DRAFT

DEPARTMENT FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS.

2003 RESEARCH VESSEL REPORT

PROGRAMME: MAIDEN SCIENTIFIC VOYAGE OF RV *ENDEAVOUR*: CRUISE 4a

STAFF:

Part 1 :
D Limpenny (SIC)
W Meadows
S Boyd
K Cooper
R Kilbride
A Hewer
P Whomersley
M Schratzberger
M Cassap
J Eggleton
C Limpenny
N Lyman (from 1st June)
E Garnacho
J Hancock (Simrad) (25th May only)

Part 2 :
S Boyd (SIC)
D Limpenny
W Meadows
S Bolam
P Whomersley
M Curtis
R Coggan
K Cooper
R Kilbride
H Bates
C Morris
N Lyman
J Hancock (Simrad) (until 9th June)
D Gill (SES) (until 12th June)
M Proctor (Tower) (12th June only)
D Pearce (12th June only)

DURATION:

Part 1 : 25 May – 5 June
Part 2 : 5 June – 16th/17th June

LOCALITY:

North Sea & E. Channel

AIMS:

1. To survey dredged material disposal sites at the Souter Point (Tyne), North Tyne (Tyne), Tees Bay, Inner Gabbard (outer Thames estuary), Roughs Tower (off Harwich), Nab Tower (Isle of Wight), and Rame Head (off Plymouth) and Falmouth for benthos and for trace metal and organic contaminants in sediments, using grabbing, coring and acoustic methods.

2. To apply a range of sampling methodologies at a number of dredged material disposal and aggregate extraction sites, to assist in the development of environmental indicators for these activities.

3. To sample representative NMMP locations using grabbing, coring, acoustic and trawl methods for trace metal and organic contaminants, litter and the epi-, macro-, meio-, and micro fauna.

4. To sample surface waters at representative offshore and intermediate NMMP locations for salinity, nutrients and chlorophyll.

5. To sample the benthos and sediments for time-series studies using the Hamon grab, in the vicinity of aggregate extraction sites off the Isle of Wight and Lowestoft.

6. To conduct time-series studies at gravelly locations following cessation of aggregate dredging, using grabbing, trawling, photographic and acoustic (including multibeam bathymetry) techniques.

7. To sample horse-mussels from the Humber/Wash area for later analyses of contaminants in flesh.

8. To sample the sediments and benthos off the Tyne for time-series studies using grab, core and beam trawl and continuation of sampling within a temporal box.

9. To conduct habitat mapping surveys at a range of sites impacted by anthropogenic activities using grabbing, coring, trawling, photographic and acoustic (including multibeam bathymetry) techniques.

10. To carry out a short sidescan sonar survey at an aggregate extraction site in the outer Wash.

11. To undertake a broadscale survey of an area of seabed between Dungeness and Hastings using acoustic, photographic and biological sampling techniques.

12. To acoustically survey and collect samples from a western English Channel site for comparison with existing samples from the eastern English Channel.

NARRATIVE

Endeavour sailed at 18:15h on 25th May and carried out trials of the Simrad EM 3000 multibeam bathymetric system off Lowestoft (Additional Aim). On completion of these trials, the Simrad representative was put ashore by small boat at Lowestoft. *Endeavour* then headed to NMMP 345 (Off Humber/Wash), where on 26th May, sediment samples were collected for sediment-bound heavy metal contaminants and organic compounds (Aim 3), and surface waters were collected for nutrients, chlorophyll, salinity and suspended load (Aim 4). Replicate samples of epifauna, macrofauna, meiofauna, microfauna and litter were also collected at this site (Aim 3). Later the same day, similar sampling was carried out at NMMP 285 (Off Tyne/Tees) and the following morning at NMMP 245 (Off Tyne) (Aims 3 & 4). Following this, a comprehensive sidescan sonar and multibeam survey was conducted within and in the vicinity of the North Tyne disposal site (TY070) (Aims 1, 2 & 9). A transponder was fitted to the sidescan sonar fish to provide an initial assessment of the HIPAP positioning system (Additional Aim).

