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English fishery for pink shrimp, Pandalus montagui, in the Wash

by

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### Summary

The fishery for pink shrimp Pandalus montagui in the Wash, on the east coast of England, has been in existence for more than 100 years and was first worked by vessels under sail. Currently about 20 full-time boats trawl for shrimp on a daily basis from two tidal ports. The fishing season is not year-round, but lasts from April to December in most years. In the winter, the majority of the stock leaves the inshore fishery during the period when female shrimp are berried, and the implications of this migration are discussed.

Monthly landings are presented for the last 25 years and illustrate the seasonal nature of the fishery as well as a sudden serious decline in landings which occurred in the early 1960s. Catch per unit effort data are available for the last seven years and these show the weight of shrimp landed per boat-day over this period. Landings are normally 1-5 cwt (50-250 kg) per boat-day, but exceptionally they approach 1 ton (1 000 kg) per day.

The biology of P. montagui is summarized for the Wash fishery, and comparisons are made with respect to the published account of a pink shrimp fishery in the Thames Estuary which is no longer commercially viable.

### Introduction

The pink shrimp, Pandalus montagui, occurs along much of the coast of England and Wales, and commercial fisheries have been in existence for at least 100 years in three main areas: the Thames Estuary and the Wash on the east coast, and Morecambe Bay on the north-west coast. Of these areas, only the Wash at present supports a viable fishery, since pink shrimp stocks in the Thames Estuary and Morecambe Bay have declined to a very low level and are no longer fished. Ten years ago the Wash fishery also suffered a major decline in landings. The stock has shown a considerable improvement since that time, although it has yet to approach the levels of landings attained in the past.

## The Wash fishery

The pink shrimp fishery is conducted in a well defined area, approximately 24 km long by 3-5 km wide, in water depths of 20-60 m and on a mainly hard substrate, composed of gravel and muddy sand. The present shrimp fleet numbers about 20 vessels, some of which have fished from the time when the fishery was worked under sail. Currently the vessels are 12-17 m in length and powered by engines of 40-100 hp. Each vessel tows one heavy beam trawl of 7-9 m spread, with a chain groundrope along which are spaced large wooden rollers to minimize the collection of rubbish. Cod-end mesh size is 18-20 mm fully stretched, and the entire belly and cod-end of the net is protected by heavy netting covers, fitted with additional rubber and plastic chafers to reduce net damage.

Vessels work from two tidal harbours on a daily basis and normally complete two or three tows of 1-2½ hours' duration, towing with the tide, in each working day. Before returning to port, the day's catch is sorted and the shrimps are cooked on board. There is no restriction on the size of shrimp which may be landed, but the catch is sieved by hand to remove small shrimp at times when they are abundant. These hand sieves are made in a range of sizes, and those in common use have a metric spacing of 4.9, 5.2 or 6.2 mm; the sieve size depends upon the size of shrimps taken during the season.

Although commercial fish species occur seasonally in the fishery, shrimp trawls are towed slowly and the capture of fish species is usually minimal. However, at the inshore end of the fishery, quantities of juvenile flatfish may be taken with the shrimp.

### Annual and seasonal abundance

Commercial landings are made at the ports of Boston and King's Lynn, and Fig. 1 illustrates the pattern of landings over the past 25 years.

Statistics from the major port of Boston (1945-1959) demonstrate the annual and seasonal changes in abundance, including the effect on commercial fishing when the stock migrates offshore in winter. Since 1960 Boston landings are not available in this form, but King's Lynn data are adequate to demonstrate the sudden decline and subsequent recovery to date of the fishery. In 1961 total annual landings for the port were 1.5 cwt (75 kg) which improved to exceed 4 400 cwt (220 000 kg) in 1970.

Catch per unit effort in cwt (50 kg) per boat-day is available for the last 7 years (Fig. 2). Daily landings are normally of 1-5 cwt (50-250 kg) per boat, but, exceptionally, the catch of a single vessel may approach 1 ton (1 000 kg) for one day's fishing.

