

**MINISTRY OF AGRICULTURE, FISHERIES AND FOOD
FISHERIES LABORATORY, LOWESTOFT, SUFFOLK, ENGLAND**

1996 RESEARCH VESSEL PROGRAMME

REPORT: RV CORYSTES: CRUISE 8

STAFF: G P Arnold (SIC)
B H Holford
B F Riches
A A Buckley
P M Hudson
T A Mead

DURATION: Left Lowestoft 1300 h 6 June
Arrived Lowestoft 1100 h 20 June
ALL times are GMT

LOCALITY: Southern North Sea

AIMS:

1. To track cod equipped with long-life transponding acoustic tags and to estimate their swimming speed and orientation by simultaneous use of the sector scanning sonar and acoustic Doppler current profiler (ADCP).
2. To estimate depths of neutral buoyancy of cod in relation to the time allowed for pressure adaptation.

NARRATIVE:

CORYSTES sailed on the midday tide on 6 June and proceeded to the first station about 6 miles off Benacre Ness to carry out tag and cage trials. The first cod was deployed in a cage on the seabed at 0830 h 7 June and CORYSTES remained on station close to the cage making ADCP measurements and testing a new 300 kHz gear marking tag. The fish was released at 0800 h 8 June and tracked continuously until 0900 h 12 June when the tag signal was lost near the entrance to the East Swin. After searching for the tag for several hours, the track was abandoned and CORYSTES returned to Lowestoft to collect a second batch of live cod tagged with pairs of Petersen discs (rather than the single wire frame used with plaice during recent cruises) and attempt repairs to the NT Server. CORYSTES was alongside the MAFF quay from 0630 to 0830 h 13 June and back on station by 1130 h; after further tag tests, the second cage was deployed at slackwater at 1545 h. Cod 2 was released at 1700 h 14 June and tracked until 2030 h 17 June. At that time the tag had been stationary on the sea bed for several hours and it was concluded that it had become detached from the fish. A 45 cm plaice was released at 0700 h 18 June in the hope that it might show selective tidal stream transport. This did not happen and the fish was abandoned at 1045 h 19 June, after it had remained stationary overnight. A third cod was released on the surface at 1150 h 19 June and tracked until 0005 h 20 June, when the tag signal was lost as a result of a fault with the sonar

transmitter. The cruise was then concluded and CORYSTES returned to Lowestoft, docking at 1100 h.

RESULTS:

- Geographical tracks:* Cod 1 (Fig. 1) spent the first 30 h after release within a fairly limited area and for quite a time took up station around a large wreck, from which it made occasional forays of limited duration. At about midday on 9 June, the fish began to move south and continued to do so for six consecutive south-going tides. During the first and last north-going tides this fish swam against the tide, moving east without losing ground to the north. During the intervening north-going tides it also swam against the tidal stream, losing little ground on the first of these three tides but rather more on the second and third. Cod 2 (Fig. 2) moved rapidly to the south after release on a south-going tide. It covered more ground than the tide and continued to move south during the following north-going tide. Subsequently, however, this fish became much less active, moving to and fro over the ground with both north-going and south-going tides. The track generally followed the pattern of the local tidal stream ellipse but also entailed lateral movements, particularly during the periods of slower tidal currents either side of slackwater, when the fish was on or close to the bottom (see 2). Cod 2 also maintained station in the lee of a large sand bar for a period of some hours, moving from north to south of this topographical feature as the tide changed direction. The single plaice tracked during the cruise was unusual in that it swam strongly, making ground against a south-going tide after release and moving around quite a lot before settling on the sea bed.
- Vertical movements and pressure adaptation:* Cod 1 initially remained on or close to seabed after release and may have been either negatively buoyant or neutrally buoyant on the bottom at a depth of 32 m after 24 h pressure adaptation. This fish remained within 8-10 m of the seabed for the rest of the track and there was no obvious association between forays off the bottom and slackwater or sunrise and sunset. Cod 2 (Fig. 3) was released on the bottom at a depth of 45 m after 25 hours adaptation to pressure. On release from the cage it came up to a depth of about 10 m. Apart from a few brief excursions to the bottom, the fish spent the next 36 h slowly increasing its average depth in midwater at 0.65 m h^{-1} , a rate compatible with rates of gas secretion exhibited by cod in the laboratory. For the rest of the track cod 2 was on or near the seabed, never moving above a depth of 30 m. Although it remained within 5-6 m of the bottom during this period there were nevertheless systematic changes in its pattern of vertical movement. The fish swam off the bottom whilst the tidal stream was running fast but returned to the bottom some time before slackwater and remained there while the water speed was reduced. Cod 3, which was released at the surface, immediately dived to the seabed at a depth of 50 m, where it remained for 7 h, apart from one excursion to a depth of 8-10 m at 1245 h. At 1930 h the fish was disturbed by a passing beam trawler and left the bottom. It took 30 minutes to swim up to a depth of 20 m and a further 5 minutes to return to the bottom, where it remained until 2145 h. The rest of the track was spent in midwater. The tag signal was lost at 2220 h because of a technical problem with the sonar receiver.
- Interpretation:* Whilst it is not possible to draw firm conclusions from two such contrasting tracks, it would appear from earlier work that the behaviour of cod 1 was that of a migratory fish moving consistently in the direction of one transporting tide and swimming against the opposing tide. Any interpretation of the behaviour of cod 2 is