On the 28th May 2003, sampling using the Day grab and NIOZ box corer was carried at TY070 (Aims 1 & 2), finishing in the early hours of the 29th May. Water sampling to assess TBT levels in suspended particulate material was also undertaken at this site (Additional Aim). The following morning, a series of Shipek grab samples were collected within and in the vicinity of the same disposal site for later contaminant analysis (Aim 1). A transect of stations was sampled at the Souter Point dredged material disposal site using the Day Grab, NIOZ Box corer and Bowers and Connelly Multiple-Corer throughout the afternoon and evening, finishing at 2400h on the 29th May (Aim 1). Following a preliminary interpretation of the sidescan sonar record collected at TY070, a series of Hamon grabs, 2m Beam trawls and Shipek grab samples were collected in the area throughout the day until late evening on 30th May (Aims 1 & 9). Overnight, a sidescan sonar and multibeam bathymetry survey of the Souter Point disposal site was conducted (Aim 1). Grabbing and trawling surveys at TY070 were completed by midday on 31st May. *Endeavour* then carried out sampling of benthos and sediments at three sites on the time series transect through the historic Tyne sewage sludge disposal site (Aim 7). Sampling for sediment bound contaminants was then completed around the Souter Point disposal site using a Shipek grab (Aim 1). A trial of the towed video sledge system was conducted at TY070, with work being completed by midnight on 31st. On completion, a series of multibeam bathymetry lines were surveyed across the Souter Point disposal site which, in combination with the previous nights work, provided 100% bathymetric coverage of the region (Aim 1).

The following morning, 2-m beam trawl tows were carried out at TY070 (Aim 1 & 9). The species composition, biomass and size-weight relationships of selected taxa were determined from the resulting samples (Aims 1 & 9). Video sledge tows were then carried out at TY070 using the ship's Dynamic Positioning capability. This contruibuted towards a better understanding of the habitats within the survey area (Aims 1 & 9). At this point, work was suspended whilst Nigel Lyman was picked up from Tyne Harbour using *Endeavour's* small boat. Work then continued with the

collection of 2m beam trawl samples at the Souter Point disposal site (Aim 1). *Endeavour* then sailed to the Tees Bay dredged material disposal site, where a series of grab and beam trawl samples were collected, work being completed by 0100h on 2nd June (Aim 1). The dredged material disposal site at Bridlington Bay was sampled for sediment contaminants around 0500h the same morning (Additional Aim), before heading east to an aggregate extraction area (Area 408), located off the Humber. Sampling using a Hamon grab of a previously dredged area and two reference locations within the licensed site commenced on arrival (Aim 6). This was followed by a number of video sledge tows within the dredged areas. Work was completed by 2230h, and the vessel sailed to an historic Humber sewage sludge disposal site where a Newhaven Scallop dredge was deployed, on the following morning, to collect horse mussels (*Modiolus*) for contaminant analysis (Aim 7).

Endeavour then sailed to the repositioned Humber NMMP site (NMMP 376) where sediment samples were collected for sediment-bound heavy metal contaminants and organic compounds, and surface waters were collected for nutrients, suspended load, salinity and chlorophyll (Aims 3 & 4). The vessel then sailed to the Lynn Deep NMMP site (NMMP 386), which was sampled for sediment-bound heavy metal contaminants and organic compounds (Aim 3) and surface water (Aim 4). On completion of sampling, *Endeavour* sailed to aggregate extraction site Area 107 where a short sidescan sonar survey was conducted over a characteristic pair of dredge tracks first identified in 1995 (Aim 10). The vessel then headed to a nearby temporal site off the North Norfolk coast where a sample of horse mussels was collected for contaminant analysis. This work was completed by 2400h (Aim 7).

