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Shrimp landings in the Wash: a possible relationship with temperature

by

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SUMMARY

From an appraisal of shrimp landing statistics and water temperature data in the Wash, England, a relationship has been determined between annual mean water temperature and landings of shrimp in the following year. Correlation and regression analyses for 1948–69 Boston landings, which consisted mainly of Pandalus montagui, suggest that before annual landings fell to very low levels in 1962, a negative correlation existed between temperature and landings. Since 1962, landings have improved, and the correlation appears to have become positive. Similar correlations appear to prevail between combined commercial landings of P. montagui plus Crangon crangon at Boston and King's Lynn, and annual mean water temperatures since the early 1920s. The apparent reversal of the landings-temperature relationship since 1962, which may have resulted from the effect of the extreme climatic conditions in the 1962/63 winter upon an already depleted stock, would make the use of temperature to predict fishing prospects difficult to evaluate.

INTRODUCTION

The analyses of commercial Penaeid and Pandalid shrimp landings show considerable annual variation, and cyclic changes in relative abundance are often evident (Scattergood 1952). A number of environmental factors have been considered responsible for fluctuations in shrimp abundance. In the Penaeid shrimp fishery off the south-eastern USA, significant correlations have been found between good catches in warm years and poor catches in cold years (Williams 1969). In Maine, USA, where Pandalus borealis is near the southern edge of its geographic range, the fishable stock has been judged to be composed mainly of two-year-old shrimp, and water temperature at the time of peak spawning has been related to commercial landings two years later (Dow 1963). Highest annual landings were correlated with a favourable temperature range of 34 to 36°F (1 to 2°C). After more detailed examination of the data (Dow 1966, 1967), it was suggested that water

temperature had more influence on the abundance of P. borealis in that area than any other single factor. Boddeke (1966, 1968) has described a method of forecasting the landings of C. crangon in the Netherlands shrimp fishery, based on a negative correlation between temperature at the time of hatching in January and February, and commercial shrimp landings late in the same year when these shrimp entered the commercial fishery. It was suggested that temperature affected the development of eggs and/or larvae.

In the Wash, two species of shrimp are exploited commercially, the pink shrimp Pandalus montagui and the brown shrimp Crangon crangon. P. montagui has been recorded over a wide geographic area where water temperatures range from -1 to 21°C, but it is most widespread at the lower temperatures within this range (Simpson, Howell and Warren 1970). Off the English coast, P. montagui occurs at the southern end of its geographic range and is found in relatively high water temperatures. In the rivers and estuaries around the River Thames, it occurs in water having a temperature range of 2 to 19°C (Mistakidis 1957). Temperatures in the Wash approximate to those in the River Thames estuary, with an annual range of monthly mean temperatures of 3.0 to 17.5°C (Johnson 1970).

Total annual landings of shrimp in the Wash fishery have tended to show short-term fluctuations, but with a gradual downward trend since the 1920s, which appears to have reflected changes of relative abundance (Fig. 1). Recently, in 1950 and to a greater degree in the early 1960s, annual landings of pink shrimp fell sharply in the Wash, as well as in other areas where pink shrimp are fished, such as the Thames Estuary and Morecambe Bay. In the Wash, landings have improved after each period of decline, but the populations in the other areas are now at very low levels. The aim of this paper is to examine the relationship between the annual landings of shrimps caught in the Wash and the water temperature.

METHODS

Length frequency observations over a seven-year period have shown that the P. montagui population in the Wash consists primarily of two year-classes. 0-group shrimp are first taken by trawling when they are approximately six months of age, but commercial landings are composed predominantly of 1-group shrimp. For the purpose of this preliminary assessment of shrimp landings and temperature, correlation and regression analyses were made between annual mean water temperature and annual landings of shrimp in the following year, when 1-group shrimp are commercially

exploited. Except for isolated years when data are incomplete, records are available since 1920 for shrimp landings at the Wash ports of Boston and King's Lynn, and water temperatures at the Smith's Knoll lightvessel, which are representative of the area (Dickson pers. comm.).

RESULTS

During the past 25 years, fishing from the Wash port of Boston has been concentrated upon the stocks of P. montagui, effort has remained fairly stable, and this species has dominated the commercial shrimp landings. During the decline of the pink shrimp fishery during the early 1960s, Boston landings reached very low levels, but have subsequently improved. A preliminary assessment of the P. montagui landings at Boston suggested that data from before the decline (1948-62) might be considered separately from the subsequent period, 1963-69. For the period 1948-62, a significant negative correlation ($P = < 0.01$) was established between landings and temperature (Fig. 2, calculated regression lines). During the years 1963-69 the relationship between landings and temperature appears to have been reversed, and a significant positive correlation ($P = < 0.01$) was found.

