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An aerial survey of fishing effort in the lobster fishery of northern Northumberland Strait

by

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ABSTRACT

The spatial distribution of effort in lobster fishery of Southern Gulf of St Lawrence is surveyed by counting the floats of lobster traps during aerial flights over the fishing grounds. Contour plotting allows drawing maps of fishing intensity. The technique is found useful for assessing overall effort, studying relationships between lobster distribution and physical parameters such as residual gyres and type of sea bottom, as well as for stratifying sampling at sea.

RESUME

La distribution spatiale de l'effort de pêche dans la pêcherie de homard du sud du Golfe du Saint Laurent est étudiée à partir de comptes des bouées de casiers lors de suvols aériens des lieux de pêche. La technique s'avère efficace pour évaluer globalement l'éffort, pour étudier les relations entre la distribution des homards et des paramètres physiques tels que les courants giratoires résiduels, le type sédimentaire du fond, et également pour stratifier l'échantillonnage effectué en mer.

Introduction

Spacial distribution of fishing effort in the lobster fisheries of the Gulf Region is still little known as mentioned by Ahrens (1982). A good knowledge of the spacial distribution and intensity of fishing effort on fishing grounds is required for stratifying sampling of biological as well as fishery parameters.

The traditional way of assessing spacial distribution of effort is to collect information recorded on log books by the fishermen. However this technique requires a large amount of field personnel, and it has generally been observed that the returns of log books decrease over the years. In the lobster fishery, fishermen do not readily provide information such as the exact position of their fishing gear. Or when they provide such information it is frequently difficult to match local names for the fishing grounds with geographic positions.

After considering the large area to be covered in the Gulf Region and the limited amount of personnel available, we concluded that the use of log books would be inefficient in the lobster fishery. An efficient method for assessing effort over long distances and within a short time interval appeared to be aerial surveys of either trap buoys or fishing boats at sea.

We chose the first alternative for this experimental assessment and obtained 10 hours of flight from fishery patrol aircraft stationed at Summerside, P.E.I.

Material and Methods

A coverage of lobster fishing district 8 (Fig. 1) was designed. Buoys were counted along the flight directly by eye and photographs were taken on black and white and colour film. Two altitudes were tried: 500' and 700'.

On August 21, 22, 1982 the buoys were counted during flight on port by the pilot and on starboard by a research technician. A radar technician recorded the counts provided to him between each position he would read on the OMEGA navigation system available on board.

A principal component analysis (PCA) was run on the data in order to identify factors which might have been correlated with the counts: port or starboard counts, day, time of the day, direction of flight. The ratios for each flight were compared by using a 2 way contingency table test.

It was later assumed that the mathematical expectation of the ratios of starboard to port counts during a flight was equal to 1. An overall ratio was calculated for each flight and a correction specific to the flight was made by applying this ratio to each couple of observations in order to adequately balance the port and starboard observations. Average density per square kilometer was then calculated for each mid-point between the stations. The number of buoys was converted to a number of traps using previously collected information on the average number of traps per string in different locations and on the number of buoys per line (either one or two) in different locations (Fig. 2).

Digitization of cartographic data, contour plotting, PCA, statistical analysis and computations were made on the HP 9845B available at Marine Biological Research Centre, Moncton.

Results

The angle covered by each observer on each side of the aircraft was estimated as 55° (Fig. 3). At 500' the distance covered laterally was 435m, and 609m at 700'. Both altitudes allowed good direct counts of the buoys. It was found that although the buoys could be seen on black and white photographs, they could be easily mistaken for breaking waves or seagulls. Colour photographs provided better results but were expensive and the planes were not equipped for routinely handling such film. The area covered by photographs was too small at 500' or 700' altitude using the standard cameras on board.

The flights and stations are presented in Figure 1. A complete coverage of lobster district 8 was achieved. An example of port and starboard counts for a flight is given in Figure 4.

Results of the PCA are presented in Figure 5 in the plane defined by the first and the second principal component. Most variables were strongly correlated (2,3,5,6) between themselves and correlated with the port/starboard ratio of counts. The direction of the flight (4) did not appear to drastically affect the port/starboard ratio. In this survey it was not possible to assess experimentally the effects of the different factors (hour of day, i.e. position of the sun) on the accuracy of the counts. The port to starboard ratios, however, differed very significantly from flight-to-flight as shown by the contingency table test. We decided to make flight-specific corrections for the port to starboard ratios without taking into account the other factors which were highly correlated with the flight number (Fig. 5).

