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

1982 RESEARCH VESSEL PROGRAMME

REPORT: RV CORELLA: CRUISE 13

STAFF:

G P Arnold
M H Beach (13-27 September)
B H Holford (7-20 and 23-27 September) (Diver)
N D Pearson (9-12 September)
B F Riches
P H Cook (NERC) (Diver)
M R Vince (Shore-based diver)
A E Howard (Shore-based diver)
K A Tucker (Shore-based diving trainee; 16-20 September)
M R Thomas (Shore-based engineer; 9-12 September)

DURATION:

Left Lowestoft 1030h, 7 September
Arrived Lowestoft 0400h, 27 September

(All times are Greenwich Mean Time)

LOCALITY:

Start Bay

AIMS:

1. To investigate the orientation and behaviour of plaice in relation to bottom topography and near-bed currents under the combined influence of tide and swell.

2. To test the deployment and operation of the MAFF antonomous near-bed velocity recorder.

3. To collect samples of juvenile scallops seeded in the Salcombe estuary.

4. To carry out trial dives with a potential diving trainee.

NARRATIVE:

CORELLA left Lowestoft at 1030h, 7 September and arrived in Start Bay late the following afternoon. A toroid marker buoy was laid during the evening and contact established with the shore-based divers. Pearson and Thomas joined the ship the following morning with the near-bed velocity recorder (NBVR). Diving operations began as soon as the ship was moored fore and aft and the combined fish cage/NBVR frame was deployed together with two underwater television cameras and cables. One camera was attached to a pan and tilt unit so that it could scan the whole floor of the cage. Five plaice (L ~20cm) marked with float tags were released in the cage and regular television observations began on the morning of 10 September. The NBVR underwent final bench tests and was deployed by midday on 11 September, together with a sea bed wave recorder and two recording current meters. Difficulties were encountered with the underwater electrical connections of the pan and tilt unit and fish observations were spasmodic until 13 September when the problem was finally resolved.

Pearson and Thomas were driven to Totnes station early on the morning of 13 September by Howard, who then went on to Plymouth to collect 30 small plaice from the MBA Laboratory. Ten of these fish were tagged and introduced into the cage later the same day. A second larger fish cage was assembled and deployed on 14 September and work continued uninterrupted until 1700h, 15 September when CORELLA left Start Bay and steamed to Plymouth to replenish fresh water. Tucker arrived the same evening and the following day accompanied the other four divers to Salcombe to carry out aim 3 of the programme.

CORELLA returned to Start Bay early on 17 September and was anchored fore and aft again by 1800h. On 18 September the divers retrieved the NBVR and introduced a 45cm plaice fitted with a transpending acoustic compass tag into the larger fish cage. Television observations continued until 1700h when the line to the marker buff on the smaller cage became entangled in the ship's anode and the cage was overturned. The cage was relaid the following morning, new fish introduced and the observations continued. The orientation of the large plaice was recorded until 2140h, 19 September when the tag batteries failed. Deteriorating weather on the morning of 20 September forced CORELLA to leave station and take shelter in Tor Bay.

CORELLA was anchored on station again by 1100h, 22 September and work continued smoothly until the evening of 23 September. The larger cage was retrieved during the course of the day. Early the following morning with rapidly deteriorating weather the inboard ends of the television cables were shot away on a prepared dhan and buff but the cables became badly entangled in the ship's propeller. Inspection showed that they could not be cleared in the prevailing conditions and assistance was requested from Brixham Coastguard at 0710h, 24 September. CORELLA lay at anchor all morning with the wind steadily increasing in speed from the south until she was taken in tow by MV ALGA at 1200h. After a difficult passage in heavy seas CORELLA anchored in Brixham roads at 1445h. The two shore-based dives then joined the ship and the diving team cleared the propeller.

CORELLA took freshwater from the oil jetty in Brixham during the morning of 25 September and returned to Start Bay in the afternoon to retrieve the smaller fish cage with the television cameras, the hydrographic instruments and the toroid buoys. The two shore-based dives were put ashore at 2000h and CORELLA steamed for Lowestoft docking at 0400h, 27 September.

RESULTS:

1. The fish cages were laid on the inner part of the Skerries Bank in approximately 7m of water, where the bottom consists of small sand ridges (λ = 8-10m; h = 25-30cm) covered with sand ripples (λ = 15-20cm). Both cages were aligned to the tide and the larger one straddled a sand ridge. Small groups of plaice of 8, 12 and 20cm mean length were introduced into the smaller cage.

a) Small cage. Frequent television observations of the behaviour of the fish in the small cage were made and their orientation recorded every ½h during daylight. The fish began to feed within 24h of release and a natural population of gobies and dragonets rapidly appeared in the cage. The feeding behaviour of a small school of juvenile red

mullet was observed and recorded.

