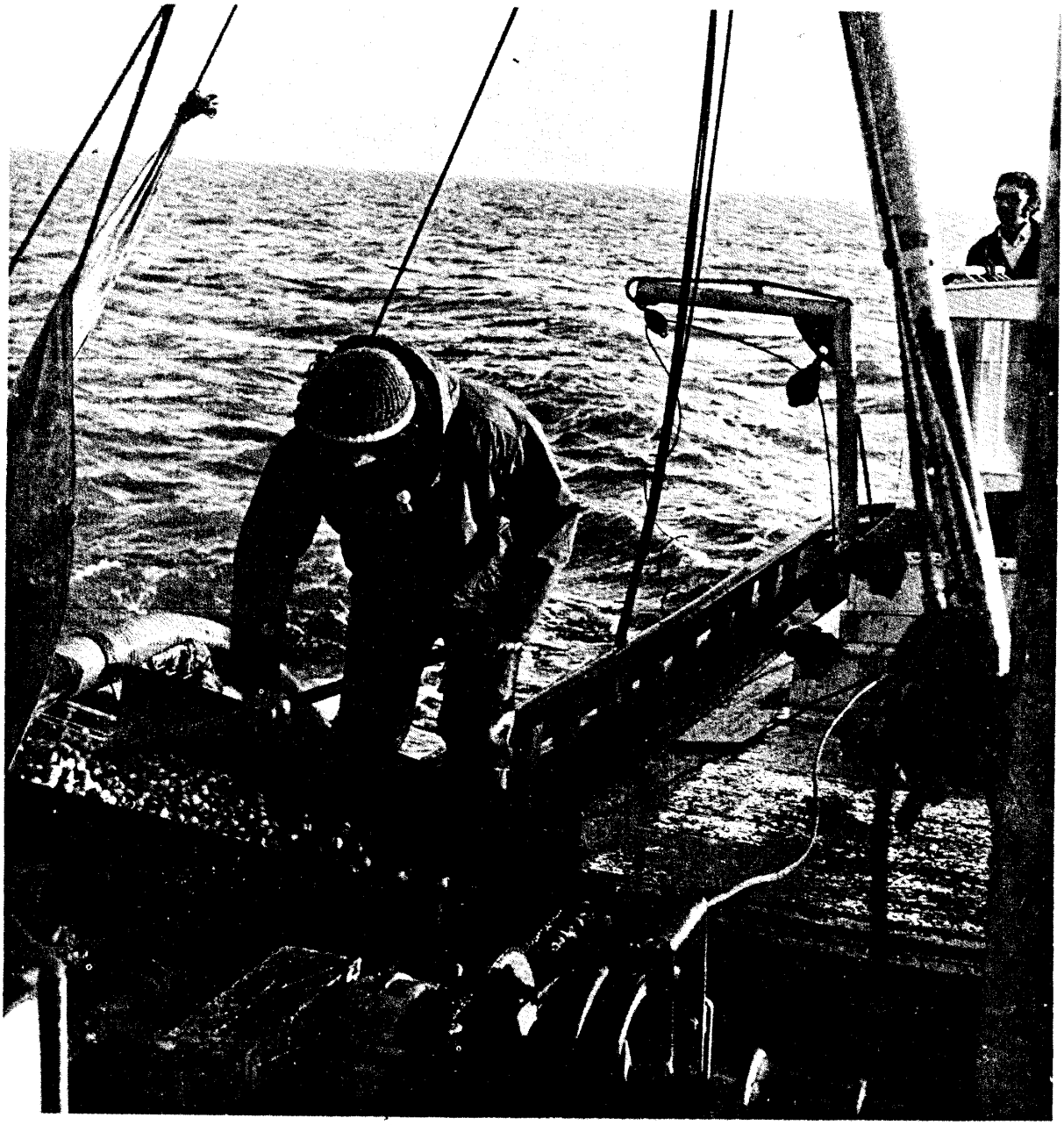
MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

THE IMPACT OF MECHANICAL HARVESTING ON THE THAMES ESTUARY COCKLE FISHERY



BY GRAHAM PICKETT

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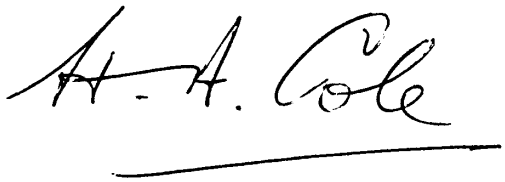
The replacement of hand gathering by continuous-delivery hydraulic dredging of cockles in the Thames estuary has revitalized the fishery but it has also introduced some new problems. In this leaflet Graham Pickett examines these problems and relates them to conservation of stocks and management of the fishery. It is a particularly timely study because the projected construction of a major airport and other massive developments in the Maplin Sands area will inevitably change the shape and character of the cockle fishery in the years to come.



H. A. Cole
Director of Fishery Research

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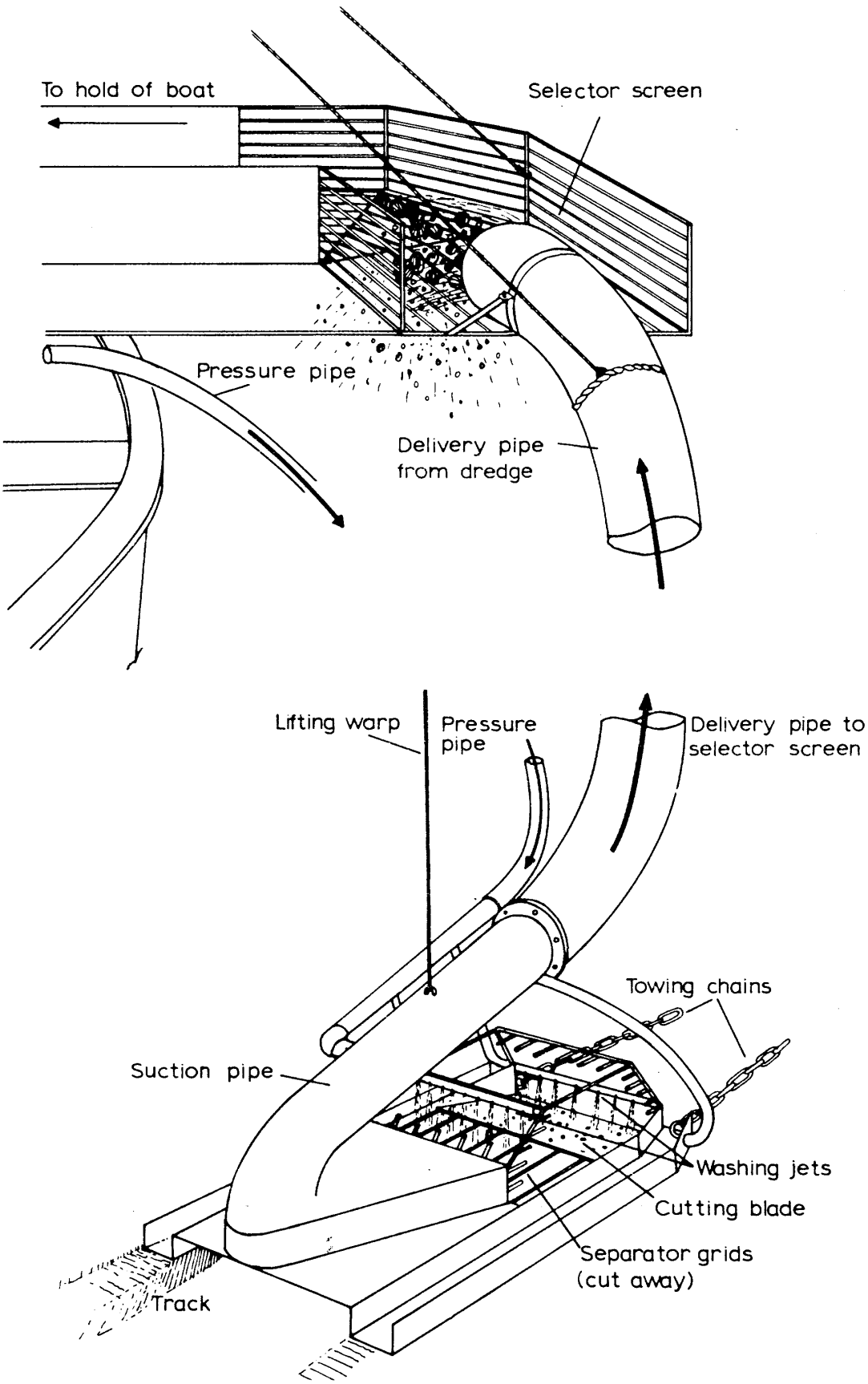

Figure 1 The hydraulic dredge.

Laboratory Leaflet (New Series) No. 29

THE IMPACT OF MECHANICAL HARVESTING ON THE THAMES ESTUARY COCKLE FISHERY

INTRODUCTION

The three main fisheries for cockles (Cardium edule Linn.) in the United Kingdom are found in the Wash, the Burry Inlet (South Wales), and the Thames estuary. All these areas have extensive mudflats and sandbanks, ideally suited to supporting the large stocks of cockles which are usually found intertidally between the levels of high water neap tide and low water spring tide. Cockles live in the top 1 or 2 inches ($2\frac{1}{2}$-5 cm) of sand or mud and are traditionally gathered during the low-water period with a hand-rake; a net or sieve is used for riddling. In most areas, including the Wash and the Burry Inlet, the by-laws of local Sea Fisheries Committees prohibit mechanical methods of gathering. A full description of the cockle and its fisheries, together with extracts of Sea Fisheries Committee by-laws relating to methods of cockle fishing, is given in Laboratory Leaflet No. 26 by A. Franklin.