Annual landings statistics are available for the Wash ports of Boston and King's Lynn since 1922, but the data are related to combined landings of P. montagui and C. crangon. These data have also been examined by correlation and regression analyses, considering separately the periods 1922-1962 and 1963-69 (Fig. 3, calculated regression lines). For the years 1922-62 a significant negative correlation ($P = < 0.01$) was established between landings and temperature. Once again, a significant positive correlation ($P = < 0.05$) was demonstrated for 1963-69.

DISCUSSION

At this stage, it would be premature to do more than consider the possibility of a causal relationship between temperature and the success of the Wash shrimp fishery. Obviously a number of factors may be involved and all available data on the Wash fisheries need to be examined in more detail, with particular reference to critical periods in the life-history of shrimp, including those of egg maturation and larval life.

Since 1963, there appears to have been a reversal in the relationship between landings and temperature. The severe winter of 1962/63 probably caused a major upset in the ecological balance of the area at a time when shrimp stocks were already at a low level, and this may have resulted in

a reversal of the landings-temperature correlation. If this is true, it might be expected that the change of trend noted since 1963 reflects the return of this balance to the more normal (pre-1962) condition. Whether the positive correlation for the years 1963-69 is temporary or not, a reversal of the landings-temperature relationship renders the predictive value of temperature as an indicator of fishery prospects in the Wash difficult to evaluate. Annual mean water temperature at Smith's Knoll lightvessel for 1970 was 9.9°C, and it will be of interest to follow the fortunes of the 1971 fishery at the Wash ports.

Landings of shrimp from the fishery since 1922 are composed of unknown proportions of P. montagui and C. crangon. Size composition data have shown that the commercial catches of P. montagui are predominantly 1-group shrimp, so that where the landings are of mainly pink shrimp, i.e. at Boston since 1948, it is not unreasonable to relate temperature to landings in the succeeding year. However, commercial landings of C. crangon are composed of both 0-group and 1-group shrimp, and were it possible to isolate the data for C. crangon, a relationship might be found between temperature and landings in the same and/or following year. Although the total landings at both ports since 1922 do consist of an unknown mixture of P. montagui and C. crangon (Fig. 3), the relationship has been found to be basically similar to that for P. montagui at Boston since 1948 (Fig. 2).

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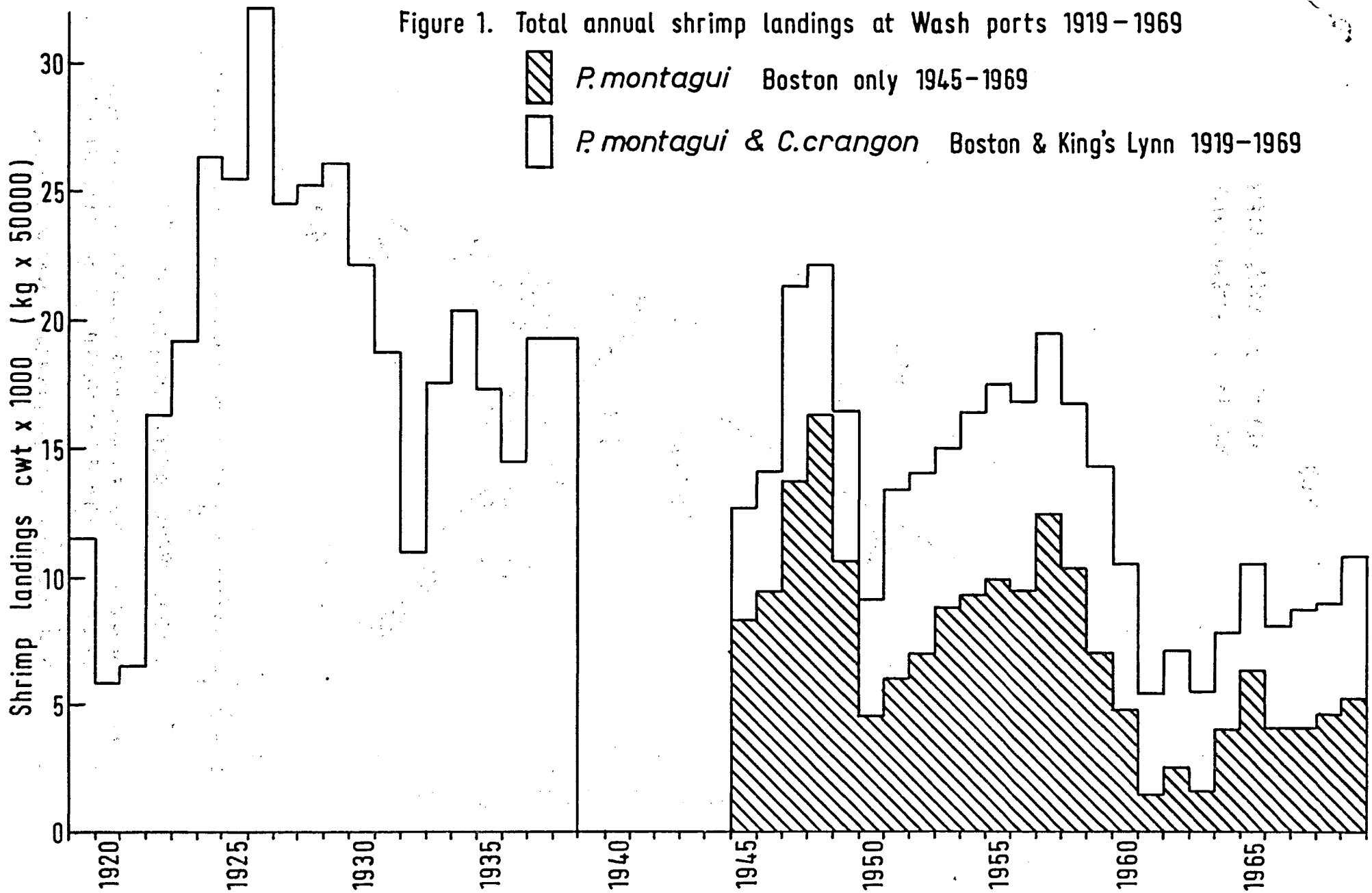
Figure 1. Total annual shrimp landings at Wash ports 1919–1969



