



Det här verket har digitaliserats vid Göteborgs universitetsbibliotek och är fritt att använda. Alla tryckta texter är OCR-tolkade till maskinläsbar text. Det betyder att du kan söka och kopiera texten från dokumentet. Vissa äldre dokument med dåligt tryck kan vara svåra att OCR-tolka korrekt vilket medför att den OCR-tolkade texten kan innehålla fel och därför bör man visuellt jämföra med verkets bilder för att avgöra vad som är riktigt.

This work has been digitized at Gothenburg University Library and is free to use. All printed texts have been OCR-processed and converted to machine readable text. This means that you can search and copy text from the document. Some early printed books are hard to OCR-process correctly and the text may contain errors, so one should always visually compare it with the images to determine what is correct.





Ödsmål, Kville sn, Bohuslän

Hällristning
Fiskare från
bronsåldern

Rock carving
Bronze age
fishermen



MEDDELANDE från
HAVSFISKELABORATORIET · LYSEKIL

nr
239

Hydrografiska avdelningen, Göteborg

Decade Mean Values of Hydrographical
Parameters measured from Marstrand
to Skagen (the P-Section)

by Bodil Thorstensson

August 1978

Decade Mean Values of Hydrographical Parameters
measured from Marstrand to Skagen (the P-Section)

by Bodil Thorstensson, National Board of Fisheries,
Hydrographic Department
Fack, S-403 10 Göteborg, Sweden

Decade mean values were calculated on results of hydrographical measurements made from Swedish research vessels during the period 1949 to 1958 respectively 1962 to 1971. From the first period there are values of temperature and salinity only, but from the latter one also of oxygen, phosphate and total phosphorus. The stations included in all the observations are P1, P2, P3 and P4 (see map). The period 1962 - 1971 also includes R53 off Skagen and the inner stations Fj 55, "Marstrandsfjorden", and Fj 53 "Åstol". In a more detailed study, values from the B stations of the P-Section, P18 and P28, have been included. As those stations were not introduced until 1965, they are not included in the survey of mean values from 1962 - 1971.

The observations, 1949 - 1958, are available in the form of decade mean monthly values based on data from more than sixty measurements (fewer in the case of greater depth). Each monthly average is based on 5 values. This means that the stations were attended approximately 6 times a year. Basic data have been published, (see References).

Decade mean annual values of temperatures T were calculated in two ways:

1. Decade mean monthly values T_i , times number of measurements n_i pr month during the decade divided by total number of measurements N ($N = \sum n_i$) :

$$\frac{\sum_{i=1}^{12} n_i T_i}{N} \quad (\text{Formula 1})$$

2. Decade mean monthly values T_i divided by number of months per year:

$$\frac{\sum T_i}{12} \quad (\text{Formula 2})$$

The measurements from 1962 - 1971 are available in the form of computer print-outs of decade annual mean values and decade quarterly mean values. The print-outs also contain information about standard deviation and number of observations.

The frequency of station attendances is about 30 times during the period of ten years, that is, the decade mean quarterly values are based on about 8 measurements. Determinations of oxygen and total phosphorus were made at only half respectively one third of these expeditions.

Theoretically, a series of unregular measurements will not give a representative view of the mean situation over the whole year. To calculate the mean annual values via mean monthly values seems to be more relevant. In the present form of the material from the period 1962 - 1971, however, it is not possible to calculate decade mean annual values based on decade mean monthly values. For the period 1949 - 1958 a comparison between the two ways of calculating mean values of temperature, (Figures 1 and 2), and salinity, shows that there is good agreement in the case of salinity (in a very few depths there is a difference of maximum 0.2 ‰). But in the case of

a parameter like temperature there is bad agreement because of its high variability during the year.

The mean numbers of measurement during 1949 - 1958 were

J	F	M	A	M	J	J	A	S	O	N	D
8	7	7	6	4	3	7	2	4	5	3	4.5

Decade mean annual values of temperature using Formula 1.

Figures 1 and 3, are rather similar for both periods. Differences in temperature between surface and bottom range about 2°C. The greater part of the water mass has a temperature between 7.5° and 8.5°C.

Measurements made from the light vessel Vinga, show a tendency of diminishing temperatures from the thirties to the seventies for depths down to 20 m. The decrease at 0 m and 5 m was about half a degree for decade values of May - November (Svansson, 1977). It is clearly seen (i.e. Fig. 3) that the temperature increases in the westerly direction. The station P3 appears anomalous by having lower temperature.

The long-term mean annual temperature at L/V Skagens Rev in the beginning of this century (Anon., 1933) is at the surface 8.7° (1881 - 1930) and at the bottom (38 m) 8.2°C (1903 - 1926). These values compare well with those at P4 in Fig. 3.

Comparison of the salinities for the two decades shows that there is a weak increase from 1949 - 1958 to 1962 - 1971 at all stations except P4. Salinities at the L/V Vinga, however, decreased from the fifties to the sixties (Svansson, 1974).

Long-term mean monthly values of temperature and salinity from daily measurements at L/V Skagens Rev during the years 1903 - 1926 are shown in Fig. 20. Decade mean monthly values from the station P4 from the years 1949 - 1958 are shown in Fig. 9. These figures show the same relative structure. As they are from quite different periods, however, the absolute values are not the same neither of temperature nor of salinity.

An attempt to investigate if the inflow of high saline water from the Skagerrak to the Kattegat is differential in the deep section has been made. A comparison between the stations P18, P2 and P28 with respect to salinity is made in Table 1. Here the mean values of salinity at the depths 30, 40, 50 and 60 m are calculated from measurements made during the years 1965 to 1973. The horizontal differences in salinity are very small, possibly indicating no such differential flow.

The decade mean annual values of oxygen for 1962 - 1971 are given in Fig. 5. The oxygen situation is very satisfactory, with values of saturation of 90 % down to 100 m and supersaturation in the upper layer down to 20 m. The values in the fjords are somewhat lower, however.

The concentration of phosphate increases regularly with depth. This is illustrated in Fig. 6 containing the decade mean annual values for 1962 - 1971. The increase is larger near the Swedish coast and fjords. As in the diagram of temperature the station P3 differs from the surrounding stations by showing higher concentrations.

The corresponding values for total phosphorus, Fig. 7 show homogeneity down to 20 m. Further down there is a slight increase in the values.

Decade mean monthly values of temperature and salinity from the period 1949 - 1958 for the stations P2 and P4 are shown in Fig. 8 and 9. The two stations show a similar development with time. The difference in temperature between summer and winter are greatest at the easterly station, P2. The minimum of salinity at surface occurs for P4 in May and for P2 in June.

The decade mean quarterly values of oxygen saturation during the period 1962 - 1971 show differences between winter and

summer (quarter I, IV and quarter II, III respectively), Fig. 10 - 13. During the winter half the water mass is more uniform. During the second quarter the higher temperatures of water and the primary production give supersaturation in the upper layer and the break down of biological matter starts causing a lower degree of saturation in the deepwater. In the third quarter there is a concentration of isolines in the fjords. It appears from the figure of the fourth quarter as well that the water near the bottom is exchanged more slowly.

The circulation of phosphate during the quarters I - IV, Fig. 15 - 18, shows direct connection with the production.

For the stations P2, P4 and Fj 55 time evolutions during the four quarters, for oxygen and phosphate, are presented in the Fig. 14 and 19. Remarkable, in quarter III, is a noticeable reduction of the phosphate concentrations right down to 100 m at the station P2.

Five year running mean values of salinity from the first quarter were calculated for the station P2 at 75 m during the period 1949 - 1974. These values can be compared with five year running annual mean values of salinity in surface for L/V Anholt Nord during the years 1950 - 1970 (Nilsson and Svansson, 1974). There is a positive correlation between them. A decrease from the beginning of the fifties to the year 1958 is apparent in both salinitygraphs (Fig. 21). At the end of the sixties there is a slow rise of the concentrations.

Acknowledgements to

Jan Johansson who was responsible for processing the data from the years 1962 to 1971,
Birgit Stahm for typewriting,
Artur Svansson for valuable discussions,
Anita Taglind for performing all figures.

References:

- Anonymus, 1933: Mean values of observations from Danish light-vessels. København, 1933, 12 s. Special print of the Nautical-Meteorological Annual 1932.
- Nilsson, H. and Svansson, A., 1974: Long term variations of oceanographic parameters in the Baltic and adjacent waters. Medd. fr. Havsfiskelab., Lysekil. Nr 174.
- Svansson, A., 1974: Decade mean values of salinities measured on Swedish lightships 1880-1970. Medd. fr. Havsfiskelab., Lysekil. Nr. 162.
- Svansson, A., 1975: Physical and Chemical Oceanography of the Skagerrak and the Kattegat. Report, Fish. Bd., Sweden, Inst. Mar. Res. No. 1, 88 p.
- Svansson, A., 1977: Decade mean values of temperatures measured on Swedish lightships and Bornö station 1880-1970. Medd. fr. Havsfiskelab., Lysekil. Nr. 231.

Data were published for 1949 - 1956 in Bulletin Hydrographique (ICES)

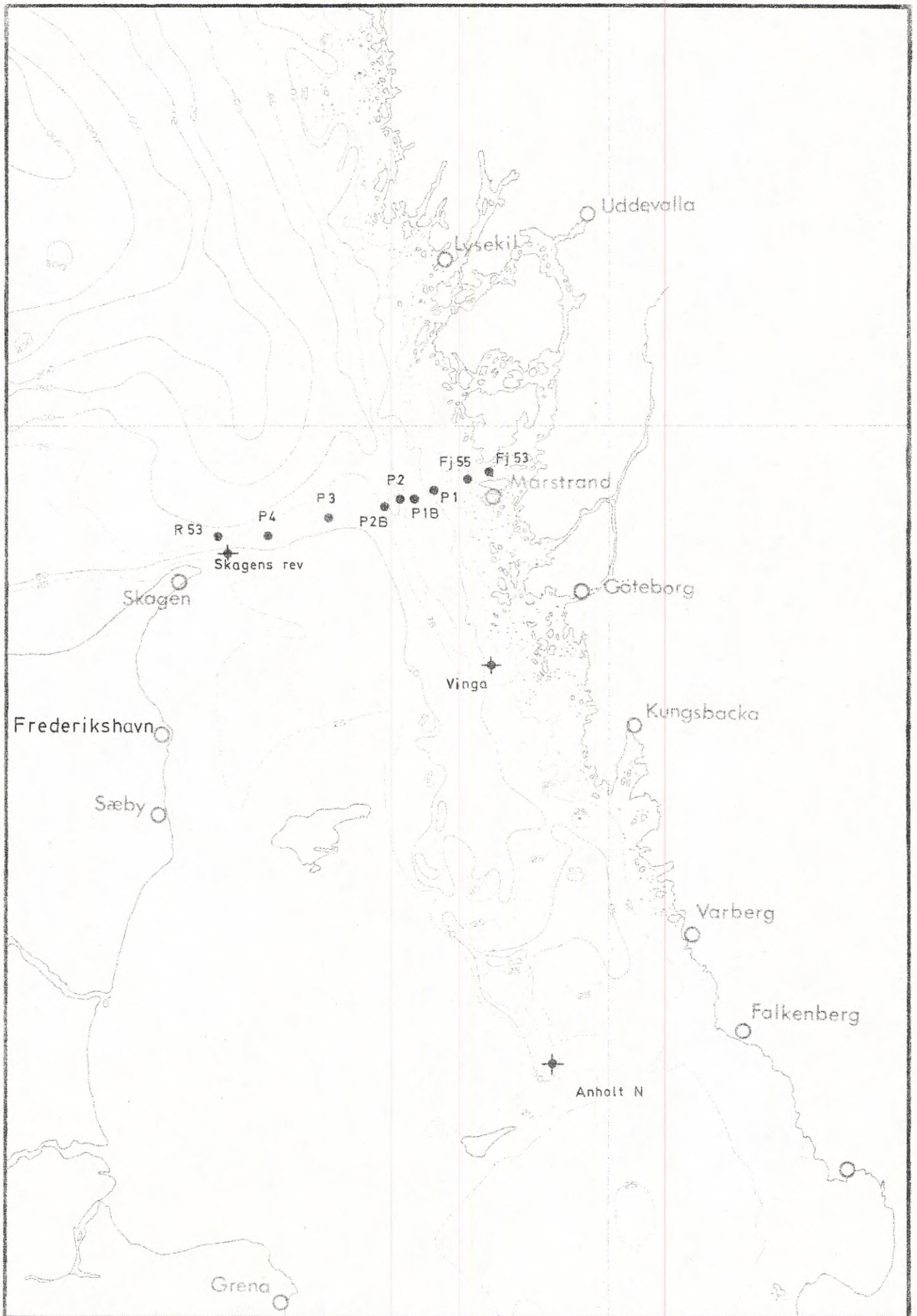
1957 - 1962 ICES Oceanographic Data Lists

1963 - 1972 Meddelande från Havsfiskelaboratoriet, Lysekil (No:s 38, 41, 51, 52, 63, 70, 80, 82, 83, 84, 85, 93, 104, 112, 116, 132).