The average number of traps per buoy and the number of buoys per line are presented in Figure 2. The adjusted data in number of trap (x 10^{-1}) per square km is provided in Figure 6. The contour map of trap densities per square km is given in Figure 7.

Discussion

Aerial surveys were used successfully to study inshore herring fishing effort in the Gulf of St Lawrence (e.g. Messieh and MacPherson, 1981). However, the present aerial survey technique used for mapping out lobster fishing areas and distribution of fishing effort intensity had not been previously used to our knowledge. It appears to be a very promising efficient technique. Lobster fishing district 8 was entirely surveyed in two days of flight and estimates of spacial distribution of the abundance of traps were provided independently from official estimates of legal number of traps per boat.

It appears advisable for the future to make several surveys over a single fishing season in order to have a better understanding of the changes in fishing effort distribution patterns. Such changes would provide important biological information such as seasonal movements of lobsters.

A logical approach for estimating the biological parameters such as molting periods, mortalities, growth at molt will be to stratify the sea sampling in the different fishing concentrations.

It will also be useful to investigate whether the fishing zones correspond only to areas of abundance of lobsters, sedimentary characteristics of the sea bed,residual gyres, or whether they are also determined by technical characteristics of the fleet.

A fully computerized approach for fishing effort surveys on board of a plane is being prepared. A portable HP 85 computer with an incorporated clock will monitor a Loran C navigational system coupled to a plotter. The observers will only need to periodically type in their counts, which will be automatically recorded on file with corresponding time and position. The HP 85 casette will be transfered into the HP 9845 B system, which will provide a contour plotting as soon as the area will have been fully covered.

Bibliography

Ahrens, Martin, 1982. A background document to guide future biological research programmes related to the Southern Gulf of St Lawrence in shore fisheries. Prepared under contract to the Department of Fisheries & Oceans.

Messieh, S.and MacPherson, 1981. Aerial survey of inshore herring fishing effort in the Gulf of St Lawrence. CAFSAC Res. Doc. 81/13.

Fig. 1 - Aerial coverage of Northern Northumberland Strait.
Position of the stations along the flight transects.