On the morning of 4th June at 0600h, sampling using the Hamon grab commenced on a widely spaced transect of stations between Cromer and Southwold (Aim 5). On completion of this work, *Endeavour* sailed south to the Inner Gabbard dredged material disposal site where sampling using a Hamon and Shipek grab was initiated (Aim 1). A sidescan sonar and multibeam survey was carried out over the site and completed by 2400h on the 4th June, 2003 (Aim 1). *Endeavour* sailed to Lowestoft, docking at 12:30h on 5th June, where a changeover of scientific staff was completed with A. Hewer, M. Schratzberger, M. Cassap, E. Garnacho, C. Limpenny J. Eggleton leaving the vessel, and S. Bolam, H. Bates, and C. Morris, M. Curtis and R. Coggan joining. In addition, representatives from Simrad and SES Ltd joined the vessel. Docking in Lowestoft also allowed *Endeavour* to take onboard an anti-twist crane wire which replaced the defective wire previously loaded on the coring winch.

PART B

On departing Lowestoft at 1455h on 5th June, further trials of the Simrad EM 3000 multibeam bathymetric system were conducted whilst in transit to the Inner Gabbard dredged material disposal site (Additional Aim). The Hamon and Shipek grab survey of the area then recommenced (Aim 1) and was followed overnight by a sidescan sonar and multibeam survey (Aim 6) of a nearby relinquished aggregate extraction site (Area 222).

The next morning, a sequence of Day grab samples were taken for later analyses of sediment contaminants and the benthic fauna (Aim 3) at the Inner Gabbard NMMP

site (NMMP 475). This was supplemented by surface water samples for nutrients, chlorophyll, salinity and suspended load (Aim 4). *Endeavour* then returned to the Inner Gabbard dredged material disposal site to complete the grab survey (Aim 1). Taking advantage of a heightened sea state, further multibeam lines were run to the north of the disposal site to test the capability of the EM 3000 system and check any anomalies connected with heave of the vessel. The remainder of the day was spent collecting a series of Hamon and Shipek grab samples within and in the vicinity of the Roughs Tower disposal site, off Harwich (Aim 1).

The next day (7th June), the grab survey at Roughs Tower disposal site was completed (Aim 1) before sailing to the Warp where the Oaze Deep NMMP station (NMMP 466) was sampled for sediment particle size analysis, trace contaminants, macrofauna and meiofauna (Aim 3). This was followed by the collection of water samples for nutrients, chlorophyll, salinity and suspended load (Aim 4).

On arrival at the Dungeness NMMP station (NMMP 484), the following day (8th June), sediments and benthos were sampled using the Day grab and 2m Beam trawl, followed by the collection of surface water samples (Aims 3 & 4). Meiofauna samples were also collected using a Multiple Corer. The utility of a modified Ocean Scientific™ mini-box corer was also assessed through the collection of replicate macrofauna and meiofauna samples. On completion, the *Endeavour* sailed to the Hastings Shingle Bank and *en route* running a single sidescan sonar line (Aim 11). Despite worsening weather conditions, on arrival at Hastings, the ship was able to safely collect a series of Hamon grab samples in sea states up to Beaufort Force 7 (Aims 2 & 9). Later, a number of video sledge tows were conducted across sites known to have a range of different sediment facies (Aim 9). The following morning (9th June), J. Hancock (Simrad) left the ship *via* small boat at Sovereign Harbour. The ship then steamed to a location of a CEFAS Waverider buoy moored in the traffic separation zone off Hastings which was later recovered for repairs (Additional Aim). Planned work then continued at the Hastings Shingle Bank with the retrieval of a number of 2m beam trawls samples and collection of video images (Aim 9). The ship then sailed to a current aggregate extraction area off Shoreham, where an acoustic survey was completed (Aim 9) before sailing to the Isle of Wight area.

Hamon grab sampling for the benthic fauna and sediments on a widely spaced transect of stations commenced on arrival at 0145h on 10th June (Aim 5) and the offshore part of the gravelly stations to the south east of the Isle of Wight was completed by the morning of June 10th. Sampling for the benthic fauna and sediment contaminants then followed using the Hamon and Shipek grabs within and in the vicinity of the Nab Tower Disposal Site and was completed by 2045h (Aims 1 & 5). *Endeavour* then sailed to Lyme Bay overnight, for sampling at a muddy sand NMMP (NMMP 536) station using a 2m beam trawl, Day Grab and a Multiple–Corer to meet various objectives (Aim 3). Surface water samples were also collected here (Aim 4) and a sidescan sonar line was run across the site in order to obtain information on the nature of the substrata surrounding the site (Aim 3).