Table 1.

S ‰ Mean values 65-02-11 -- 73-10-16

Depth	Station		
	P2B	P2	P1B
30 m	33.33	33.33	33.21
40 m	33.75	33.68	33.67
50 m	34.12	34.03	34.00
60 m	34.45	34.39	34.44



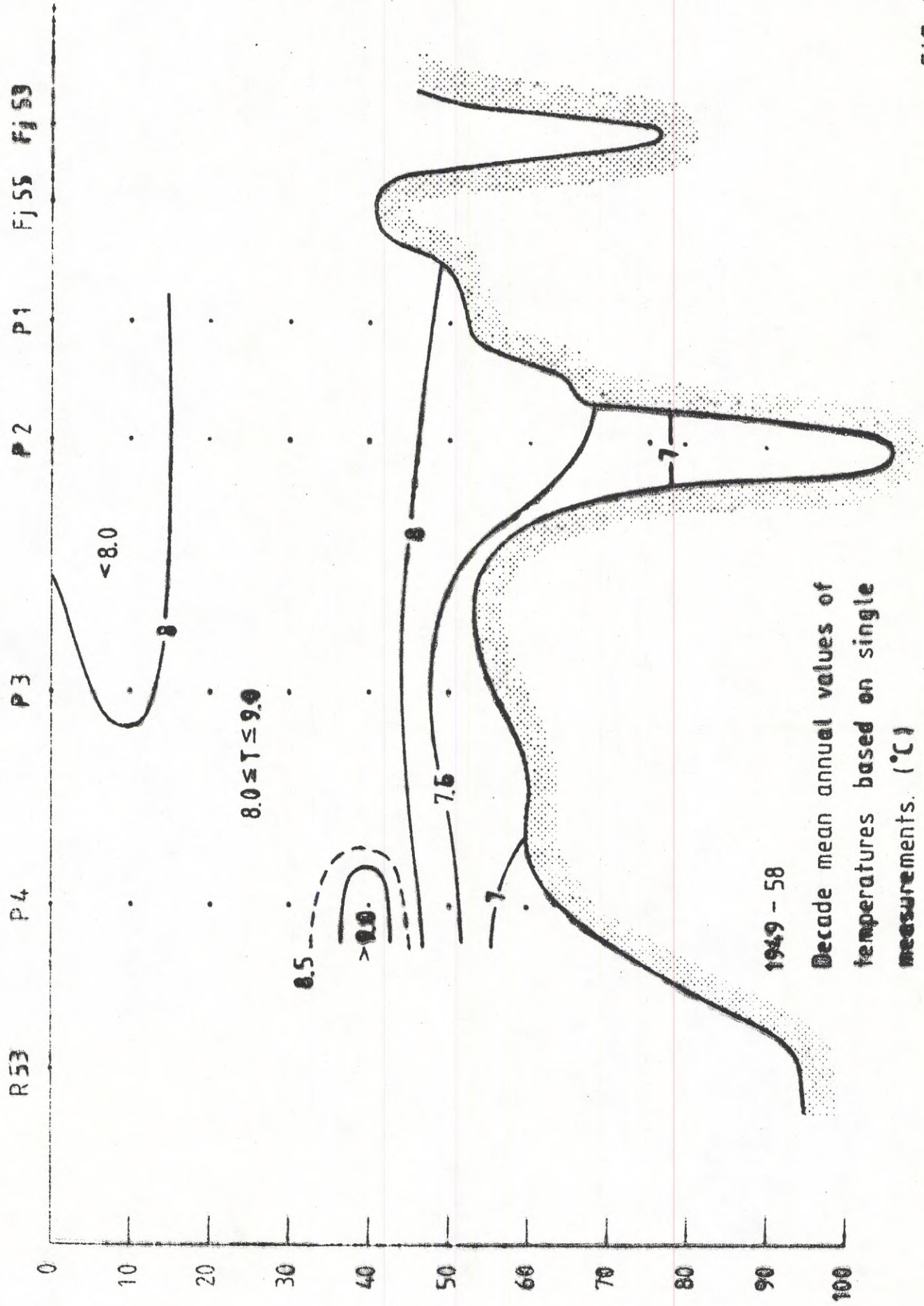


FIG. 1

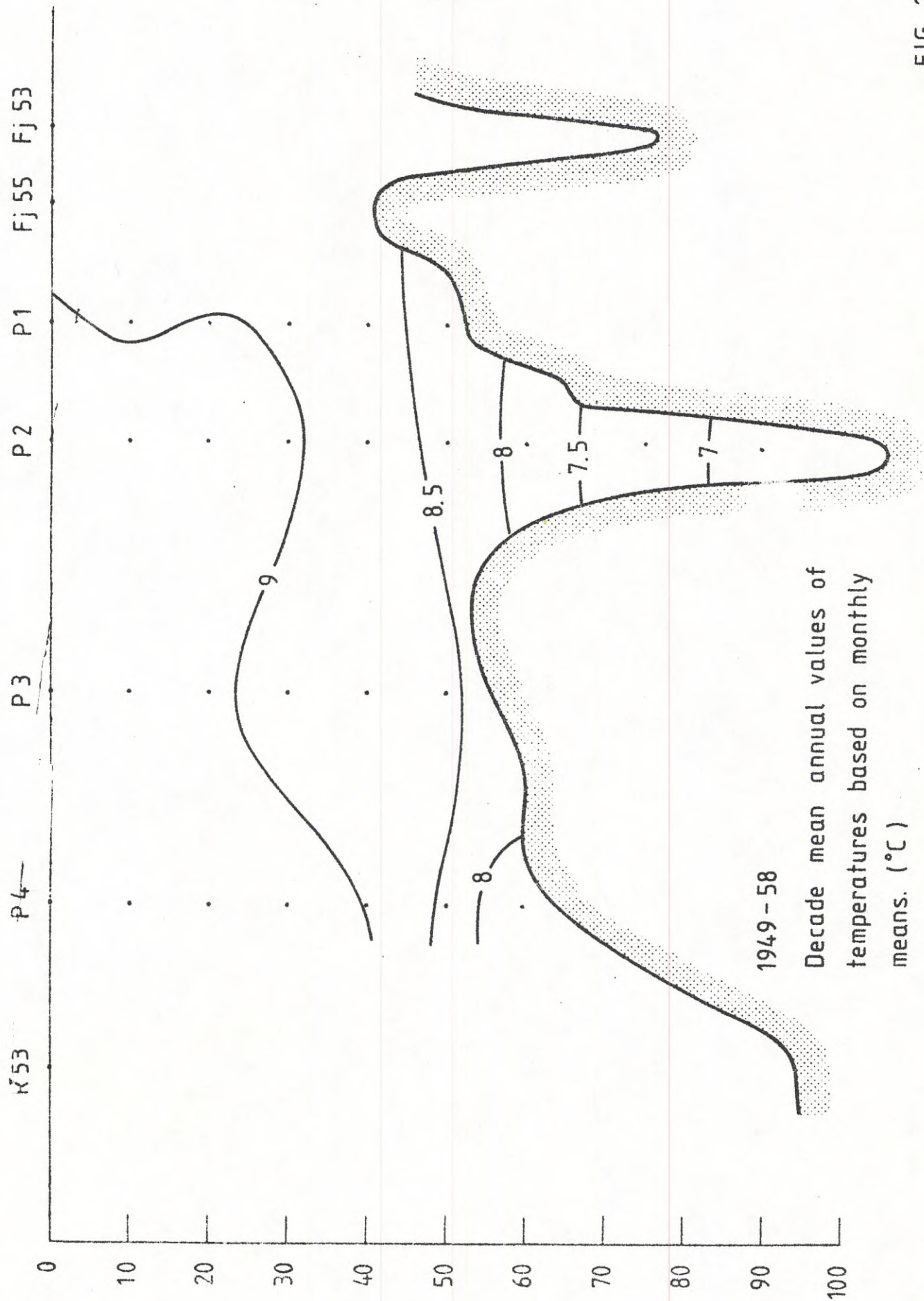


FIG. 2

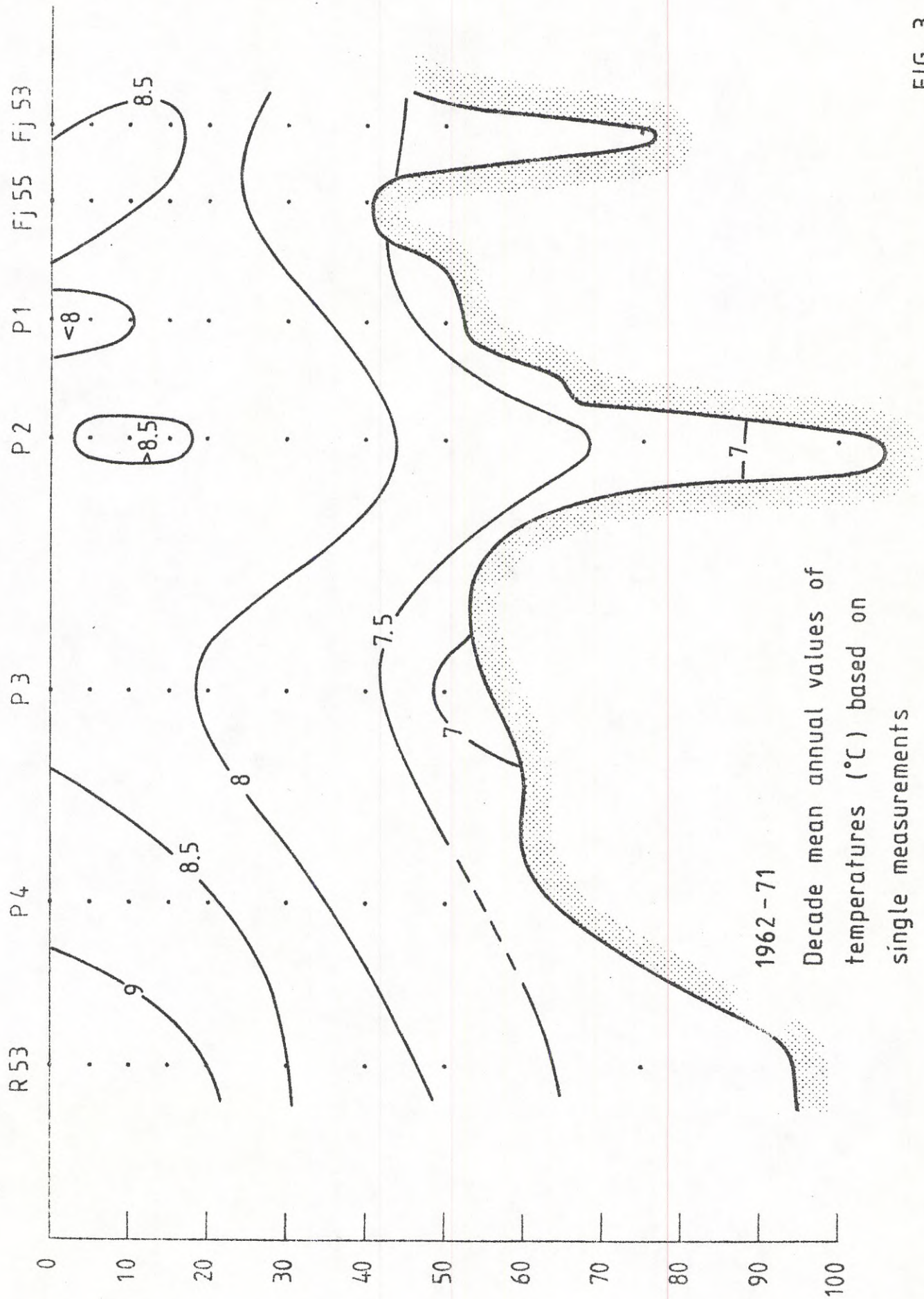
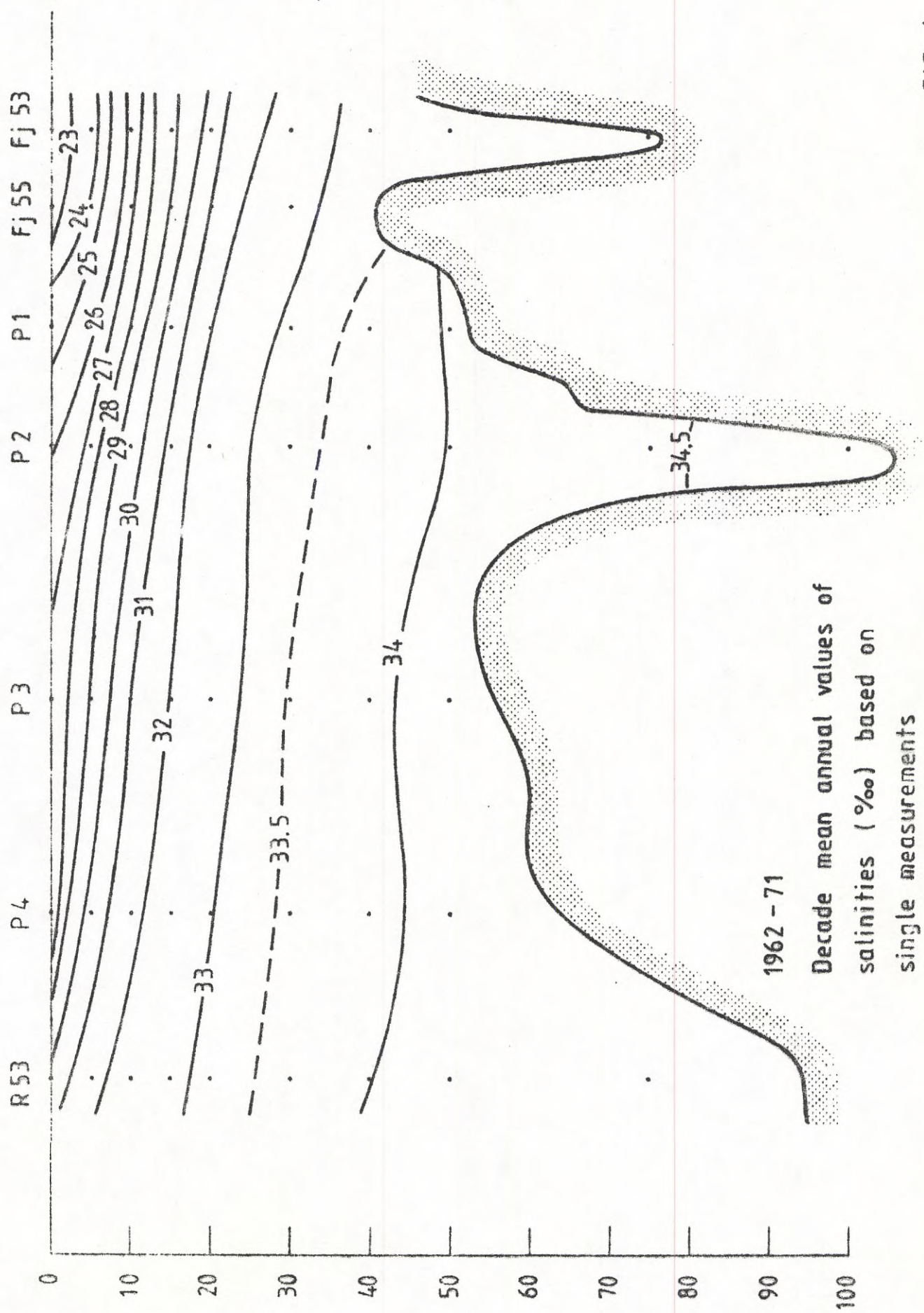


