/2005	06:14	53.55.452 N	03.50.993 W	2	1
22/06/2005	07:35	54.03.892 N	03.49.446 W	2	1
22/06/2005	14:33	53.57.842 N	03.34.237 W	2	1
22/06/2005	19:45	53.54.916 N	03.15.704 W	2	1
22/06/2005	23:45	53.47.037 N	03.10.076 W	2	1
23/06/2005	03:30	53.34.875 N	03.22.084 W	2	1
23/06/2005	21:27	53.24.141 N	03.38.951 W	2	1
24/06/2005	17:50	53.30.813 N	04.15.632 W	2	1
24/06/2005	22:10	52.58.614 N	05.21.569 W	2	1
25/06/2005	01:05	52.33.038 N	05.49.469 W	2	1
25/06/2005	02:55	52.09.645 N	06.06.863 W	2	1
25/06/2005	03:35	52.01.746 N	06.17.253 W	2	1
02/06/2005	21:24	55.42.707 N	02.46.744 E	2	1
03/07/2005	02:20	55.50.141 N	01.10.643 E	2	1
03/07/2005	04:05	55.35.197 N	00.48.484 E	2	1
03/07/2005	07:50	54.48.930 N	01.15.664 E	2	1
04/07/2005	01:25	54.53.198 N	00.16.857 E	2	1
06/07/2005	19:17	53.56.573 N	00.16.603 N	2	1