When monthly landings and catch per unit effort are compared with monthly mean values for seawater temperature and salinity, it is possible to make the general observation that the P. montagui stock leaves the inshore fishery as water temperature and salinity values are showing downward trends, and that usually they remain offshore while temperatures are minimal and salinities are lowered in the inshore waters. However, over the seven-year period (1964-70) for which complete temperature and salinity data are available for the fishery, the onset of migration does not appear to be associated with a particular level of temperature or salinity.

Various authors have discussed the migratory habit of Pandalid and other shrimp (Murie, 1903; Kemp, 1910; Mistakidis, 1957; Allen, 1966; Wollibaek, 1908; Scattergood, 1952; Horsted and Snidt, 1956; Haynes and Wigley, 1969). Although there is general agreement that seasonal migrations may be associated with the requirements of the breeding cycle, it has been suggested that populations may migrate into more favourable conditions of temperature, salinity, wave action and food supply. In a recent paper, Johnson (1970) illustrates data from Colebrook and Robinson (1965) which concern plankton production in the western half of the southern North Sea (Fig. 3). From these data it is apparent that after shrimp eggs are hatched in March and April, developing larval and juvenile P. montagui are present when phytoplankton and later copepod production are reaching seasonal peaks; thus the development and growth of 0-group shrimp may proceed in optimum feeding conditions.

Subsequently, 0-group shrimp are first taken by bottom trawls in the fishery as water temperatures reach their annual peak in August. When females return to the fishery in the spring, very few remain in a berried condition and it is suggested that the seasonal migration from the Wash is concerned with the breeding cycle, and particularly with the survival and growth of the new year-class in optimum conditions of temperature and food supply.

#### Biology

Samples of P. montagui have been taken from commercial catches, examined for carapace length-frequency, sex differentiation, and egg carriage. In the Wash the commercial pink shrimp population appears to be composed mainly of two year-classes (Fig. 4), the first year-class being apparent in these samples from September. The life history of the species may be summarized as follows. The ovaries of large mature females begin to develop during August and the first females begin oviposition in October. The number of berried females increases during November, and by December

most large females and a few 0-group females are carrying eggs. The majority of the population migrates offshore in December or January during most winters, and while offshore, more of the 0-group females produce broods of eggs, until almost all mature females within the size range 8-18 mm carapace length are berried. Hatching of eggs begins in March and continues through April, after which the population begins to return inshore. 0-group shrimp grow rapidly and in most years are first caught by commercial trawls when they have reached a carapace length of 5-9 mm.

Sex differentiation was determined from an examination of the secondary sex characters on the first pleopod. P. montagui is a protandric hermaphrodite, and the Wash 0-group contains both primary females, and males which transform into secondary females during their first or second years. Although the stocks of pink shrimp in the Thames Estuary (Mistakidis, 1957) and the Wash appear to have a basically similar size and year-class structure, the Wash stock has been observed to differ in several respects from the published account of Thames shrimp. Mistakidis reported finding only one male with fully developed secondary sex characters at a size above 13 mm carapace length. In the Wash, males which show no external signs of transition to females have been found up to a carapace length of 16 mm in a population whose maximum size seldom exceeds 18 mm carapace length. In both areas, male shrimp may reach transitional stages by May or June and most sex-change individuals occur during the summer months. Decreasing numbers are found later in the year. Mistakidis records one transitional individual as "late" when it occurred in a Thames Estuary sample in December 1950 at a length of 14.4 mm carapace length. This specimen possessed a well-developed ovary, ovigerous setae and a single egg on one pleopod. In the Wash, transitionals have been recorded over a size range of 10.0-17.0 mm carapace length. From a sample taken in September 1969, 3.2% were transitional individuals at sizes between 14.0 and 15.6 mm carapace length. Seven of these transitionals were sectioned for histological examination and found to contain only small quantities (estimated 5-15%) of developing ova, while the remainder of the gonad still consisted of degenerating male cells. Subsequently, the November 1969 sample contained 2% transitionals and these were of 15.0-16.2 mm carapace length.

Finally, although the maximum size of P. montagui is approximately 18 mm carapace length in both areas, Mistakidis states that: "individuals of 16.0-18.0 mm carapace length, which were probably in the fourth year of their lives, were very few". In the Wash population, pink shrimp which

occur in this size range are numerous and could well be I-group shrimp (Fig. 4).