FIG. 3



1962 - 71

Decade mean annual values of
salinities (‰) based on
single measurements

FIG. 4

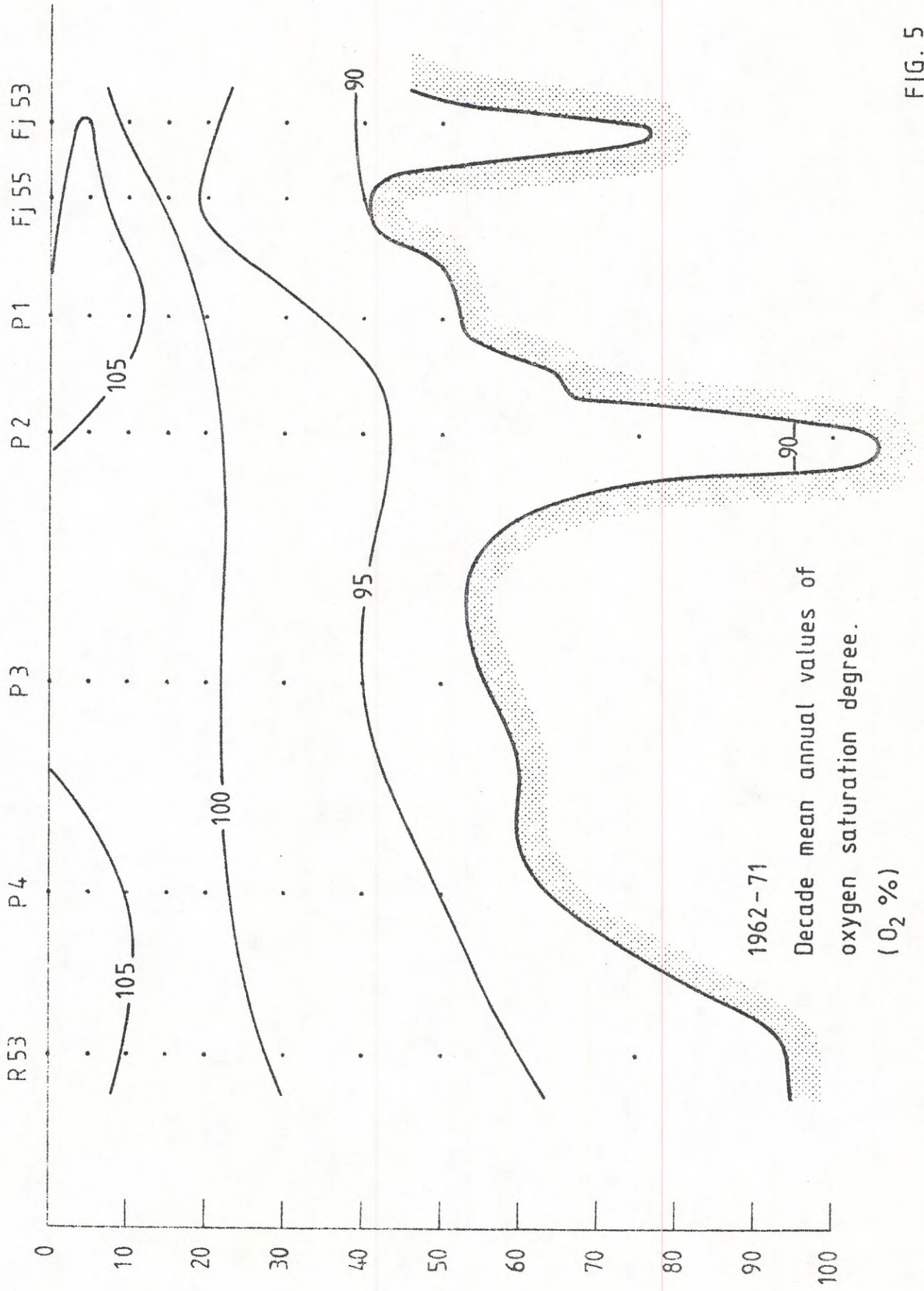


FIG. 5

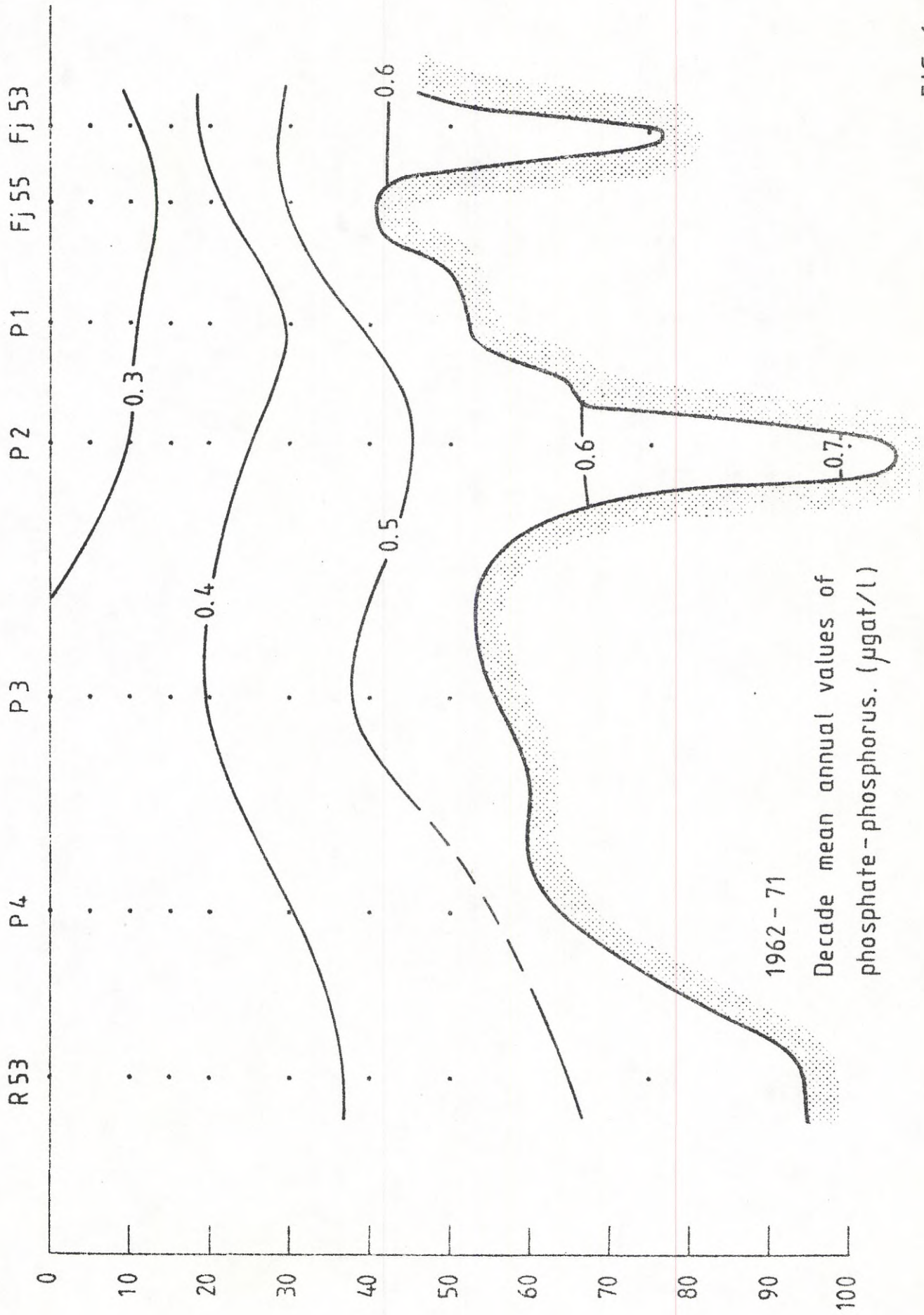


FIG. 6