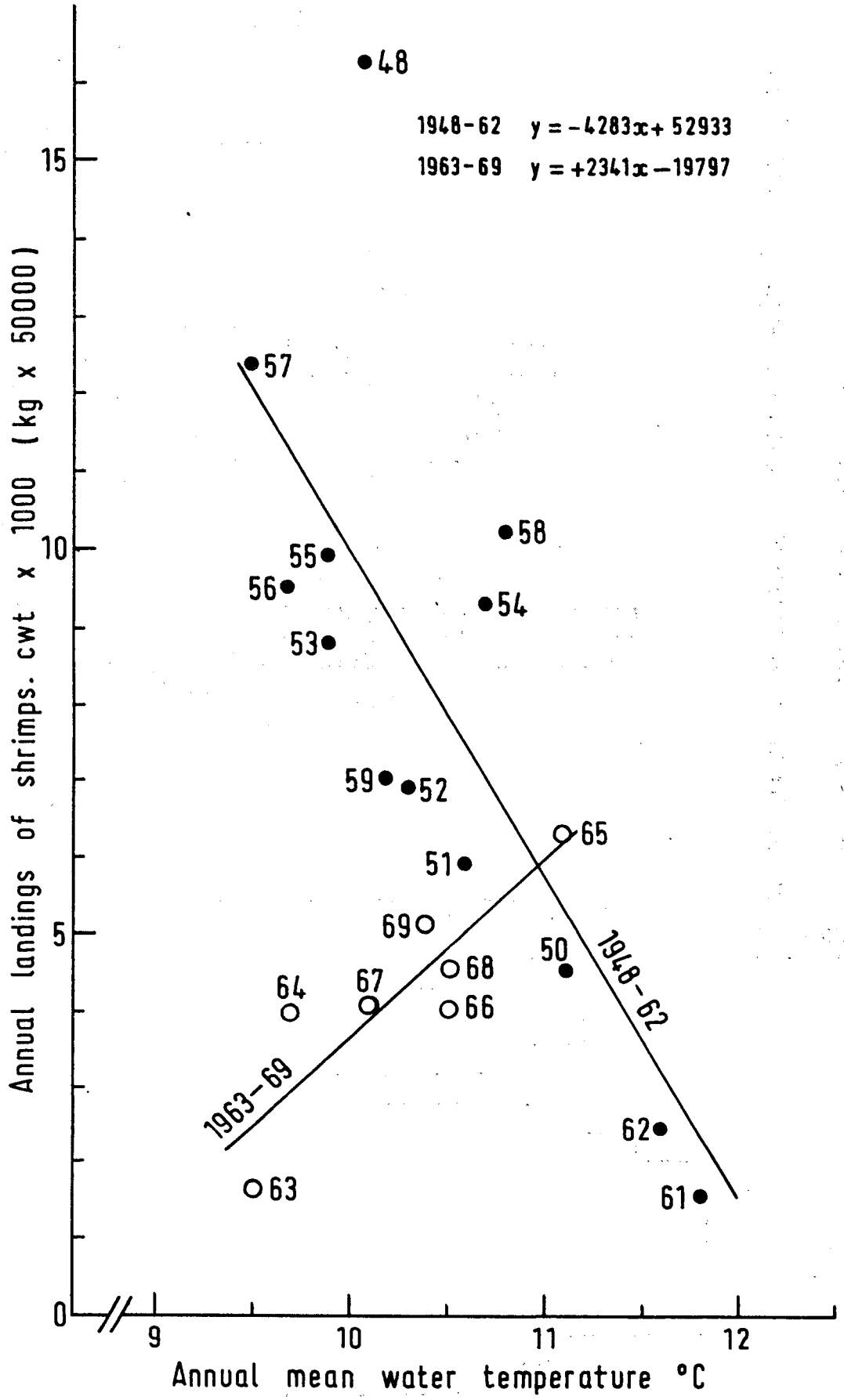


Figure 2 Annual mean water temperatures at Smith's Knoll Lightvessel related to landings of pink shrimp at Boston in the following year (1948-69).
N.B. Dates on the figure refer to the year of landings.