At neap tides with a barely perceptible swell the 20cm plaice ranged freely round the cage and showed no response to the tidal current. Their orientation was random with respect to both tide and sand ripples. The smaller fish were noticeably less active but still fed and changed their positions between ½h fixes. They rested in the troughs between sand ripples, usually buried in the soft sediment. The 12cm fish invariably aligned themselves parallel to the adjacent ripple crests; the orientation of the 8cm fish was more variable. Feeding appeared to cease at slack water.

At peak spring tides an artificial sand ridge built up rapidly inside the cage to a height of approximately 20cm, with its steep slope facing the ebb tide and its crest one third of the way along the cage. There was a large amount of sand in suspension, which reduced the visibility and made it difficult to observe the corners of the cage. There was substantial bed load transport and an area of extremely turbulent flow immediately downstream of the crest. The fish were much less active than before, although one 20cm plaice was observed to move and feed during the peak of the ebb tide. The others were buried at the downstream end of the lee slope and none was present in the turbulent zone near the crest.

Four days after peak springs with the speed of the tide much reduced but with an 8–10s period swell present there was a markedly different situation. There was substantial bed load transport and the sand ripples were migrating steadily downstream. The 12cm fish were lying in the troughs, as before, but were being buried by the advancing ripples. Some allowed themselves to be totally buried and those whose marginal fins subsequently protruded through the upstream face of the ripple became extremely vulnerable to the swell. Several were flipped completely over by the swell and were carried along upside down by the tide before they could correct their posture and swim back into another trough. The following day when the swell was no longer sufficient to erode them the fish remained inactive and buried in the sand.

b) Large cage. The orientation of the 45cm plaice in the large cage was recorded with the Miniscanner and Alden recorder over both a flood and an ebb tide at peak springs. The fish headed against both tides but unfortunately the natural ridge over which the cage was laid was destroyed by the flow through the cage.

The observations are consistent with the hypothesis that the orientation of plaice on the seabed is affected by local topography and provide direct evidence that small fish, at least, are adversely affected by swell. Taking the observations in conjunction with those of CLIONE 11/81 and earlier sector scanning cruises, it seems probable that there is a critical water speed - either due to the tide alone or to the combined effect of tide and swell - above which fish of a given size will seek the protection of topographical features. Tidally induced sand ripples will obviously provide protection for the smaller fish but clearly not for fish whose length (L) is greater than the wavelength (λ) of the ripples or some fraction of it, possibly of the order of $L = 0.6\lambda$. Larger fish would then be expected to seek the shelter of sand ridges, sand waves or indeed sand banks. In areas

where the tidal current is of insufficient speed to generate such features, large fish disturbed by the swell might be expected to seek shelter in deeper water, perhaps in pits or holes where these are available. Wave-induced oscillatory sand ripples - which have sharper symmetrical crests and a much more regular pattern than tidally induced ones - could be of particular significance to small plaice in shallow water nursery areas.

2. The NBVR was deployed for 6 days between neap and spring tides when the sea was calm. It was set to record in a 'tidal' mode taking a burst of 255 samples at 1s intervals, with a 15 minute interval between bursts. Four of the five electromagnetic current meter probes were mounted inside the smaller fish cage at heights of 10, 25, 50 and 100cm above the seabed; the fifth probe was defective. A failure of the circuitry, which could not be resolved on board ship, prevented a further trial with the instrument sampling in a 'wave' recording mode.

3. Samples of juvenile scallops seeded in the Salcombe estuary were retrieved and measured. Two exploratory devices were made on Beesands Rough.

4. Mr Tucker accompanied the diving team to Salcombe on 16 September and dived from the ship from 17-19 September.

G P Arnold
27 September 1982

SEEN IN DRAFT:
Master G Sinclair
Fishing Skipper R C Newrick

INITIALLED: DJG

DISTRIBUTION:
Basic List
G P Arnold
M H Beach
B H Holford
N D Pearson
B F Riches
P H Cook
M R Vince
A E Howard
K A Tucker
M R Thomas
Dr J D Gilpin-Brown (MBA Plymouth)
Dr K R Dyer (IOS Taunton)
Clerk to Devon Sea Fisheries Committee