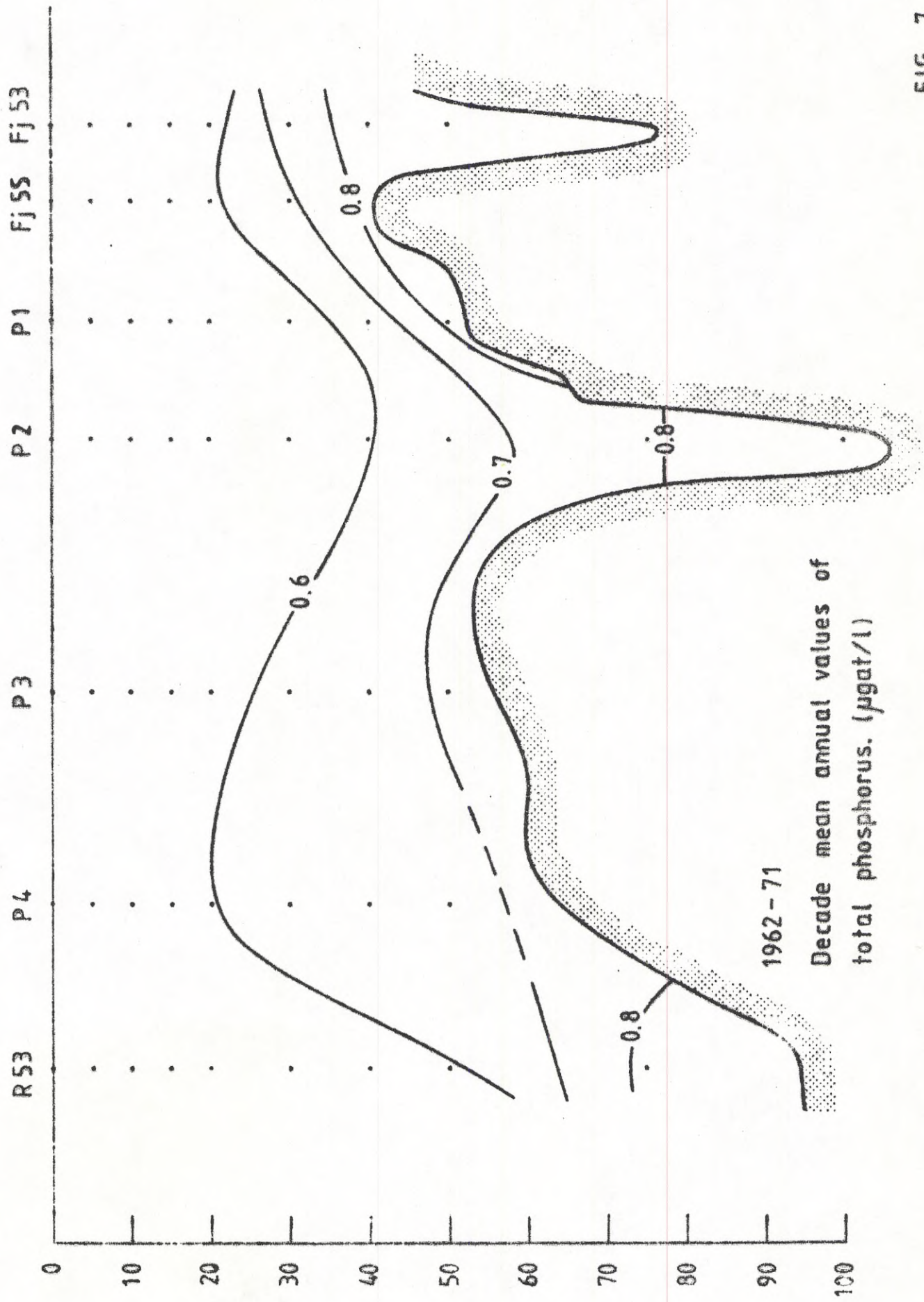
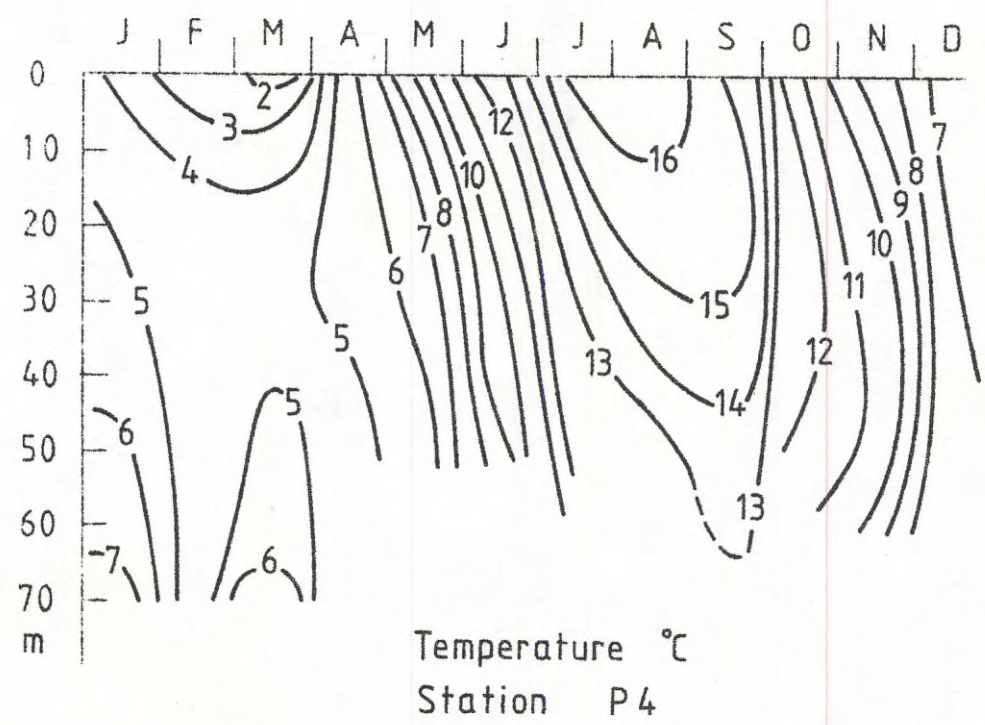
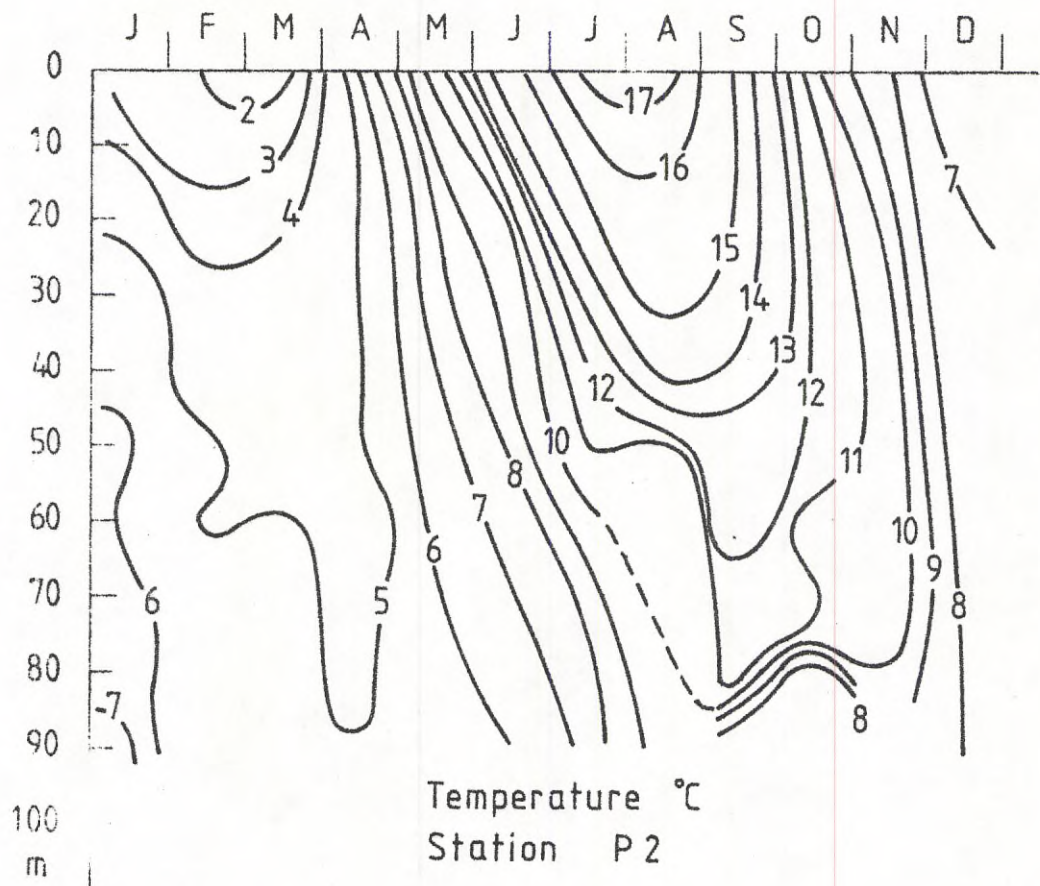


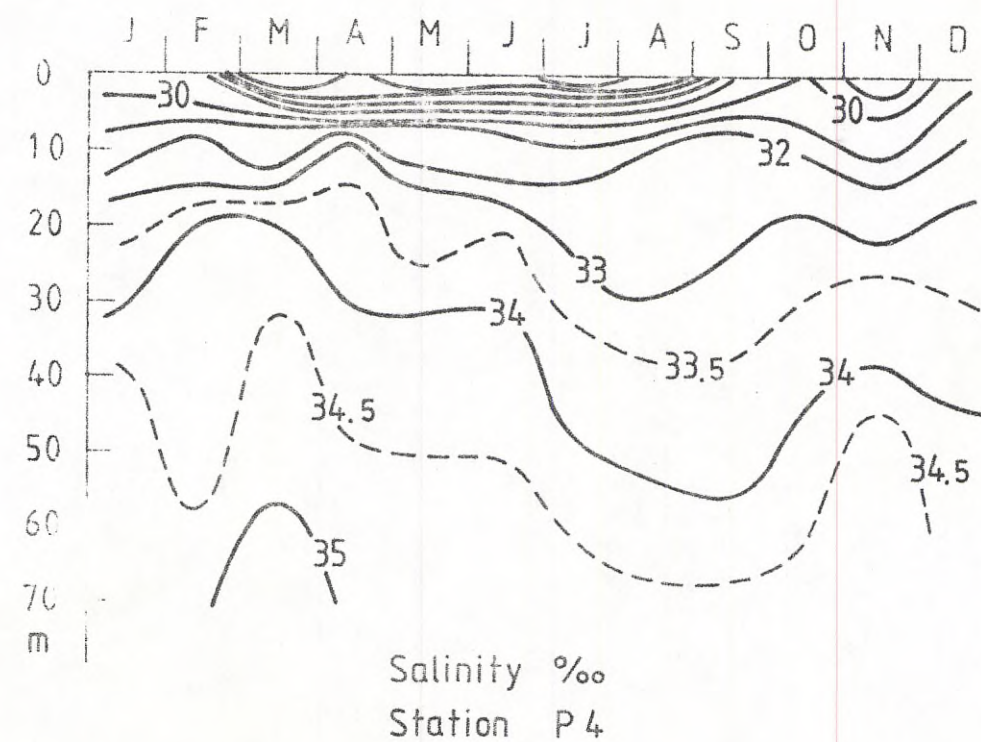
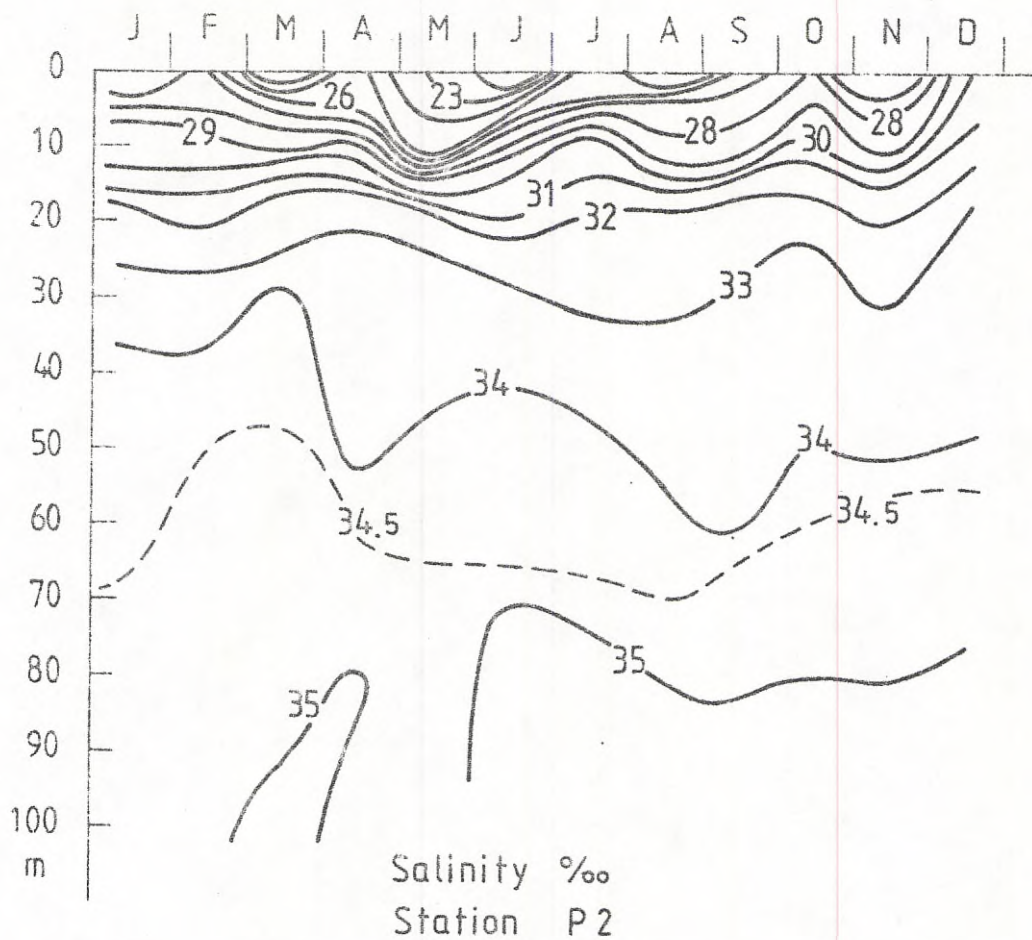
FIG. 7



