MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

YORKSHIRE CRAB INVESTIGATIONS 1962

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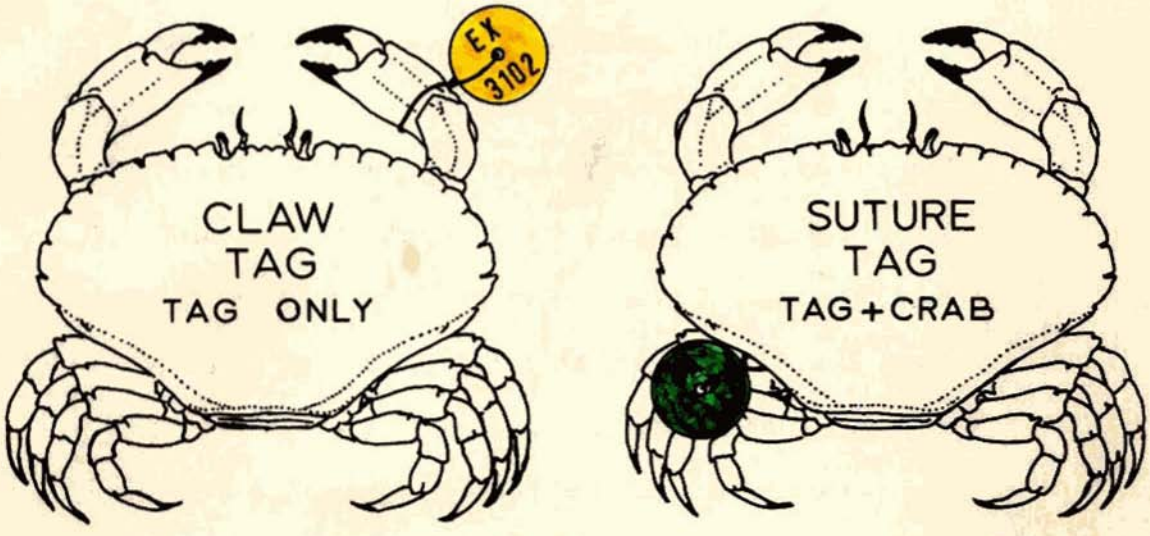

REWARD

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD
FISHERIES LABORATORY
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LABORATORY LEAFLET (NEW SERIES) No. 3

FISHERIES LABORATORY
BURNHAM ON CROUCH
ESSEX

MAY, 1963

Laboratory Leaflet (New Series) No. 3

YORKSHIRE CRAB INVESTIGATIONS 1962

AIMS OF RESEARCH

Work was started in 1961 to investigate the state of the Yorkshire crab stocks. Catches of crabs off Yorkshire have declined steadily during the last few years (Figure 1), and this investigation was designed to tell us whether the present minimum legal size of 4½ inches could be changed to advantage, and what effect any change would have on landings, both immediately and in the long term.

In order to predict the effects of an alteration in the minimum size a considerable amount of background knowledge of the fishery is required, including details of landings, amount of fishing and the growth and death rates of crabs. The 1962 programme was directed towards this end, and the object of this report is to make available some of the preliminary results obtained. Further information is required before a final recommendation can be made, and the work will be continued during the 1963 fishing season.

We would like to take this opportunity of thanking all the people concerned for their co-operation and help during the year. Once again we thank the skippers and crews of crab fishing boats who so willingly took us to sea and assisted us in the research work.

SIZE AND WEIGHT COMPOSITION OF THE 1962 CATCH

The composition of the catches was examined at sea on commercial vessels and also at the ports. Monthly visits to the fishery yielded information on the sizes, proportions of each sex and the numbers of hard and moulted (soft) crabs in the catches. Information was also collected on the proportion of crabs below 4½ inches - the future recruits - in the catches. During the year over 20,000 crabs of commercial size were measured.

