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MINISTRY OF AGRICULTURE, FISHERIES AND FOOD

NORFOLK CRAB INVESTIGATIONS 1969-73

BY C.G. BROWN

MINISTRY OF AGRICULTURE
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LABORATORY LEAFLET (NEW SERIES) No. 30
FISHERIES LABORATORY, LOWESTOFT, SUFFOLK.

NOVEMBER 1975

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DATE DUE

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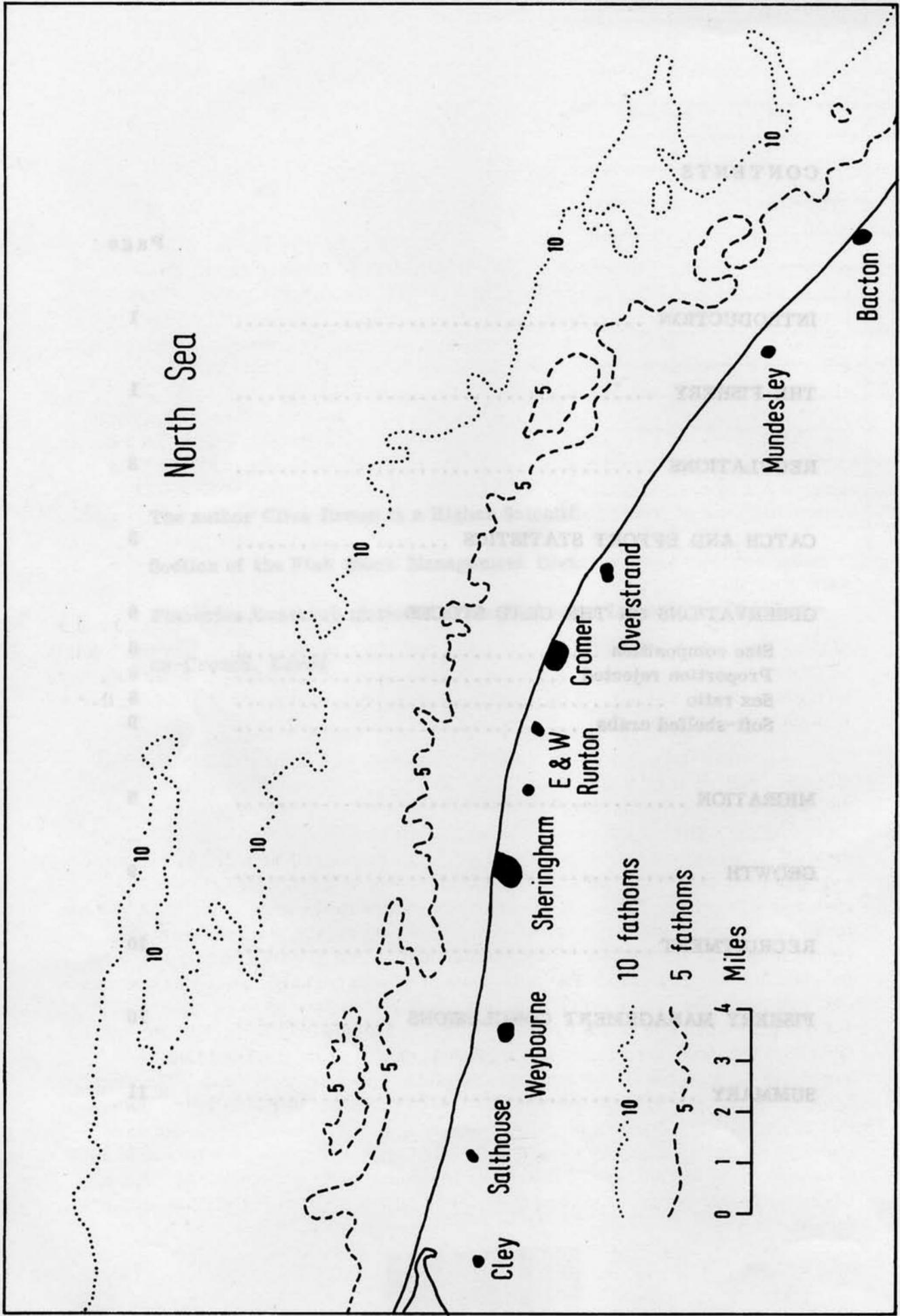


Figure 1 The Norfolk crab fishery: location.