1949-58

Decade mean monthly values of temperatures

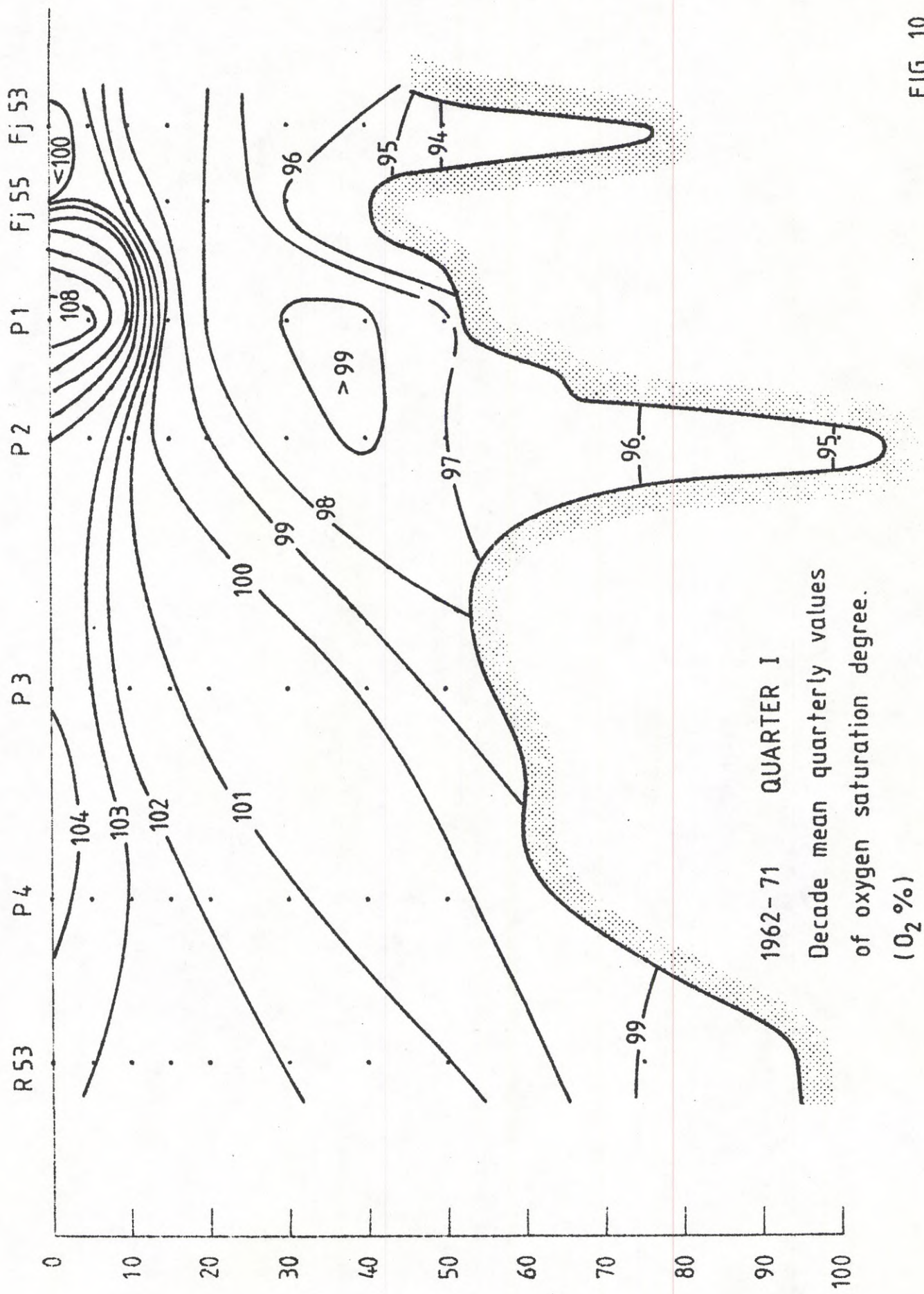
FIG. 8



1949 - 58

Decade mean monthly values of salinities

FIG. 9



1962-71 QUARTER I
 Decade mean quarterly values
 of oxygen saturation degree.
 (O₂ %)

FIG. 10

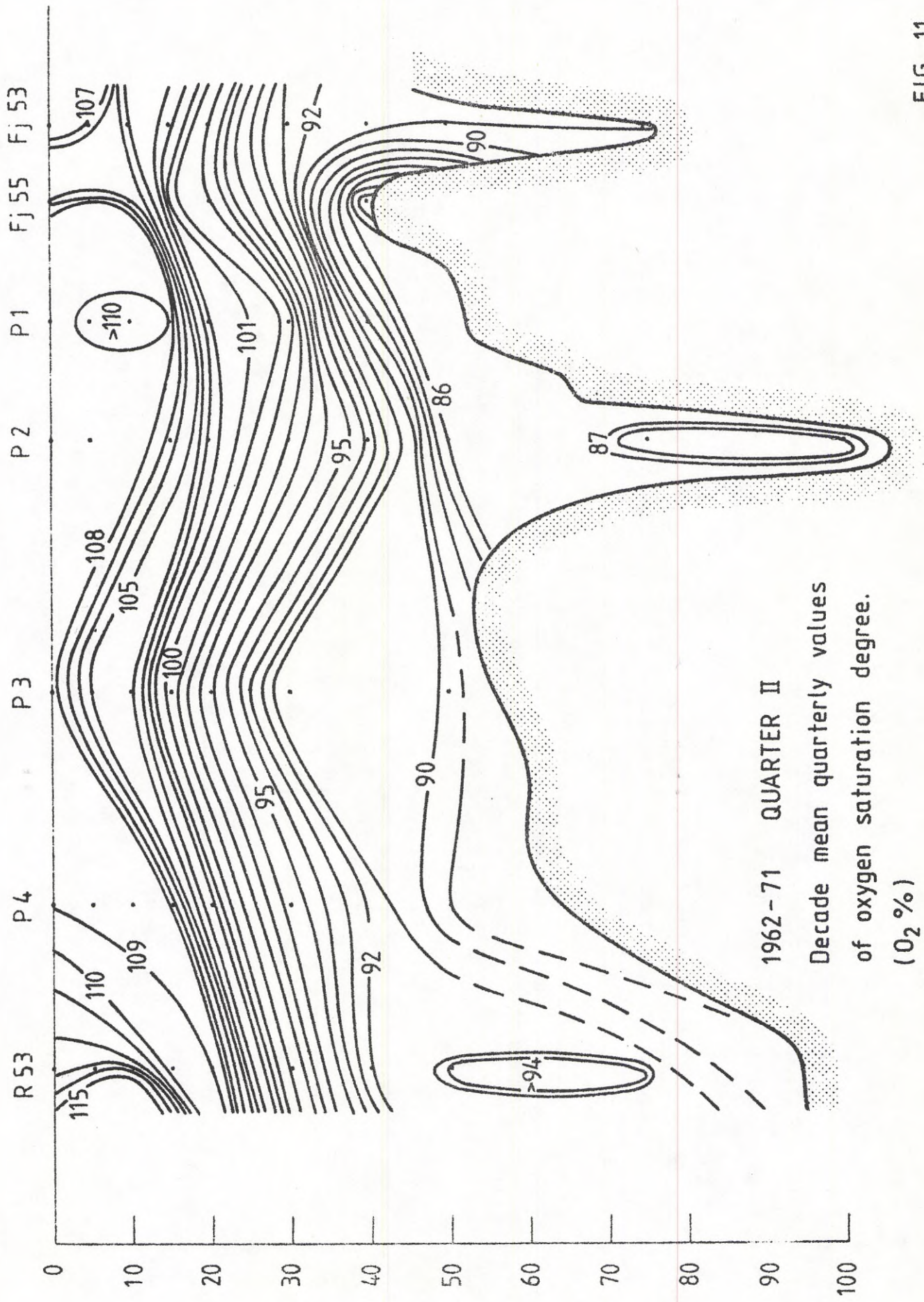
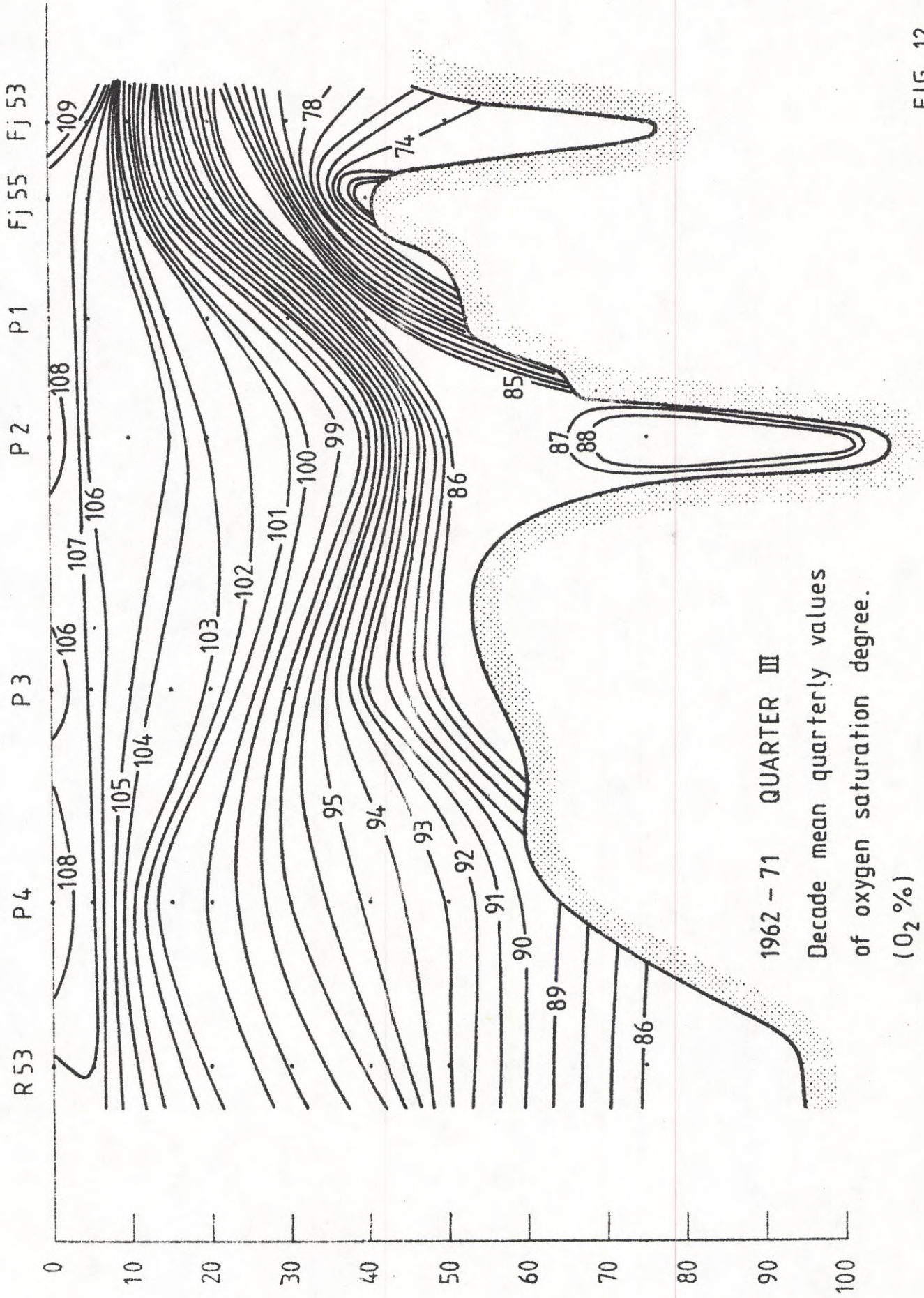