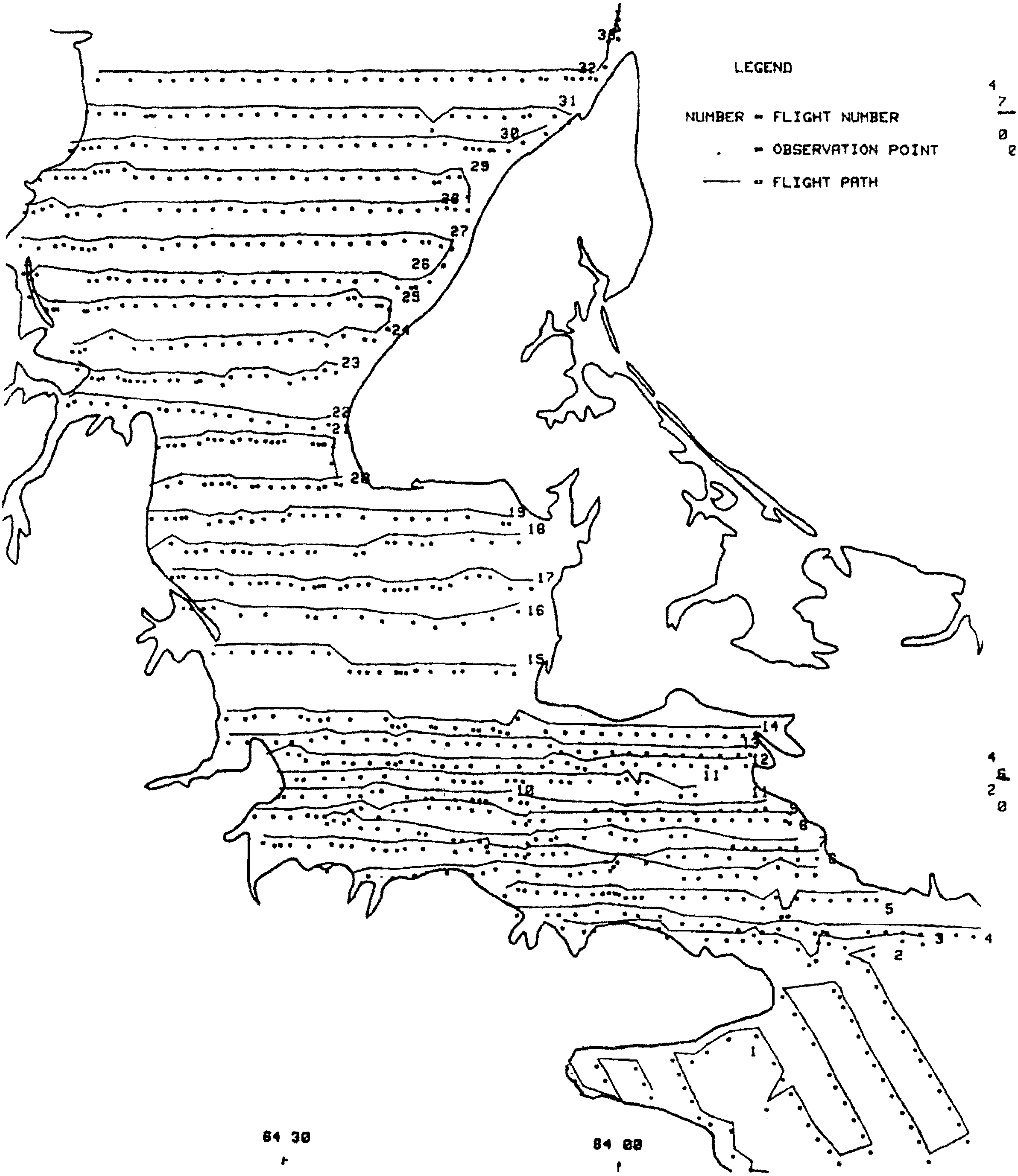


Fig. 2 - Areas used for stratifying the number of traps per string and the number of buoys per string.