At the time of writing (early 1973), the Thames estuary is still free of restriction on fishing methods for cockles, apart from a recent by-law introduced by the Kent and Essex Sea Fisheries Committee controlling the size of any dredge used in the fishery. In this area, the White Fish Authority demonstrated the recently-developed continuous delivery hydraulic dredge in a commercial-scale trial (Kerr 1969). Following successful trials in Wales with a prototype dredge (Figure 1), a similar machine fitted with a 12 inch, ≡ 305 mm, blade was installed and operated on a cockle boat working from Leigh during 1968.

By 1971, there were nine commercial vessels dredging for cockles in the Thames estuary, using 18 inch, ≡ 457 mm (in one case 24 inch, ≡ 610 mm) blades. These boats included those owned by firms which had in that year begun fishing cockles for the first time. Only a few part-time cockle fishermen on the Kent side of the estuary, who did not possess boats, continued to rake.

While the dredge was still at the trial stage, the Fisheries Laboratory, Burnham-on-Crouch collaborated with the White Fish Authority in studies on its efficiency and its effects on cockle beds. For example, there was concern about possible damage to stocks, and it was felt in some quarters that the benefits of dredging might be only of a short-term nature. The performance of the dredge during the initial trials was encouraging and most of the merchants invested in dredges, and by the time the initial scientific investigations were complete, the new gear was in full-scale commercial operation. The research programme to determine changes in the fishery associated with dredging continued, with a view to advising the Sea Fisheries Committee on matters related to conservation. Much of the information from this research programme is published in detail elsewhere (Franklin and Pickett 1971, 1972, in press); it is summarized on page 15, where the advantages and disadvantages of dredging are discussed.

RECENT DEVELOPMENTS IN THE FISHERY

The Thames estuary cockle fishery, based mainly on boats from Leigh, has produced consistently high landings (rarely below 40 000 cwt, ≡ 800 kg, per year) since at least the mid-1920s, before which details are obscure (Figure 2). Up to 16 craft carrying crews of 3-7 men were employed before the second world war, but many were light skiffs with limited range. Fishing ceased during the war but afterwards landings soon rose, reaching 81 000 cwt, ≡ 1 620 kg, in 1951. The craft then used were powerful, seaworthy boats, sometimes called 'bawleys'. It is these craft that still form the backbone of the fleet, most being suited for conversion to hydraulic dredging.

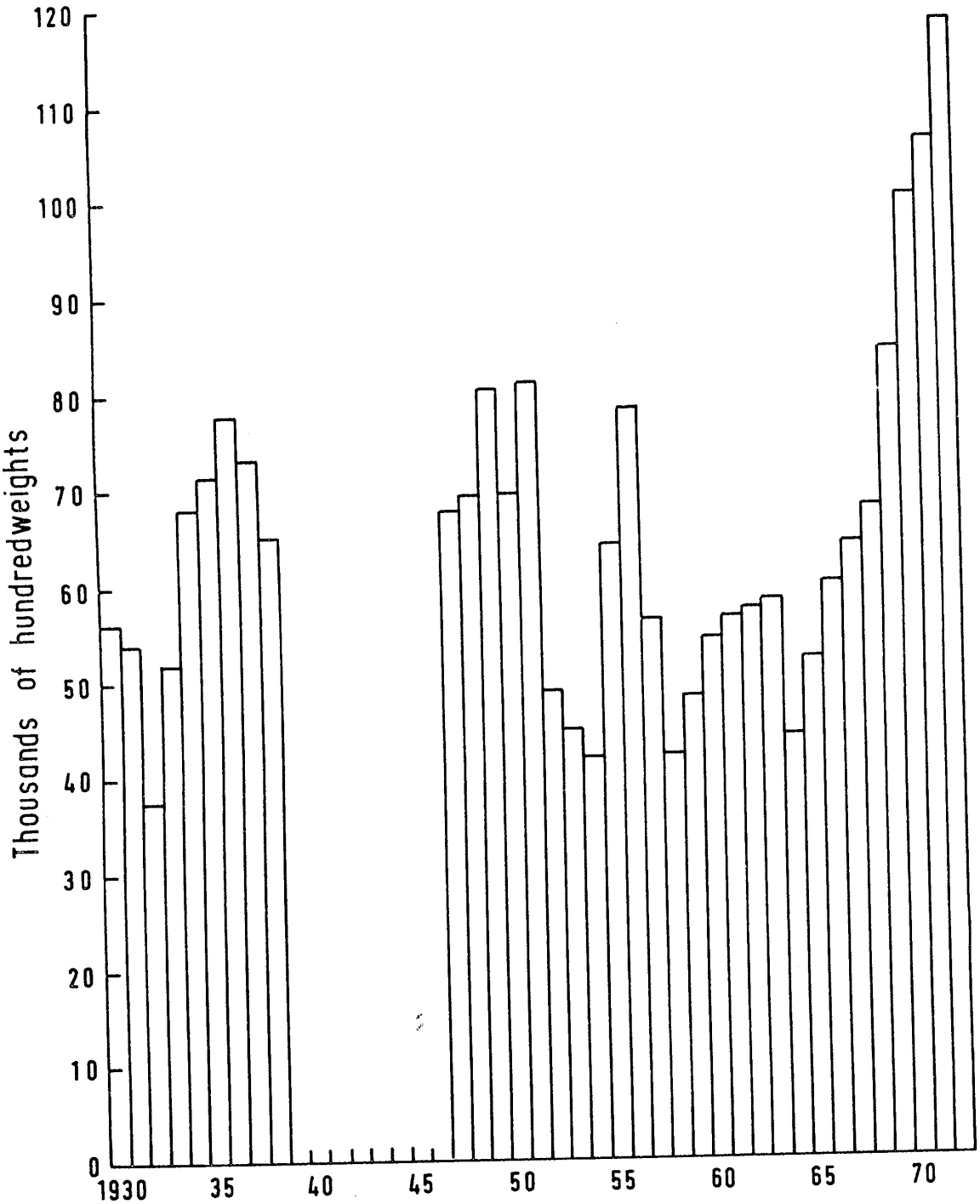

Figure 2 Thames estuary cockle landings, 1930-72.

The fleet remained constant at seven boats during the sixties, but landings were not as high as expected, although vast stocks of cockles were available from survivors of the huge 1963 spatfall. Total fishing effort, however, was probably irregular at this time, due in part to difficulties of obtaining crews. In addition, the recorded landings during the middle sixties were found to have been somewhat underestimated and the rise in the late sixties is partly the result of better statistics becoming available.

The continued rise in landings from 1969 to 1971 could not have occurred, however, if hand-raking had still been employed, because surveys showed that the total stock and the density of cockles had rapidly declined after 1968 (Franklin and Pickett 1971). Hydraulic dredging is a more efficient method of harvesting cockles on low-density beds, for hand-raking on less than 30 cockles/square foot ($323/m^2$) is rarely economic, whereas dredging is still worth while at densities less than 10/square foot ($107/m^2$). Thus, the hydraulic dredge was able not only to maintain but also to increase catches from the declining stocks. The increase was not as large as was originally anticipated, but was very significant when compared with the decline in catches expected if hand-raking had continued after 1969. Information supplied by one merchant showed that his catches, obtained by hand-raking with 2-5 gatherers on low-density stocks during 1962-64, were similar in quantity to his catches in 1969-70 using a dredge. This illustrates how catches at Leigh are generally limited by market demand, although an overall increase in landings was apparent during 1970 and 1971 as markets expanded and new boats started fishing. These vessels which joined the fishery in 1971 increased the fishing effort by about 40 per cent. Such an expansion was the cause of some concern, since some areas were shown by MAFF surveys to be already depleted as a result of heavy fishing and high natural losses. Catch rates in all areas declined and the laboratory recommended that conservation measures should be applied, especially to areas such as those off Shoeburyness and the south-western end of the Maplin Sands (Figure 3), and the Kent and Essex Sea Fisheries Committee now have the power to close to fishing any grounds which are severely depleted (Appendix).

Fortunately, the areas at risk were not worked during the summer of 1971, when other substantial stocks of cockles were found to exist on previously unexploited offshore sands, many of which were below low-water spring tides level. So extensive were these stocks that they were fished throughout the latter half of 1971 and are believed to have produced around 75 per cent of landings at Leigh in this period.

As many of these cockles are sublittoral (i.e. not exposed by the tide), they can be fished during the low-water period and this has become accepted practice by Leigh boats. It is often preferable to fish at this time because it makes access to port easier when working single tides, the moorings at Leigh and Southend being navigable only for a short period either side of high water. This pattern of fishing has in some cases considerably reduced the length of the fishing day, compared with that needed for hand-raking.