Table 1 The percentage of the crabs landed at the various ports in the area, in certain size groups

Port	Size range (percentage)			
	4½"-5"	5"-6"	6"-7"	over 7"
Grimsby	44	50	5	1
Bridlington	37	48	13	2
Flamborough	30	49	18	3
Scarborough	27	48	19	6
Whitby	23	47	23	7
Average for whole fishery	30	48	18	4

These results are very similar to those obtained in 1961. There were great differences in the size composition of the crabs landed at various ports in the area; crabs in the south were on average smaller than those landed at Scarborough and Whitby.

Weight of crabs landed

In the Yorkshire fishery, where crabs are sold by weight, it is important to know the weight of crabs at each size so that the loss or gain to the fishery due to any change in the size limit can be calculated. During 1962, 1,500 crabs over 4½ inches were weighed individually and a relationship between shell width and weight obtained for each sex. This has allowed the figures given in Table 1 to be re-calculated on the basis of weights.

Table 2 The percentage of the total weight of crabs, landed at each port, falling in each size group

Port	Size range (percentage)			
	4½"-5"	5"-6"	6"-7"	over 7"
Grimsby	32	56	10	2
Bridlington	24	49	22	5
Flamborough	18	48	28	6
Scarborough	16	43	28	13
Whitby	12	40	33	15
Average for whole fishery	18	45	27	10

Any increase in the minimum legal size must lead to a reduction in the numbers and weight of the crabs landed during the first year. The first column in Tables 1 and 2 shows the reduction in numbers and weight which would have occurred in 1962 if the size limit had been increased from 4½ to 5 inches before the 1962 season. It can be seen that the loss would have varied from port to port. If, however, the growth rate is good, and the deaths from natural causes are few, the loss in numbers may be more than made up in the following years by the increased weight of the crabs which have been protected by the increased minimum size. In order to understand this, it is necessary to obtain information on growth rates, weight increases and the number of deaths from natural causes.

GROWTH

In the crab growth occurs as a result of a series of moults. After the old shell has been cast the new soft shell increases in size and then gradually hardens in a period of two to three months.

The catches of commercial crab boats were examined at sea for the numbers of soft (recently moulted) crabs present throughout the season, and from these the onset of moulting was determined. In 1962, after a delayed start to the fishing season, probably associated with the cold

weather conditions in March, the main moulting period was found to begin in late July to early August and to continue until October. This was estimated to be a month later than in 1961. It was found that females moulted first, followed about a month later by the males. Both in Norfolk and in Yorkshire it was found that when the fishery started late the onset of the main moulting period, with the accompanying fall in catches, was also usually late, so that the length of the fishing season was not necessarily reduced.

Much difficulty has been found in determining the true growth rate of crabs, since this depends not only on the increase in size at each moult, but also on the number of times a crab moults each year.

Size increases can be measured by the use of a new tagging method in which the tag is attached on the side of the body where the shell splits and remains attached to the new shell after the moult. This type of mark is known as a "suture tag". In June 1962, 1,000 crabs with shell widths ranging from three to eight inches were marked with green suture tags in this way and released on the inshore grounds between Staithes and Robin Hood Bay. By the end of December 1962, 54 tagged crabs had been recovered, but only three of these had moulted. As it is common practice to throw overboard any soft or hardening crabs found in the pots, it is quite possible that some moulted crabs still carrrying the tag were missed by fishermen. It is hoped that substantial numbers of these will be recaptured during the 1963 season.

Table 3 The increase in size and weight of the three moulted recaptured crabs

Sex	Size (inches)		Increase (inches)	Percentage increase	
	at release	after moult		Size	Weight
Male	4.1	5.3	1.2	29	158
Male	4.6	5.9	1.3	28	147
Male	3.7	4.7	1.0	27	150

It can be seen that a crab of about 4½ inches reached a size of nearly 6 inches after one moult, an increase of 28%; but the weight increased from 9 ounces to 22 ounces, an increase of 140%. In this fishery, where crabs are sold by weight, the weight increase per moult must also be known, and it is hoped that sufficient crabs will be returned during 1963 to determine this accurately.