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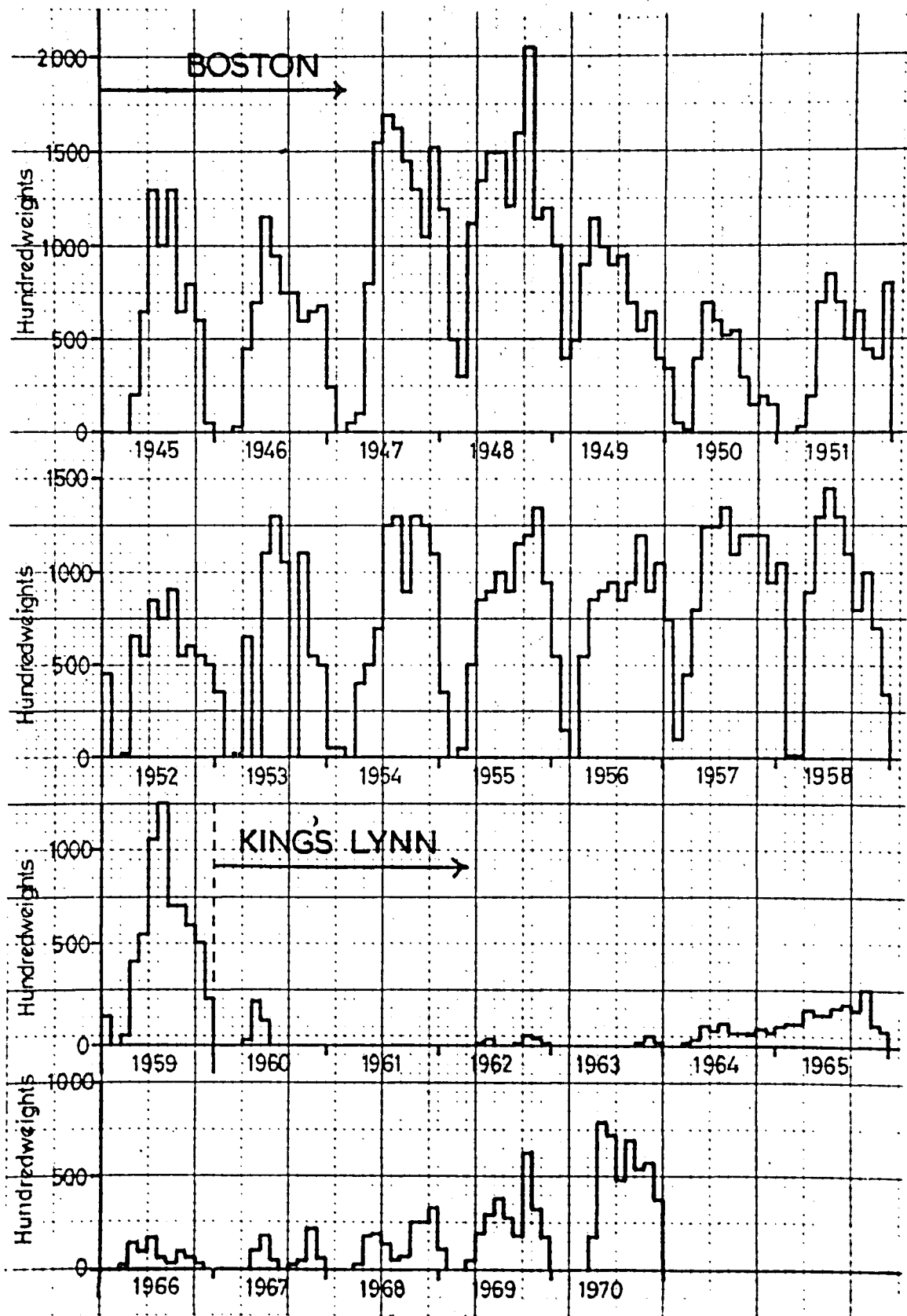


Figure 1 Monthly landings by weight of Pandalus montagui at Boston (1945-59) and King's Lynn (1960-70). 1 cwt = 50 kg approximately.