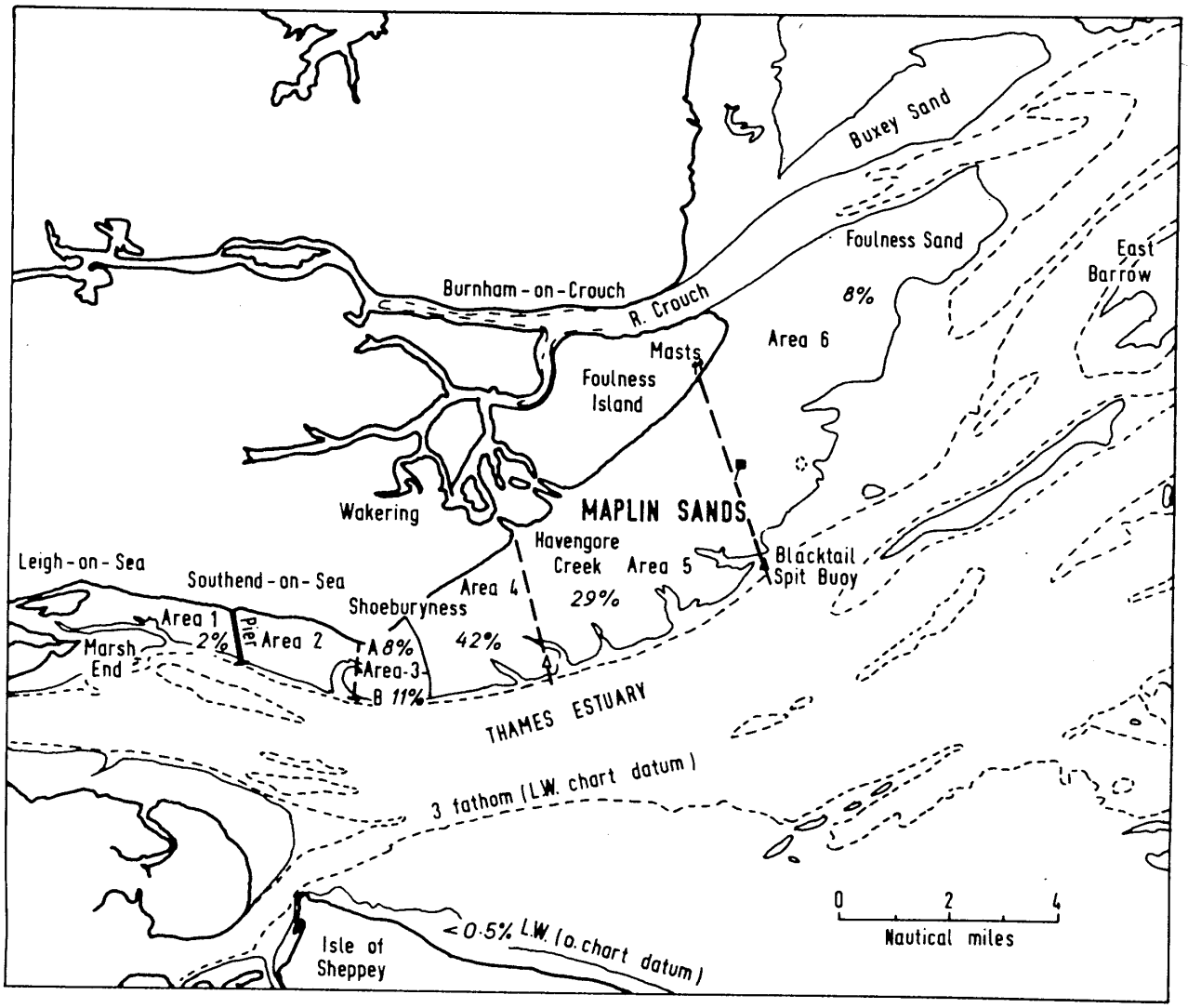

Figure 3 Cockle-fishing areas in the Thames estuary, with percentage landings from each area (by weight) during the period November 1969 to April 1970.

FISHING TECHNIQUES

In the past, cockles in the Thames estuary were gathered following the beaching of the boats on the chosen fishing area on the falling tide; hand-rakes were used in conjunction with a retaining (or 'lab') net. The cockles were put in baskets and transferred to the hold of the vessel, often two baskets being carried on a yoke, a method still employed for unloading the vessels at port.

Precise location of stocks was essential so that the boats could be beached in the required area to allow fishing to take place close to the boat. The gatherers were thus limited in the areas they could fish, only traditional beds being exploited. On occasions, poorly ebbing tides prevented even these areas from being reached. Areas which become completely dry at low water were usually avoided, because a lack of surface water made raking much more difficult. The amount of fishing time was limited by the length of tidal exposure, and time was wasted waiting for the tide to drop, following anchorage over the fishing area, and for the vessel to refloat again after fishing.

With the introduction of continuous delivery hydraulic dredging, the situation was completely reversed, cockle beds becoming fishable by this method only when they had sufficient water coverage. The minimum fishable depth is limited by the draught of the boat but for most craft under 30 feet (9 m) in length is usually around 6 feet (1.8 m). The maximum depth in which the gear has been fished successfully, so far, is around 15 feet, this being limited by the power of the pump and the length and diameter of the delivery pipe (Figure 1 and Plate 1). Further details of these features are shown in technical publications (WFA 1967, 1969).

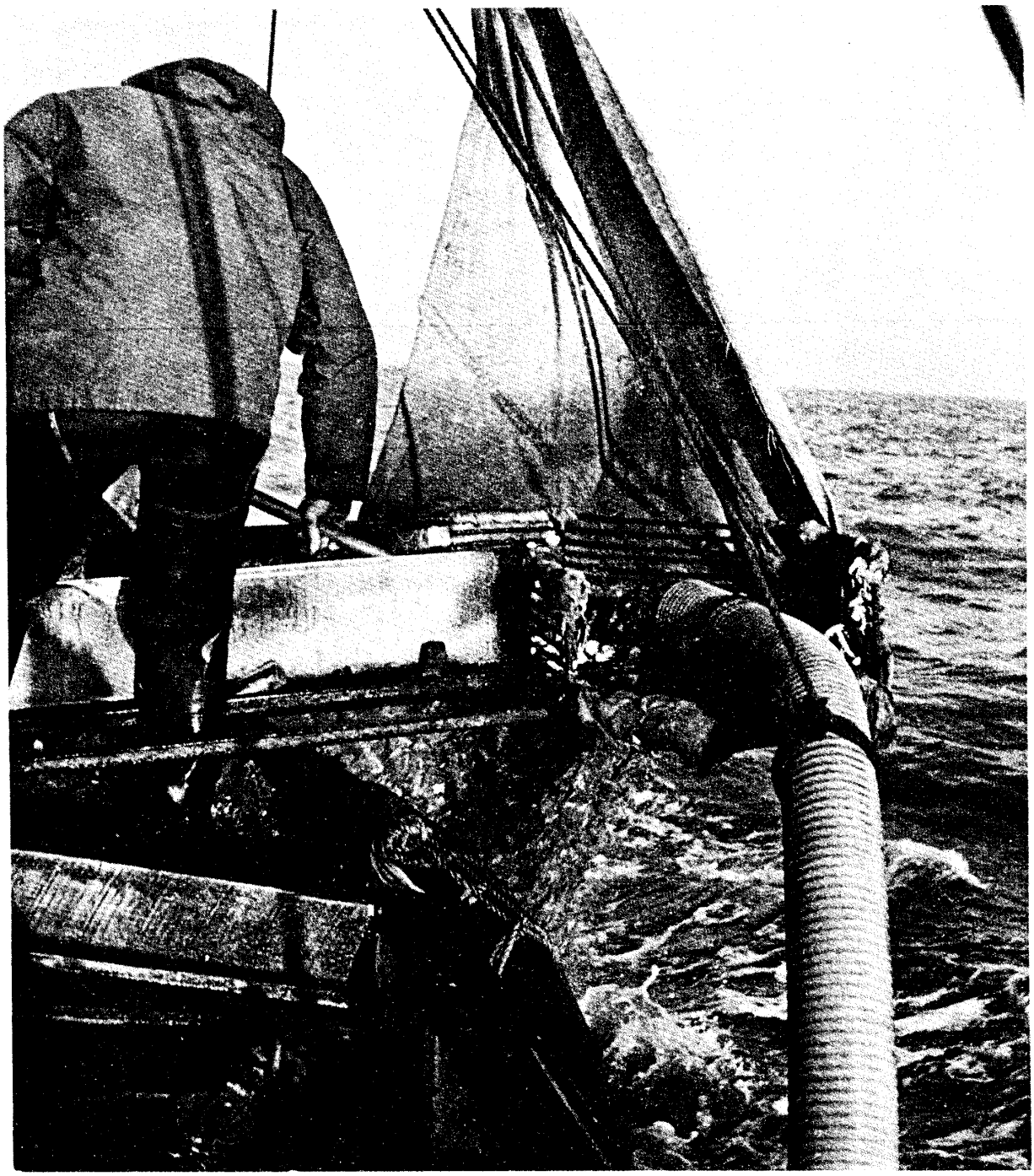

Plate 1 Delivery pipe and selector screen, showing waste material going back over the side of the boat.

Some amount of experience is required to work the gear effectively, a knowledge of boat-handling with the tides being essential. It is necessary to regulate the ship's speed, and the water pressure of the pump, to improve efficiency and to keep cockle damage to a minimum. The cutting blade must be set at a position that matches the depth at which the cockles are buried and the type of mud or sand being fished on. This single factor alone can make a substantial difference between a good and a poor catch. It is known that two or more boats fishing together for a similar length of time under identical conditions may obtain catches of widely differing size.