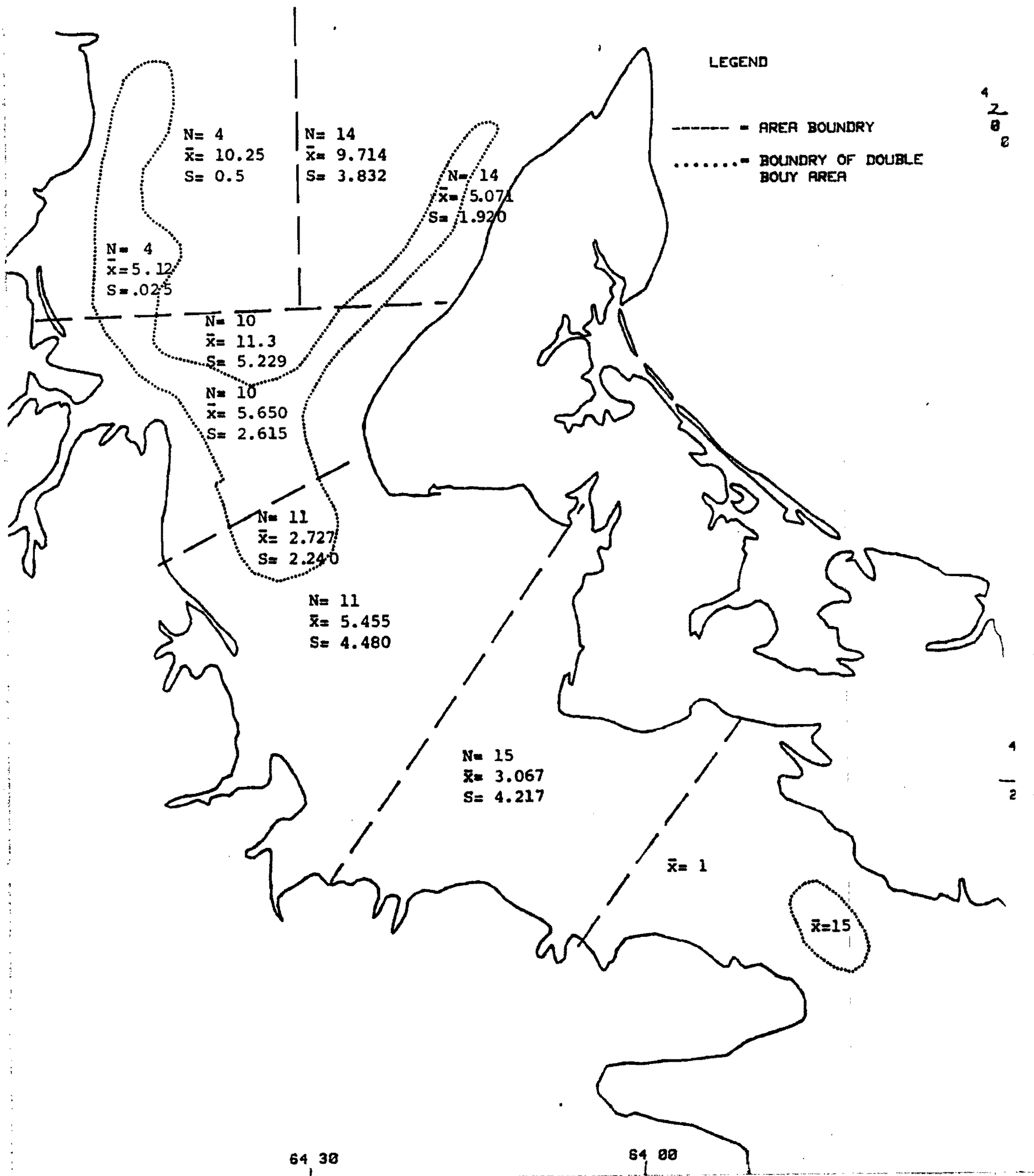


Fig. 3 - Distances covered laterally by the observers at 500' and 700'.