The average time between moults is more difficult to determine, but for crabs over 4½ inches it is believed to be a year or more.

PROPORTION OF THE STOCK REMOVED BY FISHING

By means of tagging experiments the effect of fishing on the crab stocks can also be estimated. Between 24th March and 3rd April 1962, 800 crabs of commercial size (4½ inches and over) were marked with a yellow plastic serially numbered disc attached to the claw, and released at 44 positions between Staithes and the Humber. By the end of December 1962, 200 (25%) of the tagged crabs had been recaptured, most of these being returned during the months of April, May, June and July. The overall percentage recovery of 25% gives an indication of the proportion of the stock removed by fishing between March and December, but since it is possible that some tagged crabs died, moved away from the area, or lost tags, the true fishing rate will have been greater than 25% per annum. Tagged crabs caught but not reported would also affect the results, and it is significant that 39 (19.5%) of the tags were recovered at processing factories, after having been overlooked by the crews sorting the crabs at sea. A second tagging experiment is planned for 1963.

SOME PROBABLE EFFECTS OF TEMPERATURE

During the year information on the weight of crabs and lobsters landed, the number of boats fishing, and the number of pots used was obtained for ports in Yorkshire. The catch from 100 pots hauled has been calculated for each month and used as a convenient means of comparison to show the seasonal pattern of the fishery. This showed that during the winter months less than 3 stones of crabs were caught for

each 100 pots lifted, but that the figure rose suddenly to 8 stones in April 1962, suggesting that there may have been a change in behaviour, due either to an increase in response to bait or to a movement of crabs on to the fishing grounds. The seasonal variation in yield for the whole fishery in 1962 is shown in Fig. 1. The yearly regularity of the rise in catch suggests that it is related to the rise in temperature of the sea. Experiments have been started in the laboratory to obtain information on the effects of temperature on feeding. Preliminary results show a rapid decline in feeding with a fall of temperature. Crabs held for 10 days at a temperature of 60°F ate 46% of the food supplied, but at 40°F only 1% of the food was eaten. Activity was also reduced at low temperatures, and below 39° normally lively crabs became sluggish, stopped feeding and remained dormant on the tank bottom. It was worth noting that in the early part of 1961, when water temperatures were still low after the cold spring, boats potting offshore had better catches than those working the shallower inshore water. It is possible that after a severe winter the crabs do not immediately come inshore on to the usual grounds, but remain in depths ranging from 15–20 fathoms until inshore water temperatures rise.

CRAB MOVEMENTS

Tagging experiments also give information on the movements of crabs. In the March 1962 claw-tagging experiment, out of 800 crabs released 159 were returned by fishermen during the following 9 months, together with the dates and positions of recapture. The distances moved by the crabs are shown in Table 4 and, as they are the shortest distances between the points of release and the positions of recapture, the actual distances travelled may have been greater.

Table 4 Returns of tagged crabs, grouped by distance between points of release and recapture

Sex	Distance (miles)										
	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-20	21-30	Over 30	Total number of crabs returned
Female	31	19	17	7	7	3	3	4	3	2	96
Male	25	23	6	2	1	1	1	3	1	0	63
Total	56	42	23	9	8	4	4	7	4	2	159

Over 60% of the crabs returned were recaptured within 5 miles of the point of release, and 13% had moved more than 10 miles before recapture. Female crabs seem to move further than males. Recapture positions of tagged crabs which had moved more than 10 miles are shown in Figure 2. The majority were recaptured within a short time after release and the movements do not show any greater trend to the north than to the south, but further recaptures may alter the picture. There are several long distance movements in a northerly direction by female crabs recaptured in the autumn, and these may be associated with breeding behaviour. The greatest distance travelled by a male was 26 miles in a southerly direction, and three other males also moved more than 15 miles in this direction. These results support the generally accepted theory that large crabs move offshore in the autumn and return inshore in the spring.