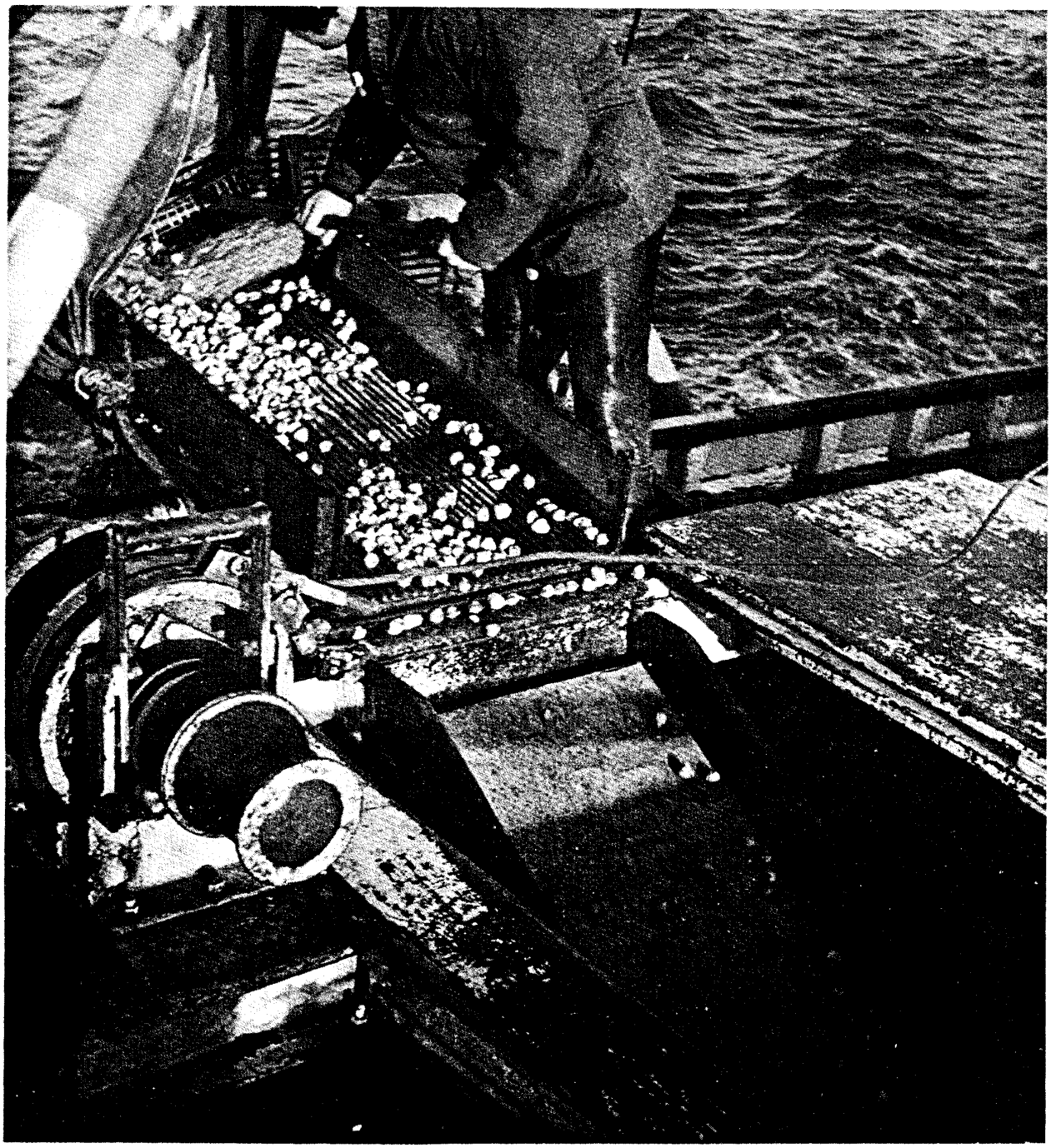

Plate 2 Raking catch down the selector screen.

The behaviour of the dredge depends on the type of craft used; lighter boats tend to move in a circle, due to the drag of the dredge on one side of the boat. 'Tight' circles or sharp changes in direction can make the dredge 'bite' into the bottom, causing damage to the cockles and characteristic wear on one side of the dredge blade.

The grid size of the selector screen (Figure 1 and Plate 2) is of importance in selecting the size of the catch. When cockles being fished are small, a high proportion of them can be lost if the gauge of the grid is too wide. When fishing shelly areas, too narrow a gauge causes shell, rubbish and broken cockles to be retained in the catch. For these reasons, some of the boats are fitted with interchangeable screens of different gauges.

Traditional hand-raking involved an acquired skill, and it is clear from this account that new skills have to be developed to fish the hydraulic dredge effectively.

RESEARCH INTO SPECIFIC SIDE EFFECTS OF HYDRAULIC DREDGING

During the course of this study, commenced in 1967 to determine the overall impact of mechanical harvesting in the Thames estuary, certain specific effects of dredging were observed. Any that seemed possibly harmful were studied in detail against a background of information collected on the state of the fishery, i.e. catches, stock levels, etc.

Other possible advantages of hydraulic dredging emerged early in the study and most of these have been amply described in other publications (WFA 1967, 1969); some were confirmed much later under practical fishing conditions.

In this section the harmful effects of dredging are also described, together with details of the investigations which were made. The advantages of this fishing method, although self-evident, are described at the end of the section in order that a balanced appraisal can be made of this form of dredging.

1 Breakage of cockles

One of the effects noticed initially was that a high proportion of the catch was smashed or damaged in some way. During early trials, assessments were made of the amount of cockles which were chipped, smashed or remained whole in the catches. It was found that a very low proportion had no damage whatsoever, the majority having small chips in the shell. The amount was very variable, but a smaller, more constant proportion (about 20 per cent) was so badly damaged as to be unsuitable for processing (Plate 3). On cooking, the meats of smashed cockles were found to adhere to the shell, some being rejected with the shell when riddled, others being processed but containing fragments of shell which lowered the quality of the final product. Even chipped cockles often produced low-quality meats due to the presence of tiny bits of shell which became embedded in the flesh of the cockle. Initially, this was not recognized in the processing sheds, but complaints from buyers prompted extra care to be taken in picking out bits of shell during washing. This, of course, meant extra work in the cooking sheds, which partially balanced the benefit of less effort

needed in catching the cockles. In some processing sheds, it has become the practice to put the catch down a gridded shute which removes some of the broken cockles before cooking (Plate 4).

Breakage can be caused by: (a) the dredge blade, especially if set at too shallow an angle, (b) cockles hitting the back of the suction chamber of the dredge, and (c) abrasion while passing up the pressure pipe. Attempts have been made to reduce the damage by working at lower pump pressures and towing speeds, but this has resulted in a reduced catch rate.

The proportion of the catch which is slightly damaged (chipped) seems to vary considerably, but during two years of study on the Leigh boats, an average of 20 per cent of each catch was unsuitable for processing,though 25 per cent of cockles coming up the delivery pipe were smashed. This difference (5 per cent) is due mainly to a number of shattered cockles passing through the screen back into the water.

A recent additional source of breakage to cockles in the dredging fleet now working in the northern part of the estuary (see page 18) is the use of mechanical riddles. These are revolving gridded drums which are set at a slight angle and are driven by an additional motor on deck. They are used to replace the conventional delivery screen, thus saving work involved in raking down the cockles which pile up. In some cases the drums are driven too fast, causing additional breakage to whole and chipped cockles. Trials have shown this amount to be as high as 9 per cent to whole cockles leaving the delivery pipe. It was advised that these sorting screens should be kept revolving at the slowest possible speed to avoid this additional wastage.

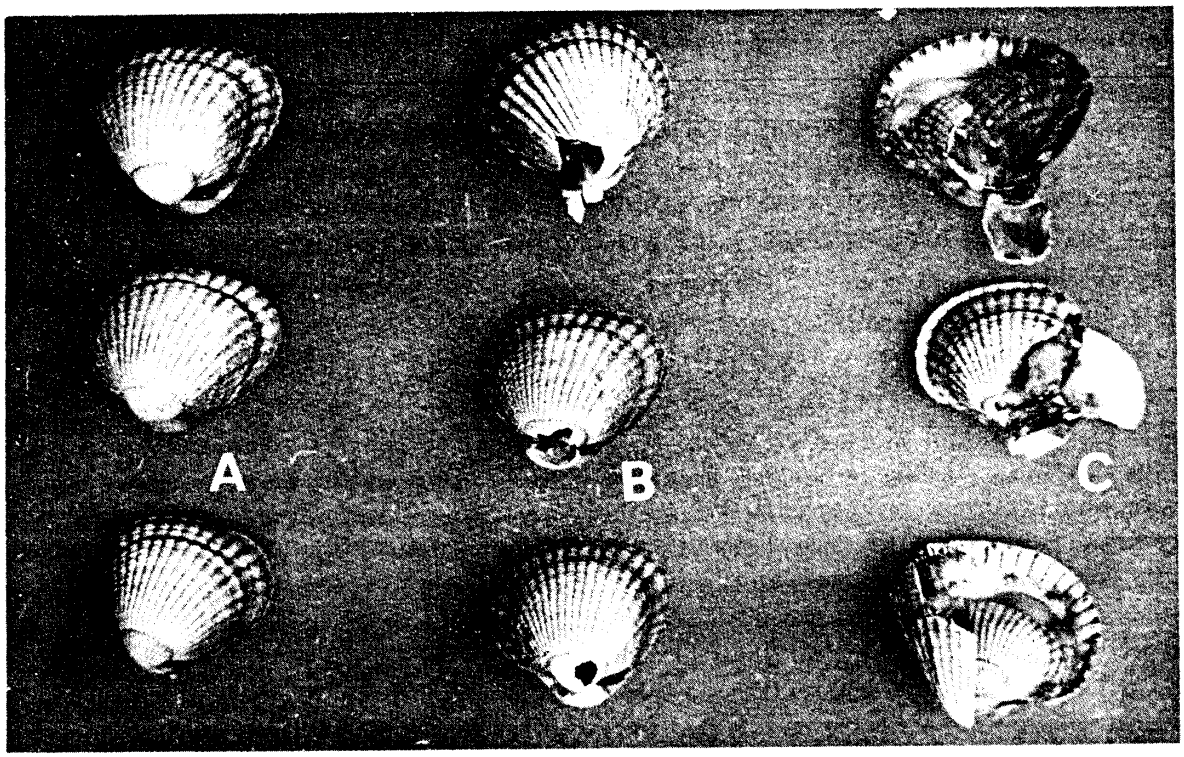

Plate 3 Cockles delivered by a hydraulic dredge: A, whole; B, chipped; C, smashed.