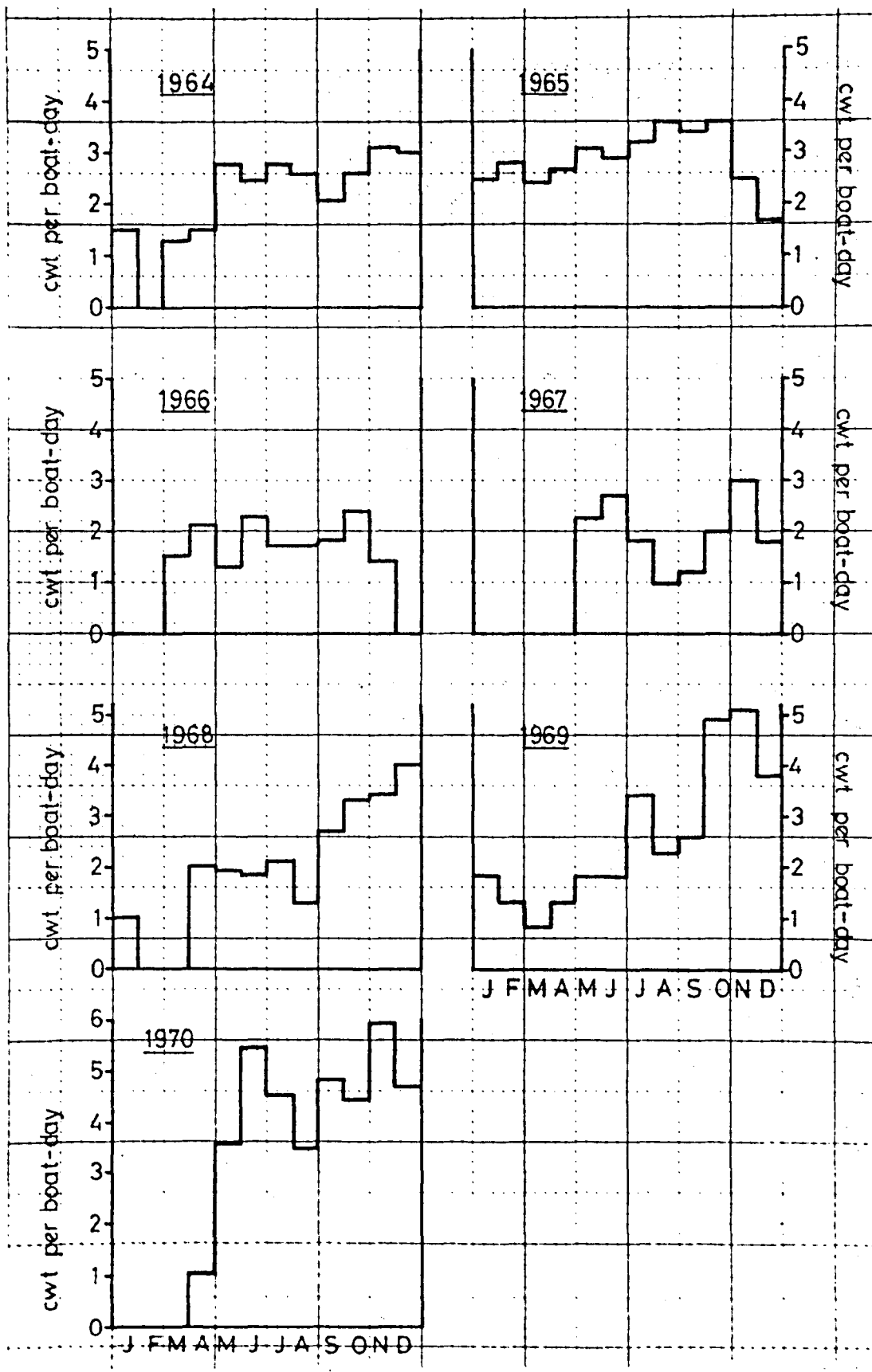


Figure 2 Catch per unit effort of Pandalus montagui in the Wash (1964-70).