NORFOLK CRAB INVESTIGATIONS, 1969-73

INTRODUCTION

Along the Norfolk coast there is an important fishery for the edible crab (Cancer pagurus). It is based mainly on the ports of Cromer and Sheringham and in 1973 landed 5 375 cwt, valued at £86 530, i.e. approximately 8% of the England and Wales annual catch. Ministry studies in this area first began in 1957 in order to enable fishery management advice to be given and to add to the available knowledge on the biology of the crab. In 1966, as a result of these studies, it was recommended that the appropriate minimum landing size for crabs in this area should remain at 4.5 inches (114 mm) carapace width. Since this recommendation was made, a monitoring programme which included the collection of catch and effort data and size composition measurements has been carried out by the Fisheries Laboratory, Burnham-on-Crouch. This leaflet describes the present fishery and analyses the results of the monitoring programme.

THE FISHERY

The crab fishing grounds cover a relatively small area comprising 20 miles of coastline from Cley-next-the-Sea to Bacton and extending approximately 2 miles offshore (Figure 1). The sea bed in this area is mainly composed of flint boulders on a chalk base. Fishing takes place in water depths of between 2 and 10 fathoms (1.8 and 18 metres):

Approximately 80% of the Norfolk crab catch is landed at Sheringham and Cromer, and smaller landings are made at Cley, Salthouse, Weybourne, East and West Runton, Overstrand, Mundesley and Bacton. Fishing is carried out from clinker-built beach-launched boats of between 16 and 20 feet (4.9 and 6.1 metres) in length, usually powered by petrol engines, although diesel engines are now in use in the fleet (Plate 1). Tractors or winches are normally used to launch and beach the boats; there are no harbours in the area. Crabs and lobsters are caught by means of baited creel-type pots (Plate 2) which are usually fished in strings or 'shanks' of between 20 and 30, each boat working a total of between 120 and 225 pots. The pots are baited with gurnard, plaice or cod-heads obtained from the Lowestoft fish market. All pots were hauled by hand until the 1967 season when one of the Cromer boats was fitted with a hydraulic pot-hauler. Over the next few years there was a gradual change from hand-hauling to hydraulic-hauling and by 1970 most of the full-time fleet were equipped with pot-haulers (Plate 3). The crab and lobster catch is normally sold alive to individual fishmongers, each fisherman having his own markets. Some fishermen have stalls or shops where a proportion of their catch is sold direct to the public as dressed crab. Norfolk crabs are normally sold as select whole crabs, and they have an excellent reputation for good quality. Only a small proportion are sold for processing.



Plate 1 Crabbing boats at Cromer.