The ship then sailed to a dredged material disposal site off Rame Head, where, later on 11th June, Hamon and Shipek grab samples were collected around the site for macrofauna, trace metal contaminants, TBT, PAHs, and other organic contaminants

(Aim 1). Sub-surface water samples were also collected using Niskin bottles through out the water column for determination of suspended particulate matter (Additional Aim). On the morning of the 12th June, David Gill (SES Ltd) was transferred ashore at Plymouth *via* charter vessel and David Pearce and Mark Proctor (Tower) joined the ship. Following this, the grab survey recommenced at the Rame Head disposal site (Aim 1). During the afternoon, *Endeavour's* small work boat was dispatched inshore of the disposal site to collect a series of sediment samples for trace metal contaminants, TBT, PAHs, and other organic contaminants (Additional Aim). Video images were also obtained using the 'drop' camera frame from within the disposal site (Aim 1), before *Endeavour* undertook a *rendezvous* with a charter vessel which conveyed David Pearce and Mark Proctor ashore. Later that evening, a sidescan sonar and multibeam bathymetry survey of an area of seabed off Looe was carried out (Aim 12), before *Endeavour* sailed to a dredged material disposal site off Falmouth. Sampling for the benthic fauna and sediment bound contaminants ensued the following day (13th June) along a transect of stations in the vicinity of the disposal site and within the Falmouth cSAC (Aim 1).

The ship then returned to a site off Looe in order to 'groundtruth' the output from the previous nights acoustic surveys (Aim 12). A series of beam trawls were collected for this purpose along with video images using a Hamon grab with attached camera (Ham-Cam) and video sledge. On completion of this work at 2315h, *Endeavour* sailed to a current aggregate extraction area off Shoreham and on arrival (14th June), video images were obtained here using a Ham-Cam, followed by the collection of a number of epifauna samples using a 2m Jennings Beam trawl (Aim 9). The video sledge was also deployed to 'groundtruth' the output from acoustic surveys conducted earlier in the cruise. This was followed by the collection of multibeam bathymetric data from closely spaced lines across a dredged area to supplement data obtained earlier in the voyage (Aim 9).

The next day at Hastings Shingle Bank, a number of hauls were taken using the 2m Jennings Beam trawl together with a series of video sledge tows (see Figure 1). The aim of this work was to 'groundtruth' a seabed facies map derived from sidescan sonar data obtained during previous research cruises (Aims 2 & 9). The repaired Waverider buoy was then deployed in the traffic separation zone. Later, the ship ran a number of sidescan sonar lines across and in the vicinity of the Hastings aggregate extraction area (Aim 11).

Endeavour then headed to Lowestoft via a relinquished aggregate extraction site (Area 222), off Harwich, where multibeam and video camera surveys were completed (Aim 6), before docking on the evening tide at 23:25h on the 16th June.