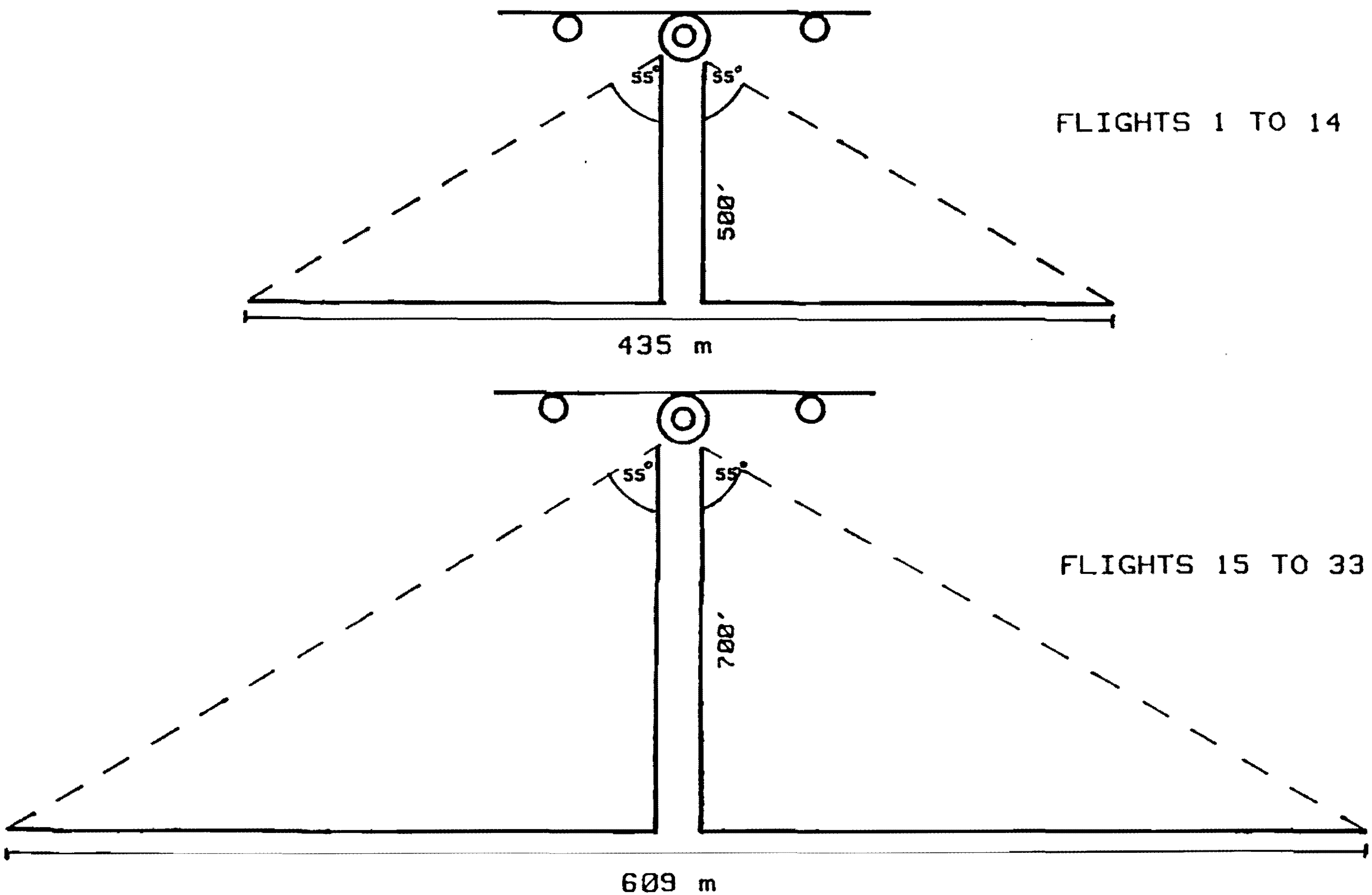
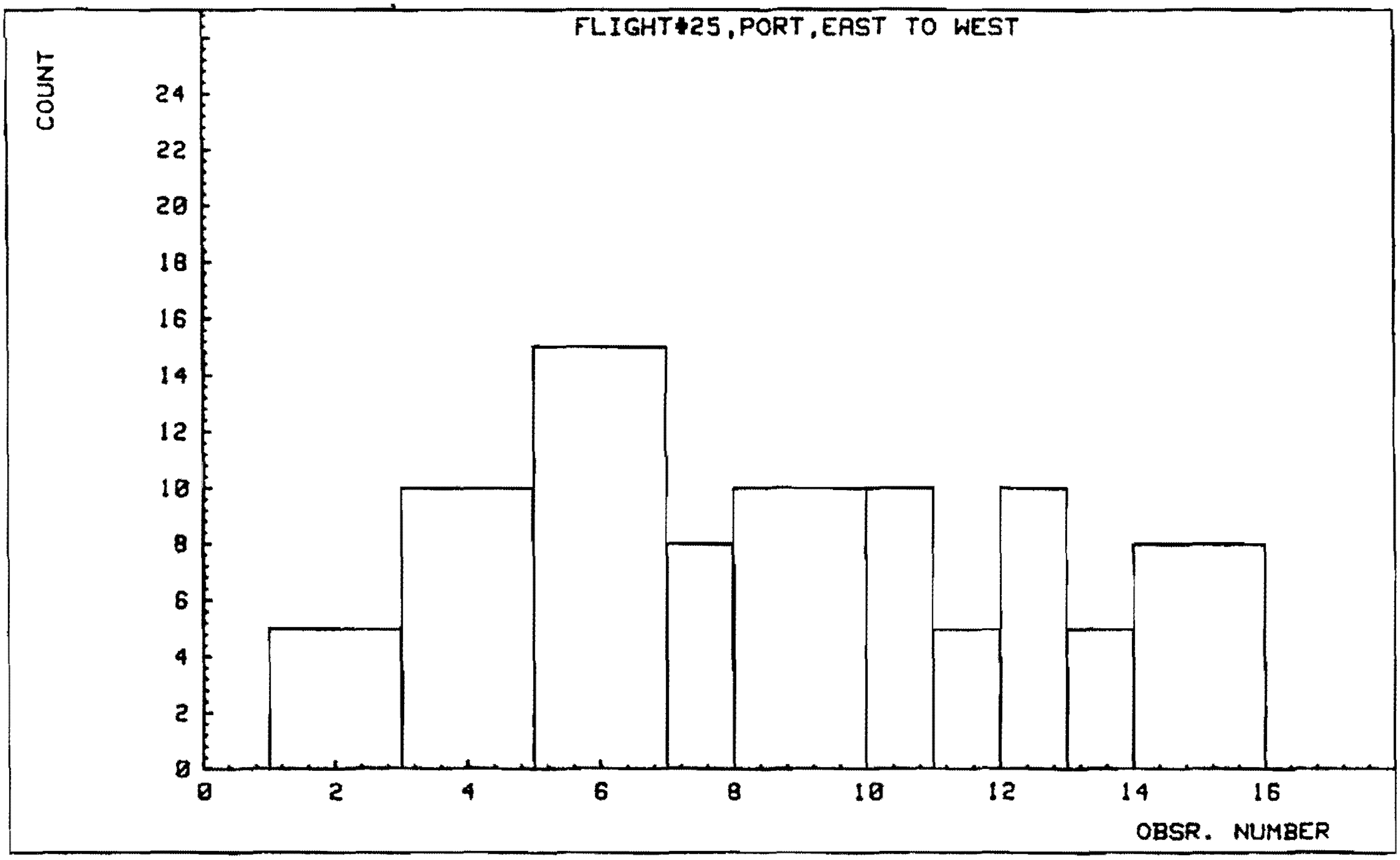