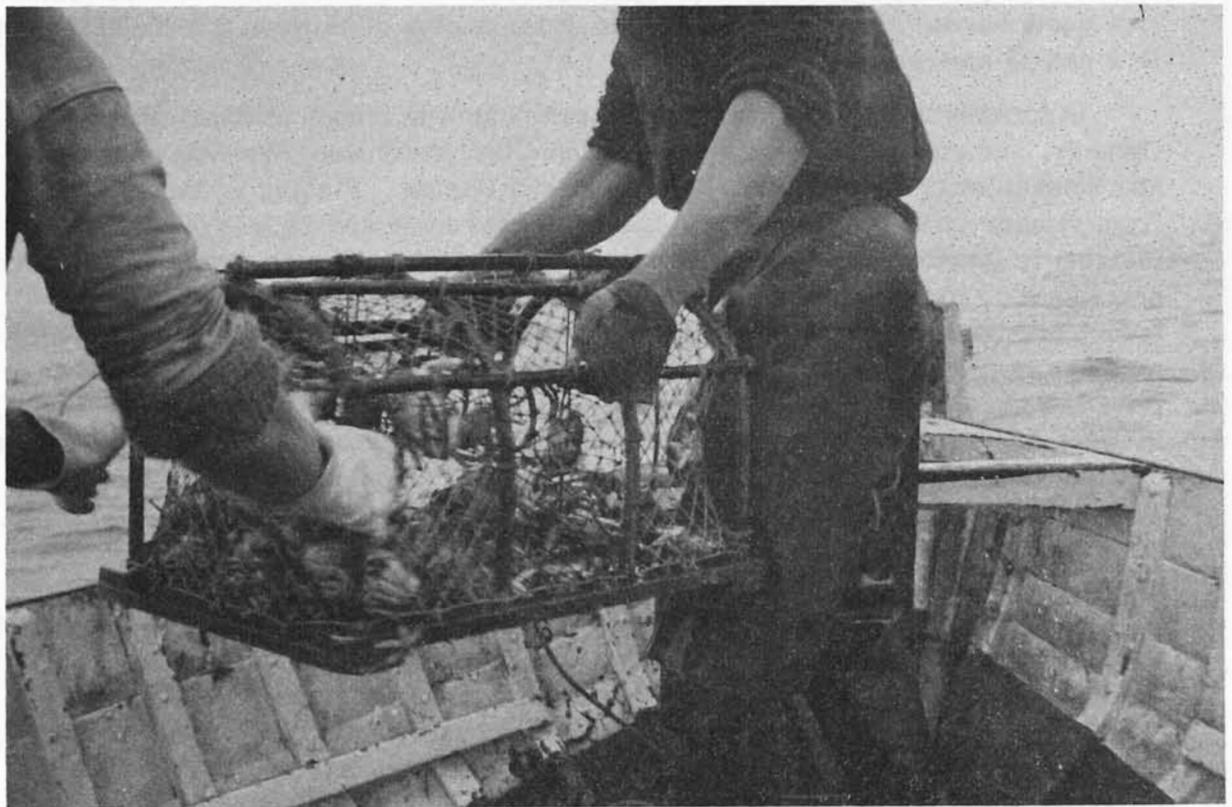


Plate 2 Hauling a Norfolk crab pot.



Plate 3 Hydraulic pot-hauler.

Peak crab landings occur during May and June, when on average 56% of the season's catch is landed. The lower catches of crabs in July and August are to some extent offset by higher lobster landings at this time (Table 1). The 1973 lobster catch was 244 cwt valued at £21 813, and over the period 1969-73 lobster landings averaged 264 cwt, i. e. 3% by weight of the total England and Wales catch.

Table 1 Monthly landings of crabs and lobsters expressed as percentages of the total annual landings, 1962-73

	March	April	May	June	July	August	September	October
Crabs	3	16	30	26	12	8	4	1
Lobsters	1	4	14	10	28	31	11	1

REGULATIONS

In addition to the national statutory regulations, which make it an offence to land 'berried' crabs (egg-carrying), 'soft' crabs (recently moulted), or crabs whose carapace width measures less than 4.5 inches (114 mm), there is also an Eastern Sea Fisheries Committee by-law which makes it an offence to land 'white-footed' crabs between 1 November and 30 June. 'Whitefooted' crabs are those which have not hardened fully after the moult; the tips of their pincers are grey compared with the black pincers of hard crabs. There is also an Eastern Sea Fisheries Committee by-law making it an offence to use edible crabs for bait.