necessarily more speculative but the track may indicate how cod behave on summer feeding grounds with fast tidal streams where the energetic costs of foraging must be high. One way of reducing these costs would be to shelter in the lee of topographical features and only come out to forage at slackwater. Another would be for the fish to drift passively with the tidal current (possibly foraging for pelagic prey) and only return to the bottom when the water speed slackened sufficiently to permit benthic foraging. If this behaviour proves to be typical of fish on their summer feeding grounds, the shape and size of the tidal stream ellipse would provide a first approximation to the scale of local foraging movements.

4. *Implications for future cruises:* The behaviour of cod 3 suggests that it may be possible to routinely deploy cod at the surface without the use of cages. Tagging would obviously have to be carried out in good time so that any effects of anaesthesia or surgery had worn off by the start of the cruise but dispensing with cages would result in more efficient use of research vessel time.

G P Arnold
20 June 1996

SEEN IN DRAFT: M J Willcock (Master)
R F Graham (Senior Fishing Mate)

INITIALLED: J W H

DISTRIBUTION:

Basic list +

G P Arnold

B H Holford

B F Riches

A A Buckley

P M Hudson

T A Mead

Clerk to Eastern SFC; FCO.

FIGURE CAPTIONS:

Figure 1. Ground track of cod 1 released at 0800 h 7 June and tracked until 0900 h 12 June.

Figure 2. Ground track of cod 2 released at 1700 h 14 June and tracked until 2030 h 17 June.

Figure 3. Vertical track of cod 2. The average rate of descent for the first 36 h was 0.65 m h^{-1} (fitted straight line). The bottom is indicated by the fine line.