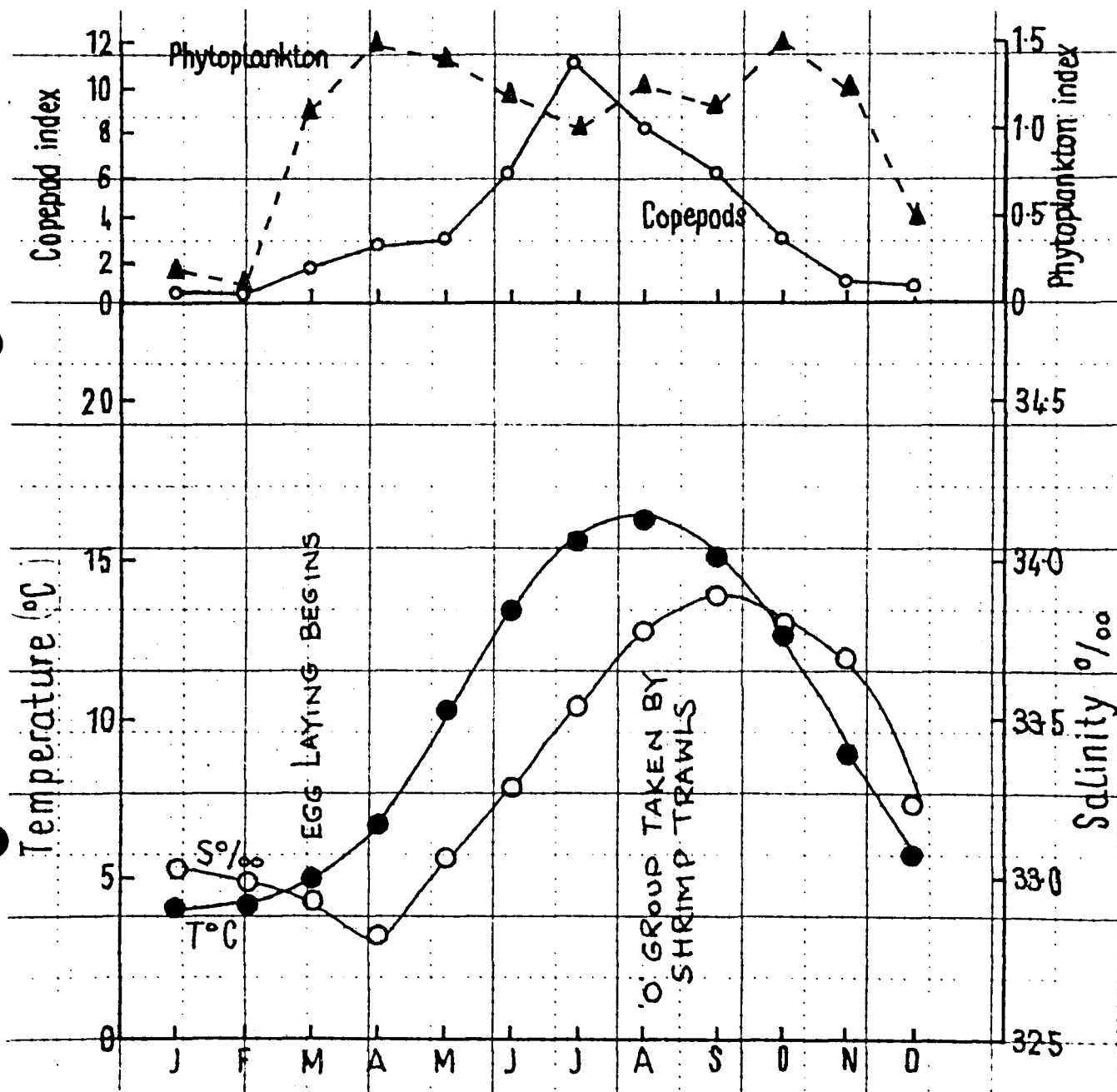


Figure 3 Plankton production cycles in area D2, southern North Sea (Colebrook and Robinson 1965) and mean temperature and salinity in the Wash (Johnson 1970), compared with growth of 0-group pink shrimp.