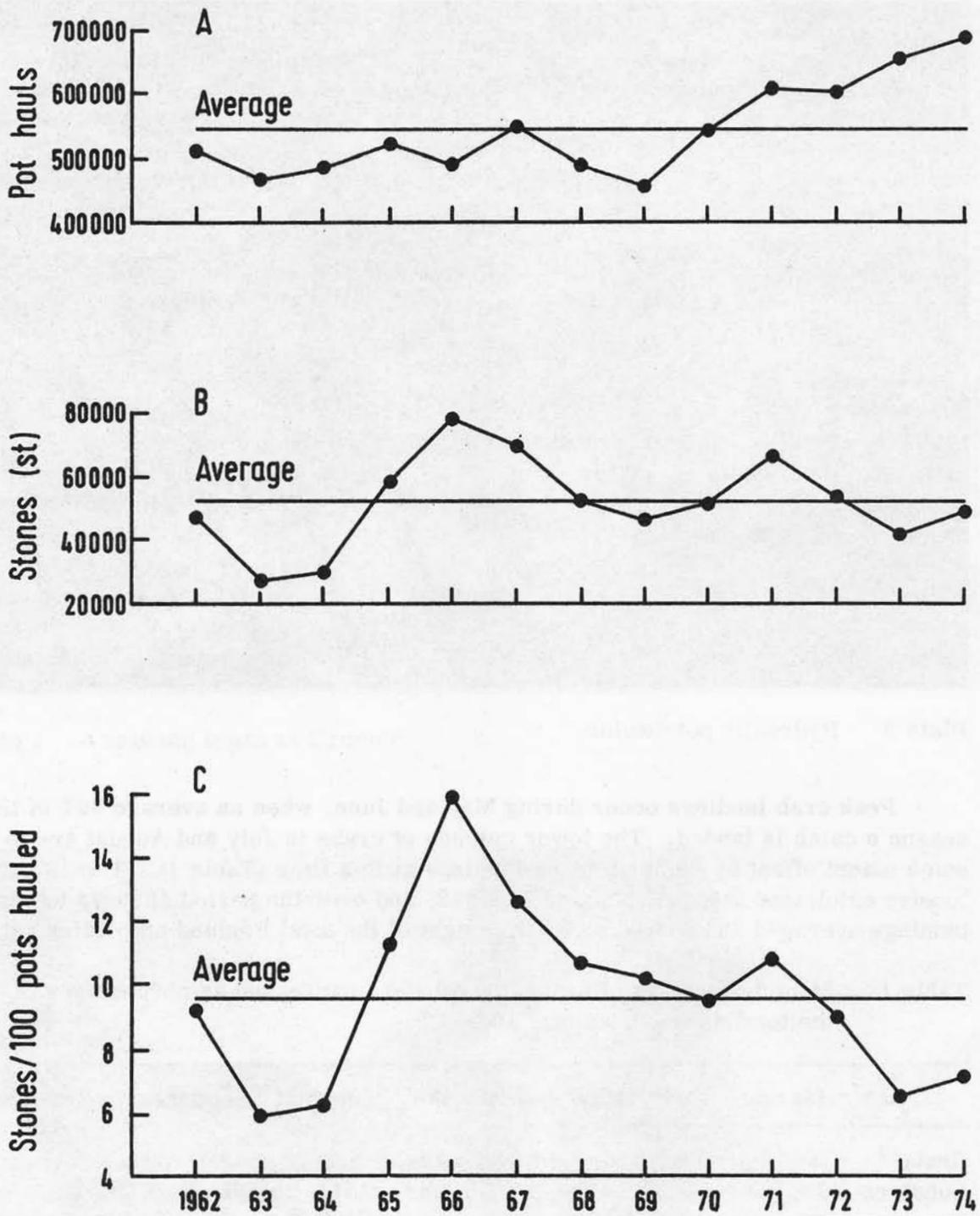


Figure 2 Annual crab fishing effort (A), catch (B), and catch per unit fishing effort (C) for the Norfolk fishery, 1962-74.

CATCH AND EFFORT STATISTICS

Adequate knowledge of the catch and the amount of fishing (fishing effort) are essential requirements for any fishery research programme. A knowledge of the annual landings for a port does not, by itself, give information on the abundance of crabs. If the catch at a port doubles in a year, this could merely be the result of doubling the number of boats potting. However, expression of the data in terms of catch per unit of effort (for example, the weight of crabs caught by 100 pots) can be used as a guide to the abundance of crabs from month to month, and year to year, because it takes into account changes in both catch and effort.

Details of the weight of crabs and lobsters landed, the number of days fished and the number of pots hauled have been recorded for the Norfolk ports since 1962. Crab landings fluctuated over a fairly wide range during the period 1962-74 (Figure 2B), with an average annual weight of landings around 50 000 stones. The number of pot hauls during this period showed much less variation (Figure 2A) and consequently the catch per unit effort trends (Figure 2C) are similar to the annual catch trends. This suggests that the major variations in the crab catch were the result of changes in abundance or catchability of the crabs. There are a number of natural factors which can influence both the abundance and catchability of crabs and lobsters. Since these crustaceans are cold blooded, their feeding behaviour is related to the sea temperatures. Extremely low winter or spring temperatures in the shallow water found in this area result in decreased feeding activity and therefore lower catches. The low values of catch per unit effort in 1963 and 1964 (Figure 2C) were probably due to the severe winter of 1962/63, the effects of which persisted until 1964. Low annual catch per unit effort figures can also be the result of bad weather or the loss of fishing gear at the time when high catches are normally made and when effort is usually at a high level. So much gear and fishing time were lost because of gales during April 1973 that the catches in that month were only 28% of those in April 1972. The high catch per unit effort figures in 1966 may have been a result of increased feeding activity, and hence higher catchability, due to favourable weather conditions, or the result of an increase in the abundance of crabs.

Maximum catches are taken during the month of May. The average number of pots used per week during this month over the period 1962-69 was 4 238 and since 1969 the number of pots fished has increased by 36% to a level of 5 744 in 1974 (Figure 3). This increase in pots is the result of (i) the introduction of hydraulic pot-haulers (hauling pots mechanically is easier and quicker than hand-hauling and it is possible for more pots to be worked by each boat), and (ii) an increase in the number of full-time and part-time fishermen. The annual catch per unit effort for the Norfolk crab fishery during 1972, 1973 and 1974 was below the average for the 13-year period.