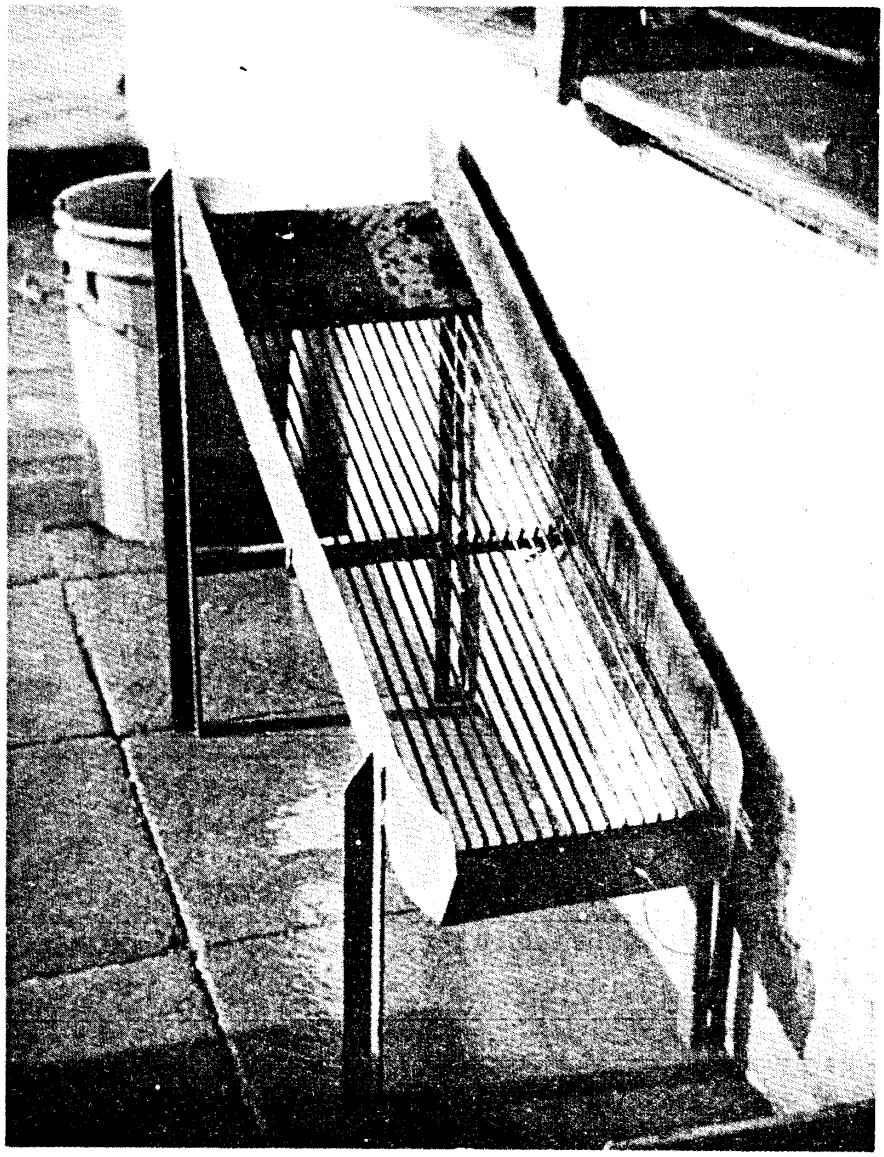

Plate 4 Gridded shute for removing smashed cockles and waste shell at Leigh processing sheds.

Samples of catches taken from all the Leigh processors over two years showed that the breakage rate varied between boats from 16 per cent to 24 per cent, indicating that it might be possible to reduce the damage with careful fishing. The effect of this level of breakage is to reduce the meat yield of the catch. To compensate for this, larger amounts of cockles are taken to obtain a yield equivalent to that from hand-raked cockles. For comparison, in 1969-70, about 10 per cent of each raked catch was not suitable for processing. In attaining an equivalent yield of meat, hydraulic dredging kills at least 15 per cent more cockles than hand-raking - in addition to the 25 per cent which are smashed before reaching the selector screen, a further 2-3 per cent are thought to pass through the dredge itself. Thus, although the dredge is more efficient in terms of catch per unit time, it fails to utilize all the potential catch in its path, because of the high breakage rates.

A further disadvantage associated with the processing of dredged cockles is that they do not survive very well in warm weather and have to be cooked promptly after landing. This is probably due to damage causing fluid loss from the shell cavities.

Despite such high levels of damage, as a result of increased care during processing the cockles are acceptable in the processing sheds, where the final product from dredging is almost indistinguishable from that previously gathered by hand-raking. The extra work required in processing has reduced the redundancies expected when dredging was introduced.

2 Over-exploitation

Due to its great efficiency, a hydraulic dredge can remove a larger number of cockles from an area than several men raking for the same length of time. Thus, a ground can be commercially 'fished-out' by dredges in a much shorter time and the densities remaining are usually much less than those left after raking. It has been calculated that an average Leigh cockle dredger, whilst fishing, travels about 2 000 yards (1 830 m) per hour, removing sand from 1 000 square yards (837 m^2). During the study period of 12 months, the average area covered by each dredger was calculated to be about 800 000-900 000 square yards (about a quarter square mile). A fleet of eight boats is therefore able to remove the surface from 2 square miles in a year. As densities decrease, the area fished must be greater if catch levels are to be maintained. In a fishery of small area, particularly on an isolated population thought to be a self-propagating one, the reduction in numbers of potential spawning cockles below a critical density might adversely affect the future fishery.

To assess the intensity of fishing on the main areas in the Thames estuary, it was necessary to undertake detailed surveys of the population of cockles and to assess accurately the number of cockles removed or destroyed by fishing. The surveys took place in the summers of 1969 and 1970 and covered well defined areas, each numbered in order of distance from port (Figure 3). The grounds covered by the surveys were all intertidal sandflats, the sublittoral stocks not having been discovered.

During the period between the surveys, the fishermen helpfully provided details of their catch from each area on a weekly basis. Included in this information was a record of time spent fishing on each area and this enabled the calculations of catch rates to be made.

The catches were measured as baskets (roughly half hundredweight ≡ 25 kg) and were converted to numbers of cockles fished by multiplying the landings by the average number of cockles per basket; the latter was obtained by regular sample counts at the Leigh sheds. To assess the total number of cockles lost to the fishery, a further $7\frac{1}{2}$ per cent was added to these figures to account for the proportion of cockles smashed by the dredge but not landed.

Each area was treated separately, since they all possessed geographical differences; as expected, some areas were fished much more heavily than others, the area nearest port (area 3) receiving the largest amount of effort relative to its small size.

In all areas, including even those unfished areas used as a control, losses due to natural causes during the year were high. On area 3, where heavy fishing took place, the losses due to fishing exceeded those attributed to natural causes. It was estimated that of all the cockles of fishable size in the area, including those recruited to the fishery during the summer of 1970, over one-third were taken by fishing. This represents a very high level of exploitation and although catches taken from this area during the year amounted to only 19 per cent of the total Thames estuary landings (Figure 3) the area which produced them is very small. Area 3B was frequently fished, there being few other places to fish when rough weather or range practice prevented fishing on the main beds on the Maplin Sands (areas 4, 5 and 6). This sustained fishing effort continued into 1971, by which time densities were exceedingly low. At the time of writing (early 1973) the area has still not been replenished by spat, unlike the adjacent inshore area 3A, which was not so heavily fished. The timely discovery of new, unfished offshore areas has redirected fishing effort and prevented further heavy fishing, which by 1971 was also adversely affecting area 4. Even in such a large area as the Thames estuary, it has been necessary to consider conservation measures, and provision has been made by the Kent and Essex Sea Fisheries Committee to close areas to fishing and to limit the width of dredge blades to 2 feet (610 mm). In a more confined fishery some limit on fishing effort might also be needed to prevent intensive fishing from spoiling future prospects.

3 Effects on undersized cockles

The detailed results of three years' study on the effects of dredging over beds of spat and undersized cockles are being published elsewhere (Franklin and Pickett, in press). Conservation of young and undersized stock is vital for the maintenance of a commercial fishery, and the possibility that hydraulic dredging might be harmful to these cockles had to be investigated. The hypothesis that dredged ground might be unsuitable for spat settlement and survival also needed to be tested.

Experiments to provide this information were commenced in December 1969. However, the practical demonstration of these effects can be obtained only from observations made on the commercial fishery, where at present there is no control of fishing effort. The assessment of changes resulting from three years of full-scale dredging is given later in this leaflet.

The experiments were carried out at Shoeburyness, mainly in a number of marked square plots on an area which receives regular spatfalls. These plots were either subjected to different dredging treatments - for example prolonged dredging, or intensive dredging on one day - or were left undisturbed. In one instance, observations to determine the proportion of spat being taken with the catch were made on board a fishing vessel while it was experimentally fishing one plot. All the areas were sampled at intervals to determine cockle density, growth and subsequent spat settlements. To estimate annual differences, similar experiments were carried out over several years.