FIG. 11



1962 - 71 QUARTER III
 Decade mean quarterly values
 of oxygen saturation degree.
 (O₂ %)

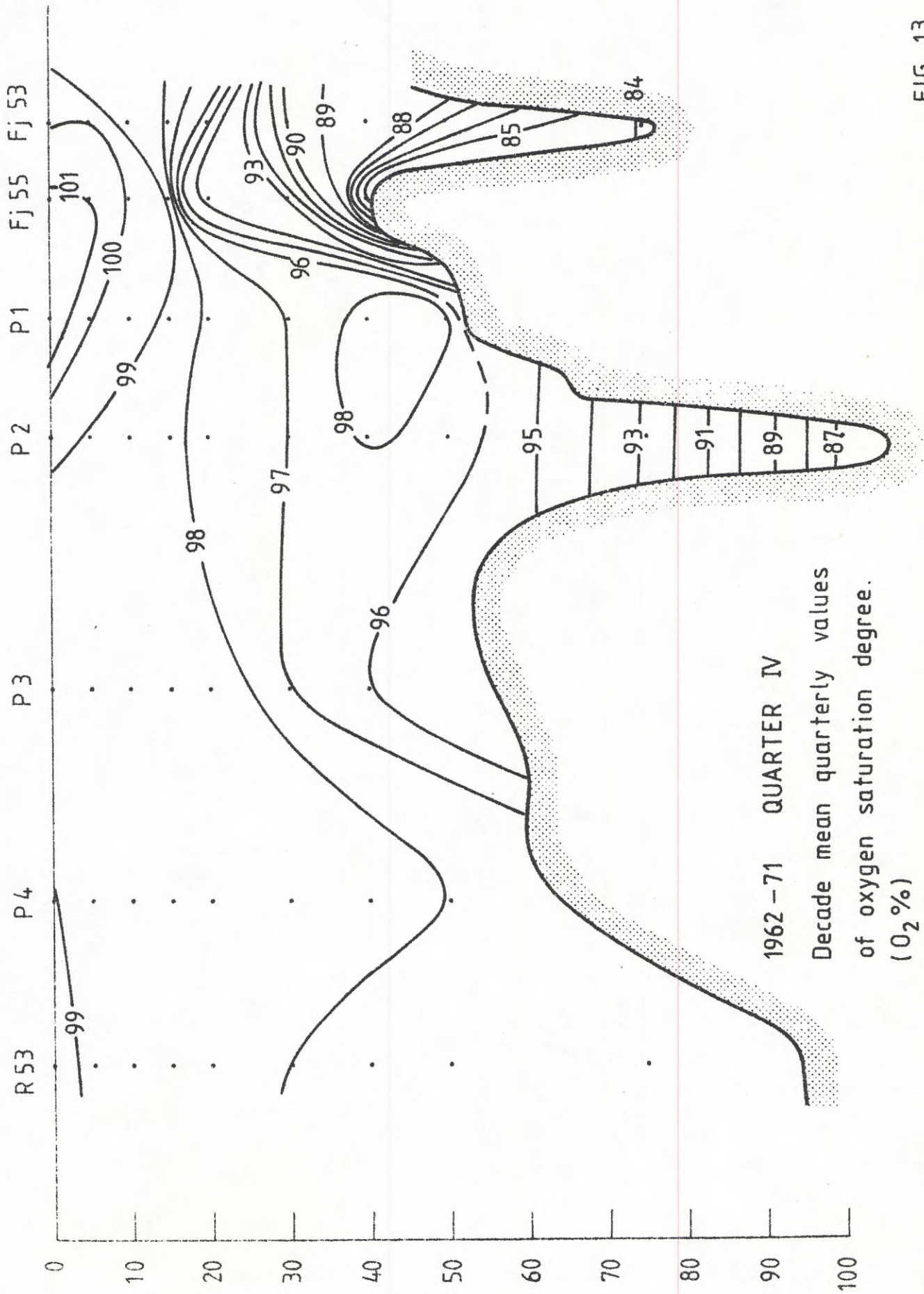
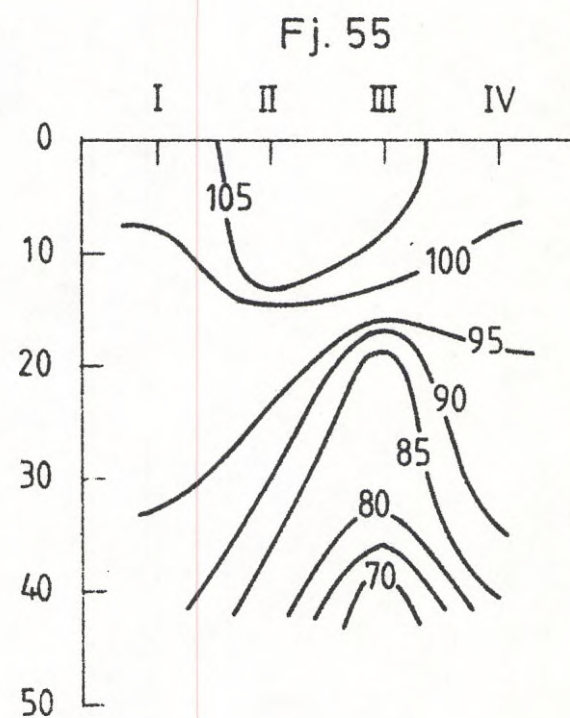
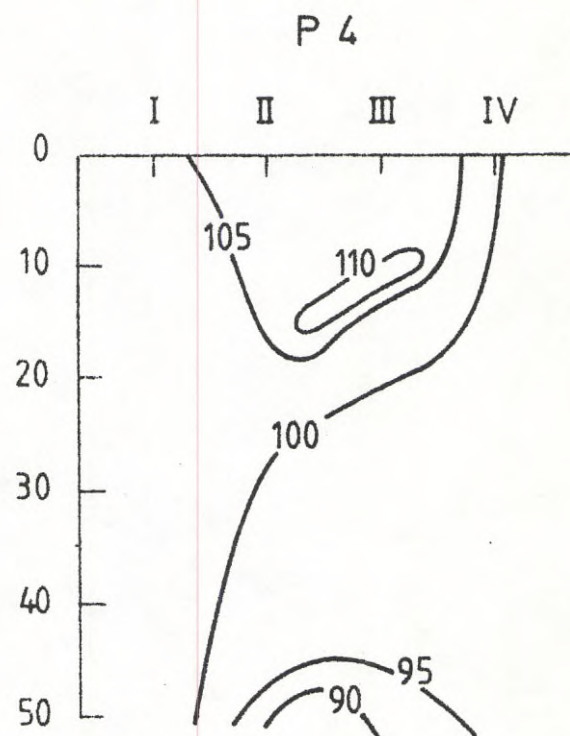
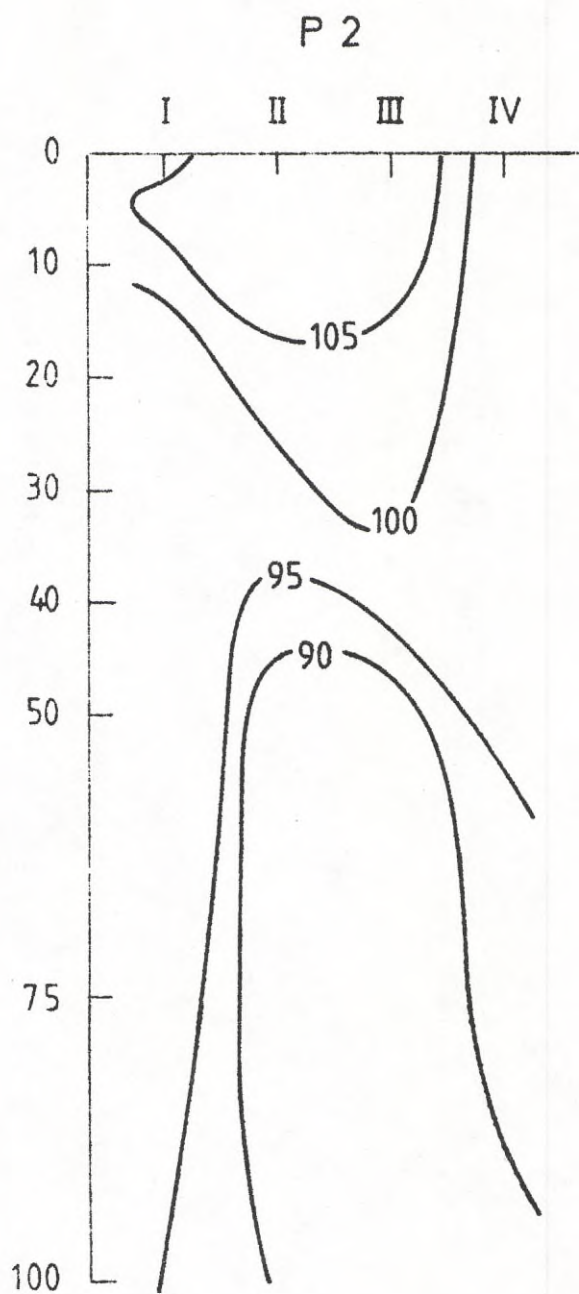


FIG. 13



1962 - 71

Decade mean quaterly values of oxygen saturation degree. (O₂%)