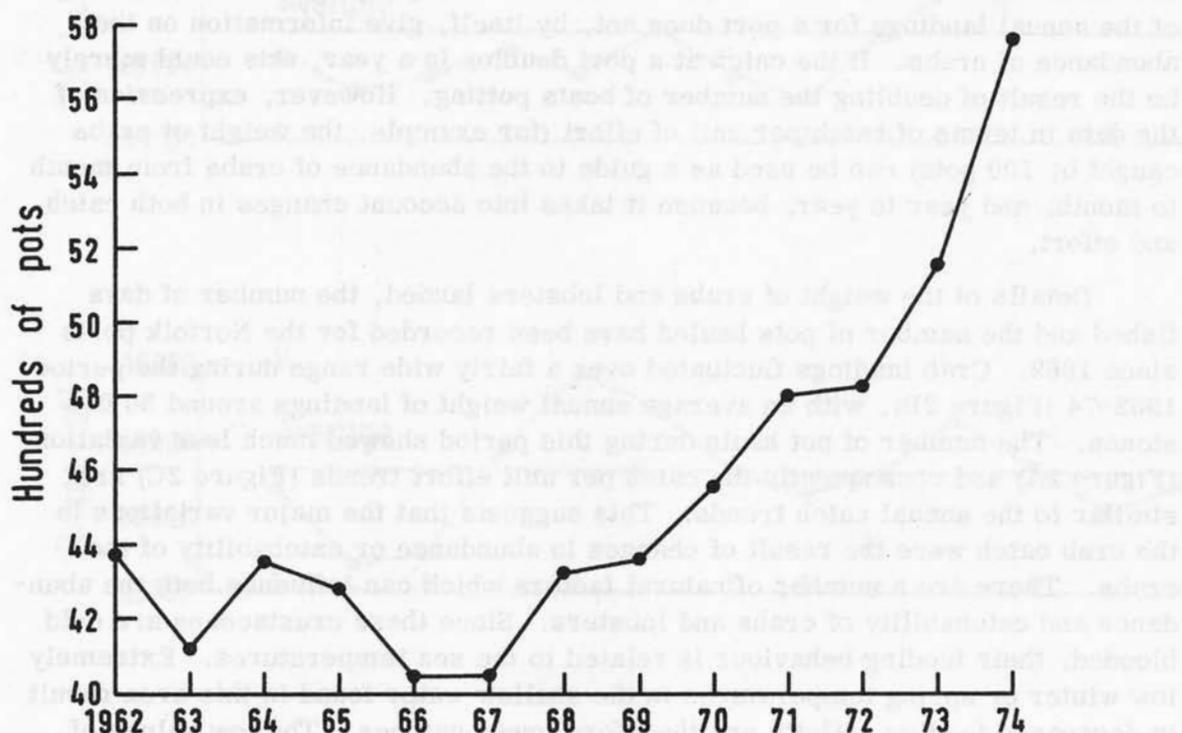


Figure 3 The average number of pots used per week during May, 1962-74

OBSERVATIONS ON THE CRAB STOCKS

Since 1969 monthly visits have been made to the fishery during the fishing season. Observations on the crab catches were made during trips on commercial boats. The total catch from the pots was examined to determine the size composition, sex ratio, proportion undersized, proportion rejected and moult condition.

Size composition

The landed catch

The mean size of the landed catch sampled during the period 1969-73 has varied between 122 mm (4.8 inches) and 130 mm (5.1 inches) carapace width (Table 2); 90% of the catch was usually between 114 mm (4.5 inches: the legal minimum landing size) and 139 mm (5.5 inches) carapace width.

Table 2 Mean carapace width (mm) of landed crab catch

	1969	1970	1971	1972	1973
Males	124	125	123	122	126
Females	130	129	125	129	126

Undersized crabs

There is a high proportion of undersized crabs in the fished stock of Norfolk crabs. Between 47 and 96% of the total female catch and between 82 and 97% of the total male catch are undersized. Crabs below 60 mm (2.4 inches) are seldom found in the crab pots, the size ranges 80-89 mm (3.1-3.5 inches) for the females and 90-99 mm (3.5-3.9 inches) for the males containing the greatest number of individuals (Figure 4).