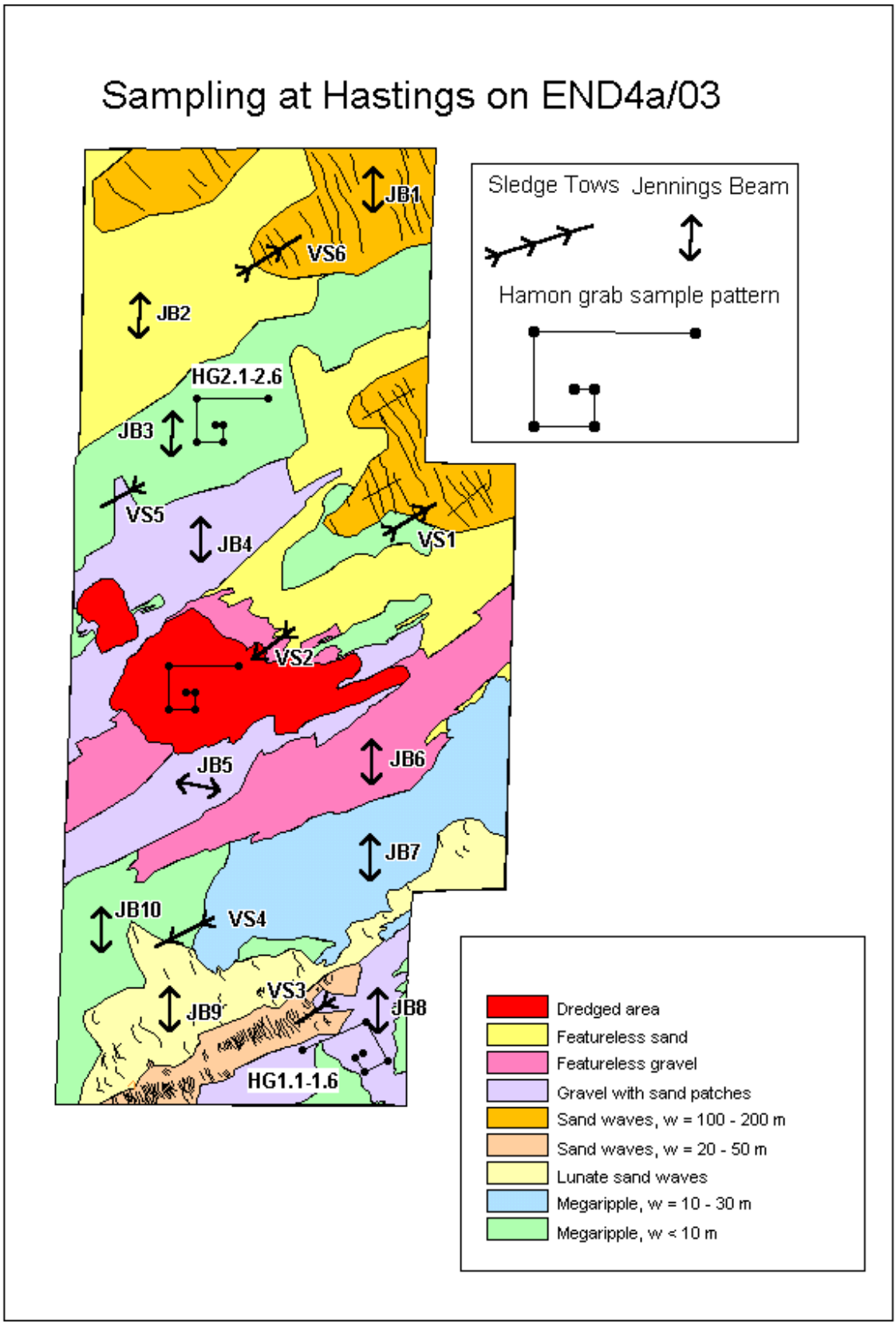

Figure 1 A map of identified seabed facies off Hastings in the Eastern English Channel which was characterised using 2-m beam trawls and video sledge tows during Endeavour 4a 2003.