The findings of this research are summarized below:

(a) Most of the spat and small cockles in the path of the dredge are either taken into it and expelled through the grids of the dredge or are dispersed by the high-pressure water jets in front of the dredge blade. Comparatively few

pass up the dredge pipe and even fewer get into the catch (less than 2 per cent). Most are in some way dispersed, about 50 per cent settling near the dredge track, the rest being spread more widely and under some conditions possibly failing to settle and survive. Incidence of breakage to these small cockles is slight and if the shell is not extensively damaged, some have been observed to 'heal' and continue growing.

(b) Intense dredging for a short period over a bed of spat during their first winter has little effect on the numbers surviving to become fishable size.

(c) Prolonged dredging on an area, especially during the cockle's second growing season (May-October), can result in a significant reduction in numbers surviving to fishable size.

(d) Growth of small cockles does not seem to be adversely affected by disturbance due to dredging, and in areas of dense settlement where cockles have been well 'thinned-out' there seems to be some improvement of growth.

Thus, prolonged dredging over a bed with young cockles does cause some concern, for it has been shown that continued dredging over spat beds whilst fishing for larger cockles can be of detriment to the fishery, especially if extended into the summer months. If, however, high densities of adults are associated with spat there is no justification for the conservation of the younger stocks by reduction of dredging, but where there are low densities of adults and high densities of spat other fishing areas should be sought. As an alternative method of preventing damage to young stocks, areas may be fished intensively and then left until the remaining spat reach commercial size. Damage to the young stock is detrimental to the fishery but can be overcome by careful regulation of fishing effort by the whole fleet.

4 Stress and spawning

Where a cockle bed is heavily dredged, many cockles will be disturbed by the dredge and some undersized ones may be fished several times. It is not known whether spat and small-sized adults passing through the selector screen at deck level survive. It does seem likely that as cockles are quite sensitive to changes in their environment, disturbance by the dredge and reburying after rejection might cause some form of stress. Even rough weather or cold spells can produce growth checks in cockles that are sometimes visible on the outside of the shell (House and Farrow 1968); Orton (1926) found disturbance rings on cockles that had been experimentally handled for a short period.

Growth checks were not observed in cockles from heavily fished areas, although the proportion likely to be affected in this way is small. Certainly, for spat cockles in intensively fished areas growth seemed better than in less fished areas, due to 'thinning-out'. Stresses such as damage and disturbance might also affect the meat condition or fecundity of individuals, but samples from a dredged area containing disturbed and undisturbed cockles showed no ill effects on either meat content or breeding condition. There is some suggestion that the 'thinning-out' of dense beds of cockles by fishing can also improve the meat yield whatever fishing technique is employed, be it raking or dredging.

5 Effect on the sea bed

The dredge blade bites into the sea bed when fishing, removing sand and cockles from the top inch or so and leaving a shallow track. Most of the sand or mud is brought into suspension in sea water by the water jets on the dredge which play on to the sand in front of the dredge, disturbing it and so allowing the blade to travel more smoothly. Other jets play on the blade (Figure 1), keeping it free of mud or sand. Much of the suspended matter passes out of the grids on the dredge but some also rises in the delivery pipe with the catch and passes through the screen back into the sea. The distance that this suspended material travels before reaching the sea bed depends on factors such as tidal velocities and grain size of the sand or mud, but very little goes back into the track made by the dredge. When the tide recedes following fishing, the tracks are nearly always clearly visible and often associated with shell and broken cockles rejected by the dredging gear. This appearance suggests that there is much damage to the ground, but although the tracks are sometimes detectable for up to 2 months, the shell usually disappears from the surface. A heavily fished ground will often develop a 'clean' look, because much shell is brought to the surface to be washed away and new silt fills the dredge tracks.

There is no evidence that large-scale removal of the substrate affects the feeding of the cockles, for they maintain a satisfactory growth rate and meat condition. Evidence from sampling squares at Shoeburyness suggests that spat settlement on dredged ground is in no way impaired (Franklin and Pickett, in press), such areas receiving as much spat as unfished areas. It is only when fishing is continued after the spat have settled that reduction in their numbers takes place. Despite the vast quantities of sand that can be removed from an area by a fleet of dredging boats, it has been observed that weather conditions produce rapid changes of far greater magnitude, in some cases whole beds of cockles being swept away or sand being deposited in large quantities during gale conditions. The effects of continued dredging are likely to be detrimental to the state of the substrate only in a confined, sheltered area where sand is not replaced rapidly enough by natural processes.

6 Economics

Although not a biological problem, the question of cost and maintenance of dredging equipment must be considered when the limitations of dredging are discussed. The initial cost of the gear and its installation is considerably greater than that used in traditional methods and must be offset by increased productivity. In some poorly stocked areas, catches might not be enough to cover the cost of the gear, repairs, wages, etc., whereas a hand-raker with few overheads might obtain some sort of living. There are many such areas in Great Britain and Ireland.

While dredging, it is necessary to keep the boat's main engine running all the time, i.e. from leaving port until return. This results in greater engine wear and bigger fuel bills than non-mechanical methods of harvesting. Added to this is the cost of running the pump engine.

Maintenance costs vary with the amount of use and care in handling. As with any equipment, parts wear in time, dredge blades needing to be replaced quite frequently, and pump impellers at times causing considerable trouble. The delivery pipes and hoses become worn and, although they can be repaired,

they eventually need replacing. Breakdowns due to engine faults and dredge blockages take place, with consequential loss of fishing time. Sometimes pump intakes will block with rubbish such as polythene bags, which require considerable effort for removal.

As with all sorts of fishing, a certain amount of luck is necessary, but there are times when events such as the fouling of the dredge on submerged snags can occur. This can cause considerable damage (Plate 5) and in sublittoral areas even the loss of the dredge.

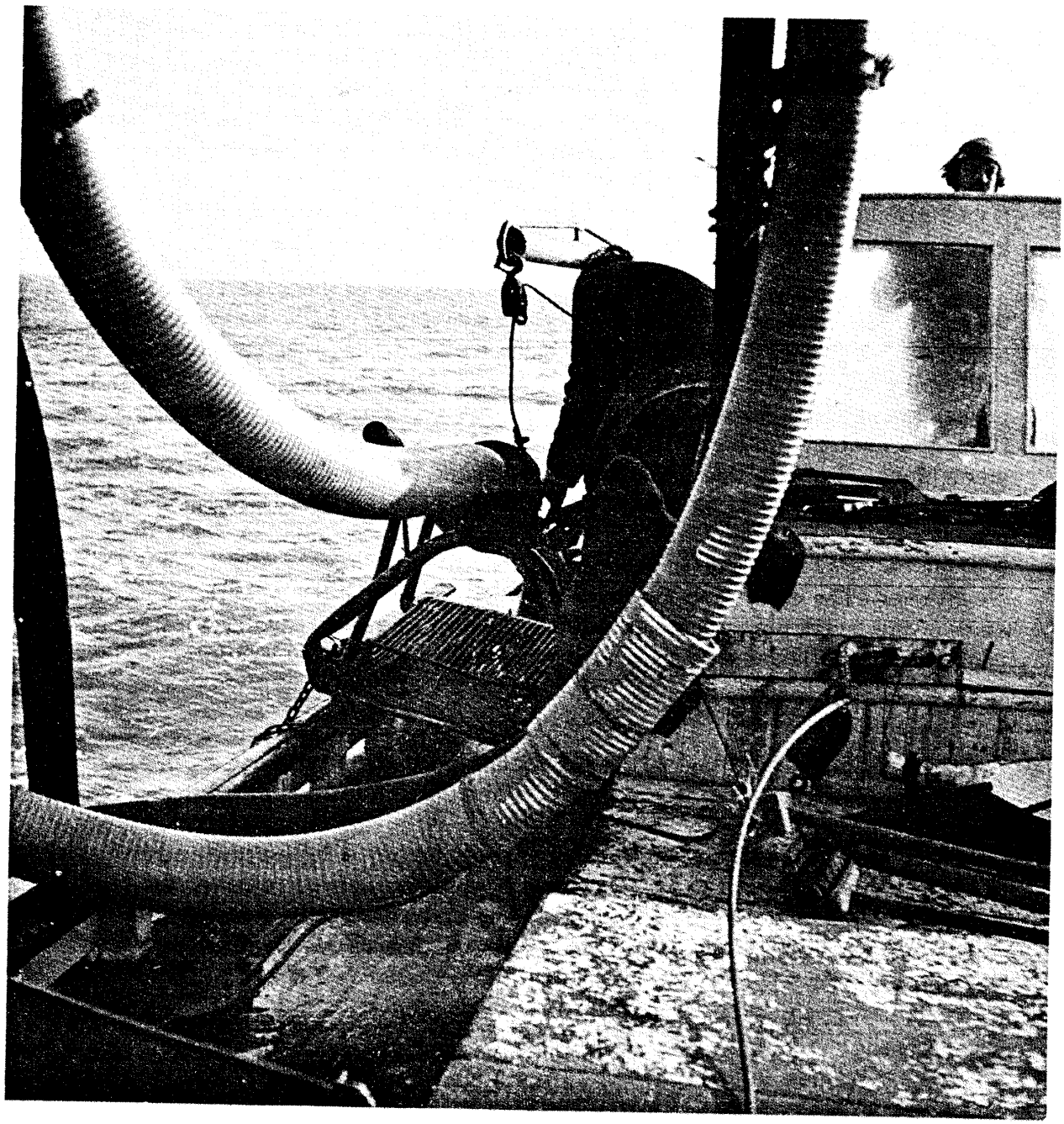

Plate 5 Dredge being repaired after fouling a submerged wreck.
Note bent top grid and detached impeller pipe on left. Delivery pipe also snapped as well as towing chain. Recovered only by lifting warp.