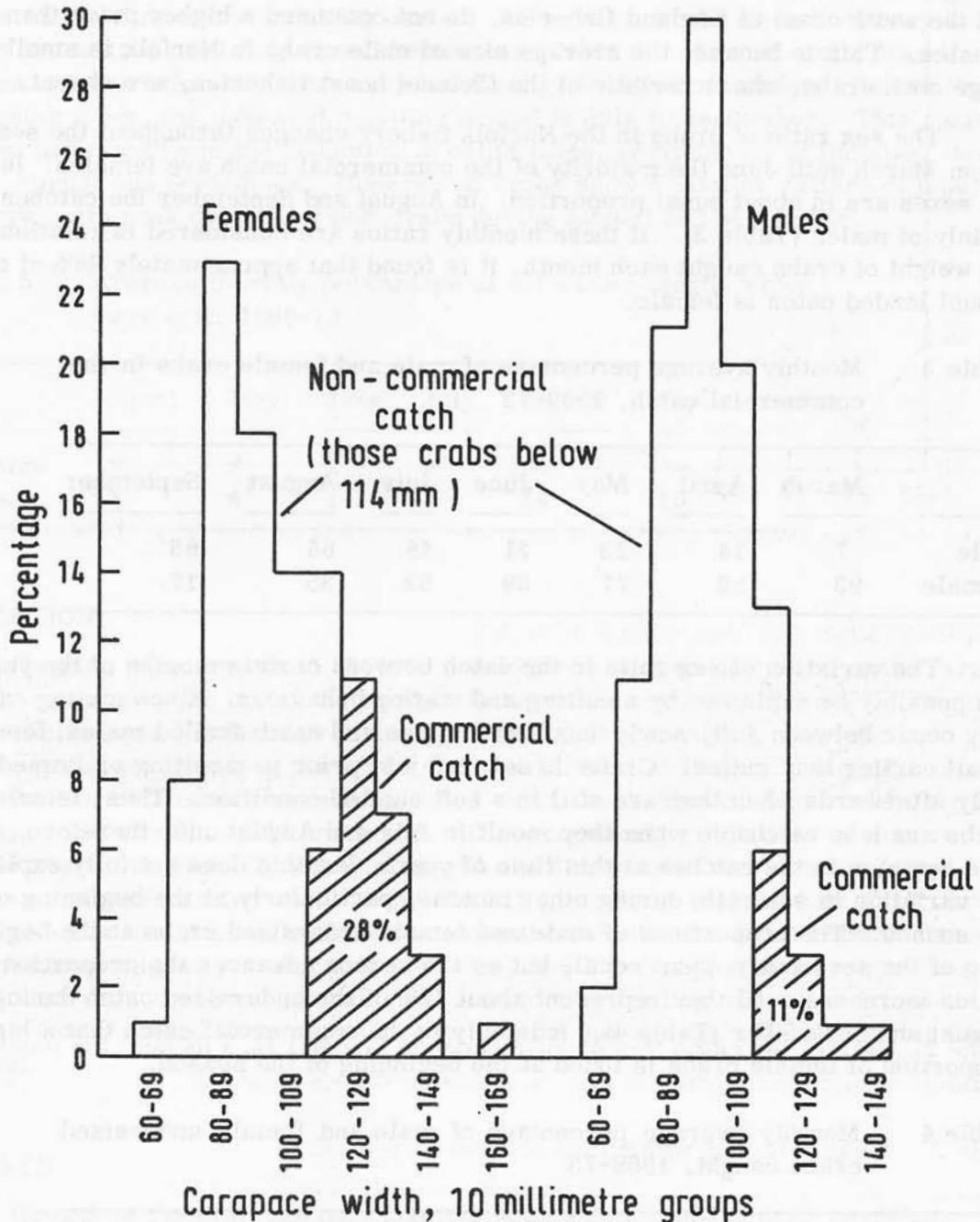


Figure 4 Average percentage size distribution of crabs in the Norfolk fishery during May.

Proportion rejected

Between 47 and 97% of the female catch and between 83 and 98% of the male catch were rejected as undersized, soft, white-footed, berried or diseased. The majority of these were undersized.

Sex ratio

The male crabs in the Norfolk fishery, unlike those in the Devon, Cornish and the south coast of England fisheries, do not command a higher price than the females. This is because the average size of male crabs in Norfolk is small and large cock crabs, characteristic of the Channel coast fisheries, are absent.

The sex ratio of crabs in the Norfolk fishery changes throughout the season. From March until June the majority of the commercial catch are females; in July the sexes are in about equal proportion; in August and September the catches are mainly of males (Table 3). If these monthly ratios are considered in relation to the weight of crabs caught each month, it is found that approximately 68% of the annual landed catch is female.

Table 3 Monthly average percentage of male and female crabs in the commercial catch, 1969-73

	March	April	May	June	July	August	September
Male	7	14	23	31	48	65	83
Female	93	86	77	69	52	35	17

The variation of sex ratio in the catch between certain months of the year can possibly be explained by moulting and mating behaviour. Since mating can only occur between soft, newly-moulted females and hard-shelled males, females moult earlier than males. Crabs do not feed just prior to moulting or immediately afterwards when they are still in a soft shelled condition. Thus, female crabs are less catchable when they moult in July and August and, therefore, are less common in the catches at this time of year. But this does not fully explain the variation in sex ratio during other months, particularly at the beginning of the season. The proportions of male and female undersized crabs at the beginning of the season are about equal, but as the season advances the proportion of males increases until they represent about 75% of the undersized catch during August and September (Table 4). It is only in the commercial catch that a high proportion of female crabs is found at the beginning of the season.