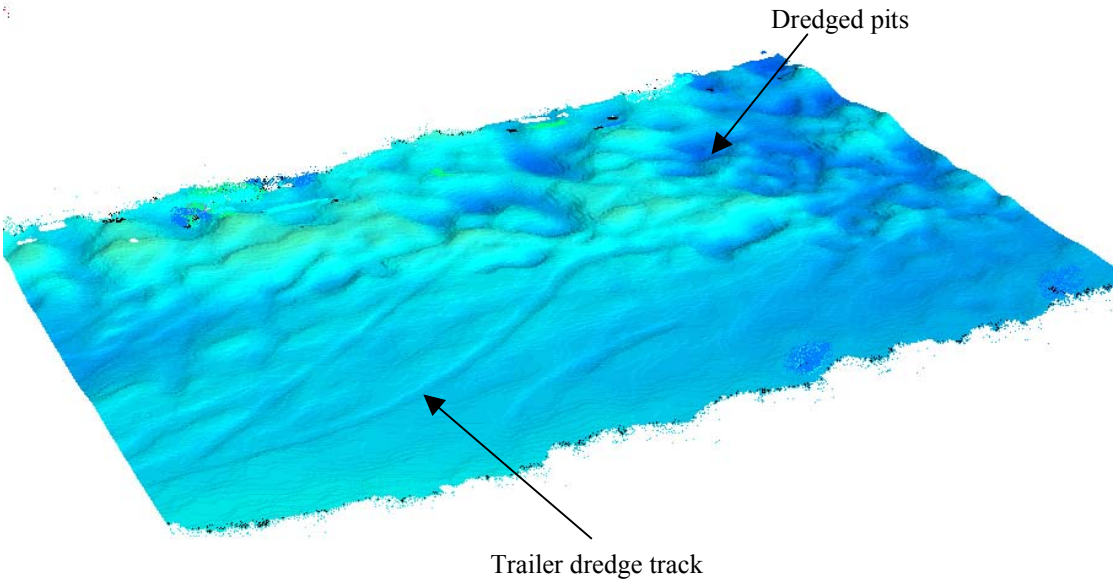

Figure 2 Trailer suction hopper dredge tracks and static dredged depressions in an area off Shoreham detected using the Simrad EM 3000 Multibeam bathymetric system.

RESULTS:

Ships operations

The capability of the new vessel was tested against a varied programme of work on her maiden scientific voyage. Aspects of the scientific work programme have been assessed in relation to recent experiences on RV *Cirolana* and *Corystes*. *Endeavour's* Dynamic Positioning (DP) system enabled the vessel to maintain position over stations with centrimetric resolution, reducing the need to relocate the vessel during replicate sampling. Whilst this was shown to save a significant amount of time, the improved accuracy and precision of positioning will have implications for time-series investigations (e.g. associated with the NMMP sampling). This is because replicate samples collected on previous cruises are likely to have been collected over a wider

area of seabed (even when constraints such as range rings have been imposed), which in turn may lead to higher between sample variability.

The DP facility also ensured sledge mounted camera equipment and beam trawls could be towed at controlled speeds along predefined lines during most tidal and weather conditions. This greatly enhanced our ability to target specific features or ground types. DP also allowed the vessel to be more manoeuvrable and be maintained in the most favourable aspect for undertaking the work (e.g. head or stern to sea). In addition, the use of HIPAP allows the accurate tracking of sampling gear (e.g. grabs, trawls and sidescan sonar fish) following deployment. This facility is likely to have a wide utility since it will allow accurate positioning of sampling locations.

Remote control of the coring winch allowed the operator to have greater and safer control during the deployment and retrieval of grabs and corers when using the starboard A-frame. In conjunction with DP, the conduct of this activity was found to be feasible, without compromising safety, during conditions which would be considered marginal on other CEFAS RV's. The safe conduct of this activity could be further enhanced if the operation of the A-frame hydraulics could also be operated from the remote control box.

The separation of winch operators from the scientists during sidescan sonar and camera sledge deployments is a retrograde step when compared with the set-up on *Cirolana* and *Corystes*. This needs to be resolved through the provision of remote control boxes which allow the winch operator to be in close vocal contact with the scientific staff running the equipment.

Grabbing and coring activities were successfully carried out using the aft A-frame and the upper trawl winch when the wire on the starboard winch became unusable. Although this facility presents a useful alternative to grabbing off the starboard A-frame, safe operation will be limited by weather conditions under the current configuration.

Problems with the EM 3000 Simrad multibeam system were recognised prior to this cruise. These problems were further explored during the cruise by a Simrad representative and although progress was made, some problems remain outstanding and are currently being addressed by Simrad. However, in spite of the limitations, useful data was obtained from a number of sites of interest during calm weather conditions, when the persisting problems concerning heave were less evident in the data-sets.