These are some of the disadvantages of hydraulic dredging, and rarely will a dredge operate successfully for more than a few months without some problems cropping up. However, provided that the market for cockles does not decline and prices are maintained, the large catches possible with this equipment outweigh the relatively high costs of running it.

All the major factors associated with dredging, and comparison with traditional hand-raking, may be conveniently summarized by considering the advantages and disadvantages of dredging. These are as follows:

Advantages

1 Efficiency: much more efficient than hand-raking; large catches still possible on low densities

2 Mobility: fishing not restricted to one area on one day

3 Cleaner catch: the cockles are usually clean and free from mud and sand when they come on board

4 Versatility: can fish stocks inaccessible to hand-rakers, i.e. sublittoral cockles

5 Time-saving: length of fishing day can be regulated, especially as catch rates are usually predictable

6 Labour-saving: usually only requires two men on the boat

Disadvantages

1 Breakage: causes a high proportion of the catch to be rendered unsuitable for processing, in addition to killing others that are not taken into the catch

2 Over-exploitation: has the capacity to fish-out large areas in a short time, which without adequate regulation could reduce densities to a dangerously low level

3 Harm to undersized cockles: in some cases fishing over beds of spat or undersized cockles may reduce subsequent recruitment

4 Stress and growth: possible, but ill effects have yet to be observed

5 Damage to sea bed: by removing bottom sediment with the dredge blade, harm is possible in confined sheltered areas where sand is not replaced. No ill effects yet observed

6 Cost: running costs, repair and maintenance greater than with other methods. Must be offset by greater productivity

7 Labour: as a result of breakage, more labour is required on land for adequate processing.

PRESENT SITUATION IN THE THAMES ESTUARY FISHERY

Continuous-delivery hydraulic dredging has been the accepted fishing method in the Thames estuary for over 4 years and is now the sole method employed by fishermen on the north side of the estuary.

Cockle stocks in the main fishing areas have steadily declined since the Leigh fleet converted to dredging, although there were massive losses of cockles before dredging started (Pickett, unpublished). The stocks present at the time the dredge was introduced were mainly survivors of the huge 1963 spatfall, the magnitude of which has not been matched since, although moderate settlements are reflected in the catch rates of the boats on some areas (e.g. Figure 4).

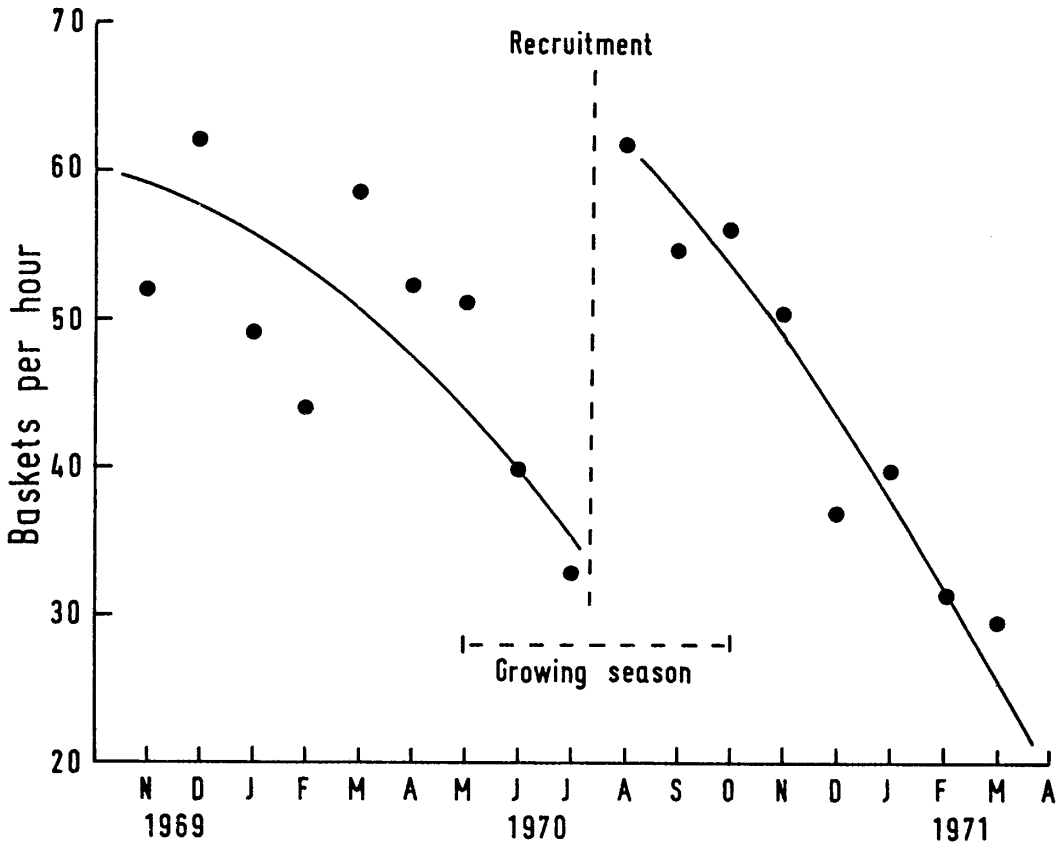

Figure 4 Average monthly catch-rate (baskets per hour) of Leigh boats working in area 3A.

The Thames is not the only area where stocks have declined. The Wash and South Wales fisheries have suffered a similar fate, with poor recruitment since 1963, but while landings in these areas declined, those in the Thames estuary rose as a direct result of hydraulic dredging (Figure 2). Although the Wash and South Wales fisheries have recovered somewhat, the Thames estuary landings are still the highest of the three (Figure 5). There is no doubt that the Thames fishery has reaped a harvest that would have been impossible if hand-raking had been the only available method.

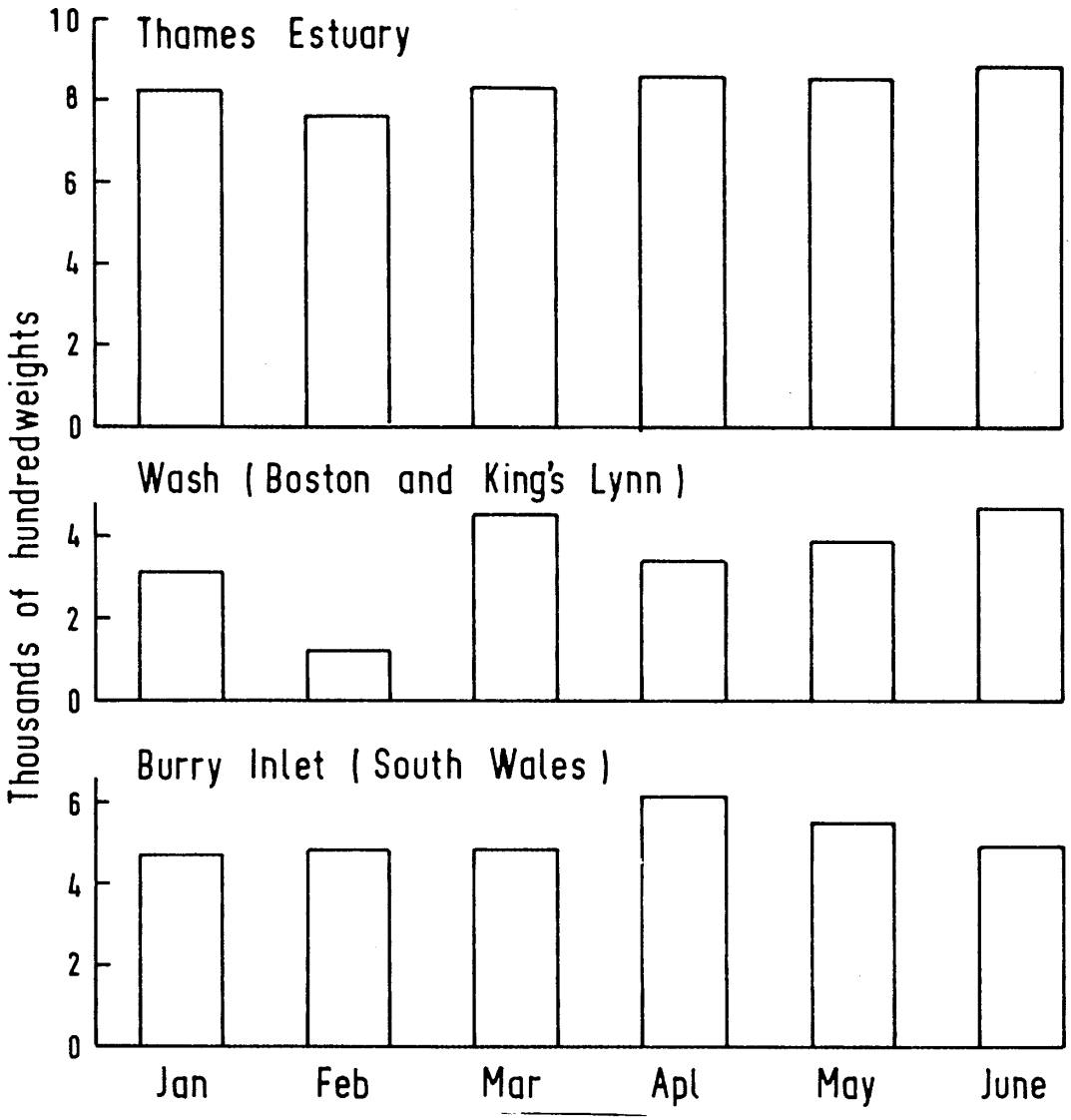

Figure 5 Landings of cockles, in the first six months of 1972, from the three main United Kingdom fisheries.