Table 4 Monthly average percentage of male and female undersized crabs caught, 1969-73

	March	April	May	June	July	August	September
Male	45	50	58	62	70	75	72
Female	55	50	42	38	30	25	28

Soft-shelled crabs

In order to grow a crab must cast its old shell. After moulting the new shell is very soft and pliable and, although it gradually hardens, for a considerable time it is easily broken. When in this soft condition the meat yield is very low but this improves with time as the crab feeds and builds up new tissues. It is illegal to land soft-shelled crabs, a measure which ensures that poor quality crabs are not marketed, but are returned to the sea to be caught later in good condition. Monthly observations on the presence of soft crabs in the catch have indicated the time of the moulting period. Generally, in the Norfolk fishery soft crabs are scarce until August and September (Table 5). As soft crabs need to harden for approximately two weeks before they feed and, therefore, before they will enter a pot, the indicated moulting period is July to September. This period is also indicated from the reduction in catch rates, particularly of females, during July, August and September. Undersized crabs show a similar pattern of moulting activity, with peak catches of soft crabs during August and September.

Table 5 Average monthly percentage of all crabs caught which were soft, 1969-73

	April	May	June	July	August	September
Females	0	2	1	8	34	34
Males	1	4	1	1	14	10

MIGRATION

Tagging experiments in 1957-60 and 1965-66 showed that some of the larger female crabs migrate out of the Norfolk fishery in a northerly direction. Tagging off Yorkshire and Northumberland suggested that this northerly migration of female crabs occurs along the whole of the east coast of England; tagged crabs from the Norfolk fishery were recaptured on the Yorkshire crab grounds, having moved up to 140 miles (225 km) north. These northerly migrations of mature female crabs are probably associated with the dispersal of the planktonic crab larvae which are carried south to the Norfolk grounds by the residual water movement which is in a southerly direction along the east coast. In addition to these long distance migrations of mature females, local inshore/offshore migrations were observed; these are probably associated with feeding and water temperatures. Crabs tended to move inshore during the spring, and offshore during the autumn.

GROWTH

Growth of the crab can only take place as a result of the crab moulting. Previous tagging studies have shown that the increase in shell width at a single moult varies between 20 and 30% of the original size. Males appear to increase slightly more at each moult than females. On average, an 89 mm (3.5 inches) crab will reach a size of 114 mm (4.5 inches) in one moult. The number of moults each year varies according to the size of the crab; small crabs moult a

number of times in a year, but the majority of those reaching 102 mm (4 inches) moult only once a year, and larger crabs less frequently.

RECRUITMENT

As already stated, larval recruitment to the Norfolk crab stock is derived from adults to the north. The larvae settle on the sea bed and develop into crabs of a size of about 2.5 mm. The survival of these very young crabs is affected by many natural factors, e.g. predation by fish, availability of food, etc.

Tagging experiments suggest that there is no immigration of crabs into the Norfolk fishery. Although northerly movements of female crabs have been observed, the stock to the south of the main fishing area appears to be so small that immigration into the Norfolk fishery is likely to be minimal.

Recruitment to the fishable stock in Norfolk is therefore due to the growth of undersized crabs already within the fishing area. The majority of the commercial landed catch consists of crabs which were below the minimum legal landing size before their last moult. Tagging studies have shown that the fishing mortality (the proportion of crabs taken from the fishery each season) is quite high; about 70% of undersized crabs which after moulting exceed 114 mm (4.5 inches) are caught within their first year in the fishable stock. For this reason, and because the larger females migrate out of the fishery, the average size of crabs in the commercial landings is low (about 126 mm or nearly 5 inches) and 90% are within the carapace width range of 114 mm (4.5 inches) to 139 mm (5.5 inches). The future success or failure of the Norfolk fishery is therefore based upon abundance of crabs just below the minimum size.

FISHERY MANAGEMENT CONCLUSIONS

The Norfolk crab fishery, although relatively small, is a highly productive fishery which because of certain characteristics needs careful management to ensure sustained yields in the future.