Tower™ survey software was used as the primary survey and logging system during the cruise and replaces the SEXTANT software employed to date. Although it is clear that this system holds a number of advantages over its predecessor, it does not presently fully meet requirements. This has been partly addressed through the attendance on board of a representative from Tower™ for 1 day. Further work is being undertaken by Tower™ to rectify remaining issues.

The ship's logging system was not operational at the beginning of the cruise. The attendance of a SES representative for 8 days of the cruise has gone some

considerable way to rectifying this and other outstanding work relating to the SES contract. Consequently, we were unable to assess the vessel's automated logging system.

It is evident that the ship's sampling seawater supply is contaminated at least for some period of time after it is turned on. Samples for later analysis were taken over a period of 12h after switching on the supply to assess the nature of the problem. Although the system was allowed to flush prior to sampling, it is possible that seawater samples collected for the NMMP will be compromised.

A bespoke sample database (Digilog) developed at the Burnham laboratory by Alison Hewer was fully utilised during the cruise and for the first time a full electronic record of all relevant data associated with each sample collected was produced by the end of the cruise. A summary of the sample data is provided in Annex I.

Overall, we were very impressed with the operational capability of the *Endeavour*. The dedication, capability and willingness of all Smit crew onboard the *Endeavour* to rapidly familiarise themselves with new systems and procedures, was greatly appreciated by the scientific staff and helped ensure a very successful cruise. Our thanks also go to all CEFAS staff who were responsible for the delivery of an extremely capable research vessel.

Scientific results

All aims were successfully realised. Six additional aims were also completed including the retrieval and redeployment of a Waverider buoy off Hastings. Water samples for the determination of suspended particulate matter were also obtained in the vicinity of the Rame Head dredgings disposal site. An inshore survey using hand held grabs from the *Endeavour's* workboat was also carried out in shallow water close to the Rame Head disposal site.

Full results will only become available following laboratory analysis of samples and processing of acoustic and photographic records.

A number of muddy NMMP stations were sampled for macrofauna, meiofauna, and sediments for later contaminant analyses as part of the long-term monitoring of temporal trends in contaminants and biota. These stations are intended to augment the time-series of information on environmental quality status around the England and Wales coastline. In addition, samples of the microbiota were collected at a number of the NMMP sites. These samples will be analysed by a PhD student at Essex University in order to evaluate whether the molecular techniques routinely employed in soil ecological studies can be applied to marine sediments. In addition sidescan sonar images were collected from Lyme Bay NMMP site in order to characterise the nature of substrata and bedforms in the wider area.

The combination of DP and the camera sledge allowed the collection of good quality video images of a range of sites and assisted with the groundtruthing of acoustic basemaps. This approach was adopted to characterise the biological assemblages associated with different seabed facies off Hastings (see Figure 1)

Habitat mapping techniques developed in a previous DEFRA funded research contract (A0908) were successfully applied at a number of sites exposed to the effects of dredged material disposal. Acoustic techniques proved effective in discriminating areas impacted by anthropogenic activities. Ultimately it is envisaged that these techniques will improve knowledge regarding the status of sites disturbed by anthropogenic activities as well as assisting in the design of cost-effective surveys. In addition, multibeam bathymetry data proved effective in discriminating small scale features such as trailer suction hopper dredge tracks at aggregate extraction sites (Figure 2).

Acoustic surveys at the Inner Gabbard and TY070 (North Tyne) and Souter Point dredged material disposal sites showed the presence and distribution of dredgings at the seabed within and surrounding the licensed areas.

A multidisciplinary approach to sampling at a site off Looe identified substrata suitable for undertaking a biogeographic comparison with similar sites in the Eastern English Channel.

Finally, it would be helpful to both SIC's if you could indicate whether you have read this report (via e-mail) – Thanks!

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D S Limpenny (mailto:d.s.limpenny@cefas.co.uk**)**
16-06-02

INITIALLED: (SEEN IN DRAFT).