Fig. 4 - Example of two histograms representing the port and starboard counts along a flight transect.



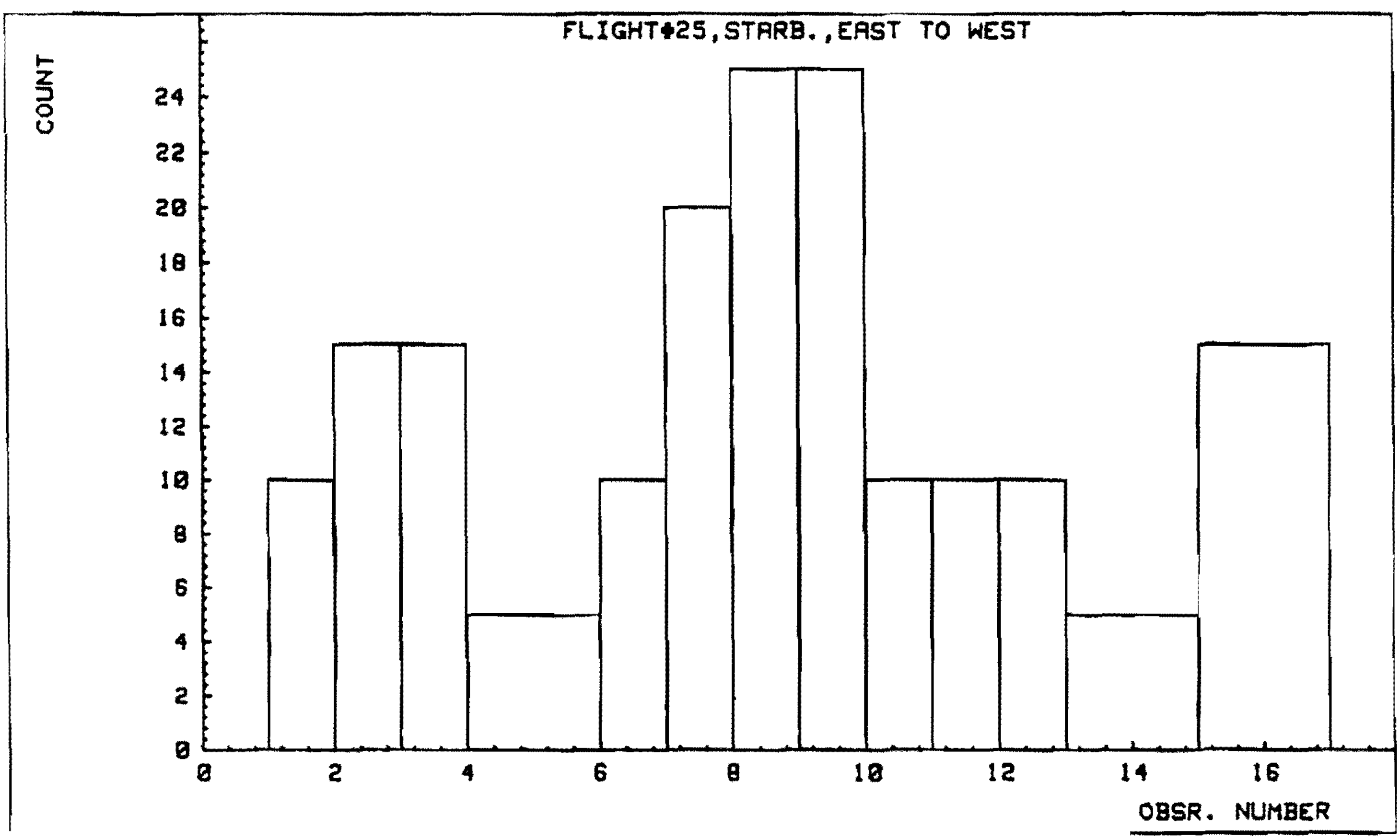


Fig. 5 - Graphical representation of the PCA of the ratios of buoy counts on port and starboard. The variables (arrows) and the observations (stars) after being centered and reduced are projected in the plane defined by the first and the second principal components.