Limited recaptures from the suture tag experiment in the Whitby area show that again the majority of crabs had moved very little in the short time since release. However, four females were returned which had moved a long way in a northerly direction, three being recaptured off Seaham Harbour and another near St. Mary's Island, Northumberland. This last crab had travelled at least 45 miles in 114 days. The fastest rate of travel over a long distance was at least half a mile per day, the crab, a female, having crawled 13 miles in 23 days.

Migration of crabs from the Norfolk fishery

Nine female crabs released off Norfolk in 1959 and 1960 have been recaptured by boats crabbing off the Yorkshire coast, and another female crab was taken by a Grimsby trawler fishing 60 miles north-east of the Humber. These recaptures show that there is some migration of female crabs into the Yorkshire fishery from the Norfolk grounds.

MEAT CONTENT

Samples of crabs have been examined to obtain information on the fluctuations in meat yield during the year. This work was done with the co-operation of a local crab processing firm and the meat was extracted by the factory staff using their standard method. Samples were examined in April, July and November, and the following table summarises the results.

Table 5 Seasonal variation in meat content

Size Range (inches)	Sex	Meat yield (oz) from 14 lb live weight of crabs								
		April			July			November		
		Brown	White	Total	Brown	White	Total	Brown	White	Total
$5\frac{1}{2}$–6	Female	$48\frac{1}{2}$	18	$66\frac{1}{2}$	61	19	80	$50\frac{3}{4}$	$17\frac{1}{2}$	$68\frac{1}{4}$
	Male	37	25	62	46	29	75	32	$22\frac{1}{2}$	$54\frac{1}{2}$
5–$5\frac{1}{2}$	Female	$52\frac{1}{2}$	17	$69\frac{1}{2}$	60	18	78	51	15	66
	Male	40	$24\frac{1}{2}$	$64\frac{1}{2}$	48	26	74	$35\frac{1}{2}$	$20\frac{1}{2}$	56

The results may be summarised as follows:-

(a) A stone (14 lb) of female crabs yielded more brown body meat than a stone of males of a similar size, but the yield of white claw meat from males was greater because of their larger claws. A stone of crabs measuring $5\frac{1}{2}$ to 6 inches yielded more meat than crabs of either a smaller or larger size.

(b) A female crab yielded less total meat than a male crab of the

same shell width. This resulted from the higher yield of white meat from the large claws of the male, but brown meat from a female was still always slightly more than from a male.

(c) The best meat yield from males and females of all sizes was obtained in July. Yields were slightly higher in April than in November, but this may have been due to the presence in November of newly-moulted, but hardened, crabs which have a low meat content. Females over 5 inches had a high brown meat yield in November, due to the development of eggs or "coral", prior to spawning.

NATURAL HISTORY AND HABITS

In Great Britain Cancer pagurus is the only kind of crab which is regularly fished for human consumption. It occurs on almost every coast of Europe from Norway to Greece, but is more numerous where the shore is rugged.

The edible crab prefers fresh to stale food; it eats fish, marine worms, mussels, cockles and other shellfish, crushing them with its powerful claws. The crab's keen sense of smell and voracious habits account for its being so easily captured by baited pots.

The early life of the edible crab is planktonic (free floating), and the young crab has a shrimp-like appearance. After a short planktonic period the young crab settles on the sea bottom and assumes the adult shape. Growth takes place by moulting and this occurs at frequent intervals during the crab's early life when growth is fast, but with the onset of maturity moulting takes place less often, being reduced to once a year and even less frequently at the larger sizes. Growth appears to be subject to considerable variations from year to year and may vary in different areas. It is impossible to state the age of a crab with any degree of certainty but it is likely that on the east coast of Britain a crab of $4\frac{1}{2}$ inches shell width will be between 4 and 5 years old.