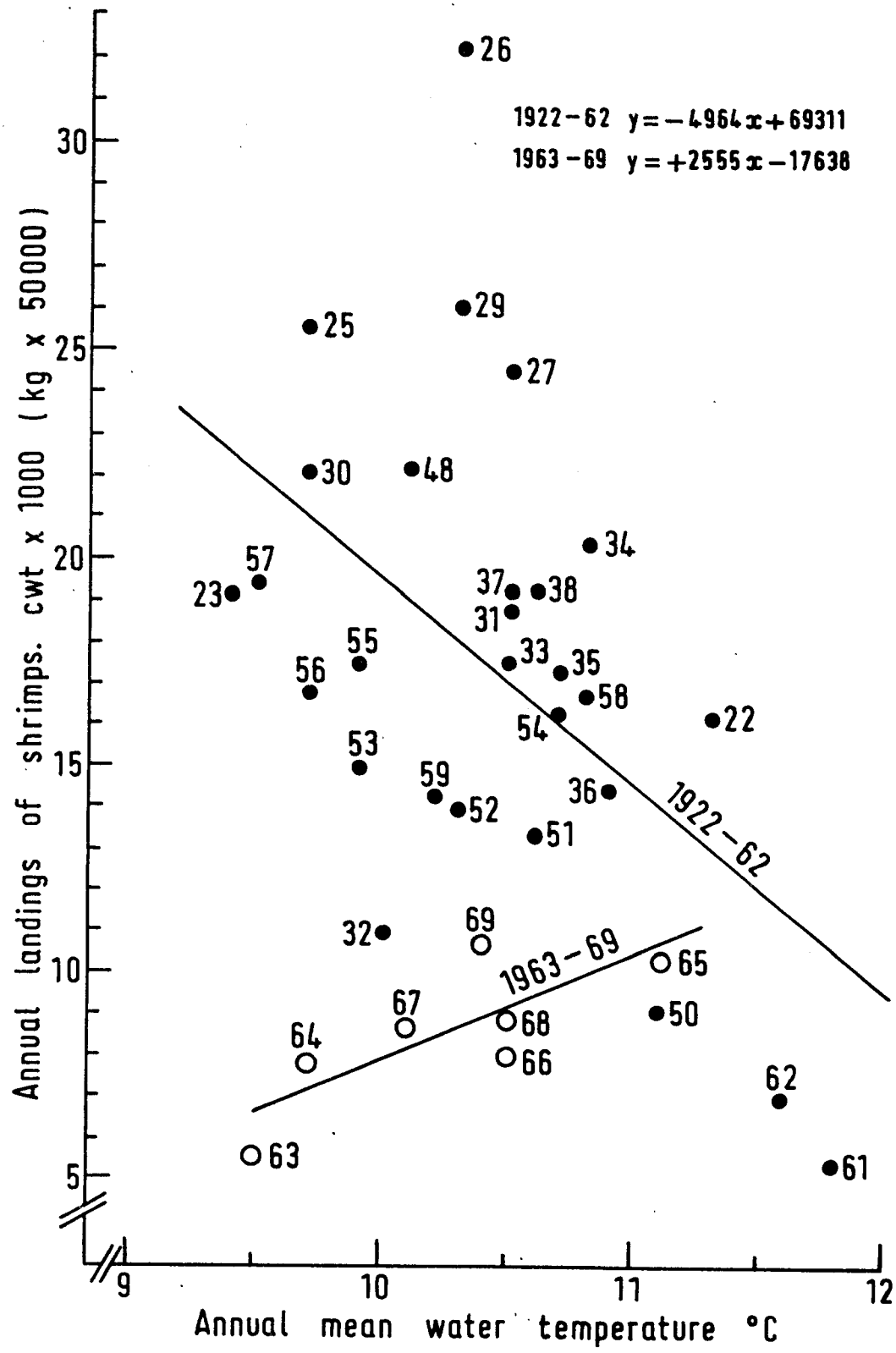


Figure 3 Annual mean water temperatures at Smith's Knoll Lightvessel related to landings of pink and brown shrimp at the Wash ports in the following year (1922-69).
N. B. Dates on the figure refer to the year of landings.