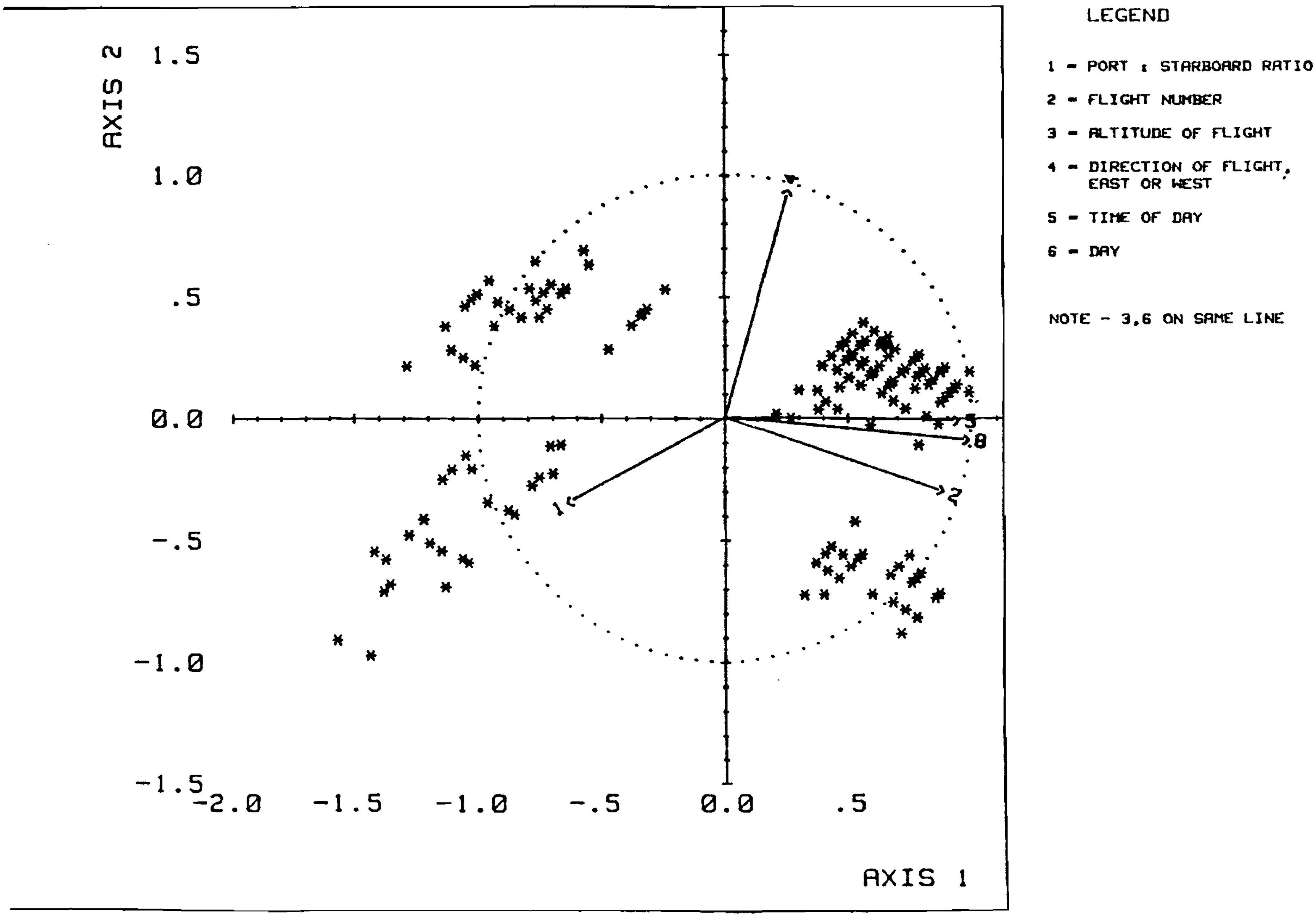


Fig. 6 - Estimated no. of traps (x 10^{-1}) for each station.