It is believed that in this area all female crabs are mature by the time they are 5 inches in shell width. Observations in our laboratory

tanks have shown that a powerful attraction exists between the sexes prior to the moulting of female crabs. Males were found to accompany females for a period of 3 to 20 days before the moult, after which mating took place, and the male then continued to protect the soft female for up to a further 12 days. (This behaviour no doubt accounts for the temporary decline which has been observed in the number of males in the catches during the moulting period.) The male sperm products are introduced into the female seminal receptacles and one supply of sperms may fertilise two or even three batches of eggs in subsequent years. The majority of female crabs fertilised during July and August become berried by the November and December of the same year. These crabs spawn in the deeper offshore water, where they lie partially buried in the bottom during the winter months. The eggs are attached to the swimmerets on the abdomen, and remain there for a period of about 7 months. The number of eggs carried may vary from 500,000 in a female crab of 5 inches to over 3,000,000 in a crab of over 7 inches. In the summer following spawning the berried crabs move inshore and the eggs are hatched in the inshore waters. During June, July and August it was found that many large female crabs showed traces of hatched eggs still attached to the swimmerets.

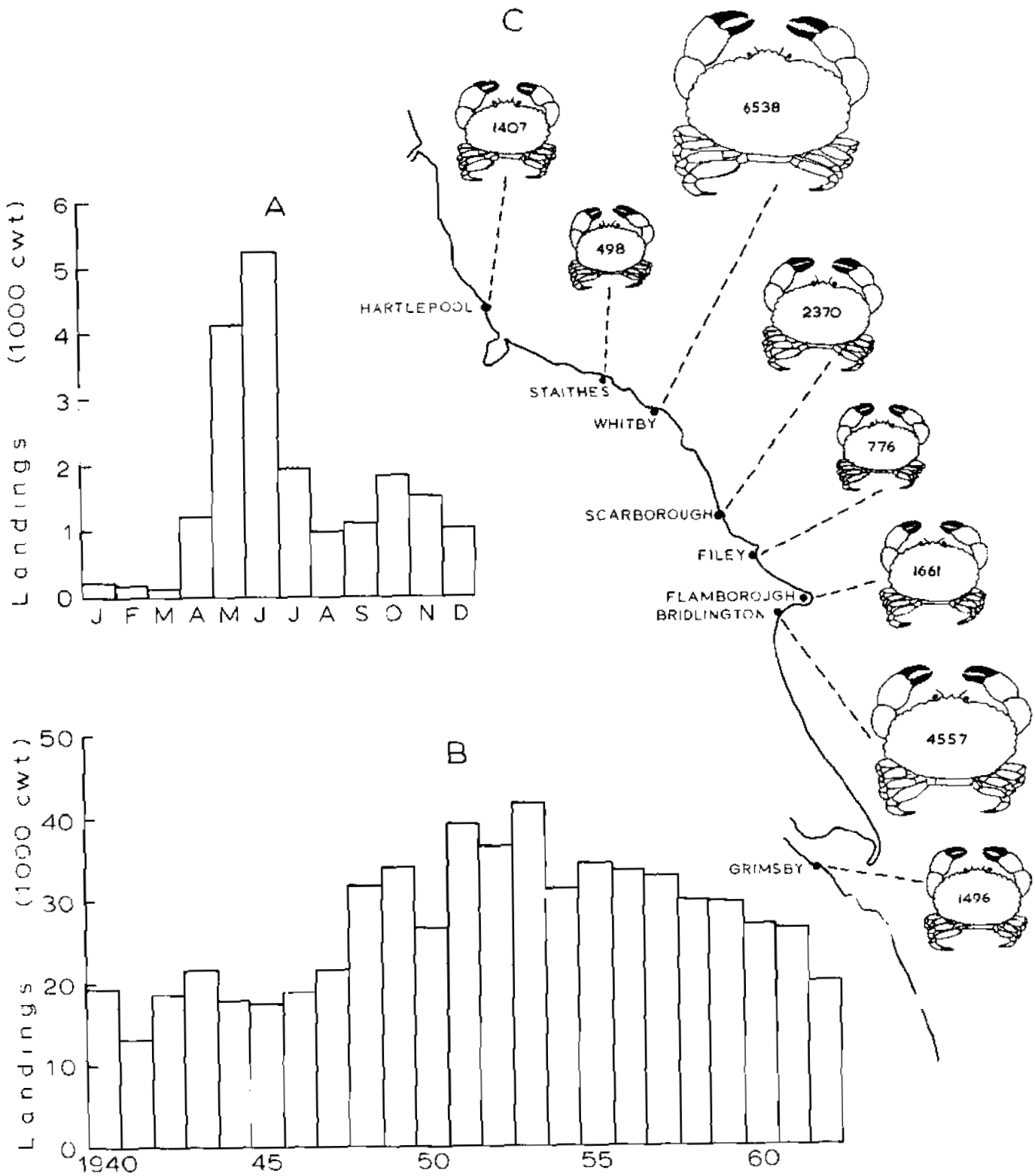

Fig. 1. The Yorkshire crab fishery.