CAPTAIN:

SENIOR FISHING SKIPPER:

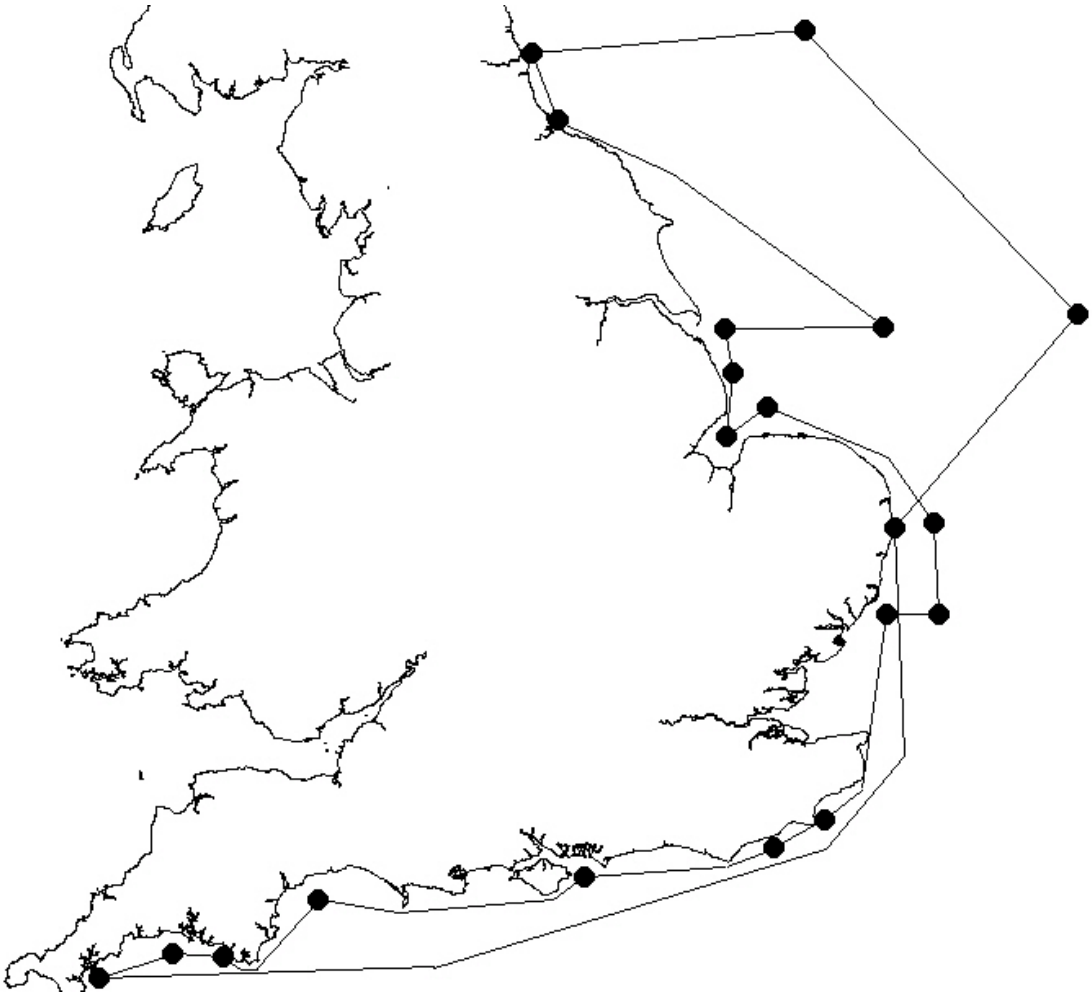

Figure 3 Route of *CEFAS Endeavour* during the research cruise Endeavour 4A/03.

DISTRIBUTION:

Basic list +
All scientific cruise personnel
M Waldock
J Hunt
R Jolliffe
A Handley
M Farrar
P Larcombe
R Law
C Kelly
C Allchin
H Rees
D Sivyer
J Jones
W Meadows
L A Murray

C Vivian
R Waldock
A Kenny
S M Rowlatt
A Franklin
J Thain
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