Track of Cod 1 - Corystes 8/96

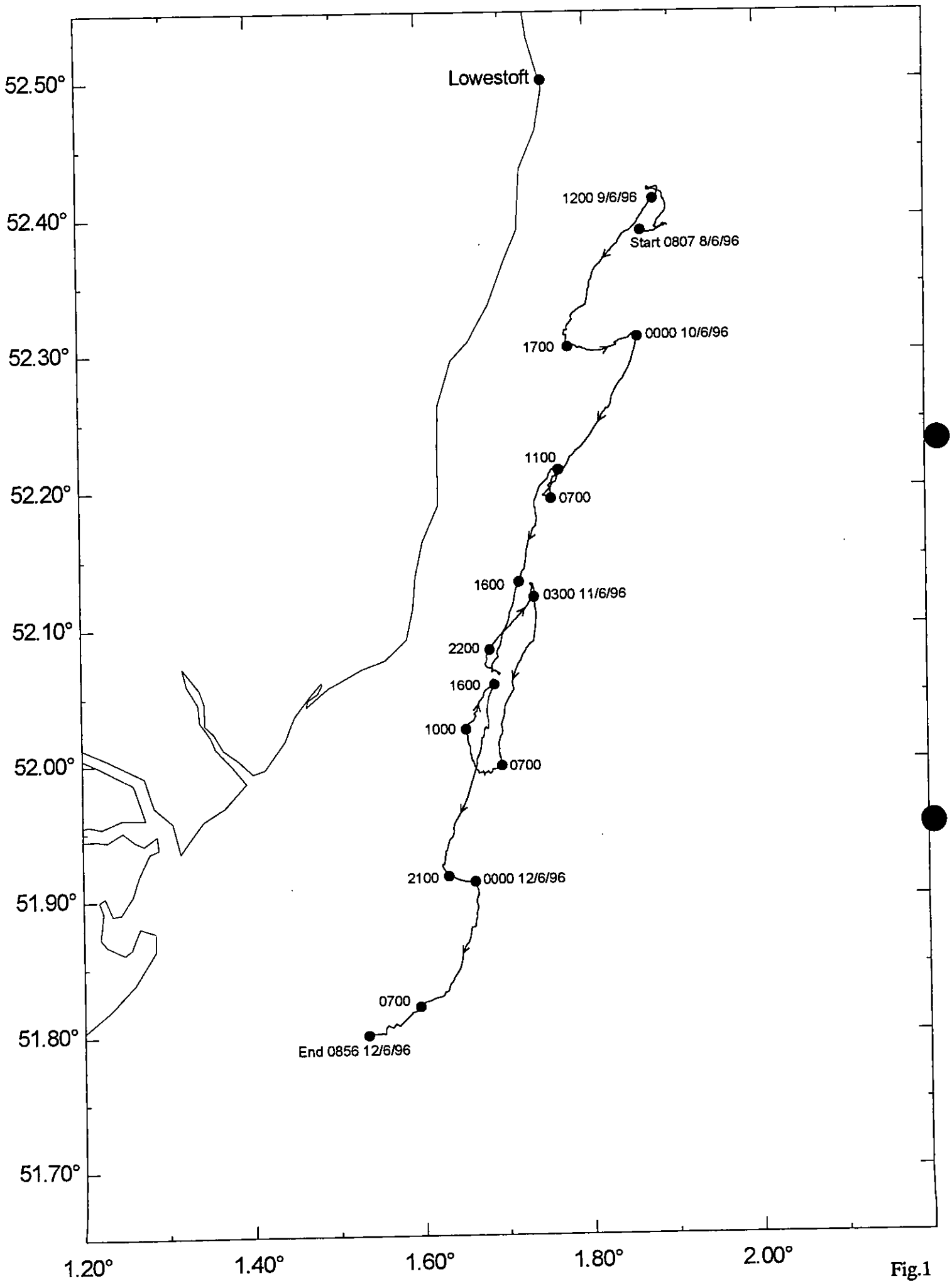


Fig.1

Track of Cod 2 - Corystes 8/96