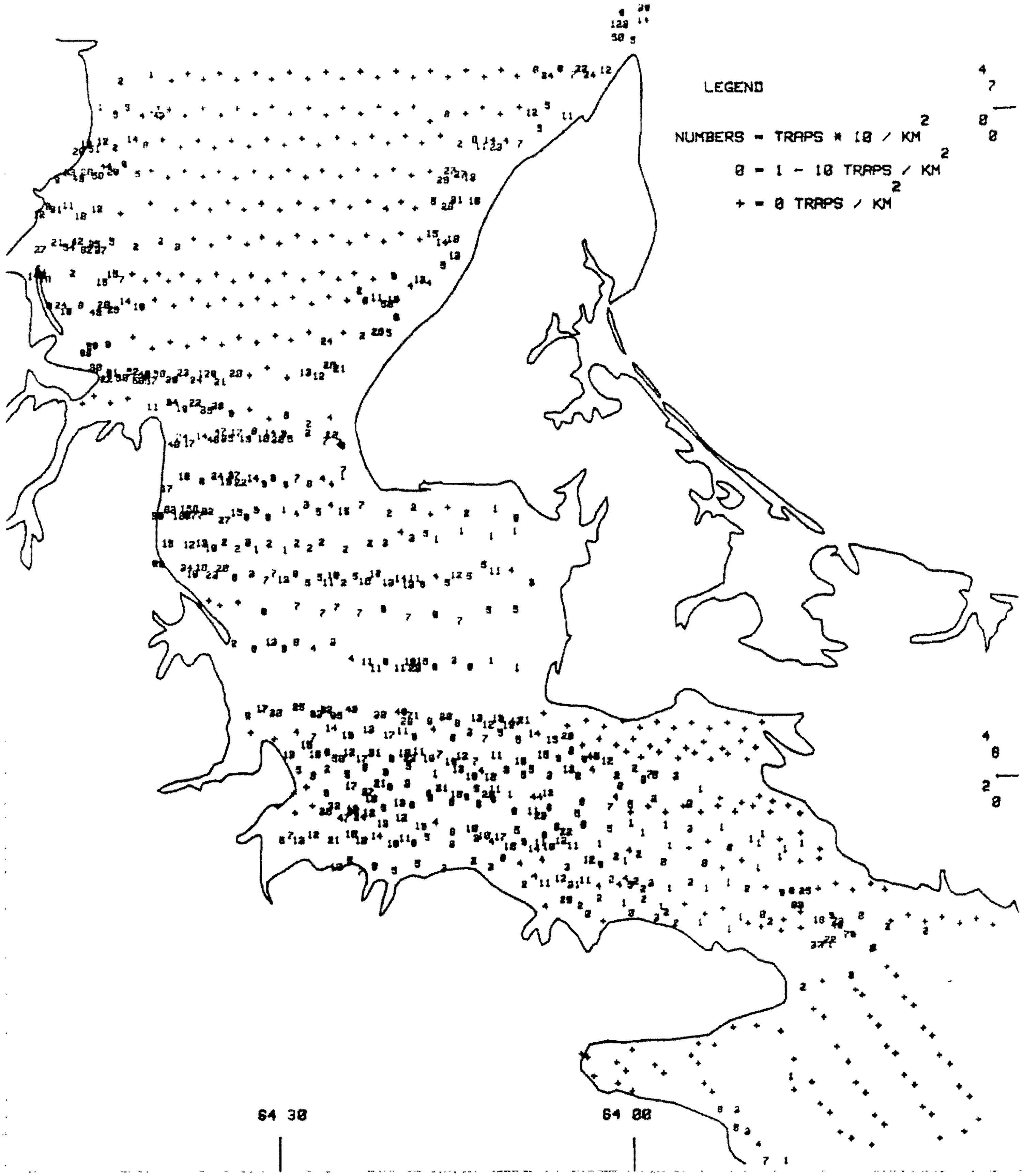


Fig. 7 - Contour plots of the distribution of number of traps in lobster district 8, northern Northumberland strait on August 21-22, 1982.