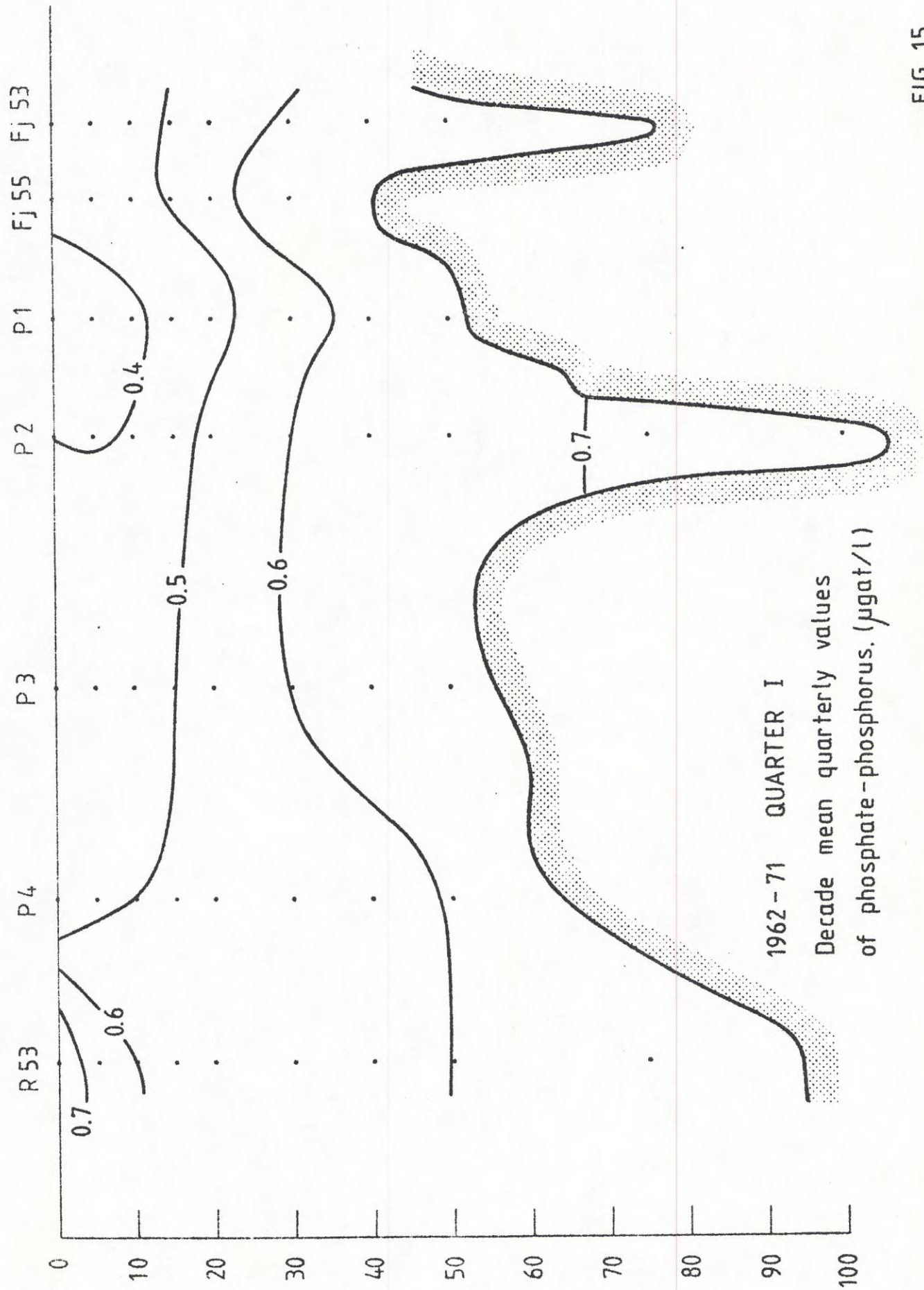


FIG. 15

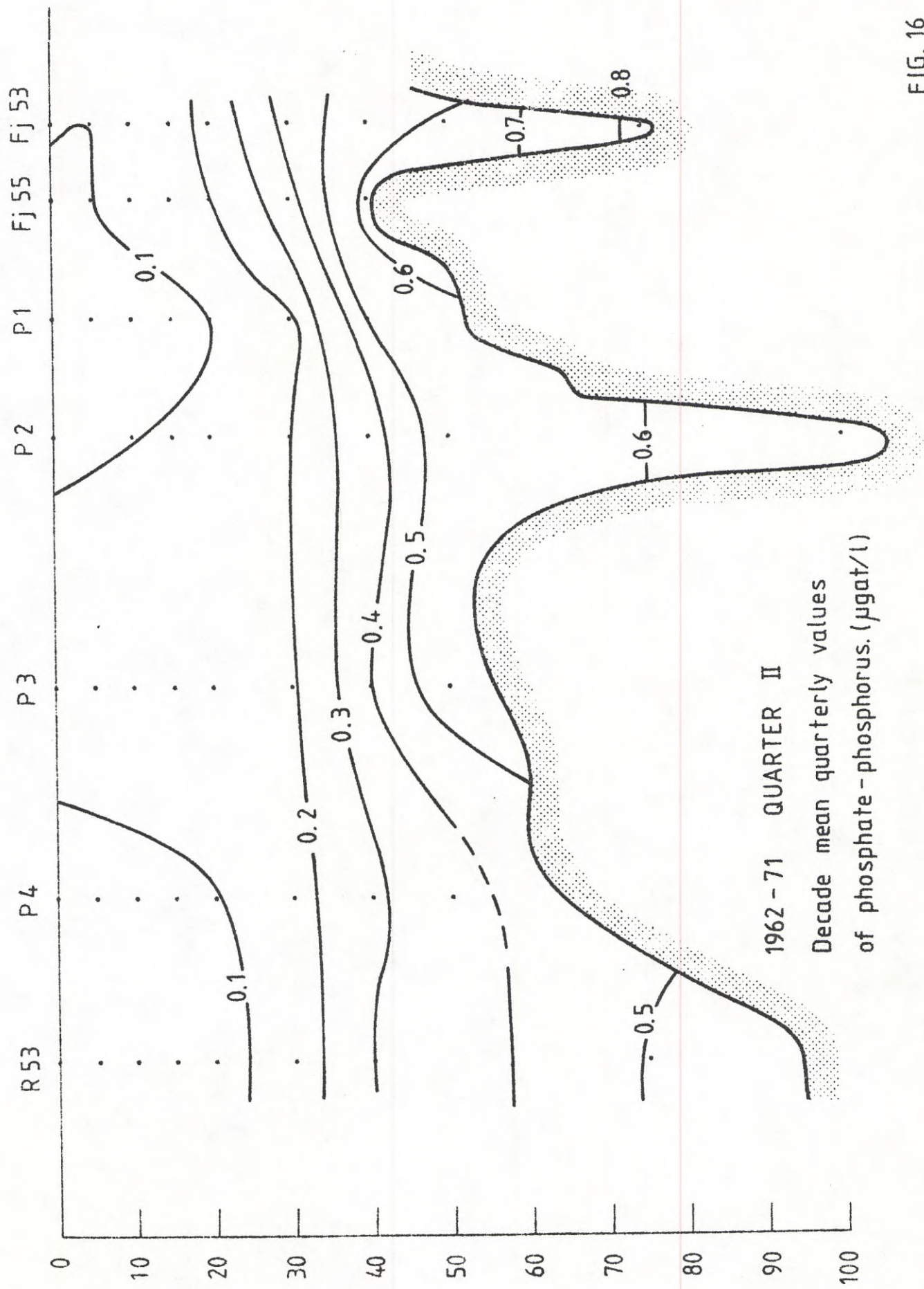


FIG. 16

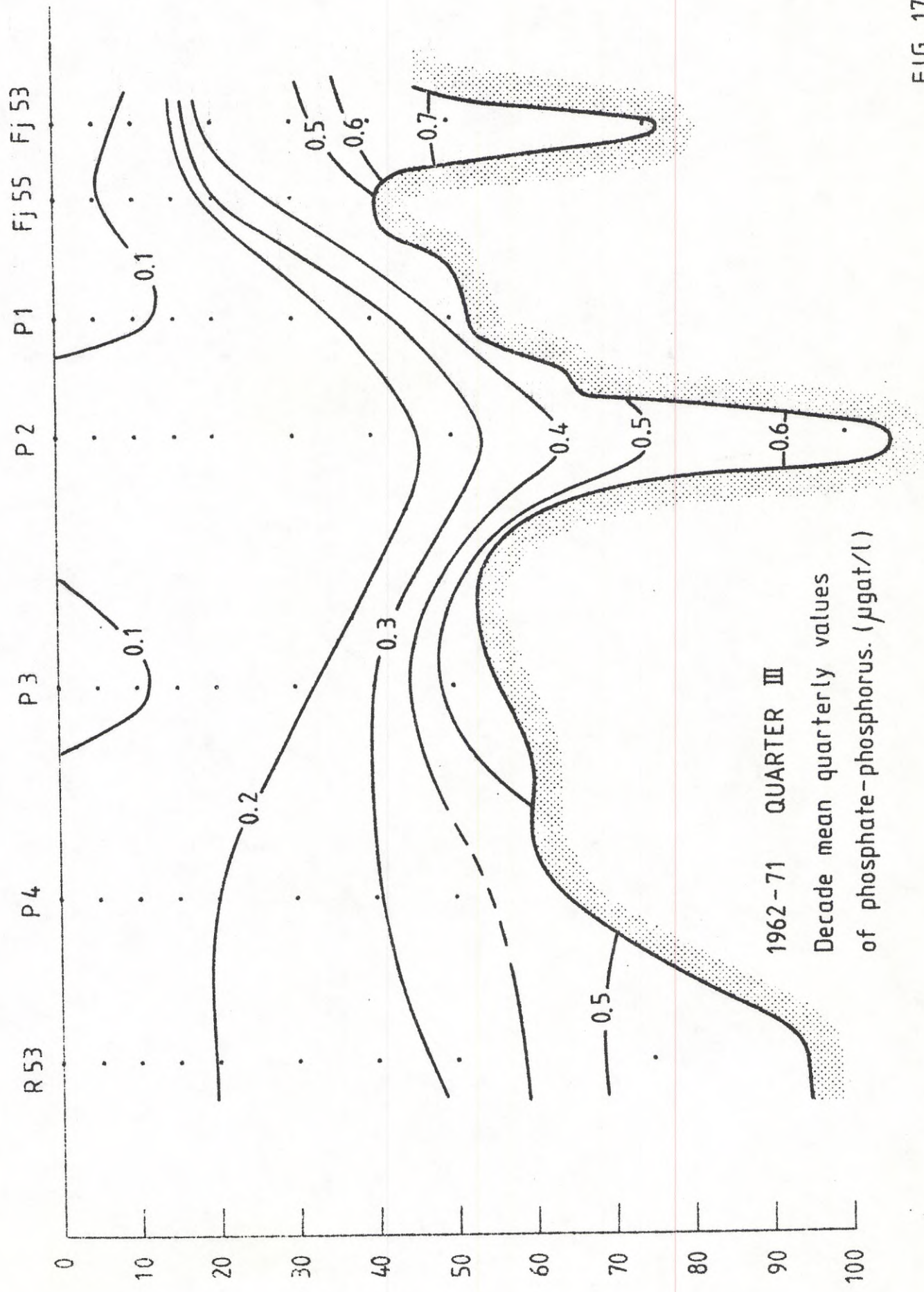


FIG. 17

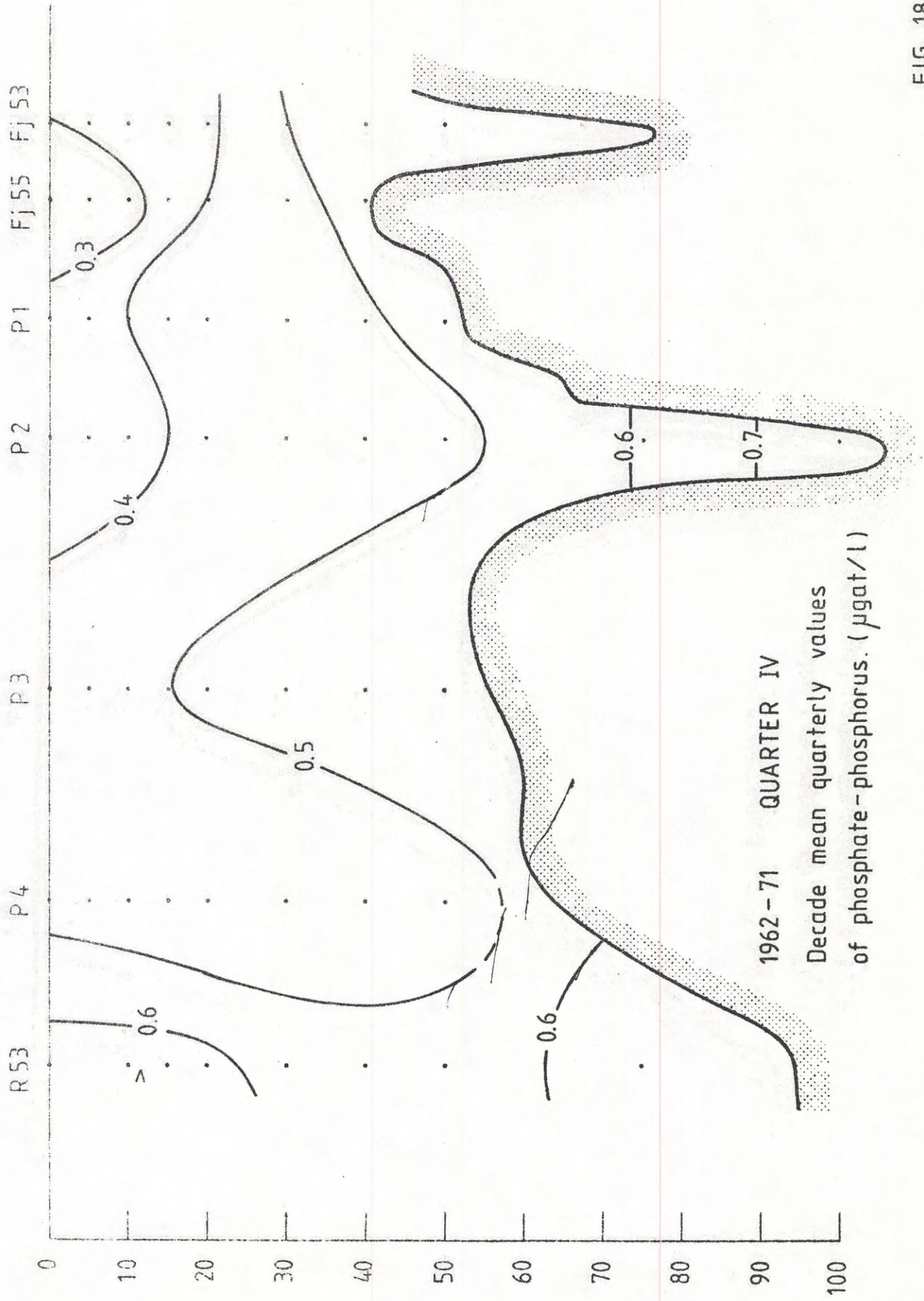
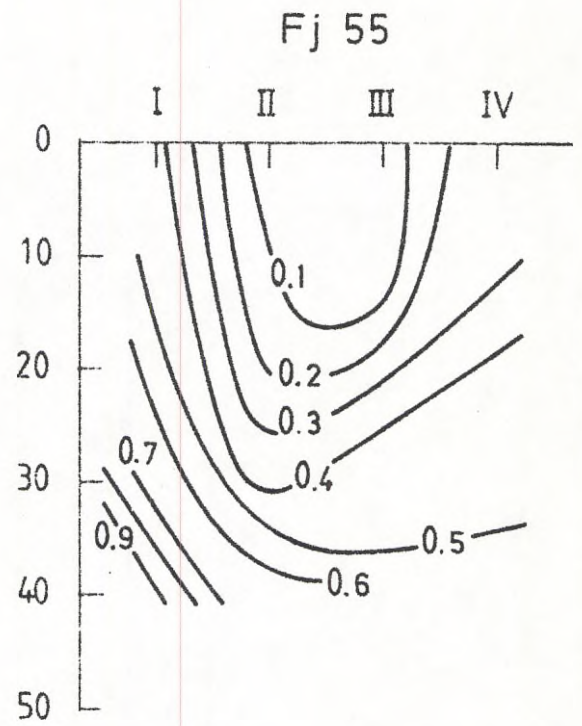
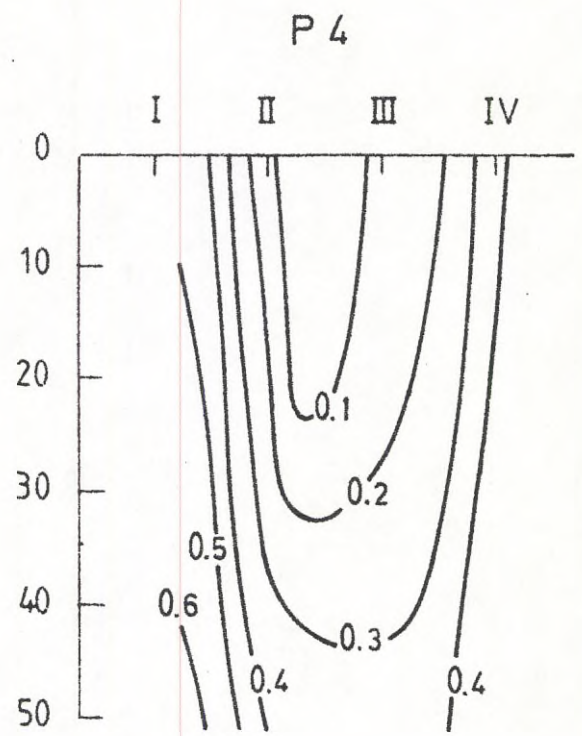
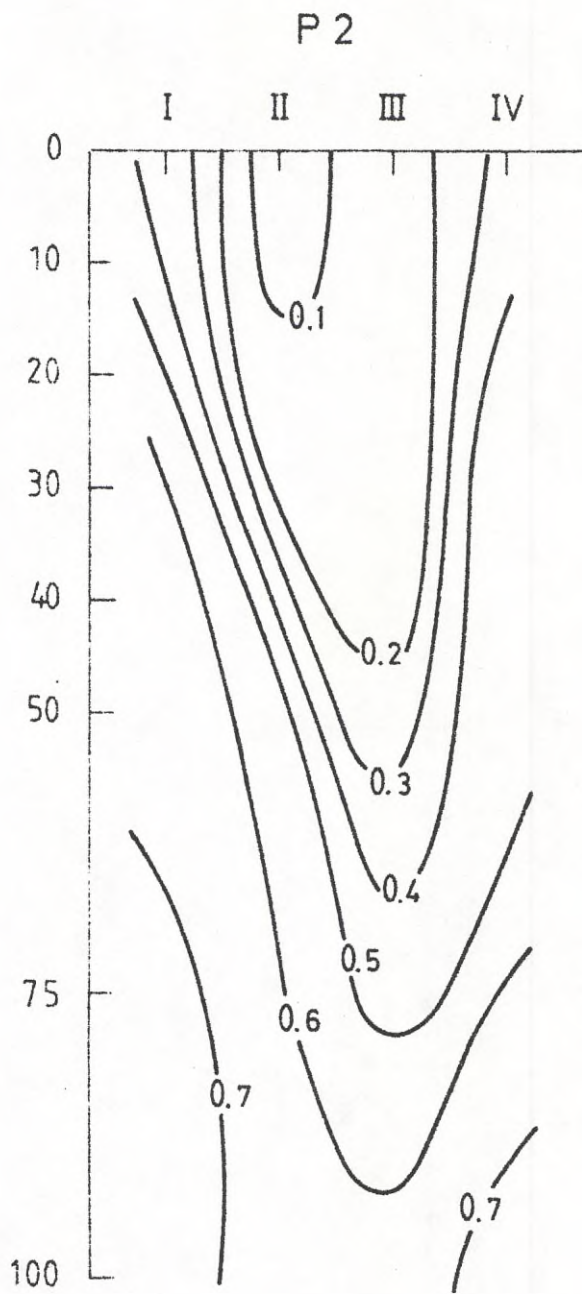
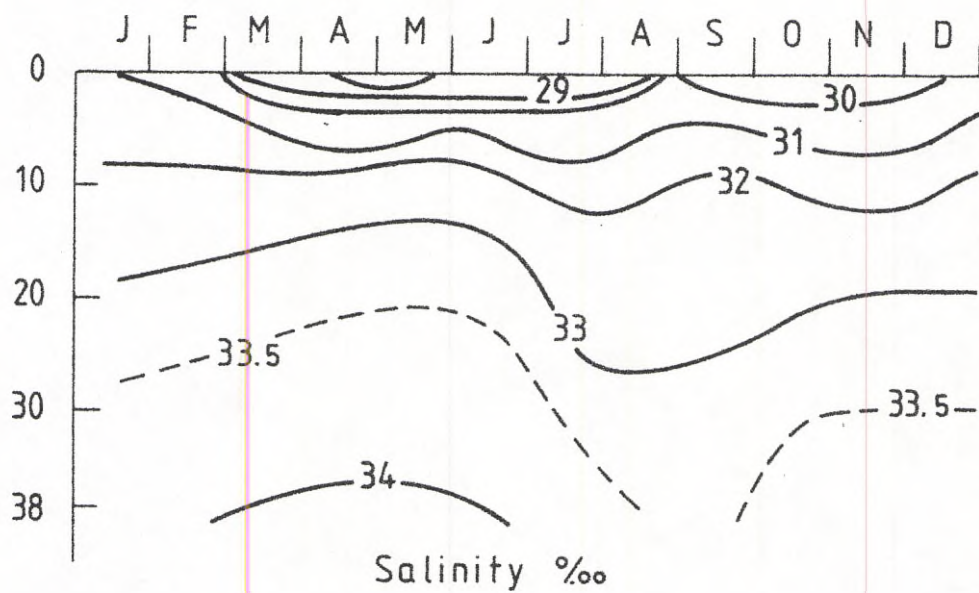
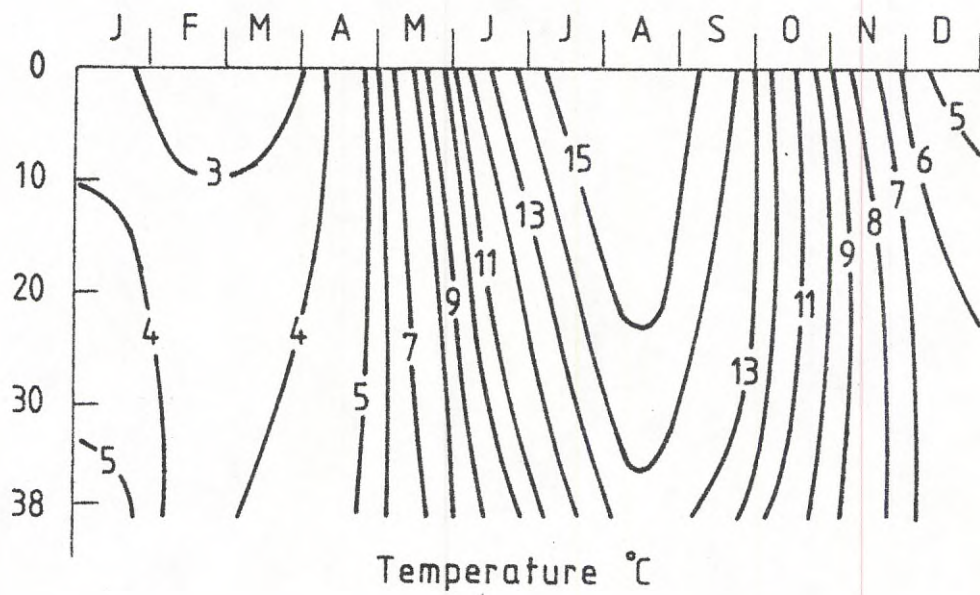