The most important management regulation at present in force is the minimum legal landing size of 4.5 inches. Previous research work has shown that, taking into account the growth rate of Norfolk crabs, the levels of fishing and natural mortality, and the migratory behaviour of the female crabs, the most appropriate minimum size for this fishery is 4.5 inches. Measurements of the landed catch have shown that the majority of the catch are only just above this. Since about 70% of these legal-sized crabs are caught within one year of entry into the fishable stock, the necessity to protect the undersized crabs on the grounds cannot be over-emphasized. This year's undersized crabs will be next year's catch. The by-law which prohibits the use of undersized crabs for bait protects the crab catch of subsequent years. Those regulations which prohibit the landing of soft and white-footed crabs have a part to play in ensuring that the maximum yield is obtained from the fishery, and also in maintaining the reputation of the excellent quality of Norfolk crabs. The increased fishing effort brought about by the introduction of hydraulic pot-haulers, and the increase in the number of pots fished, partly due to an increase in part-time fishermen, has made the present regulations even more essential to the future of the fishery. The state of the fishery at the present time gives some cause for concern, for the annual catch per unit effort

has fallen below the 13-year average in 1972, 1973 and 1974, although there was some improvement in 1974. It is hoped that this fall in catch per unit effort is due to natural factors and not to the recent increase in fishing effort. If the catch rate does not improve in the near future it will be necessary to consider additional conservation measures. Examination of the size composition of crabs entering pots suggests that there are plenty of undersized crabs in the fishery. If these are not depleted before they grow and enter the fishable stock, a profitable fishery should be maintained.

SUMMARY

- (a) The Norfolk crab fishery is a small but important fishery contributing up to 10% by weight of the total England and Wales crab landings.
- (b) With the introduction in 1967 of the pot hauler there has been an increase in fishing efficiency and a gradual build-up in the number of pots used. During the peak month of May the number of pots used in 1974 was 36% higher than in the period 1962-69; this increase is partly due to an increase in the number of fishermen.
- (c) The reasons for the fluctuations in crab landings and in catch per unit effort observed during 1962-74 are not clear. They may be the result of increased fishing effort and/or of uncontrollable natural factors affecting the abundance and catchability, e. g. cold spring water temperatures.
- (d) The average size of crabs in the landed catch has remained stable at about 126 mm (nearly 5 inches). The majority of the landed catch is between 114 mm (4.5 inches) and 139 mm (5.5 inches) carapace width.
- (e) Larval recruitment to the Norfolk crab stock is by the drift of planktonic larvae from the north.
- (f) Tagging studies suggest that little migration into the Norfolk fishery occurs and therefore recruitment to the fishable stock is by the growth of undersized crabs already within the fishing area.
- (g) If the recent increase in fishing effort and fall in catch per unit effort continues, further conservation measures may be required.
- (h) Lobsters are also caught in this fishery, mainly in July and August, although they only form 3% of the total England and Wales catch they contribute up to 20% by value of the total Norfolk crab and lobster fishery.

LABORATORY LEAFLETS

- No. 1 Newfoundland Fishing. December 1962.
- No. 2 Spotlight on the American Whelk Tingle. December 1962.
- No. 3 Yorkshire Crab Investigations 1962. May 1963.
- No. 4 Trawling Prospects off West Norway. September 1963.
- No. 5 Notes on Escallops, and Details of the Baird Sledge Dredge and its Handling. February 1965.
- No. 6 Studies with the Woodhead Sea-Bed Drifter in the Southern North Sea. February 1965.
- No. 7 The West Greenland Cod Fishery. March 1965.
- No. 8 Future Prospects in the Distant-Water Fisheries. May 1965.
- No. 9 The Cornish Pilchard and its Fishery. December 1965.
- No. 10 Protecting British Shell Fisheries. April 1966.
- No. 11 North Sea Plaice Stocks. April 1966.
- No. 12 The Norfolk Crab Fishery. July 1966.
- No. 13 Lobster Storage and Shellfish Purification. August 1966.
- No. 14 Tuna Fishing. October 1966.
- No. 15 Whelks. January 1967.
- No. 16 Spurdogs. May 1967.
- No. 17 Yorkshire Crab Stocks. September 1967.
- No. 18 The Torrey Canyon Disaster and Fisheries. February 1968.
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- No. 25 Genetics and Fish Farming. March 1972.
- No. 26 The Cockle and its Fisheries. April 1972.
- No. 27 Prawn Culture in the United Kingdom: its status and potential. June 1972.
- No. 28 The Fishery for the Pink Shrimp, Pandalus montagui, in the Wash. June 1973.
- No. 29 The Impact of Mechanical Harvesting on the Thames Estuary Cockle Fishery. November 1973.

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.