A. Landings each month during 1962.

B. Landings each year during 1940-1962.

C. Weight of crabs (cwt) landed at each port during 1962.

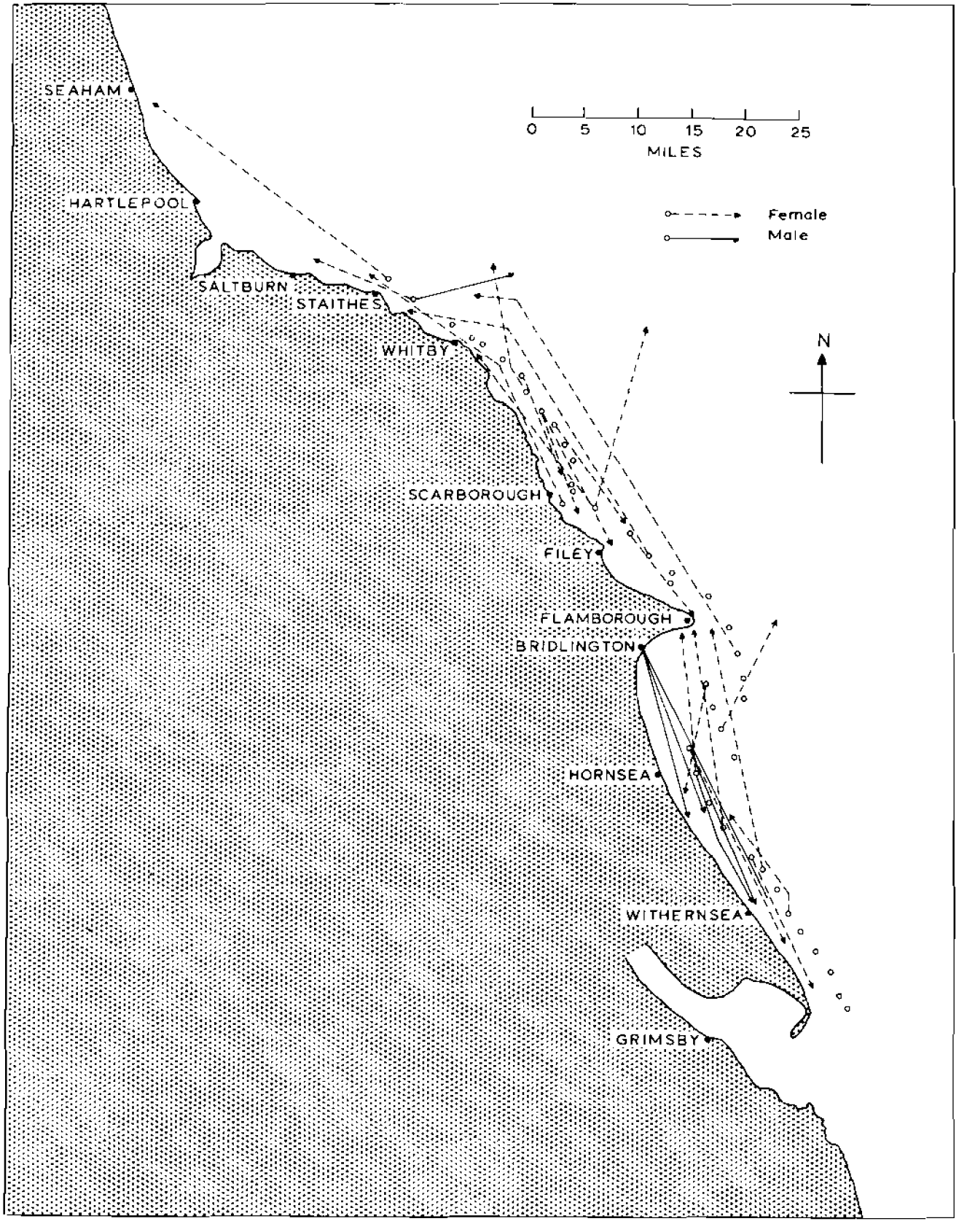

Fig. 2. Map showing position of recapture of claw-tagged crabs which had moved 10 miles or more.

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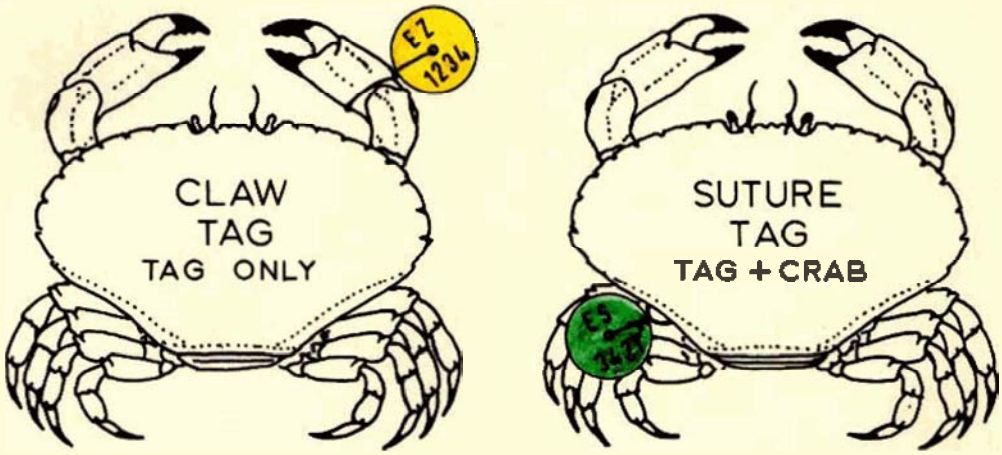

RETURN TO

STAITHES	Mr. W.James.
WHITBY	Mr. H.M Calam, 1 West Pier.
SCARBOROUGH	Mr. K.Smith, Fisheries Office.
FILEY	Mr. Peach, Station Officer, H.M.Coastguard.
FLAMBOROUGH	Mr. R.K.Bayes, 7 North Marine Road.
BRIDLINGTON	Mr. E.Taylor, 172 Queensgate Ext.
HULL	Fisheries Office, St. Andrews Dock.
GRIMSBY	Fisheries Office, 91 Cleethorpe Road.

and in other areas to your local fisheries officer or collector.

REWARD

2/- for each CLAW TAG

3/- for each SUTURE TAG with CRAB

Further crab tagging experiments are planned for 1963 in the Yorkshire area. Every tagged crab found adds to our knowledge of <u>your</u> fishery. Please help us by returning <u>every</u> single tag you find.

Fig. 3. The poster which is being used to publicize this investigation.