Detailed stock surveys in 1969-70 showed that even in an unfished area (area 6), 50 per cent of the stock died in one year as a result of natural causes. Heavy losses also occurred on Southend Flats (areas 1 and 2) prior to any dredging taking place, and this area is now almost devoid of cockles and has not in recent years received spat settlements. There have been uneven spatfalls in the Thames estuary in recent years, including the region of the Crouch estuary to the north. There seem to have been equally good spatfalls in fished and unfished areas, the 1971 settlement being particularly abundant in the heavily exploited areas at Shoeburyness.

As fishing on some areas has become uneconomic (e.g. some parts of the Maplin Sands), some of the fishing effort has moved farther away from the home port in search of new grounds. This has resulted in the discovery of previously unexploitable stocks which are nearly always water-covered, such as those on the Barrow Sand. While more abundant stocks exist elsewhere, the Maplin stocks are not absolutely essential to maintaining a fishery, as demonstrated during the second half of 1971, when it is estimated that over half the total landings came from the Barrow Sands alone.

The Buxey Sand at the mouth of the River Crouch supports substantial stocks (Symonds and Pickett 1971) and is at times now exploited by three vessels which work from Wakering and supply a new processing plant which has been set up mainly to deal with catches coming from this new fishery.

The vessels working from Leigh are maintaining their catch levels, although it has been necessary to exploit cockles during their second summer while still very small, these being utilized because of their high meat yield.

Experimental work (Franklin and Pickett, in press, and unpublished) has shown that, in certain areas, overfishing on beds containing large numbers of young cockles could be detrimental to those beds. Recently the Kent and Essex Sea Fisheries Committee have made two new by-laws aimed at conserving stocks. The Committee now has powers to close defined parts of the fishery and to limit the width of the dredge blade to a maximum of 24 inches (610 mm) (see Appendix). The by-laws do not impose any limit on the number of boats fishing for cockles in the Thames estuary, and at the time of writing (early 1973) there are ten in operation, with two more to start fishing shortly in the Crouch estuary area.

The main problems affecting the fishery are those which apply to all cockle fisheries, i.e. the difficulties which arise from yearly variation in spatfall and its survival. The effects of dredging do not appear to offer any major problem to the industry, provided that a sensible management policy is adopted. Although there can be no doubt that the introduction of the hydraulic dredge has made available valuable and extensive stocks not previously exploited, the long-term prospects of the fishery could be seriously threatened by reclamation schemes associated with the proposed port and airport.

SUMMARY AND CONCLUSIONS

Potentially harmful effects of hydraulic dredging for cockles have been studied and discussed against a background of practical fishing. The performance and degree of success of the dredges in the Thames estuary have been monitored, and the yield of the fishery has been measured and compared with other areas. In the main fisheries for cockles in the United Kingdom there has been a decline in stocks since 1966 and a corresponding fall in catches in those areas not using the hydraulic dredge, although in 1972 they started to improve again. The Thames estuary landings, however, increased as a result of dredging and at Leigh have reached a fairly stable level partly dictated by the demand of limited markets.

It has been demonstrated that in many cases both substrate and stock on cockle beds can soon recover from the effects of heavy fishing, provided that young stock is not subjected to continuous fishing in the two years that a spatfall will take to reach commercial size. In the Thames estuary this is often possible because many new fishing areas have become accessible by using the dredge. Thus, when yields from an area fall, other (denser) beds are sought. When these richer areas are not accessible due to bad weather, catches have been taken from already hard-fished grounds. This has resulted in heavy depletion of stock in some beds and the failure of spat to survive because of damage sustained during heavy fishing.

The Thames estuary has remained a successful fishery only because of the many fishing grounds now available to dredging, and at the present time there is no evidence of the need to restrict fishing effort. However, if hydraulic dredging is permitted in other areas with limited cockle resources, it may be necessary to restrict the number of craft operating if a steady yield is to be expected. There is the possibility, however, that some cockle fisheries are potentially much larger than at present realized, the example being the discovery of sublittoral stocks in the Thames estuary. At present the only way to utilize such stocks is by the use of continuous-delivery hydraulic dredging.

ACKNOWLEDGEMENTS

I wish to thank the Leigh fishermen who took great trouble in providing catch/effort data and who endured our presence on their vessels and premises during the course of this research. The assistance of Messrs D. Symonds, N. Latham and P. R. Deavin is much appreciated.

REFERENCES

FRANKLIN, A., 1972. The cockle and its fisheries. Lab. Leafl. Fish. Lab., Lowestoft, No. 26 (N.S.), 34 pp.

FRANKLIN, A. and PICKETT, G. D., 1971. The introduction of hydraulic dredging into the Thames Estuary cockle fishery. ICES C.M. 1971/K:20, 5 pp., 2 figs. (mimeo).

FRANKLIN, A. and PICKETT, G. D., 1972. Introduction of the hydraulic cockle dredge. Commercial Fishing, Vol. 3, No. 2, pp. 18-22.

FRANKLIN, A. and PICKETT, G. D. (in press). The effect of hydraulic dredging on the settlement and survival of cockles (Cardium/Cerastoderma edule). J. Cons. int. Explor. Mer.

HOUSE, M. R. and FARROW, G. E., 1968. Daily growth banding in the shell of the cockle, Cardium edule. Nature, Lond., Vol. 219, No. 5161, pp. 1384-1386.

KERR, N. M., 1969. The continuous delivery dredge - a new method for harvesting cockles. ICES C.M. 1969/K:21, 4 pp., 2 figs. (mimeo).

ORTON, J. H., 1926. On the rate of growth of Cardium edule. Part 1. Experimental observations. J. mar. biol. Ass. U.K., Vol. 14, pp. 239-279.

SYMONDS, D. J. and PICKETT, G. D., 1971. The Buxey Sand - its potential as a cockle fishery. Shellfish Inf. Leafl. Fish. Lab., Burnham, No. 20, 4 pp., 3 figs., 2 tables.

WHITE FISH AUTHORITY, 1967. Continuous delivery dredge for cockles. Research Bulletin No. 25 (no pagination).

WHITE FISH AUTHORITY, 1969. Continuous delivery dredge for cockles. Research Bulletin No. 25/2 (no pagination).

APPENDIX

SEA FISHERIES REGULATION ACT, 1966,
KENT AND ESSEX SEA FISHERIES DISTRICT,
ADDITIONAL BYELAWS

1 The following additional byelaws made by the Local Fisheries Committee and duly confirmed by the Minister of Agriculture, Fisheries and Food on the 6th March, 1972, provide as follows:-

Cockles

No person shall use within the District for the purpose of taking cockles a suction dredge fitted with a blade the width of which exceeds twenty-four inches.

Shellfish beds

Where, in the opinion of the Committee, in any fishery, any bed or part of a bed of shellfish within the District is so severely depleted as to require temporary closure in order to ensure recovery, or any bed or part of a bed contains mainly immature shellfish which in the interests of the protection and development of the fishery ought not to be disturbed for the time being, or any bed of transplanted shellfish ought not to be fished until it has become established, and where the bed, or part thereof, has been clearly defined in notices displayed in the vicinity prohibiting the removal or disturbance of the shellfish, no person shall, without the written authority of the Committee, while the bed or part thereof is so defined, take away or otherwise disturb any shellfish therein.

Provided that where the display of such notices is not practicable, the notice shall be published in a weekly newspaper circulating in the area in which the shellfish bed is situated.

2 The additional byelaws apply to the whole of the District, which extends from Dovercourt in the County of Essex to Dungeness in the County of Kent, and the precise limits of which are defined in the Order for the creation of the District made by the Board of Trade on the 5th May, 1890. The byelaws do not, however, apply to several fisheries which may exist in the District.

3 Application for authority from the Committee to take away or otherwise disturb any shellfish in a bed which is temporarily closed, in pursuance of the byelaw specified above relating to shellfish beds, should be made in writing to the undersigned.

4 Under the Sea Fisheries Regulation Act, 1966, when any vessel is used for fishing in any manner which constitutes a contravention of the above-mentioned byelaw relating to the width of blade which may be used on a suction dredge for the purpose of taking cockles, the skipper, and in some cases the owner, will each be guilty of an offence and liable on summary conviction to a fine or, in certain circumstances, to both a fine and imprisonment. Similarly,

any person who contravenes the above-mentioned byelaw relating to shellfish beds by taking away or otherwise disturbing, without the written authority of the Committee, any shellfish in a bed which is temporarily closed shall be guilty of an offence and liable on summary conviction to a fine.

M. A. Bains

Clerk of the Kent and Essex Sea Fisheries Committee

County Hall,
Maidstone, Kent.

March, 1972

LMK

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NOTE
Although the complete list of Laboratory Leaflets is given to show the scope of the series, it will be appreciated that many of these leaflets are topical and therefore of interest chiefly at the time when they are written. For this reason most of the earlier ones are being allowed to go out of print when present stocks are exhausted; few copies are available of those prior to No. 13.

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