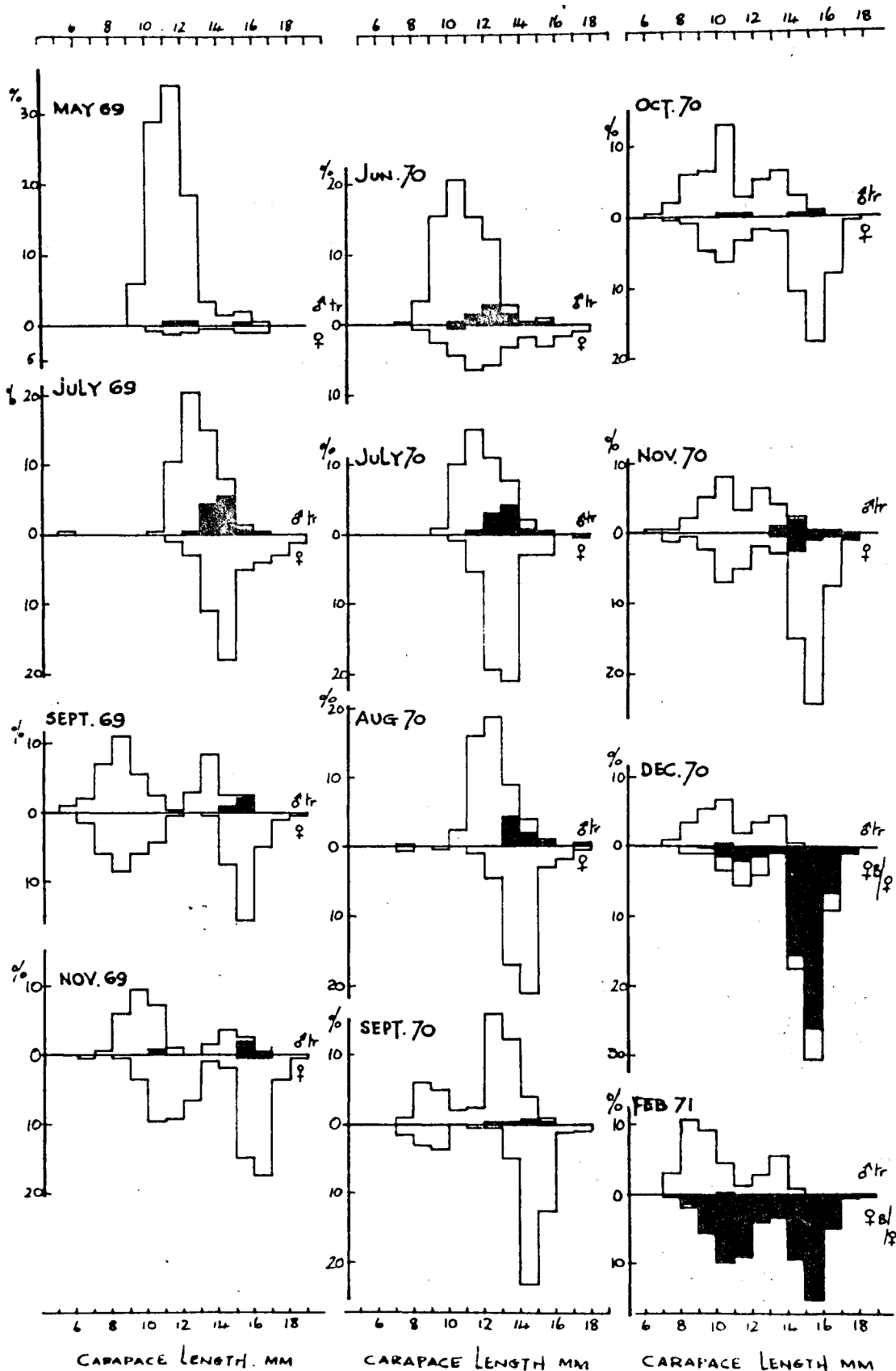


Figure 4 Carapace length-frequency of Pandalus montagui in the Wash (1969-71).

Key: Above line, clear areas = males; black areas = transitionals;  
 Below line, clear areas = females; black areas = berried females.