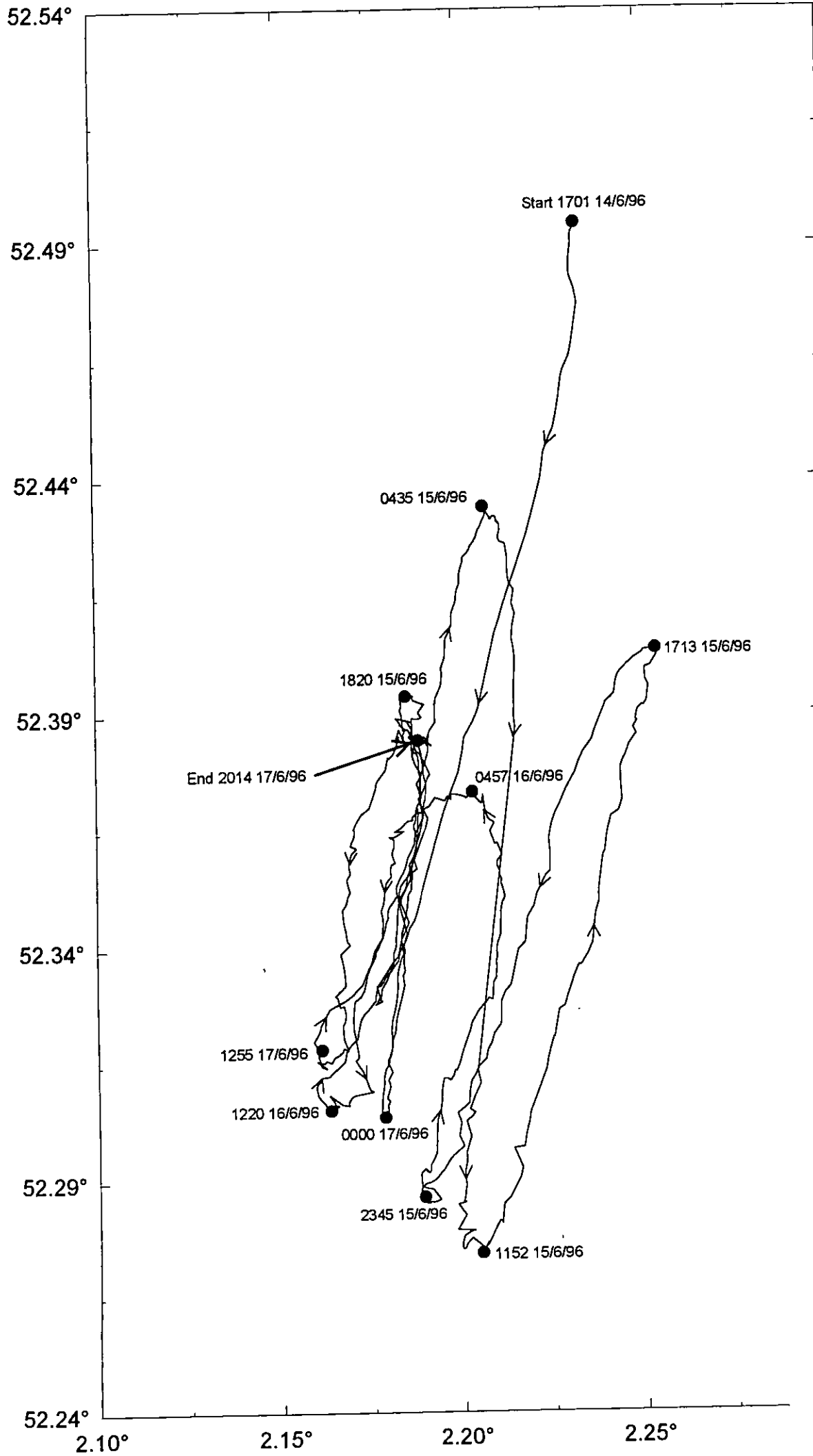


Fig. 2

Cor8/96 Cod 2

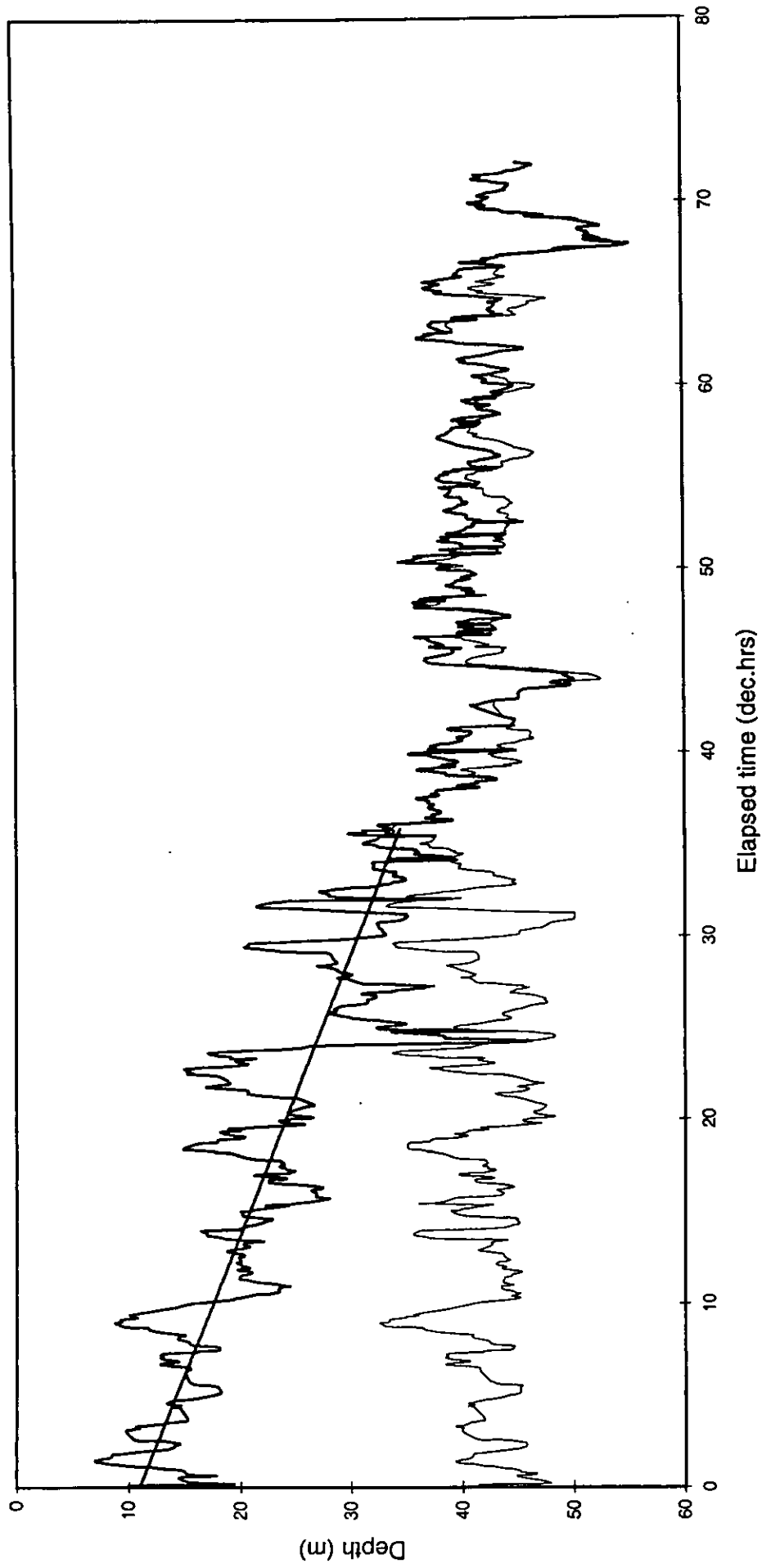


Fig. 3