FIG. 18



1962 - 71

Decade mean quarterly values of phosphate - phosphorus ($\mu\text{gat/l}$)



1903-26 (Surface 1881-1930)

Long-term means of temperatures and salinities
measured at the L/V Skagens Rev. N57°46.0 E10°43.3

1949 - 74

Running 5 years mean values of salinity (‰) from the first quarter for the station P2 at 75 m

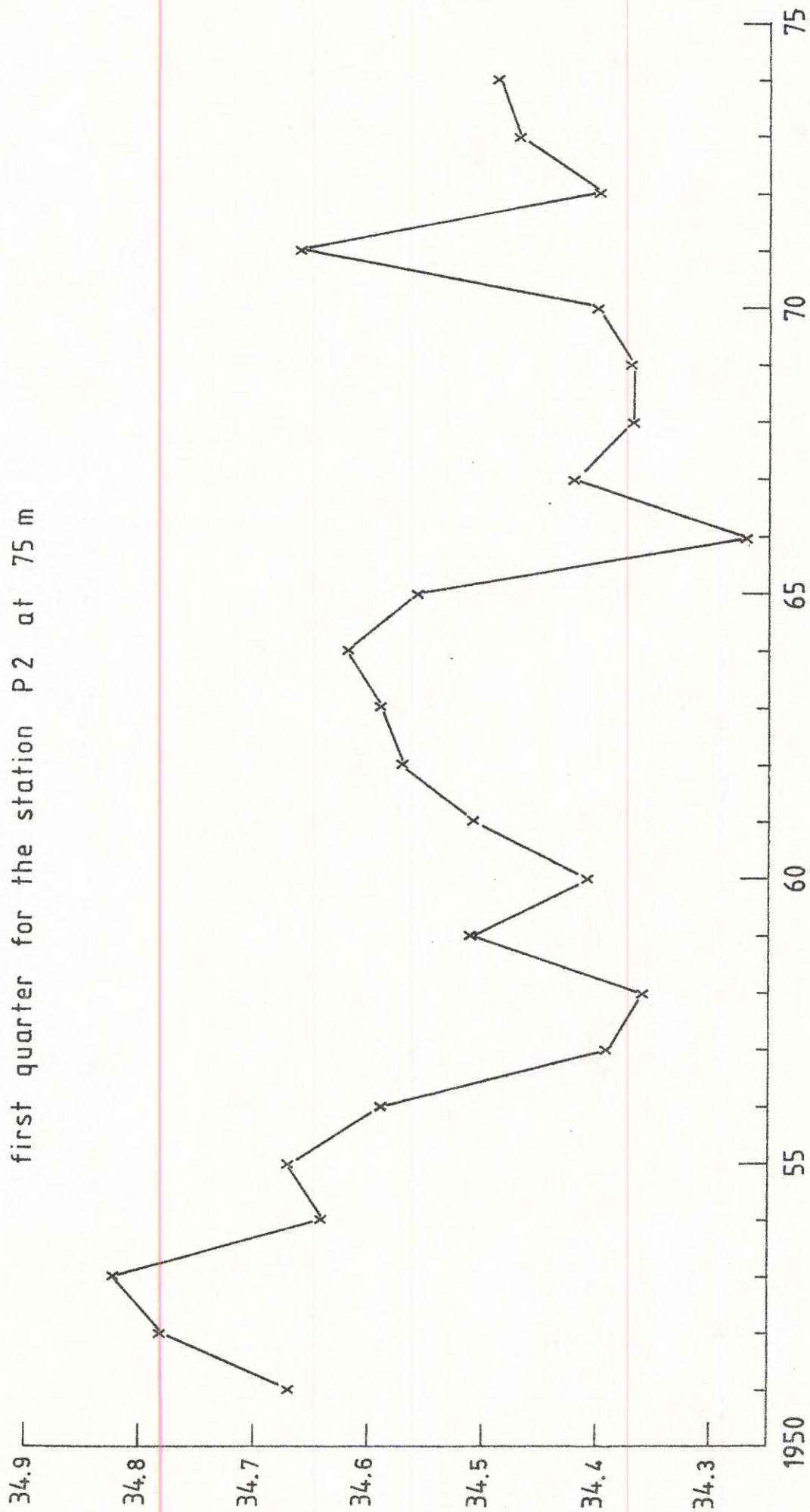


FIG. 21

